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Learning how to reason in geometry supported by video in YouTube

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Abstract. YouTube is very populer. Indeed, there are learning resources in the form of videos that can be found in YouTube. The purpose of this study is to describe whether these videos are useful for students. In this research, two students were given three new geometry problems to solve. The first student always watches Korean movies in YouTube, and the second one rarely watches such video in YouTube. They were asked to search relevant information in YouTube while trying to solve the geometry problems. Specifically, their reasoning ability is assessed including how they pose arguments, visualise a context, identify concepts, and conclude the solution. The results showed that after learning to use videos in YouTube, the reasoning abilities of the first student improved. Whereas the second student had difficulty using the searching bar in YouTube finding keywords so that the second student does not solve the given problem. It is concluded that learning using videos in YouTube is very helpful, but it is important to have sufficient knowledge on how videos in YouTube are searched and used.

1. Introduction

National Council of Teacher of Mathematics states that there are five abilities that must be learned by students to improve achievement in mathematics, i.e problem-solving, reasoning, connection, communication and representation [1]. However, many educators exclaim that reasoning ability is basic for mathematics learning [2], [3], [4], [5.], [6], [7]. If students do not develop their reasoning ability, students will only remeber without understanding the existing mathematical concepts [8]. The reasoning ability helps students to build useful knowledge in life [9]. Therefore reasoning ability is very important to be built in students.

The result of Trends in International Mathematics and Science Study (TIMSS) 2011 showed that the percentage of the eighth-grade students' reasoning ability was low and even became the lowest ability of students. The reasoning ability is closely related to geometry subjects. Geometry in mathematics requires reasoning ability because geometry is related to visualization, construction and reasoning abilities [10]. Whereas, if viewed from the data of content domain were obtained from the 2011 TIMSS and the result of national exam in Indonesia for Junior High School in 2016 [11], the average national exam scores for which the geometry content domain is the lowest compared to other content domains.

One of the media that can help in the process of learning geometry is learning with computer media. Learning with the help of computers can increase student motivation in learning [12], [13]. Learning



using technology can help students more easily understand a concept with reasoning [14], [15], [16]. Computer-assisted learning can help students develop their reasoning abilities [17]. In order to improve reasoning ability, students can learn using computer to make them easy in accessing informations related to the lesson. By connecting to the internet, students can access various websites, including YouTube.

It is known that YouTube is a site that contains various videos. The users of youtube continue to increase. The results of a survey stated that in three months, the YouTube users can achieve 25 millions transactions [18]. YouTube provides the latest news to the old news, and also many learning. However, there are also some uploaders who upload inappropriate videos. Therefore, educators must introduce to students that YouTube may be a medium of learning, with awareness that students should be able to select the most relevant to learning.

The purpose of this research was to describe whether by using videos, students can find it useful to improve their reasoning ability. Specifically, this study was aimed to compare two types of students, first is who frequently use YouTube and the second is who seldom use YouTube. The use of the videos is directed for learning reasoning in geometry.

2. Research Method

Using a qualitative approach the purpose of this study is to describe how students' mathematical reasoning abilities after learning to solve geometric problems with learning resources from YouTube. The topic of the geometry problem to solve is polyhedron. At the time of the research participation, students had not studied this topic. The teacher asked students to solve the problem by looking for videos as learning resources that already exist on YouTube. The teacher did not recommend certain videos; students were freely to choose videos on YouTube.

The subjects of this study were ten eighth graders in Yogyakarta who used the national curriculum namely 2013 curriculum. These ten students were the top 10 students in their class. They were interviewed about their duration using YouTube, and two students were chosen to participate in the data collection. The first student is the student who always uses YouTube to access Korean drama videos and other films, while the second student is the student who rarely accesses YouTube. Both students had computer facilities at their home. Both students were given a geometric problem by working on three questions about the polyhedron for 60 minutes. Previously, there was no discussion from the teacher about the lesson. During working on the problem, there was no discussion between the teacher and students and between students and students. The teacher oversees students when carrying out their duties using a computer. The activity took place outside the classroom, but in a closed room and focused on two students. After students solved this problem at the specified time, the teacher discussed it.

