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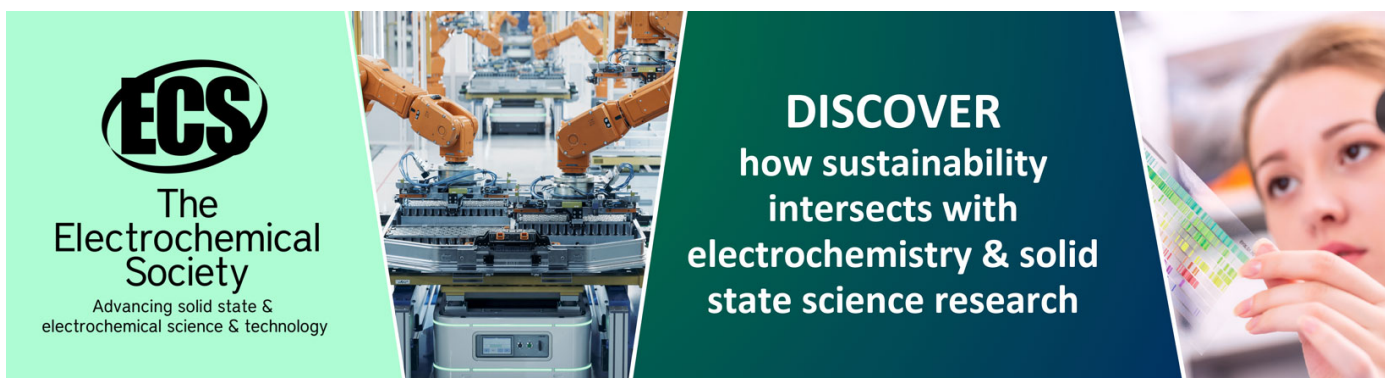
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Identification the preliminary concept of geometry through Prambanan temple artifacts

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Abstract. Student preliminary concepts are useful for knowing how much knowledge he already has. One activity that can be used to find out preliminary concepts is to ask students to describe an object. Observation skills are needed by the student to construct mathematical knowledge. This research was conducted at Prambanan Temple. The purpose of this study was to determine the preliminary concept of geometry for junior high school students. Students are invited directly to the location, then asked to describe mathematical characteristics. The method used in this paper is qualitative research in which the data analysis uses descriptive qualitative. The data collection is in the form of tests and interviews of 3 students of Junior High School Penelitian ini bertempat di Candi Prambanan dengan rentang waktu 2 minggu. The result of the research is that the students can describe the character of geometry in Prambanan Temple such as rectangle, square, triangle, circle, cube, cuboid, and cylinder which becomes student's preliminary concepts of geometry.

1. Introduction

Mathematics is one of the subjects in school. In addition, mathematics is also a knowledge inherent in the activities of life, where each activity cannot be separated from mathematics [1, 2, 3]. This is in line with D'Ambrosio [4] which says that mathematics is an intellectual instrument created by humans to describe the real world and the problems that are in it. Many materials are discussed in mathematics learning such as arithmetic, problem solving arithmetic, geometry, algebra, probability, statistics, calculus, etc.[5].

Student ability to understand geometry concepts is one of the main factors in mathematics education because it can be used to determine the successful implementation and success of students absorbing learning material [6]. The ability possessed by each student is certainly different. These differences can be caused by association, habits at home, learning motivation, and others. As a teacher must be careful in understanding how students are because not every student has high ability [7], so there needs to be a way to be able to find out how students' preliminary concept towards a geometry material. Preliminary concept students need to be known first before holding a learning. This is the first step so that teachers know what to prepare because preparation also determines success in learning. If teachers do not understand how students' preliminary concepts, it can result in losses for students. For example, when students do not know the characteristics of a flat figure. Then teachers think that they already know because they have learned it when they were at the previous level. Finally, teachers directly pass the point because it is considered to be all. This certainly can be detrimental to some students who do not understand it. So, there is a need for tests to measure students' preliminary concepts.



Preliminary concepts have a positive effect on student performance [8]. Studying mathematics also requires creativity to be able to solve the problems faced. A study shows that higher preliminary concepts have higher creative thinking abilities too [9]. The preliminary concept is one important aspect that supports deeper and more meaningful learning [10]. Mathematics is often found in everyday life such as geometry so it needs to be measured how far students' knowledge about the geometry that is around it in order to help in solving problems that exist in real life. In accordance with these criteria, the material that will be used for this paper is geometry material that is limited to only two-dimensional and three-dimensional.

