STUDENT'S ABILITY IN EXPLAINING THE CONCEPT OF SOLID FIGURE'S VOLUME REVIEWED FROM VISUALIZER VERBALIZER COGNITIVE STYLE

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Abstract

The purpose of this study was to describe student's ability to explain the concept of solid figure's volume reviewed from visualizer-verbalizer cognitive style using the Cognitive Style Test developed by Mendelson & Thorson. This study used a qualitative approach and the data collection technique was carried out by giving tests about the concept of solid figure's volume and interviews. The indicators used to measure students' ability to explain the concept of solid figure's volume are, (1) Providing information in accordance with mathematical concepts (2) Information systematically organized with the aim of showing a mathematical relationship (3) using and selecting procedures or operations certain exactly. The results showed that both visualizer subjects (SV) and verbalizer subjects (SB) were only able to fulfill the first indicator in explaining the concept, both of them just can mention the formula of pyramid's volume. Meanwhile, to explain the concept of ball's volume, SV does not meet the third indicator, SV did not use the right mathematical procedures or operations. Both subjects showed characteristics that matched their cognitive style, namely SV was more flexible in providing explanations through pictures and SB preferred to make explanations in the form of descriptions.

Keywords: Ability in explaining; Solid Figure's volume; Visualizer Verbalizer Cognitive Style

A. Introduction

Students who choose mathematics education majors should prepare themselves to become mathematics teachers in schools. What should a teacher prepare before teaching? The answer to this question is very complex, considering that there are many aspects that the teacher must have prepared. However, the first fundamental thing that a teacher provides is the concept of material that must be really mature so that there are no conceptual errors when explaining. Based on the author's experience as a lecturer in the course of Mathematical Studies and

Development at the University of Madura, it is still often difficult for students to be asked to explain the origin of the volume formula. Just as if they were asked to determine the area of a field, they were not able to mention the volume of the resulting geometric figures because they only memorized the formula without understanding the concept properly. So if given a different wake up space is not able to determine the volume.

Every individual, including students, has different characteristics, especially in obtaining, storing, and using the information they receive. The way a person processes, stores, or uses information to respond to a task or respond to various types of environmental situations is called cognitive style. Everyone has a different cognitive style, thus these differences will affect the quantity and quality of the activities carried out, including the activities carried out by students during the teaching and learning process, including problem solving. In accordance with Susan's opinion (2005) that general problem solving strategies such as these are further influenced by cognitive style. The problem-solving strategy used by a person is influenced by his cognitive style. So, when students have different cognitive styles, the way to solve a problem is also different, so this also triggers differences in their ability to explain a mathematical concept.

Cognitive styles related to a person's habit of using his senses are divided into two groups, namely visualizers and verbalizers (McEwan, 2007). Someone with a visualizer cognitive style tends to have the ability to see, so it is easier to receive, process, store and use information in the form of images. While the verbalizer cognitive style tends to have the ability to hear, so it is easier to receive, process, store, and use information in text form. The difference between the cognitive style of visualizer and verbalizer is caused by differences in one's views in describing something. There is someone who is strong in visual representations but there is also someone who is strong in verbal representations (Skemp, 1987). Furthermore, Skemp explained that there is also someone who has both abilities, but usually only one of them stands out.

Several previous studies have been carried out in analyzing the difficulties of students in solving geometrical problems (Agustini et al., 2021; Rusydy, 2019: Manullang, 2018; Taufik, 2016; Yuwono, 2016).). Listiani (2019) also make the study about error analysis of students in the mathematics department in solving geometry problems on the topic of solid figure. The study about students' mathematical representations in a cognitive style of visualizer in mathematics problem solving (Syhid, 2019 : Surahmi 2016) and Ayuningtyas (2017) conduct the study about profile of mathematical literacy on content change and relationship of class X student of cognitive visualizer and verbalizer style. However, there has been no research that analyzes student's ability to explain the concept of solid figure's volume based on the differences in visualizer verbalizer cognitive style. Even though it is important to know the ability of prospective teachers to explain a mathematical concept in terms of visualizer verbalizer cognitive style. Therefore, this study aims to analyze the ability of prospective mathematics teacher students to explain the concept of solid figure's volume in terms of the cognitive style of visualizer verbalizer at the University of Madura. The research subjects in this study were students who took Mathematical Studies and Development 1 course in odd Semester Academic Year 2021/2022 class A. Place for conducting research activities in the Mathematics Education study program of Madura University.