Students were asked to complete a test consisting of three questions about geometrical reasoning. Indicators of reasoning ability in the current research were when students could pose an argument, visualized concepts, identified concepts, drew conclusions. Posing an argument means that students are able to make arguments about how to solve them correctly and logically, while visualisation means students are able to imagine the shape of the space that is meant in the problem (modelling). The third indicator of reasoning ability is to identify concept which means students are able to solve problems in accordance with Mathematical concepts. The last indicator is to draw conclusions which means students are able to conclude the answers to the questions given [2], [5], [19], [20].

Students' reasoning abilities were analyzed based on the steps to solve the geometry problems given. Every step in the settlement consisted of various indicators of reasoning ability (shown in Table 3.) In addition to analyze students' reasoning abilities through problem solving steps, the teacher also interviews students about how students solve problems given, students' difficulties, and students' opinions about learning using YouTube videos.

3. Results and discussion

Two students were given reasoning questions of geometry that had not been studied previously. However the students were asked to work on it by using the assistance from the videos available in YouTube. Then the results of the students' work were analyzed by comparing to the indicators of

reasonings. Beside that, the students were interviewed before and after the work about how they used YouTube. Until students' reasoning ability could be found if they worked on the reasoning questions of geometry using the videos.

3.1. The first student's reasoning ability

Geometric questions for the students were essay questions that contained reasoning abilities. The students' answers were analyzed using indicators of reasoning ability as seen in Table 1.

Table 1. Assessment of each item based on indicators of geometric reasoning ability

Indicator of geometric reasoning ability	Number		
	1	2	3
Able to argue	Calculate the volume of water in a cube Calculate the volume of water that is already in the cube Determine the length of the solid cube ribs Calculate the volume of solid cubes Calculate the total volume in a water-filled cube when a solid cube is inserted Calculate the height of the water that is already in the cube before the solid cube is inserted Calculate the height of water in the cube when a solid cube is inserted into a cube containing water. Determine the increase in water	Determine the height of the first aquarium Calculate the area of the first aquarium glass Calculate the area of the second aquarium glass Calculate the area of the third aquarium glass Compare the third glass area of the aquarium	Determine the height of the prism (the distance between the two tent doors) Determine the hypotenuse of the triangle which becomes the base of the prism (tent door) Determine the area of fabric needed to make a tent complete with a tent base Compare the surface area of the tent obtained with the allegations that exist in the problem
Visualise a context	-	Describe the first aquarium model as a beam and determine the size of length, width, and height Describe the second aquarium model as a beam and determine the size of length, width, and height Describe the third aquarium model as a beam and determine the size of length, width, and height	Identify the tent as a prism
Identify concept	Using the cube volume concept to calculate the volume of water in a cube Using the concept of the beam surface area to determine the length of the solid cube ribs Using the cube volume concept to calculate the solid cube volume	Use the concept of the volume of the beam to determine the height of the first aquarium Using the concept of the surface area of the beam with the upper side of the hole to calculate the area of the first aquarium glass Using the concept of the surface area of the beam with the upper side of the hole to calculate the area of the second aquarium glass Using the concept of the surface area of the beam with the upper side of the hole to calculate the area of the third aquarium glass	Using the concept of a prism volume to determine the height of the prism Using the Pythagorean theorem concept to determine the hypotenuse of the triangle that becomes the base of the prism (tent door) Using the concept of a prism surface area to determine the area of fabric needed to make a tent with a tent
Draw conclusions	The water in the cube does not spill The increase in water level is 5 cm	An aquarium with the least glass is an aquarium with the smallest surface area, among the three aquariums, the third aquarium	The opinion of the class leader about the width of the fabric to make a large tent, which is 9 m ² of fabric is enough to make a tent because only 8.4 m ² of fabric is needed.

