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BLOOM'S TAXONOMY REVISED ASPECT ON VISUALIZER AND VERBALIZER'S PROBLEM SOLVING

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Abstract

The ability to solve problems is a part of learning mathematics that is very important. Problem solving prefers the processes and strategies undertaken by students in solving problems rather than results. The concept of learning corresponds to the stages in the bloom's taxonomy revised. The Bloom's Taxonomy revised has two dimensions, namely the dimensions of the cognitive process and the knowledge dimension. The knowledge dimension has four categories, but this research is only limited to procedural knowledge. The dimensions of cognitive processes are categorized into six types, namely remembering, understanding, applying, analyzing, evaluating, and creating. Learning implementation emphasizes the role of students. In addition, implementation must be balanced with the appropriate tools. In this study, the tools used were open-ended problems. This study aims to provide an overview of how open ended problem can help improve students' mathematical abilities through a Bloom's Taxonomy revised. The results of the study stated that students with visualizer cognitive style had more effective and efficient steps in solving problems well. It shows how it can create a problem from the open ended problem that is given. This can be a teacher's consideration in teaching, so that students can get the open ended problem.
Keywords: Problem Solving, Bloom's Taxonomy Revised, Visualizer, Verbalizer.

INTRODUCTION

Education is basically an effort to provide certain knowledge, insight, skills and expertise to humans to develop their talents and personalities. Education is also an activity that aims to improve one's abilities in various aspects including knowledge, skills, and attitudes (Hasibuan in Yanti, 2009). In the current reality of education, improving students' mathematical skills or skills is rarely done in school learning. Teachers not only teach mathematics as a tool, but teach mathematics as a human activity (Soedjadi, 2007, 6-7). This is one of the factors that causes some students to have a negative impression on mathematics (Sudarman, 2008 (a)), for example: mathematics is considered a scary thing (Lea Pamungkas, 2009), mathematics is difficult and boring (Becker and Schneider, 2009) , mathematics is not fun (Zainurie, 2009). There are things that need to be done besides teaching memorized mathematics by using routine problems or closed problems, namely teaching mathematics lessons using open-ended problems, where the basis of open-ended problems are classified into three types, namely, 1) Process is open, 2) End product are open, and 3) ways to develop are open. This Open-ended problem will be adjusted to the content that is in the bloom's taxonomy revised of cognitive processes. This can measure how much students are able to solve a problem

The most widely used methods for high-level expertise are Bloom's Taxonomy Revisedfor Educational Purposes. Bloom's Taxonomy Revised uses a multi-tiered scale for expertise needed for each measured student outcome. Organizing student results that are appropriate for the class. One of the aims of Bloom's taxonomy Revised is the extent to which teachers want students to understand and use concepts, to show their skills, and to have values, attitudes, and interests that they will have in society.

There are three types of taxonomy. the use of all three will be tailored to student learning outcomes and learning objectives. There are goals based on knowledge, goals based on expertise, and affective goals (affective: values, attitudes, and interests); accordingly, there is a taxonomy for each. Within each taxonomy, the skill level is permitted. Good student learning outcomes will determine when they are faced with a problem.

This objection focus on student's answer sheet. Certainly, this objection cant describe all of the way verbalizer or visualize do in general. But at least this can be seen as an open ended problem, which means that it can address students to find the solution with bloom's taxonomy revised content. However it can help the

teacher to reconsidered to use the open ended problem as the main problem to measure the ability of cognitive students to solve a problem.

This discussion is based on cognitive process according to bloom's taxonomy revised, but there are some merge points to make it easier to understand where the content stands for. Indeed, this content is also has its own characteristic. The conceptual framework (table 1) in analyzing and categorizing adapted in students' answer sheet is based on the following format and content proposed by bloom's taxonomy revised. They are :

Tabel 1.Cognitive Process of Bloom's Taxonomy Revised

Levels	Descriptions
Remembering	Retrieving, recognizing, and recalling relevant knowledge from long-term memory. This level is simply remembering or recalling previous learned information.
Understanding	Constructing meaning from oral, written, and graphic messages through interpreting, exemplifying, classifying, summarizing, inferring, comparing, and explaining. This is essentially demonstrating understanding of information by explaining ideas or concepts
Applying	Carrying out or using a procedure through executing, or implementing. Basically, this is using the information in another familiar situation
Analyzing	Breaking material into constituent parts, determining how the parts relate to one another and to an overall structure or purpose through differentiating, organizing, and attributing
Evaluating	Making judgments based on criteria and standards through checking and critiquing. This includes justifying a decision or course of action.
Creating	Putting elements together to form a coherent or functional whole; reorganizing elements into a new pattern or structure through generating, planning, or producing. This includes generating new ideas, products, or ways of viewing things.