B. Methodology

1. Research Design

This research is a descriptive qualitative research. Descriptive research is research that describes a symptom, event or occurrence at the time of the research. This study describes the ability of students to explain the concept of solid figure's volume in terms of the differences in cognitive styles of visualizers and verbalizers. To obtain this description, the researcher used a test in the form of problems regarding the concept of solid figure's volume and interviews, so that the data analyzed were written test results and interview results.

2. Subject

The research subjects in this study were students who took Mathematical Studies and Development 1 course in odd Semester Academic Year 2021/2022 class A. Place for conducting research activities in the Mathematics Education study program of Madura University.

3. Instruments

The research instruments consist of Visualizer and Verbalizer Questionnaire (VVQ), test of problems regarding the concept of solid figure's volume and interview guidelines. The Visualizer And Verbalizer Questions (VVQ) consist of 20 statement items that lead to the visualizer and verbalizer cognitive styles. Each student was asked to choose statements that matched their respective characteristics. The test was developed by Mendelson, which is divided into 2 items, Items 1-10 (Verbaliser Items) and items 11-20 (Visualiser Items). The result of Visualizer and Verbalizer Questionnaire (VVQ) presented in table 1 below :

Table 1. Result of Visualizer and Verbalizer Questionnaire

No	Category	Numbers of students
1	Visualizer	5
2	Verbalizer	4
3	Negligible	22
	Total	31

In this study, students were grouped into 3 categories of cognitive styles, namely visualizers, verbalizers and negligible. Then after the two groups (visualizer and verbalizer) of students were obtained, each category was taken by 1 student who have the same math skills, can communicate well and also willing to be used as research subjects. Furthermore, the selected students are designated as research subjects. To facilitate coding, the students who were selected as representatives from the Visualizer group were called SV, while the representatives from the Verbalizer group were called SB.

The tests used to determine the subject's ability to explain the concept of solid figure's volume are as follows:

Table 2. Test of Subject's Ability to Explain the Concept of Solid Figure's Volume

According to your opinion, what is the most effective way to explain the concept of solid figure's volume below :
    a. Prism
    b. Pyramid
    c. Sphere
Please give your explanation!

4. Technique of Data Analysis

In qualitative research, data analysis is intended as a process of systematically searching and compiling data obtained from interviews, field notes, and other materials, so that they are easy to understand and the findings can be informed to others. Furthermore, it is said that data analysis is carried out by organizing data, breaking it down into units, synthesizing, compiling into patterns, choosing what is important and what will be studied, and making conclusions that can be told to others.

To test the credibility of the data, the researcher triangulated. Triangulation is a technique of checking the validity of data that uses something else (Moleong, 2014). In this study, time triangulation was used as data analysis and interviews, namely checking data by giving similar questions at different times.

This study focuses on how the subject explains the concept of volume building space. The word explaining means presenting verbal information that is systematically organized with the aim of showing a relationship, (Hasibuan 2012). In this case the teacher uses the term explaining to convey information related to the subject matter being discussed during teaching and learning activities. Submission of information that is well planned and presented in an appropriate order is the main characteristic of explaining activities, (Bahri, 2000: 131). So not just any information given in this case.

How someone is able to give an explanation, of course this is in accordance with the knowledge he has. The ability to explain a mathematical concept is closely related to the understanding of students' concepts. Understanding the concepts that students have reflects how they understand, recognize and how students explain the material that has been conveyed

and not just memorize formulas or sentences from the sources they get. This is in accordance with Kartika's research (2018), namely, the low ability of students to understand concepts is caused by the ability to re-explain the concepts they have acquired and present concepts in the form of low mathematical representations.

Indicators of understanding mathematical concepts (Yufentya, Roza, & Maimunah, 2019) are: (1) presenting designs in various forms of mathematical representations, (2) using and utilizing and selecting certain procedures or operations, (3) realizing designs or algorithms in problem solving . So the indicators used to measure students' ability to explain the concept of volumetric geometry in this study are, (1) Providing information that is in accordance with mathematical concepts (2) Information systematically organized with the aim of showing a mathematical relationship (3) using and utilizing and choose the right procedure or operation.

