

Spatial Representation On Geometry

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Abstract: Spatial representation is important in learning geometry. Spatial representation is needed by students to communicate spatial objects to others. This research is a qualitative research. The purpose of this study is to describe the thought process in students' spatial representation. The research subjects were students of grade VIII junior high school level who were able to complete geometry assignments. The results showed that the spatial representation contained 4 components of representation, namely shape, size, position, and special attributes. The importance of this research is that spatial representation is needed to know what someone is thinking and how to communicate it with others so that others understand what is represented.

Index Terms: spatial, representation, geometry.

1 INTRODUCTION

Geometri geometry is a part of mathematics that studies both two-dimensional and three-dimensional shapes. Geometry can be learned through interactions with the surrounding environment and the real world [1]. Information from the environment and the real world requires spatial presentation so that information can be stored, analyzed, compensated and communicated to others [2], [3]. Spatial ability is used to know the description of objects in space, using presentation and spatial reasoning. Spatial ability refers to a person's ability to represent mentally about two-dimensional and three-dimensional shadows [4]. Another study states that a person's spatial ability includes the ability to present, modify, construct, and remember symbols where symbols are non-linguistic information [5]. Someone who has the spatial ability of course he can describe a spatial object even though the object is not in front of him. He experiences mental processes to recognize, store, remember, improve, and communicate spatial images to others. Through spatial cognitive skills, a person has the possibility to imagine and mentally represent real world objects from different perspectives [6]. Spatial ability consists of spatial visualization, spatial orientation and spatial relations [7]. Spatial visualization is generally associated with more complex tasks, and there are manipulations of the stages of information presented. Spatial orientation is the visualization of objects given as observations of objects from different perspectives. but spatial relations are the ability to form mental relationships between objects. Representation is an important thing to do so that what someone thinks can be known by others. Through representation, a person's abstract mind can be known.

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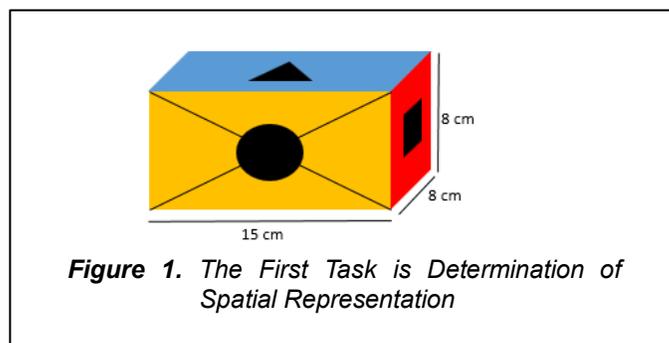


Figure 1. The First Task is Determination of Spatial Representation

Spatial presentation can be divided into two, namely internal and external presentation [7], [8]. Spatial presentation internally focuses on the formation and manipulation of spatial shadows in the mind, which requires spatial abilities in spatial visualization, orientation and relations, while spatial presentation externally refers to organizing, understanding and communicating information with maps, images, verbal and graphs. In this study the spatial representation used is an external representation. The purpose of this study is to describe the thought process and spatial representation of students in completing Geometry assignments.

2 RESEARCH METHODS

2.1 Participant

The research subjects were students of class VIII at SMPN 4 Malang consisting of 33 students (18 females, 15 male). The subject has studied material about the properties, nets, area, and volume of flat side spaces.

2.2 Data Collection

Data collection is done by giving Geometry assignments. The task given consists of two tasks. the first task is a spatial object consisting of one form and the second task is an image consisting of several spatial objects. On each task item, students are asked to write a description of each spatial form. The results of the work are written on the answer sheets that have been provided. At the completion of the task students are asked to write stories about spatial objects in as much detail as possible in accordance with the knowledge they have. Figure 1 shows the assignments students must complete. The assignment contained the assignment that Ani had wooden

toys that looked like Figure 1. The parallel sides had the same shape and color. Ani wants to tell the shape of her toy to her cousin. Help Ani to tell the toy. Figure 2 shows the image in the second task. The assignment contained the assignment that Abi arranged the shape as in Figure 2 using blocks of wood in the form of blocks and cubes. Students are asked to tell the form arranged by Abi and the components needed to arrange the shape.