METHODS

The Student's worksheet used in this analysis is the visualizer and verbalizer student's worksheet. In detail, visualizer is devided by 2 part, there are object visualizer and spatial visualizer. Object visualizer considered on whole object as main aspect of their answer and spatial visualizer considered on partial portion of the answer, so their answer more details. The problem was adapted from game in early 20's, It was about several people who try to cross a river with some kind of rule and the student's job is determine how many trip they did. The problem is also changed into open – ended problem, so it has multiple correct answer. The problem has been validated by highly competent in mathematics (Figure 1).

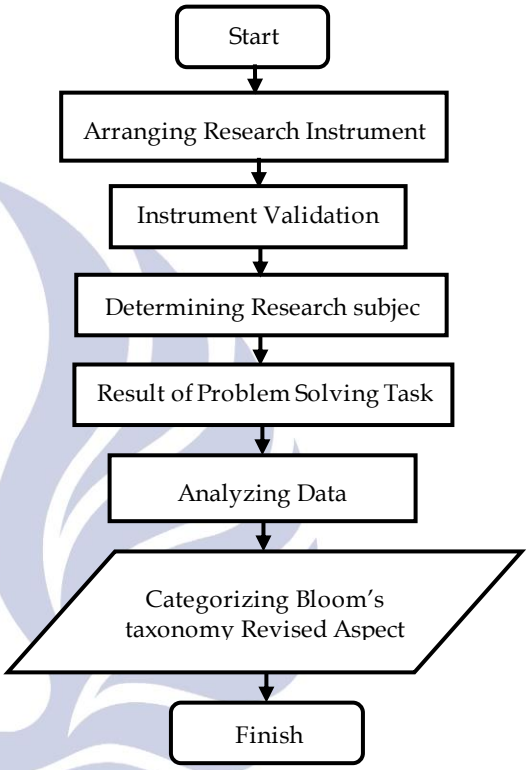

Figure 1. Research Plan

RESULT AND DISCCUSION

In general, this topic is about algebra's riddle. The analyzed parts are defined as categorized Bloom's taxonomy revised. In fact, those parts rarely mention explicitly on how this classify into taxonomy. Using the format and content Categorization from Bloom's taxonomy revised, we can conclude that there are categories on some merge points on subject's results. They are visualizer and verbalizer subject aspect on remember and understand the problem, apply and analyze the solution through the problem, evaluate their answer, Creating a new problem with those new solution, and each indicator to make easier in categorize it.

1. Object Visualizer

The object of the object visualizer was students of high school in Sidoarjo. This subject participated in the work of two Problem solving tasks and two interviews. In the first problem solving task, VO took 35 minutes, then an interview was conducted out. In the second problem solving task, it took 37 minutes, then an interview was conducted. This aims to observe whether the subject is

consistent with the steps to solving the problems that were carried out previously.

Table 1. Visualizer Object Description

Content	Indicators	Details
Where the students remember and understand the problem	Read given problem	Subject reads the questions given.
	List the information	Subject writes down the informations known on the answer sheet
	List the question	Subject deafers what he wants to find
	Sketch the problem	Subject illustrated the problem given. It seems like VO makes a kind of trip that can be done by the boat.
How students apply and analyze the solution through the problem	Make a map showing interrelation ships	Subject describes the model of a boat trip. It is seen that there are boats and the flow of travel from the boat. There are a number of adults and the number of teenagers is on the riverbank. Then Subject arranges a boat crossing by following the conditions / conditions provided.
	Construct a sketch to organize data	Subject constructs boat trips by following the rules that a boat can carry only 1 adult or 1 teenager or 2 teenagers.
	Solve a problem	Subject try to find the solution by calculating the trip of boat do. And then, subject find those solution
How the student evaluate their answer	Check the answer	Subject revealed that the answer was correct. When subject states this, it does so by reviewing the answers he has written on the answer sheet. Subject occasionally looks at questions to check for errors that occur during the problem solving process. In addition, he also adjusted to the plan he had compiled beforehand.
	Try another strategy to solve the problems	Subject revealed that there were other alternative solutions. Subject uses the formula that he has found. Subject revealed that he found the formula from the two comparisons drawn.
Creating a new problem with those new solution	Creating a new solution from edited problem	Subject shows there are 2 answers, namely by changing the ratio of the number of adults and adolescents.