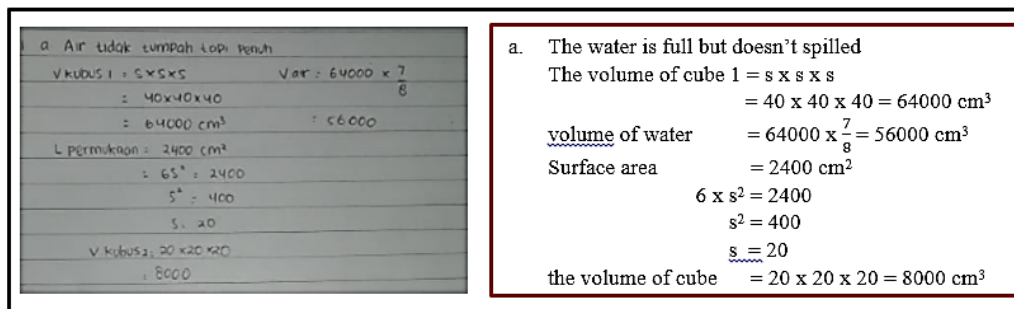


Figure 1. Answer of number 1 from the first student; (a) original work (b) translation

The results of the students' answers to problem number 1 were in figure 1. The first student's answer number 1 indicated that students had been able to calculate the volume of water in a cube, the volume of water already in the cube, determine the length of the cube ribs and the volume of solid cubes. In other words, students were able to use the concept of cube volume to calculate the volume of water in a cube, using the concept of the surface area of the beam to determine the length of the solid cube ribs and using the concept of cube volume to calculate the volume of solid cubes. It can be seen that the student indicated a geometry reasoning ability, as they can answer the question in a logical manner.

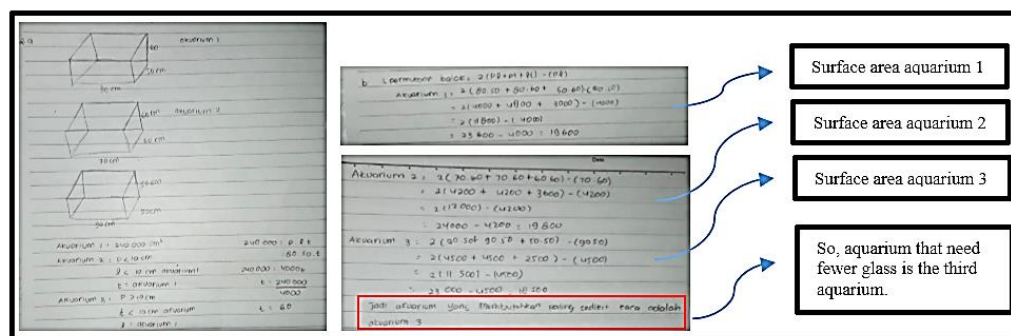


Figure 2. Answer of number 2 from the first student

Figure 2 shows the answer for the given problem to the first student that is to find the first aquarium height, calculate the area of the first aquarium sides (made of glass), calculate the area of the second aquarium glass, calculate the area of the third aquarium glass and compare the third glass area of the aquarium. The five aspects for logical argument indicators were indicated. Students were able to describe, analyse and conclude how to solve the problem, by describing each aquarium model, and write their length, width, and height (visualization). Then, it is indicated that the student can calculate the surface area, as well as were able to conclude that the aquarium had the smallest surface area among the three aquariums is the third aquarium.

The students' answers to question number 3 (can be seen in Figure 3) indicated that students were able to determine the height of the prism (the distance between the two tent doors), the triangle sloping side which became the base of the prism (tent door), the area of fabric needed to form a complete tent with the base of the tent and compare the surface area. The student indicated that they can visualize the problem, were able to use the concept of the prism volume and used the concept of a prism surface area to determine the area of fabric needed to make tents with tents. In addition to the indicators making conclusions students were able to conclude that the opinion of the class leader was correct that the 9m^2 cloth was enough to make a tent that only requires 8.4m^2 of fabric.