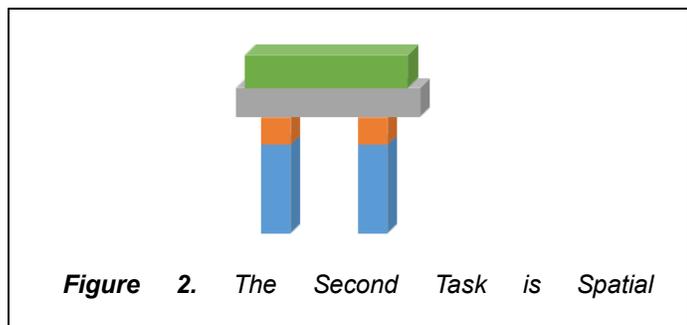


Figure 2. The Second Task is Spatial

Data analysis was carried out through several steps, namely tabulating student work outcomes, coding, categorizing, and describing students' spatial representations. Student work outcomes are grouped by components on representations consisting of shapes, sizes, positions, and special marking attributes. Analysis of the thinking process is realized through the form of schemes that describe students' thought processes in spatial representation. Based on the scheme of thinking and description then the data is concluded.

3 RESULT AND DISCUSSION

The results showed that in the process of spatial representation in written form, the components that emerged consisted of four namely shape, size, position, and special attributes. In each assignment component appears on the results of student work. This shows that students use their spatial ability in representing spatial objects.

TABLE 1
SPATIAL REPRESENTATION CATEGORY BASED ON COMPONENTS

Task	Component	Emerging Representation Terms
1	Shape	Block, square, rectangle
	Size	Block: 15 cm × 8 cm × 8 cm Square size: 8 cm × 8 cm Rectangle size: 15 cm × 8 cm
	Position	Up, front, side, back, center
	Special marker attributes	<ul style="list-style-type: none"> Color: red, blue, yellow, black Shapes on the sides: circle, triangle, square, line
2	Shape	Block, cube
	Size	Bigger, smaller, number of blocks, number of cubes
	Position	Up and down,
	Special marker attributes	Color: green, gray, orange