Based on the analysis described above the object visualizer is able to solve the mathematical problem given. The work shown is related to the 4 stages of problem solving, (1) Understanding the problem; (2) Select or determine plans; (3) Carry out the plan; and (4) Evaluating results. The results of the visualizer object work are in accordance with Paivio & Richardson (in Kozhevnikov et al., 2005) which reveals that visualizers mainly rely on imagery when trying to do cognitive-related tasks. In solving subject problems visualizer objects prioritize using drawing strategies to explain them. The results shown by the subject visualizer object can solve the problem very well. The answer given is also true for the problem. This is not in accordance with that stated by Woolner (2004), saying there is a suspicion that students with cognitive visualizers might fail in school mathematics because of a mismatch between the cognitive styles they have and the dominance of teachers who teach verbally. In other words, the subject of visualizer objects is able to solve mathematical problems accurately and precisely according to Kozevnikhov (2005) Object visualizers tend to encode images as a whole as a unified perception that is processed thoroughly. They tend to be faster and more accurate in recognizing and remembering things.

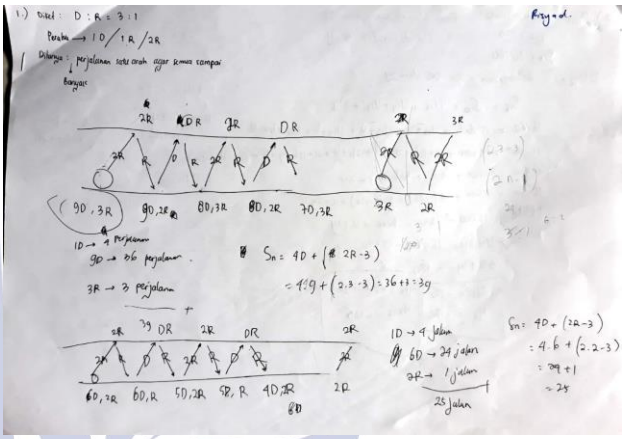

Figure 2. Visualizer Object's WorkSheet

2. Visualizer Spatial

Table 2. Visualizer Spatial Description

Content	Indicators	Details
Where the students remember and understand the problem	Read given problem	Subject reads the questions given.
	List the information	Subject writes down the informations known on the answer sheet
	List the question	Subject deafers what he wants to find
	Sketch the problem	Subject illustrates the situation the problem. Subject makes an illustration to clarify the situation the question so that it makes it easier to find a solution.
How students apply and analyze the solution through the problem	Make a map showing interrelationships	Subject describes the model of a boat trip. Subject seemed to make a boat trip to cross the river with regard to the requirements of the number of people who could use the boat. The subject also does the same for other comparisons.
	Construct a sketch to organize data	Subject constructs boat trips by following the rules that a boat can carry only 1 adult or 1 teenager or 2 teenagers.
	Solve a problem	Subject try to find the solution by calculating the trip of boat do. And then, subject find

Content	Indicators	Details
		those solution
How the student evaluate their answer	Check the answer	Subject revealed that the plan he did was correct and in accordance with what was planned. Subject also revealed that he had used things that were already known in the matter to work on the problem. When Subject states this, he does so by observing the answers he has written on the answer sheet. Subject occasionally looks at questions to check for errors that occur during the problem solving process.
	Try another strategy to solve the problems	Subject revealed that there were other alternative solutions. Subject uses the formula that he has found. Subject revealed that he found the formula from the two comparisons drawn.
Creating a new problem with those new solution	Creating a new solution from edited problem	Subject shows there are 2 answers, namely by changing the ratio of the number of adults and adolescents.