C. Findings and Discussion

1. Findings

In this study, the data analyzed consisted of the results of tests and interviews. Interviews were conducted to obtain data about student's abilities directly. Based on the data obtained and the research findings for SV are described as follows:

a. The Ability of Students With Visualizer Cognitive Style (SV) In Explaining the Prism Volume Concept

In explaining the prism volume concept both in writing and orally, SV did not find difficulties. The subject provides a detailed explanation using pictures, as shown in the following figure:
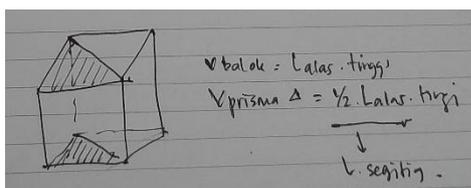

Figure 1. SV's Written Test Answer in Explaining
the Prism Volume Concept

From the results of the work above, SV has been able to show the first indicator, which is to provide information that is in accordance with mathematical concepts. SV has been able to explain that the volume of a triangular prism can be obtained by dividing the volume of the block into 2 parts, so that the formula for the volume of a prism in general is obtained. For the second indicator, the information is systematically organized with the aim of showing a mathematical relationship depicted from SV's work, namely SV chooses a way to explain the volume of a prism by drawing a relationship between a triangular prism and a rectangular prism or the subject calls a cuboids. The subject explained that the volume of a rectangular prism or cuboids is twice the volume of a triangular prism. So that the subject clearly states that the volume of the prism is half the area of the base times the height. The third indicator is using and utilizing and selecting certain procedures or operations, illustrated from the steps to obtain the prism volume formula by multiplying the area of the base times the height. From the interview results, the subject was able to draw a general conclusion that the general formula for determining the volume of a prism is adjusted to the base, which is the area of the base times the height. Furthermore, the researchers asked questions about the relationship between prisms and cuboids, ''is the volume of the cuboids the same as the volume of the prism? ''. The subject clearly says that the formula is the same, later it just needs to be adjusted to the base of the prism. SV further explains in the form of prismatic images, namely pentagon prisms and triangular prisms and how to determine the formula to find their volume.

Based on the results of the analysis, it can be concluded that SV has been able to explain the concept of prism volume correctly. In addition, the explanations given by the

SV both written and oral, namely the results of the interviews were sufficient to describe the SV's cognitive style which tends to be easier to provide information in the form of pictures than writing.

b. *The Ability of Students With Visualizer Cognitive Style (SV) in Explaining the Pyramid Volume Concept*

When explaining how to find the volume of a pyramid, SV had difficulty. SV just memorized that the formula is one third of the area of the base times the height. Furthermore, the subject was unable to describe the process to determine the formula earlier. When the subject is asked to draw a pyramid, that is, a triangular pyramid, the subject can provide the correct image and its parts. The formula given to determine the volume of a triangular pyramid is also correct. Furthermore, the researcher also checked his understanding if the pyramid given was in the form of a quadrilateral pyramid, the answer given was also correct, so that the first indicator, namely providing information that was in accordance with the mathematical concept, had been fulfilled. However, the second and third indicators are still not fulfilled.
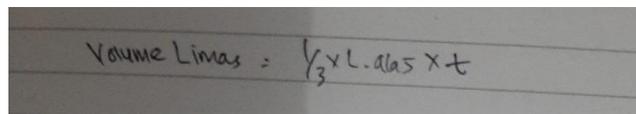

Figure 2. SV's Written Test Answer in Explaining
the Pyramid Volume Concept

The relationship between the explanation given by SV regarding the volume of the pyramid with the visualizer's cognitive style can be seen from the results of the picture when SV is asked to determine the volume of a rectangular pyramid, namely SV describes it first.

c. *The Ability of Students With Visualizer Cognitive Style (SV) In Explaining Sphere Volume Concept*

SV has been able to associate that there is a relationship between the volume of a sphere with the volume of a cone and a cylinder. The subject has been able to model into geometric shapes in the form of connections between the volumes of cylinder, cones and spheres. This can be seen from the image made by SV.
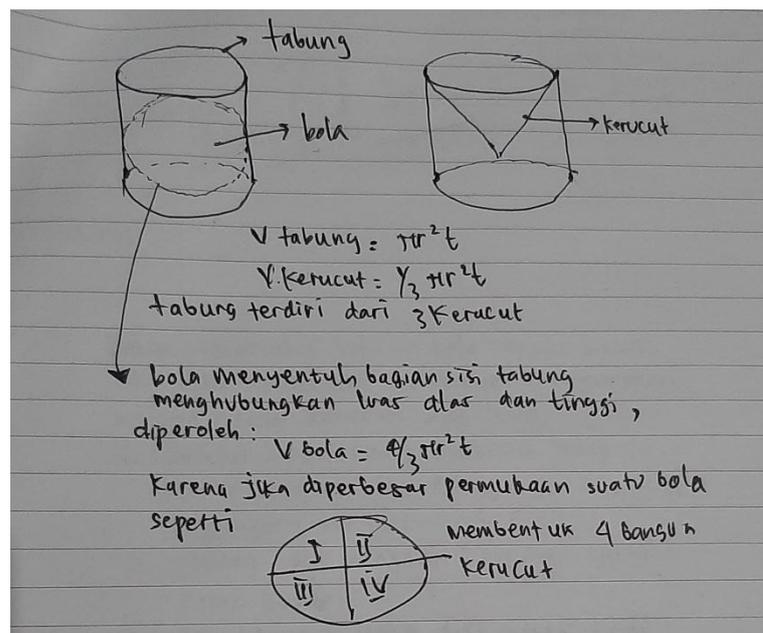