2.3 Data Analysis

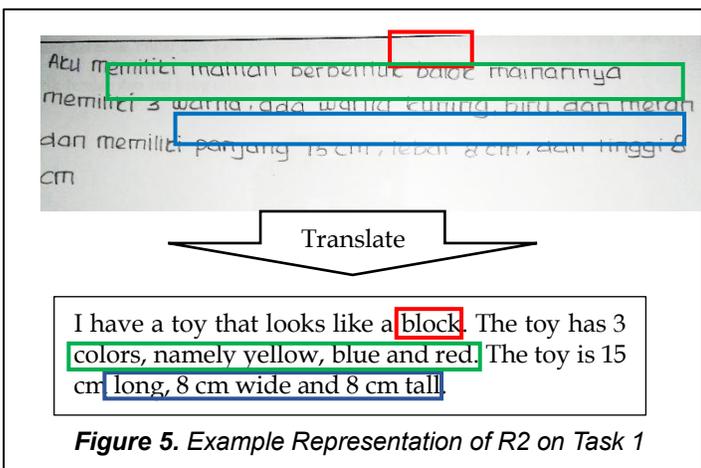
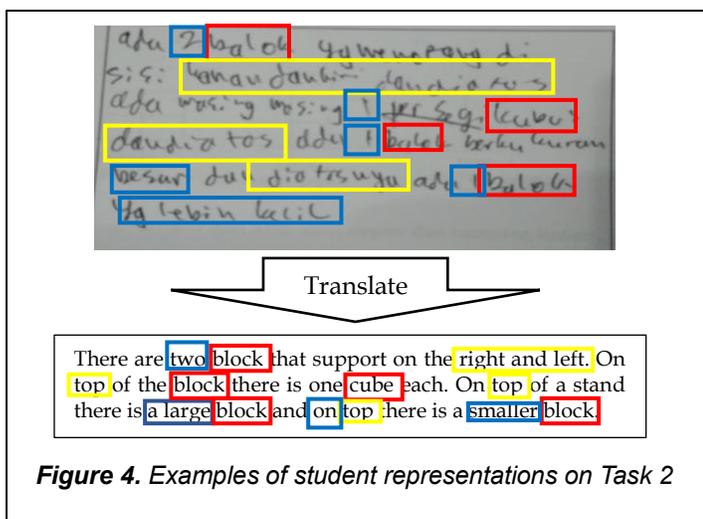
Based on Table 1 it can be said that in verbal representations of spatial objects, students have used terms based on the knowledge they have. The terms that emerge are geometrical terms that they have learned before. What distinguishes the spatial representation between students with other students is the number of components and descriptions in each student which shows the number of components that appear as well as a description of each component. From the results of the representation that has been made it appears that it can be categorized into a complete representation and an incomplete representation. Complete representation is a representation which if translated back to the initial representation will produce the same representation. however, incomplete representations are representations which if translated back to the initial representation do not form the same representation. Examples of student work are given the code R1 for the example of the first student representation while R2 for the example of the second student representation. The results of the work of R1 students on assignment 1 namely spatial representation can be seen in Figure 3. Figure 3 shows that the spatial representation of R1 in written form contains three components of spatial representation, namely shape, size, and special attributes. Each component is marked with a colored rectangle. The red rectangle shows the shape component, the

blue color indicates the size component, and the green color indicates the component's special attribute. Based on Figure

3, it appears that R1 has mentioned the shape of the spatial object, the beam. Student R1 did not mention the shape of each side of the beam. Figure 3 shows that R1 correctly

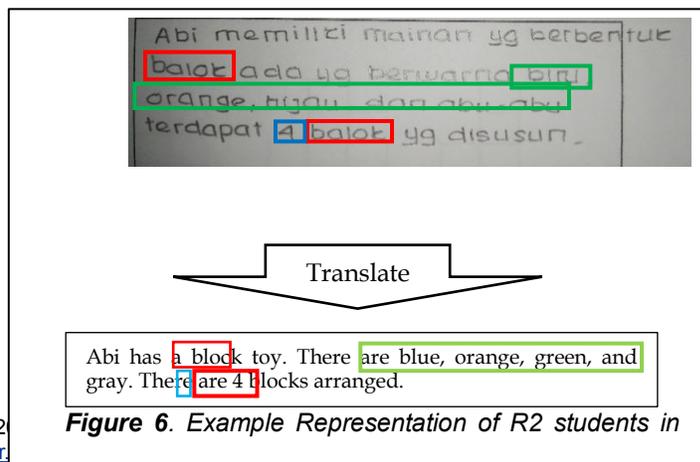
Figure 3. Examples of student representations on Task

mentions the size of the beams and the size of each side. However, the special attribute component mentioned consists of two colors and images on each side. The colors that have been mentioned are yellow, blue and red, where all three colors correspond to the intended side. Draw as special attributes namely circles, triangles, and squares, which are mentioned correctly and in accordance with their position. Special attributes that have not been mentioned are the two diagonal fields on the front side which are yellow. Students' answers to the position component shown through Figure 3 did not clearly appear written by R1. Mention of position is implicitly written by R1, namely by writing that the square is on the side of the size $8\text{ cm} \times 8\text{ cm}$.