Geometry is one of the material in mathematics. Knowledge about geometry is important to be possessed even mastered by students. This is in line with what was expressed by Ozerem [11] that learning geometry is an important component in mathematics learning because it allows students to analyze and interpret the world they live in and equip them with tools that they can apply in other fields of mathematics. Geometry is placed as an important school subject because it provides a perspective for developing students' deductive reasoning abilities and spatial awareness [12]. It is important to know that very often we encounter geometric shapes such as cardboard, ceramics, glass, and so on. In addition, there are also buildings that can be used to study geometry, for example houses, high rise buildings, or tourist attractions such as temples. The researcher wants to take up the theme of mathematics in a culture so that the object used in this study is Prambanan Temple.

Prambanan Temple is the largest Hindu temple in Indonesia [13]. In addition, the temple is also one of the cultures in Indonesia that is still preserved and is still frequently visited by local or foreign tourists. The benefits of Prambanan temple are not only as a place of worship and tourism, but can also be used as a means of learning [14], such as art, history, and mathematics. This can be known from the objects that are arranged in the making of the temple, such as the shape of a square, rectangle, and so forth. The existence of mathematical elements in Prambanan temple will help students to learn with more interesting situations and conditions. Mathematics in this culture is one way to study mathematics with the culture around it. In addition, learning mathematics in a cultural context can help students learn to explore mathematical knowledge more deeply, especially the initial concepts of geometry and get to know the culture in Indonesia more closely.

Mathematics is a subject that is considered difficult and tends to be disliked by students. Whereas if you look deeper, in mathematics there are many human activities [15] such as making cakes, printing bricks, making cupboards, and so forth. Therefore, mathematics is very important to be studied more deeply. Cornelius put forward five reasons for the need to learn mathematics, namely 1) a clear and logical means of thinking, 2) a means for solving problems of everyday life, 3) a means of recognizing patterns of relationships and generalizing experiences, 4) a means for developing creativity, and 5) a means to increase awareness of cultural development [16]. This reveals that there is still a relationship between mathematics and culture itself. Therefore, it would be better if in the learning process can link between culture and mathematics itself.

Mathematics in culture is usually called ethnomathematics. Marsigit [17] states that ethnomathematics functions to express the relationship between culture and mathematics so that it can be used to understand how mathematics is adapted from a culture. Studying mathematics based on ethnomathematics will be more interesting. Students in this case can have two advantages at once, which can learn mathematics as well as the culture around them. In addition, ethnomathematics in history and pedagogy emphasizes broad conceptualizations of mathematics and makes it possible to identify several practices which are essentially mathematical in nature [18].

D'Ambrosio [19] states that the purpose of ethnomathematics is to recognize that there are different ways of doing mathematics taking into account academic mathematical knowledge developed by various sectors of society and by considering different modes in which different cultures negotiate their mathematical practices (how to group, count, measure, design buildings or tools, play and others). The existence of mathematics in culture is expected to make students more interested in mathematics and more eager to learn mathematics. This is in line with Pramudita [20] which states that ethnomathematics can provide motivation for students to study mathematics.

This research has a difference compared to other studies. This can be seen from how students directly went to the field, namely to Prambanan Temple to see and describe the geometry shapes that were there. In addition, students are not asked to solve problems, but students are asked to describe geometry shapes according to their abilities, either by writing, drawing, or writing and drawing. The results of the description of each student will show the extent to which he understands geometry. The research conducted is not only to determine the level of understanding of students but also provide the first-hand experience of geometry in the local culture that is around it. In essence, the direct experience experienced by students will be more imprinted in his memory.

2. Method

This research is a qualitative descriptive study. Moleong [21] defines qualitative research as research that understands phenomena about what is experienced by research subjects, such as behavior, perception, motivation, actions by means of descriptions in the form of words. Collecting data in this study in the form of observations, tests, and interviews. The test referred to here is that students are asked to identify parts of the temple. Students are free in identifying it, can see in terms of flat shape or space. Testing the validity and reliability in this study by using triangulation. Then the results will be identified to find out how the students' preliminary concepts of geometry.