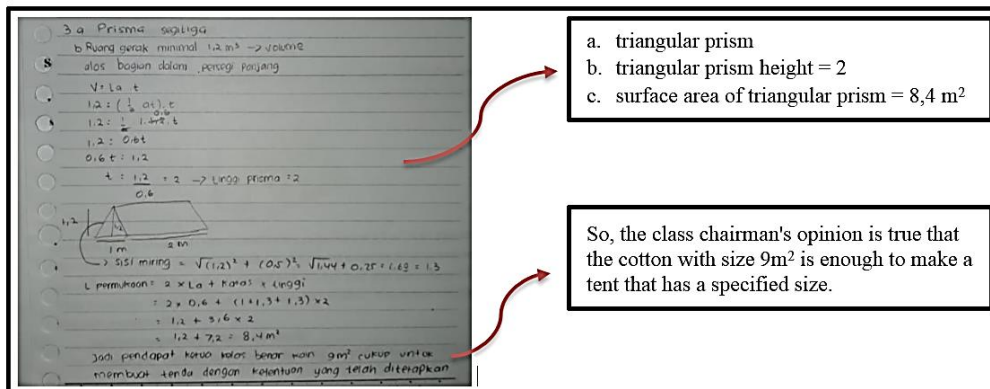


Figure 3. Answer of number 3 from the first student

Of all student answers, both students only were lack of one aspect that is to make logical arguments on problem number 1. It may be summed up that they had developed reasoning ability.

3.2. The second student's reasoning ability

The second student was found only solving two questions, shown in Figure 4 and Figure 5. The answer for number 1, the student had been able to calculate the volume of water that could be filled in the cube, calculate the volume of 7/8 of water that was already in the cube, students were also able to calculate the remaining volume of water that could be filled to full. However, students misinterpret the the volume of the solid cube that would be placed inside it. There were two (of five) aspects of making an argument that were satisfied. They did not show sufficient conceptual understanding. In addition, they did not conclude correctly.

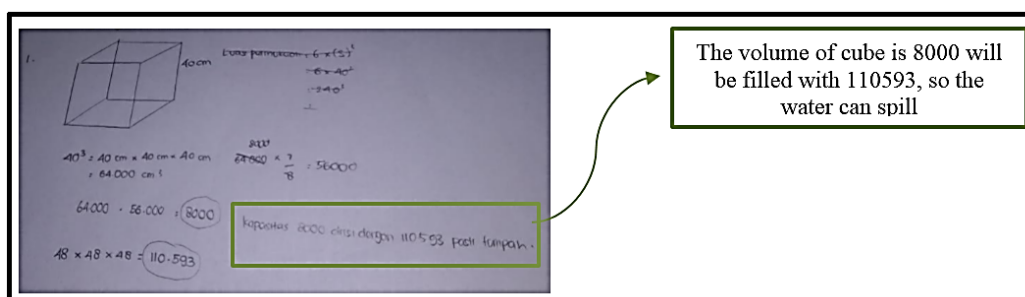


Figure 4. Answer of number 1 from the second student

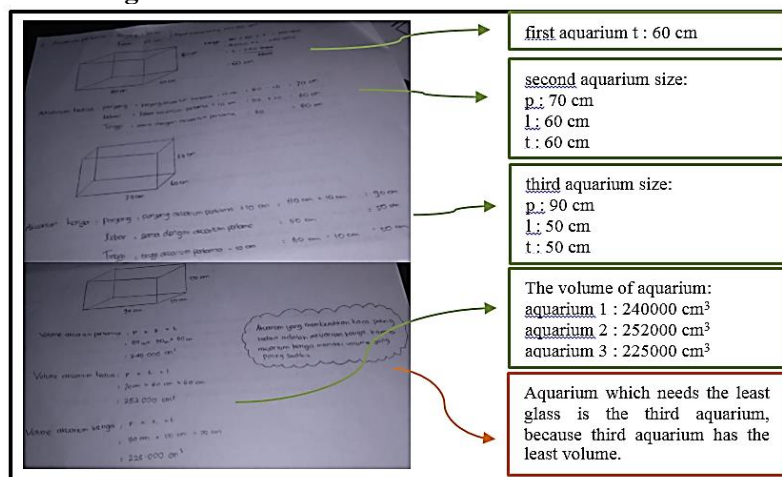


Figure 5. Answer of number 2 from the second student

Similar results were also found for the second problem. They were able to indicate visualization of the problem, but mostly failed in making arguments and showing conceptual understanding. To sum up, there were six out of 13 aspects of geometry reasoning ability achieved by this student.

