

Improve Analytical Thinking Skill and Mathematical Representation of The Students Through Math Problem Solving

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Abstract—Thinking always do by any person or individual, so that thinking is internal and appear in the individual and takes place continuously. Our expectations as an educator is to make students as thinkers and problem solvers in good way. So we need to increase the skills to think starting from the lowest to high order thinking skills. One of the higher-order thinking skills is a skill to think analytically. Analytical thinking is subjecting, one subject or problem situation decisions on a rigorous examination of logical step by step. On analytical thought processes can be seen the skills of its mathematical representation, mathematical representation are expressions of mathematical ideas used to show (communicate) work in a certain way (in conventional or unconventional way) as a result of the interpretation of mind. The problem is every student has a different level of thinking, this caused the differences analytical thinking processes in solving mathematical problems. So the necessary alternatives from the activity or environment to improve analytical thinking skills and mathematical representation of student. So that the purpose of this paper is to examine theoretically about solving math problems to improve analytical thinking skills and mathematical representation of students.

Keywords: *analytical thinking skill, mathematical representation, problem solving*

I. INTRODUCTION

Problems in mathematics is to be solved and found the solution. Consciously doing a series of appropriate action to achieve a clear figure, but accomplishment is not directly obtainable. Mathematical thinking skills is a benchmark in solving a problem and to achieve the goals of learning mathematics, especially in higher order thinking skills, one of them is to think analytically. This skills appears when the students solve a given problem, where there is the process of elaborating and understand the relationships that exist within a problem.

Learning math in the classroom should provide enough opportunity for students not only to analyze a problem but also to be able to train and improve the skills of mathematical representation as an important part in the problem solving. The problems are presented with customized content and depth of material on each extent by observing the initial knowledge or prerequisites which students belonged. When students are faced with a situation of mathematical problems in class, they will try to understand the problems and solve them in ways they had known.

Successful problem solving is not possible without the analysis and representation of the appropriate problems. The appropriate analysis and representation of problem is a basic to understand the problem and make a plan to solve the problem. Students who have difficulties in analyzing and representation mathematical problem will have difficulty in doing problem solving. Thus over the importance of problem-solving skills in mathematical learning, then analytical skills and mathematical representation of

students needs to be improved because it is the part that can not be separated from the problem solving, it was also functioned in the achievement of the objectives of the learning of mathematics

II. DISCUSSION

A. Thinking definition

Thinking is a dynamic process, in which individuals acted actively in dealing with abstract things. On the individual thinking process that making the relationship between the object being the principal problems with parts of knowledge already known. Part of the knowledge is everything that's been taken in the form of understanding according to Ismienar [1] think is the development of ideas and concepts in one's self. The development of the idea and the concept is taking place through the process of constructing the relationship between the parts of the information stored in one's self in the form of understanding-understanding. Thinking includes a lot of mental activity. Hudojo [2] states in the process learn math happens thinking processed because is said to be thinking when that persons do mental activity, and those who study mathematics definitely do mental activity. In thinking, people will draw up the relationship between the parts of the information recorded as understanding. From the understanding are drawn conclusions. The skills to think someone influenced by the intelegentsia skills, so there is a link between the intelligentsia with the learning of mathematics. Suryabrata [3] argues that thought is a dynamic process that can be described according to the process or the way. The thought process that substantially there is 3 steps, i.e. formation of the understanding, the formation of opinions and withdrawal of the conclusion. Refer to the above opinion, the process of thinking in this research is a process that begins with a receive data, process and store them in memory and recall of memories at the time needed for further processing.

B. Analytical thinking skills

According to Ismienar [1] think is a mental activity which involves the working of the brain. Although it can not be separated from the activities of the brain, the human mind is more than just a work organ called the brain. The activity of thinking also involves the whole human person and also involve feelings and human will. Think of something means to steer itself on a specified object, realizing actively and host it in mind then insight into the object.

According to Munandar [4] there is a 6 level cognitive domain Bloom thinking skills, respectively from the lowest to the highest, i.e. include knowledge, comprehension, application, analysis, synthesis, and evaluation as shown in the figure below.