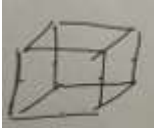
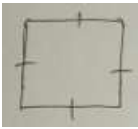
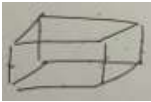
The subjects used in this study were 3 junior high school students. The researcher chooses the research subject by purposive sampling. The chosen research subjects are Grade VII students who live in the same environment. Class VII students are still in the transition phase from elementary school so they need to know how their preliminary concepts are so that learning can adjust to their abilities. Even though the research subject is small scale, it can give a little description about students' preliminary concepts of geometry. The result of the research is the preliminary concept resulted by making categorizing: 1) the kind of artifact, 2) the kind of geometrical shape, 3) the character of geometrical shape.

3. Results and Discussion

Students see the Prambanan temple directly in Yogyakarta. Then students look for geometric shapes that can be used as learning. After that, students identify the findings. Tabel 1 is the results of the geometry identification conducted by the three students.

Table 1. Exploration Results

Artefact	The Names of The Identified Geometric Shapes	The Element of Geometrical Shape Identified
	 Triangle	• Angle • Side • Height • Width • Length
	 Rectangle	

Artefact	The Names of The Identified Geometric Shapes		The Element of Geometrical Shape Identified
			• Angle • Side • Height • Length • Edges
	Cube	Square	
		Cuboid	
		Circle	• Bases • Diameter • Radius • Height
		Cylinder	

Student A observes the three images above. He found a triangle, rectangle, cuboid, cylinder, and circle in the temple. In addition, student A can also write down the elements present in the geometrical shape. However, he did not describe the geometrical shapes he discovered. He only wrote the name and identified it.

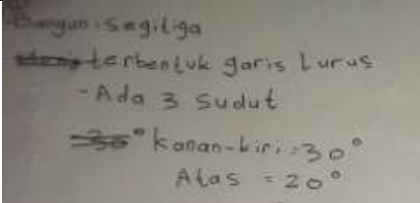
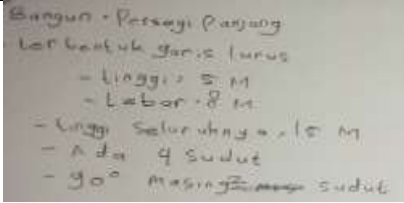
	
Triangle Formed from a straight line Has 3 angles Right and left angles of 30° The upper corner is 20°	Rectangle Formed from a straight line Height: 5 m Width: 8 m Overall height: 15 m Has 4 angles Each angle is 90°

Figure 1. Describe triangles and rectangles

In Figure 1, students know that a triangle consists of 3 angles which have the same pair of angles. However, student A does not yet know that the angle in the triangle is 180°. It is known from his writings that triangles have 3 angles, where the right and left angles have a magnitude of 30° and the topmost angle of 20°. Another case with a rectangular shape. He knows that a rectangle has 4 angles, each of which has a 90° magnitude. In addition, he also estimated the height of the shape mentioned above. However, student A still does not understand that in order to determine the overall height he must add up the height of each of the parts of the temple.

Next, student A identifies cuboid. He wrote that cuboid has many 12 sides. Student A does not understand between sides and edges. He thinks that sides and edges are the same things. Students understand that the beam has 12 edges, but it is not appropriate in writing the name of the element. This is almost the same thing as the cylinder construction identification. Student A writes that the cylinder building has a length and a width. He does not yet understand that in the structure which is considered as the width is the diameter, while what is considered as the length is the height of the cylinder. These terms are not yet known in depth by students. Therefore, he is still wrong in mentioning the names of the terms that should be used in describing a geometric shape.