Figure 3. SV's Written Test Answer in Explaining
the Sphere Volume Concept

SV is correct in showing the relationship that the volume of the cone is one-third of the volume of the cylinder. While the volume of the sphere is related to the volume of the cylinder. However, the explanation of the process that gives rise to the final result in the

form of sphere's volume is still unclear. From the analysis above, it can be concluded that the first and second indicators are met, but the third indicator, namely using and utilizing and selecting certain procedures or operations, has not been fulfilled. SV added a description that if the surface of the sphere is enlarged it will form 4 cones. This sentence becomes ambiguous with the appearance of the image given by the subject. The relationship is meant to be multi-interpreted, whether the intended meaning refers to the surface area or the subject tries to show that the formula for the volume of a sphere is 4 times the volume of a cone. Based on the results of interviews with the subject, an explanation was obtained that the subject memorized the formula for the volume of a sphere but the subject was still confused about how to prove the formula. The work done is to describe the shape of a sphere in the form of a sphere by associating it with a cylinder and a cone and forcing it to obtain the final formula for the volume of a sphere. There are stages that are passed from SV, namely the relationship between a half sphere and a cone, where the volumes of both are the same, then the relationship between the sphere and the cylinder is obtained. This resulted in misconceptions on the subject.

The relationship between SV cognitive style and the explanation given is quite significant. Where the subject tends to be more flexible in providing direct explanations to the image rather than making descriptions. This can be seen from the results of the explanation in the form of writing and the results of interviews with SV.

While the discussion for the subject of SB is described as follows:

a. *The Ability of Students With Verbalizer Cognitive Style (SB) in Explaining the Prism Volume Concept*

To answer about how to explain the prism volume concept, SB invites us to determine the volume of a cuboid by using a unit cube first, which will result in the formula for the volume of a cuboid being the area of the base in the form of a rectangle multiplied by its height. This is obtained from the results of interviews with SB. The explanation is in accordance with the results of his work as illustrated in the image below:
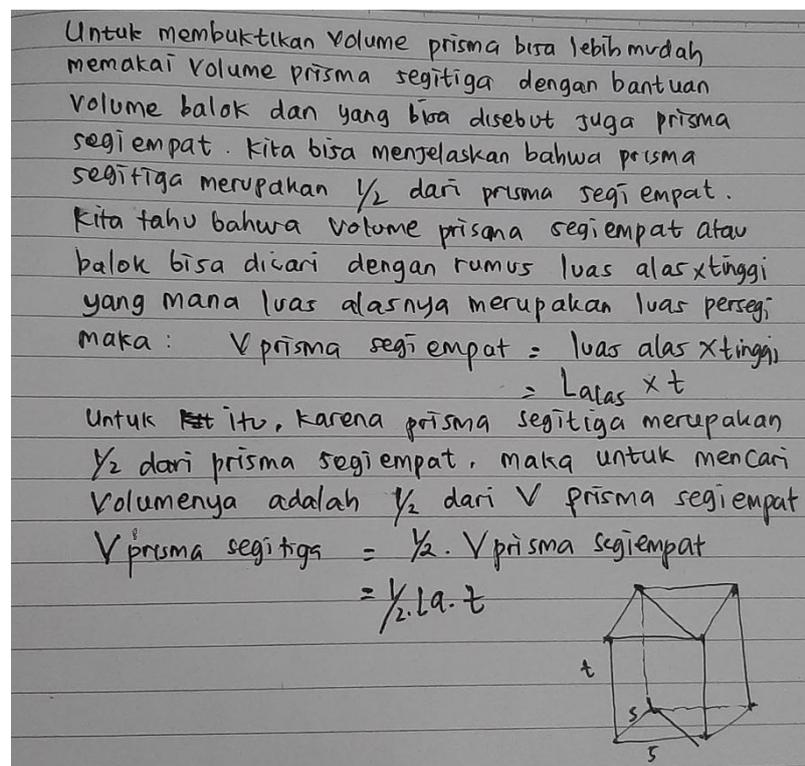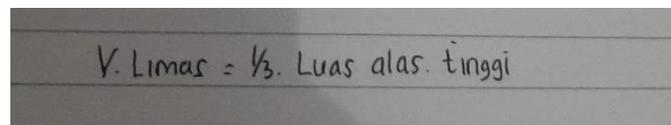