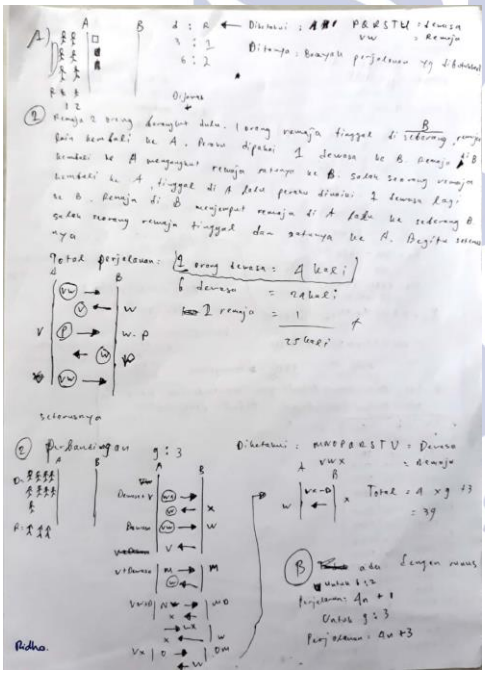

Figure 3. Visualizer Spatial's WorkSheet

Based on the analysis described above the visualizer spatial is able to solve the mathematical problem given. The result related with the 4 stages of problem solving, (1) Understanding the problem; (2) Select or determine plans; (3) Carry out the plan; and (4) Evaluating. The results in line with Paivio & Richardson (in Kozhevnikov et al., 2005) reveal that visualizers mainly rely on imagery when trying to do cognitive-related tasks. More than that, the subject of the spatial visualizer is more detailed than the visualizer object because the subject provides information regarding his work. This is in line with Kozhevnikov (2005) stating that spatial visualizers tend to encode and process images analytically, parts per section, using spatial relationships to compile and analyze each of its components.

The spatial visualizer subject experiences errors when looking for solutions to problem number 1. The subject gives an inappropriate answer. But the subject is able to fix it at the stage of evaluating the results. The subject gives the correct answer. The spatial visualizer subject also gives 2 correct answers to the problem. But the subject requires more time to find a solution to the problem given. This is not in line with Woolner (2004) saying there is a suspicion that students with cognitive visualizers might fail in school mathematics because of a mismatch between the cognitive styles they have and the dominance of teachers who teach verbally.

3. Verbalizer

Content	Indicators	Details
Where the students remember and understand the problem	Read given problem	Subject reads the questions given.
	List the information	Subject writes down the informations known on the answer sheet
	List the question	Subject deafers what he wants to find
	Sketch the problem	Subject illustrates the situation the problem. Subject makes an illustration to clarify the situation the question so that it makes it easier to find a solution.
How students apply and analyze the solution through the problem	Make a map showing interrelationships	There is one diagram given by subject. But after being analyzed, the chart is only an illustration. Illustrations made by subject to the conditions of the questions given. Then VE provided information regarding the illustration he had made. Subject explained in detail in the form of a story about a trip carried out by adults and teen using a concern.
	Construct a sketch to organize data	Subject constructs boat trips by following the rules that a boat can carry only 1 adult or 1 teenager or 2 teenagers.
	Solve a problem	Subject can find the connection of boat trips to the number of adults and teenagers. Subject found the boat trip pattern. Subject makes a pattern and find the number of trips made by boats by changing the ratio of the number of adults and teenagers. Subject also writes the formula related to the solution to this problem.

Content	Indicators	Details
How the student evaluate their answer	Check the answer	Subject corrects the work done by re-reading the answer sheet. Subject also reread the question to make sure the answer he had done was correct.
	Try another strategy to solve the problems	Subject found the boat trip pattern from the information he had made. The travel pattern was expressed in the form of a formula, namely many trips is 4D + (2R-3), D is the number of adults and R is the number of teenagers.
Creating a new problem with those new solution	Creating a new solution from edited problem	Subject shows there are 2 answers, namely by changing the ratio of the number of adults and adolescents.