Based on Figure 4, it appears that the spatial representation of students in written form on assignment 2 contains three components of spatial representation, namely shape, position, and size. Each component is marked with a colored rectangle. The red rectangle indicates the shape component, yellow indicates the position component, blue indicates the size component, and green indicates the special attribute component. In Figure 4 there is no specific attribute component. Based on Figure 4, it appears that students mention the spatial forms used to arrange the shapes in Task 2 namely blocks and cubes. While in the position component, students have mentioned the position in the arrangement of

the beam and the cube, for example: there are two blocks on the right side and the left side. The size component appears in terms of large, smaller to indicate that there are different sizes and the terms one and two to indicate the number of objects required. Special attribute component not mentioned. The attribute in question is the color of the spatial object. In this case R1 has an incomplete representation category. The results of the representation of geometry tasks that have been completed in R2 can be seen in Figure 5 and Figure 6. Figure 5 shows the performance of R2 in Task 2 which contains three components of representation namely shape, special attributes, and size. The component is marked with a colored rectangle. Each color marks the component that appears on the student's representation, red marks the shape component, blue marks the size component, and green marks the component's special attribute. Student R1 mentions the block as a representation of the shape of the spatial object in assignment 1. In this case R2 does not mention the shapes on the sides of the beam which can clearly depict the shape of the toy. In the size component, R2 specifies the length, width, and height of the beam in assignment 2. In this case R2 does not explicitly mention the shapes on each side. In addition, R2 mentions the number of colors in the toy, there are three colors. The term three colors indicate that the component size has been used by students to explain the toys in Task 2. The special attribute component that appears on R2 is the color on each side. The first task represented by R2 does not contain the position component. Figure 6 is the result of student work on the second spatial representation task by R2. In Figure 6 it appears that R2 does not represent a complete spatial object. R2 students mention the components of shape, special attributes and size. In the form component, students mention blocks, whereas in assignment 2, the shapes that appear are not only blocks. There is another form in Task 2, which is the cube. The size component that appears is the number of colors in the shape of the blocks and cubes. In this case, R2 mentions that there are four colors. The mention of colors namely blue, green, orange, and gray is the representation of special attributes in the form of color on the building blocks of Task 2. Spatial representation by R2 does not indicate the position component. R2 students do not mention terms that indicate the position of spatial objects. Even though Task 2 requires representation in the form of the position of each object, one of which is the position of the cube on the beam. In this case spatial representation R2 is an incomplete representation. Based on Table 1, it can be said that the spatial representation of students that emerged in this study consisted of four components namely shape, position, size, and special attributes. These components appear in the mention of terms written on the results of student work.



The mention of terms is important because the selection of terms and representing them will show how students imagine spatial objects and communicate with others [7], [9]. Representation on a complete spatial object will give a complete picture to others so that what is meant by someone can be understood by others [6], [10], [11]. The representation made by the two eighth grade students of junior high school is an incomplete representation. This can be seen from the results of the representation of each student which contains three of the four required components. In this study, students who represented in full were invisible. The representation of all students mostly only mentioned three of the four components of representation as shown in Table 1. The thought process of completing the task of spatial representation on students is: 1) reading the questions, 2) observing spatial objects, 3) recognizing the characteristics of spatial objects, 4) representing spatial objects in written form. In the second and third processes, namely observing spatial objects and recognizing the characteristics of spatial objects, a cognitive process occurs by coding the characteristics of spatial objects based on their shape, position, size, and other special marking attributes. In this case if the student has good spatial abilities, of course he will more fully recognize the characteristics of spatial objects [12], [13]. In the fourth process of representing spatial objects, students need mastery of the right terms to communicate with others. Mastery of the right terms results in information received by others will have the same perception as what is to be conveyed. In this study, the recipient of the representation will have a mental image in accordance with the presenter.

4 CONCLUSIONS

Spatial representation is important because spatial representation shows how students imagine a spatial object. Through spatial representation can be known what is in the minds of students of a spatial object from visualization and its relationship with other objects. The completeness of the components in spatial representation shows how students use their spatial ability to explore spatial information that exists on a spatial object so that it can communicate it with others properly. The thought process of completing the task of spatial representation on students is: 1) reading the questions, 2) observing spatial objects, 3) recognizing the characteristics of spatial objects, 4) representing spatial objects in written form. Thus, spatial representation needs to be an important concern in learning that studies spatial objects in this case Geometry.

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