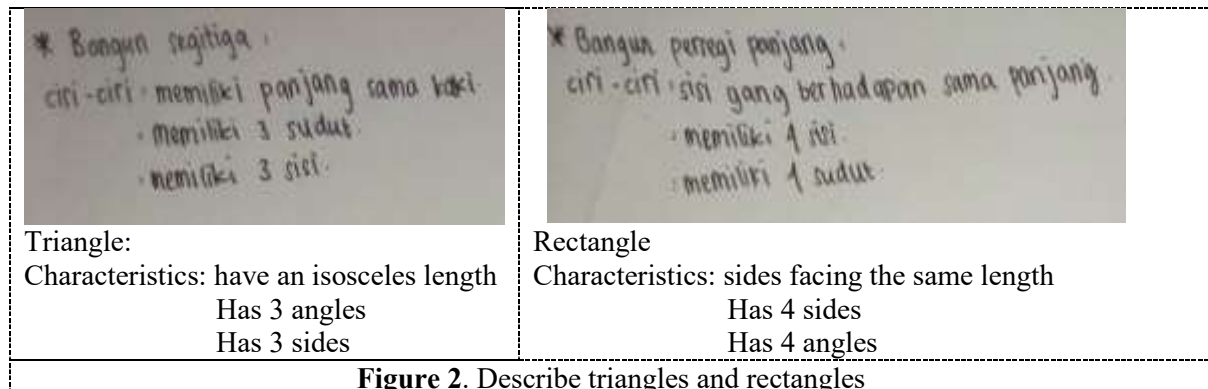


Figure 2 shows one of the results of the description by student B. He found a triangle, rectangle, square, circle and cylinder in the temple. In the form of a triangle, there are 3 angles and 3 sides. Student B also writes that the triangle is isosceles in length. It can be seen that students actually know that the triangle has 2 sides which are the same length, but it is still not appropriate in mentioning the term. In addition to mentioning the name of the shape and elements, it also estimates the size of each side.

In the rectangular shape, student B writes that there are 4 sides and 4 angles. The opposite sides have the same length. Whereas the shape of a square shape has 4 sides that are the same length and 4 angles of the same size. This proves that student B already understands that one of the differences between rectangles and rectangles is the length of each side. But for the large angle, rectangle and square each have the same angle. Then, student B describes the circle and the tube. The circle has no angle. In addition, the circle is also part of the tube. Student B describes that the tube has 2 sides facing each other. The sides of the tube are circular. The side referred to by these students can also be called bases.

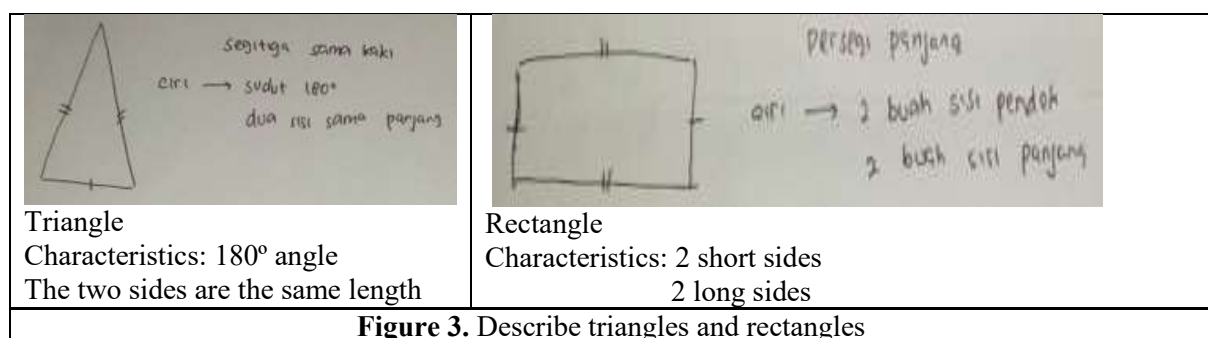


Figure 3 is an example of a description done by student C. The way of describing done by student C is slightly different from student A and student B. He describes the geometric shape by sketching it first. Student C found several geometric shapes in the temples such as triangles, squares, rectangles, cuboids, cubes, cylinders, and circles. He considers that by making a sketch it will be easier to describe it.

The triangle shape he got had two sides of equal length. This is one of the characteristics of the isosceles triangle. He gives a mark on the sketch that has been made. The sign shows differences between

the same side and different sides. The same is the case with square and rectangular shapes. Student C gives a mark on the sketch that was made by him. In the form of a square, he gives the same mark on all four sides which indicates that the square has 4 equal sides. In addition, a square also has 4 equal angles, but student C writes that a square has 4 equal angles. This proves that he still cannot mention properly between the length of the side and the size of the angle.

A rectangle has 2 sides which are shorter than the other side. This was also sketched by student C. He gave the same sign to the sides of the same length and gave different marks to the sides of different lengths. The description is done by student C also shows that he can already distinguish between squares and rectangles. In addition, he also estimated the height of the temple through the sketch he made. Student C sums the height of each part of the temple that has been sketched by him so as to obtain the appropriate concept. In contrast to student A who only estimates each part of the temple, then estimates the overall height of the temple without regard to the parts that have been determined in size.

In the cuboid shape, student C sketches and writes down his characteristics. A cuboid has 2 pairs of rectangular sides and a pair of square sides. Student C saw that the cuboid shape he sketched and saw immediately consisted of a square and rectangular shapes. Unlike the case with the shape of a cube. He described that the cube has 6 square sides. Cuboid and cube have many of the same ribs, which are 12 ribs. However, the length of each rib on the cuboid is not all the same, while the length of the ribs on the cube are all the same. The next form is a circle and cylinder. The cylinder has 2 circular sides. This is the same as expressed by student B.