Figure 4. SB's Written Test Answer in Explaining
the Prism Volume Concept

From the results of SB's work, it can be concluded that SV's ability to explain the concept of prism volume has met the three indicators, namely (1) Providing information that is in accordance with mathematical concepts (2) Information systematically organized with the aim of showing a mathematical relationship (3) using and utilizing and choose the right procedure or operation.

The relationship between the ability to explain the concept of SV prism volume with cognitive style is clearly illustrated from the results of his work which tend to like explanations in the form of written descriptions.

b. *The Ability of Students With Verbalizer Cognitive Style (SB) in Explaining the Pyramid Volume Concept*

Just like SV, SB subject has not been able to explain where the formula to find the volume of a pyramid comes from, SB just memorizes the formula. The subject only describes it without providing an explanation of the steps in determining the volume of the pyramid, so that only the first indicator is fulfilled, namely SB is only able to provide information that the formula for the volume of the pyramid is one third of the area of the base times the height of the pyramid. Even SB only describes it and is not interested in describing it according to the characteristics of the verbalizer's cognitive style.

V. Limas = ⅓. Luas alas. tinggi

Figure 5. SB's Written Test Answer in Explaining
the Pyramid Volume Concept

c. *The Ability of Students With Verbalizer Cognitive Style (SB) in Explaining the Sphere volume Concept*

In accordance with the verbalizer cognitive style where the subject tends to be easier to receive or convey information in the form of writing, SB describes the steps in determining or finding the volume of the sphere. It can be seen from the following picture of the results of the SB subject's answers:
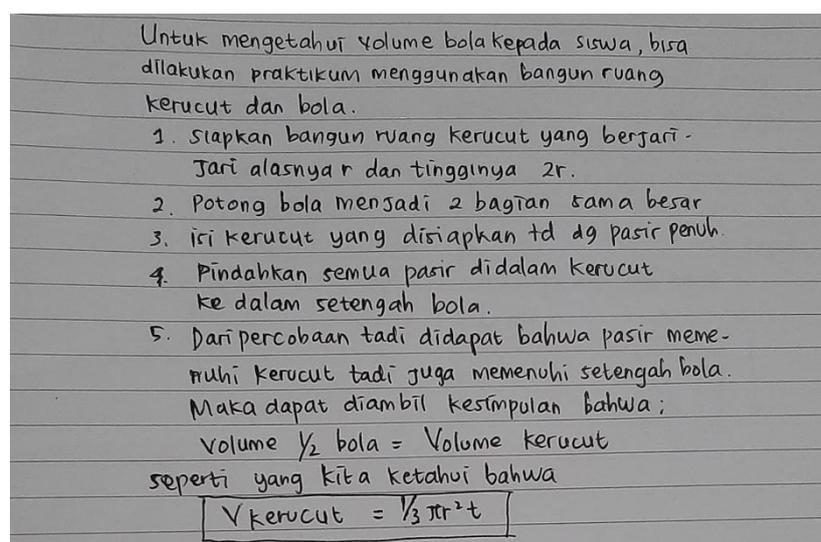
Untuk mengetahui volume bola kepada siswa, bisa
dilakukan praktikum menggunakan bangun ruang
kerucut dan bola.
1. Siapkan bangun ruang kerucut yang berjari-
   jari alasnya r dan tingginya 2r.
2. Potong bola menjadi 2 bagian sama besar
3. isi kerucut yang disiapkan td dg pasir penuh.
4. Pindahkan semua pasir didalam kerucut
   ke dalam setengah bola.
5. Dari percobaan tadi didapat bahwa pasir meme-
   nuhi kerucut tadi juga memenuhi setengah bola.
   Maka dapat diambil kesimpulan bahwa;
   Volume ½ bola = Volume kerucut
seperti yang kita ketahui bahwa
$V_{kerucut} = \frac{1}{3} \pi r^2 t$