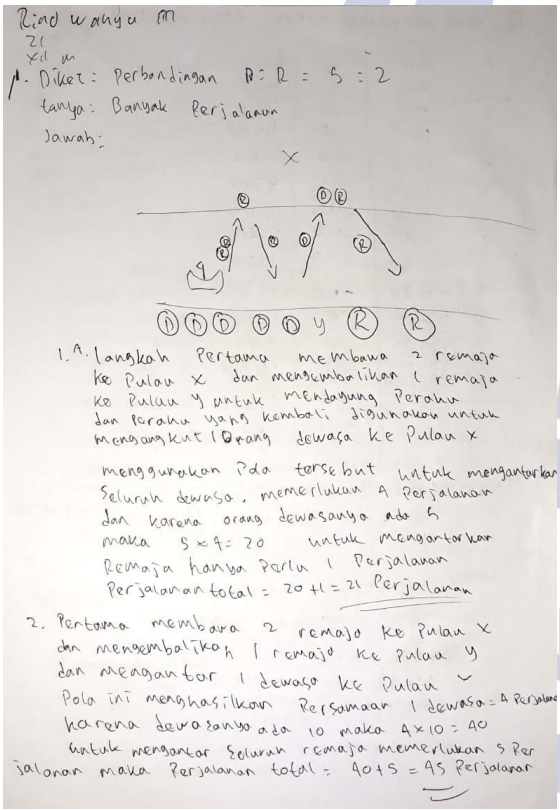

Figure 4. Verbalizer's WorkSheet

Based on the analysis described above the verbalizer is able to solve the mathematical problem given, the results shown by the verbalizer subject are in accordance with the 4 stages of problem solving, namely (1) Understanding the problem; (2) Select or determine plans; (3) Carry out the plan; and (4) Evaluating. The verbalizer subject is able to solve the problem given, even though there are indicators that are not met, namely rewriting the question on the question. The subject work of verbalizer in line with Paivio & Richardson (in Kozhevnikov et al., 2005) reveals that verbalizers rely primarily on verbal analysis strategies. This can be seen in the answer of the subject in number 1. The subject of verbalizer is more comfortable in explaining using the words themselves through the information shown on the answer sheet. But when viewed from the work done by the subject of the verbalizer, the results shown are no better than the subject visualizer object. The work of the verbalizer subject looks inefficient when compared to the subject visualizer object. This is not in accordance with Riding and Agrell's (in Arnup et al. 2013) in his research entitled The effect of cognitive style and cognitive skill on school subject performance that results in students' cognitive-style verbalizers getting better results than students cognitive style visualizer in solving mathematical problems. However, if viewed from his work, the verbalizer subject is able to answer all the questions correctly.

Closure

Conclution

In Summary, integrating open—ended problem can make students explore their ability to solve a problem. While in this case, Bloom's taxonomy revised can make it easier to prove that there are some points that many teacher forgot that those ability that students' have must be force to appear by using open—ended problem. Even there are many difficulties to make this problem, at least in this case, the visualizer and verbalizer subject can explore their knowledge to finish well. Compared to those three subjects, they can give a different solution with kind of alternative problem solving with their characteristic. So, it can shows that there are three different cognitive style.

Suggestion

Based on the conclusions above and the condition of the researcher during the field, the researcher gives the following suggestions:

1. The results of the study show that although all stages of problem solving appear on all three subjects, descriptors that show their problem solving characteristics have several differences. This difference affects the strategy of solving problems they take. Therefore, teachers should pay attention to the differences in the cognitive style of visualizer objects, spatial visualizers, and verbalizers in the learning process, especially in preparing learning that can involve or even improve student problem solving.
2. For educators, it is better to design and familiarize learning that encourages students to further optimize the ability to solve problems using open-ended problems.
3. For researchers who want to conduct research that is relevant to this study.
   a. At the interview, the researcher should use a video recorder to record so that no data or events are

missed and the researcher is facilitated more easily when analyzing the data.

b. The researcher should be able to distinguish different answers and different ways when analyzing the results of TPM work by the subject of the study, so that there are clear differences between the stages of problem solving.
c. In general, problem solving assignments made by researchers must be able to collect student problem solving according to the cognitive style possessed by students.
d. The subject of this study only focuses on students in cognitive visualizer objects, spatial visualizers, and verbalizers without looking at gender. So, in the next study it is expected to see gender in determining the subject of research can be represented.

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