3.3. Student's responses to learning using video in YouTube

Before studying with YouTube, the first student (S1) and the second student (S2) were interviewed about the initial opinion about the questions given. Initially students had difficulty understanding the purpose of the problem. When the researcher asked whether the question given was difficult?

S1: *"So hard, because we haven't learnt it, what kind of the question is? It makes me dizzy."*

S2: *"Oh, I have solved some questions about a cube before but those were not complicated like this case."*

After that the researchers invited students to watch a YouTube.

S1: *"We're going to watch korean movie, aren't we?"*

The first student showed a high enthusiasm if it had something to do with YouTube. They explained the benefits of YouTube in addition to entertainment, that it could be used as a learning medium, because many learning videos could be accessed. After that student were given the opportunity to learn about geometry related lesson independently by using video help menu on YouTube. The followed-up questions given by researchers were about whether students understand the geometrical lesson when learning with video. The first student answered little understanding, but she had to watch more than once. Then, the researchers asked whether after watching, they can solve the question, students answered:

S1: *"Even though that's not simple at all, but I know a little, those videos provided clear example though I have to search for many videos."*

S2: *"That's so hard cause there is no video which has the same content provided in the questions, so I'm confused"*

The next question, the researchers asked again whether the videos on YouTube helped the student in understanding this geometry lesson?

S1: *"That was very helpful, but I have to watch more than once, because once is not enough. Once I search for another video and watch it i got it"*

S2: *"Actually the video that I've watched makes me understand, but it doesn't provide example which is similar to problem you've given. So, I had difficult in solving that problem. Searching for video that's similar to your problem is still hard for me."*

The last question that researchers give to students is that if students choose to learn to use books or learning videos like YouTube?

S1: *"Learning using YouTube is very helpful, unfortunately I still find hard to determine the keywords. It will be simpler if the keywords have provided"*

S2: *"I like learning mathematics using videos, but I like learning it without searching in YouTube more"*

Based on the obtained analysis, that videos actually can be said to improve students' reasoning ability. The problem is because there are so many videos in YouTube, the students who rarely use it encounter difficulty in finding the right videos for solving the problem of Geometry. This occurred because the students seldom use YouTube. They found difficulty in determining the right keyword to solve the problem given. However if the Geometry learning videos are directly available, then that video will help the students to improve their geometry reasoning ability. This result provides an insight of the

previous study theory which states that technology especially computer can help improving students' reasoning ability [14]. Therefore, in order to improve students' reasoning ability, videos for learning geometry, or other specific topics, should be developed.

4. Conclusion

Reasoning is one of mathematical abilities that is needed in learning mathematics. This research describes learning using videos can help students build their reasoning ability. Data obtained from students' answer analysis, interview, and observation when the students solved the problem of Geometry. The ability to search for videos in YouTube depends on whether the students use YouTube or not. From the results of student's answer, the first student could make an argument, started visual and conceptual process and made a conclusion. This is in line with indicators of reasoning ability. The second student often made mistake in answering questions because the students had difficulty in finding the videos until they work on that problem in accordance with their prior knowledge.

It might be summed up that the learning by using the videos available in YouTube is affected by their knowledge about using YouTube. The students who rarely use YouTube experienced difficulty in searching the videos. However, once they can find relevant videos, they can use them as resources to improve reasoning ability. Consequently, development of learning resources in form of videos is ultimately needed, because there are too many distraction when accessing videos in YouTube.

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