Figure 6. SB's Written Test Answer in Explaining
the Sphere Volume Concept

Based on the results of interviews with the subject, information was obtained that the subject had understood the formula for finding the volume of a cone and a cylinder, and its relationship to the volume of a sphere. So it appears that SB has no difficulty in modeling the relationship between the three. The stages in determining the volume of the ball displayed by the subject are correct, as illustrated by the following answers:
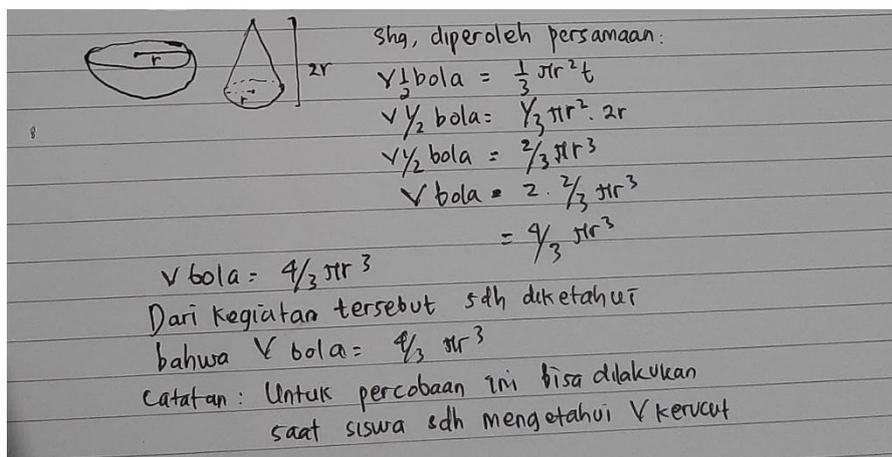
Figure 7. SB's Written Test Answer in Explaining
The Formula of the Sphere Volume Concept

From the results of the work and interviews with SB, it can be concluded that SB fulfills the three indicators, namely: (1) Providing information in accordance with mathematical concepts (2) Systematically organized information with the aim of showing a mathematical relationship (3) using and utilizing and selecting procedures or operations correctly in explaining the concept of spherical volume. In addition, the description presented by SB shows the characteristics of a very strong verbalizer cognitive style.

2. Discussion

There are several interesting things to discuss in this research. When the subject was asked to work on a question about how to find the volume of a combined figures, the visualizer subject was more careful in dividing the combined figures into several figures to make it easier to calculate the volume. This is in accordance with the opinion of Mandelson (2004) that individuals who have a visualizer cognitive style are more image-oriented and prefer visual games, such as puzzles. In addition, the subject of the visualizer is inconsistent in using the names of the sides or angles of a shape. In contrast to subjects with visualizer cognitive style, SB took longer when expressing their ideas, which tended to be slower because the subjects did not like pictorial information. In addition, the subject of the verbalizer solves the problem that is not in accordance with the request on the question. Based on these findings, we know that proving a mathematical problem does not only require mastery of concepts, but also requires skills in representing problems into mathematical models.

D. Conclusion

From the results of the study it can be concluded that, Both SV and SB have been able to meet the three indicators of ability in explaining the concept of prism volume and both of them are also only able to fulfill the first indicator in explaining the concept of pyramid volume. Meanwhile, to explain the concept of sphere volume, SV does not meet the third indicator and SB meets all indicators. From the results of SV and SB's work as well as the results of interviews with both of them, the two subjects showed the characteristics of their respective cognitive styles, namely SV was more flexible in providing explanations through pictures and SB preferred to make explanations in the form of descriptions.

The results showed that there were differences between students with cognitive visualizers and verbalisers in explaining the concept of volume, namely, verbaliser students were more thorough in every detail of the image and were more inclined to explain their understanding using pictures, while verbaliser students were a little slower in finding strategies in solving problems using image. Therefore, it is recommended to lecturers that in providing an

explanation of a material, especially about solid figures, it is accompanied by clear image illustrations and detailed steps in producing clear and precise formulas. The verbaliser subject is not correct in providing proof of the volume formula of a sphere, because his reasoning is invalid. This shows that student's reasoning is still weak in proving mathematical problems. Therefore, lecturers are expected to regularly provide problems that can develop student's reasoning.

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