The preliminary concept of each student will vary according to his ability. There are students who can describe things very well, some are mediocre, and some are low. As a good teacher to know the abilities and character of students. Students who have good preliminary concepts will find it easier to accept learning, whereas for students with less preliminary concepts they will find it difficult and require a lot of effort to be able to understand certain concepts. For this reason, it is good to know students' preliminary in order to plan learning accordingly.

Prambanan Temple is well used as a means for students to learn about geometry. We can see directly or from the picture that Prambanan temple has triangular, square, rectangular, spaced, pyramid, cube, beam, and tube shapes. The results obtained by students are not far from what was previously stated. However, there is one form that is not mentioned by the three students, namely the pyramid. They only see the top of the triangle shaped temple. Though there are forms of pyramid when viewed in terms of spatial.

Student in describing the shape of the Prambanan temple are still lacking. They only write from one perspective. If students have written the flat shape, then they have not written the shape of the room. All students in this study did the same thing. This incident happened because of several things, such as students who are lazy to find out more about the characteristics of forms, students are given the freedom to say whatever their characteristics, but there are also those who do not describe it because they do not know. Therefore, to find out more about how the students' preliminary concept, it is better to be given instructions to write down how many minimum characteristics that must be mentioned so that they are not too few and look at how they are trying to find. In addition to giving clear instructions, the teacher must also be able to provide motivation to students. If students can manage their own motivation and the activities they do, it can produce experiences that form neurobiological substrates of symbolic, social, psychomotor and other skills [22].

The results obtained also reflect that they have a little understanding of the concept of geometry, but there is still something to be clarified. They wrote the height of each part of picture 1, namely the height of the temple base, the body of the temple, and the roof of the temple. However, when writing the overall height, they write less than what they wrote at the beginning. In fact, they should just add it up, but that's not what they do. This revealed that they did not yet understand the concept of geometry and its relationship. If we don't have a concept, we will have difficulty formulating trivial problems and can't even solve them [23]. Therefore, it is important for students to be able to understand certain concepts.

Describe an object can be through images, text, or both. Students A and C describe using only writing, while students B describe using pictures and writing. Descriptions made by student A are more

numerous than the other two students, but there are still some mistakes for example in mentioning the size of the angle in the triangle. He wrote that the right and left angles were 30° each and the upper angle 20° . If added together, the result is 80° . This does not correspond to the actual angle of the triangle which is 180° . In addition, student A also has not been able to place when to use meters and square meters. This can be seen when he writes that the height of the triangle found at the top of the Prambanan temple in figure 1 is 13 m². Yet to write down the height is enough to use just meters.

In contrast to what was done by student B. He described the shape of the temple using pictures and writing. Drawings made are marked on the same length and different sections. In addition, he also wrote his characteristics in general such as mentioning that a square has 4 equal sides, a cube has 12 ribs, and so on. But here student B also still has a part that is not quite right, he says that a square has 4 equal angles. He still thinks that the terms for angle and length are the same.

Descriptions made by student C are almost the same as student A without using pictures and like student B who writes their characteristics in general. One example is that he wrote that triangles have 3 angles. Student C has not provided details regarding the size of each angle. This shows how students describe something with the knowledge they already have. There are several factors that can influence errors and deficiencies in describing an object such as forgetting and not knowing. When students are able to describe an object, they already know a little about the characteristics of the object. Of course, this is a good start for students in learning geometry because they still remember a number of things related to geometry of a flat plane or building space.

Ethnomathematics is more interesting than formal mathematics [24]. Learning mathematics through cultural relevance will help students to know more about reality, culture, society, environmental issues, and themselves by providing mathematical content and approaches that enable them to successfully master mathematics academically [25]. This revealed that culture-based mathematics learning is important to be applied in learning. Students will not only understand a concept but can also find out how many concepts they have.

4. Conclusion

This research has successful to facilitate the student to get their own preliminary concept of geometry. However, they learned that the initial concept by creating guided methods would be more structured and directed. In particular, the results of this study are that by observing and manipulating the mathematical artifacts of Prambanan temple, students can identify the various geometrical shapes, describe the various elements of certain geometrical shapes, and make a sketch of the various geometrical shapes.

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