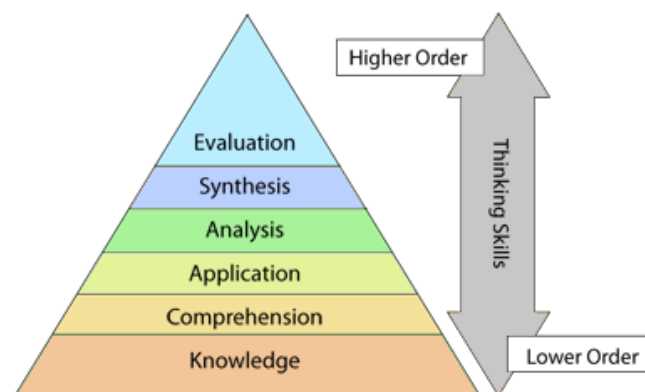


Figure 1. The Skills Of The Cognitive Domain of Bloom

Based on the picture above the skills of analytical thinking capabilities including high level thinking skills. According to Rose and Nicholl [5] "analytical thinking is subjecting one subject or problem situation, decisions on a rigorous examination of step by step logical. Test statements or evidence or proposals in front of objective standards".

Suherman and Sukjaya [6] States that "the skills of analytical thinking is the skills to specify or to elaborate on an issue (problem) into smaller parts (components) as well as being able to understand the

relationships between the parts". It is also reinforced by Bloom who claimed that emphasizes analytical thinking skills at solving the material into more specific parts or small and detect relationships and the parts and the parts were organized. Bloom divide aspects of analysis into three categories, that is: (1) analysis of parts (elements) such as fact example, the element is defined, the arguments, the axiom (assumption), the proposition, hypothesis, and the conclusion; (2) analysis of the relationship (relation) such as linking between the elements of a system (structure) mathematics; (3) analysis of such a system is able to recognize the elements and their relation to the structure of the organized

So it can be concluded that the analytical thought process is the process or its way of thinking analytically, or thought process students to elaborate, detailed, and analyze the information that is used to understand the knowledge by using common sense and logical mind, not based on feelings or guesses.

C. The skills of Mathematical Representation

NCTM [7] include problem solving, reasoning, communication, connection, and representation as a standard process of learning math. This means the representation is one of the standard processes that are important in improving students skills in mathematics.

Alhadad [8] states that the representation is a mathematical expression of the ideas shown students as a model or a replacement of a problem situation that is used to find the solution of a problem is being encountered as a result of the interpretation of his mind. In this case students can try different representation in resolving the problem mathematically.

Pape & Tchoshanov [9] suggest that there are four main ideas in order to conceptualise representation. Firstly, within the domain of mathematics, representation may be a thought of internal-abstraction of mathematical ideas or cognitive schemata that are developed by the learner through experience. Secondly, representation can be explicated as "mental reproduction of a former mental state". Thirdly "a structurally equivalent presentation through pictures, symbols and signs" also means to representation. Lastly, it is also known as "something in place of something"

Miura [10] stated that there are two general types of representations that affect children's understanding of and solution to, mathematics problems: (1) instructional representations (definitions, examples and models) that used by teachers to impart the knowledge to students and (2) cognitive representations that are constructed by the students themselves as they try to make sense of a mathematical concept or attempt to find a solution to a problem.

Lesh, Post and Behr [11] divides the representation used in the mathematics education in five types, include the representation of objects in the real world, a concrete representation, a representation of symbols in arithmetic, representation of spoken language or verbal and representation of a picture or graphic.

As one of the standard process then the NCTM [7] set the standard representation which is expected to be controlled by the students during the learning in school are:

1. Create and use representations to know, mencatatatau record, and communicate mathematical ideas;
2. Select, apply, and perform translation between mathematical representations to solve problems;
3. Use representation to model and interpret phenomena physical, social and mathematical phenomena.

So, it can be concluded that the skills of mathematical representation is students ability to express mathematical ideas are presented as models or replacement of problem situations that are used to find the solution of the problems it faces as a result of the interpretation of his mind. such a problem can be represented through images, words, tables, concrete objects or mathematical symbols

D. Mathematical Problem Solving

Blum & Niss [12] stated that the problem is the situation or circumstances there in contained open-ended questions (open question) are challenging someone intellectually wanted to immediately answer the question with methods/procedures/algorithms and more.

According to Polya [13] definition of problem solving is as a effort seeking a way out of a difficulty, achieving goals that are not immediately achievable. Polya classified problems in mathematics into two groups. The first is the problem of finding something that related to theoretical or practical. Abstract and concrete. The second is the problem related to prove or indicate that a statement is true, false both. Problems associated with finding something more appropriately used on the basic nature of mathematics while problems associated with proved more appropriate use on advanced mathematics.

According to Majid [14] solving problems is a way to give the understanding with students stimulations to observe, examine and think about a problem to further analyse the issue as the effort to solve the problem

According to Polya [13] to make it easier to understand and solve a problem, first is, the problem is organized into simple problems, then analyzed (finding all possible steps will be taken), then the next step is the synthesis of (check the truth of each step is done). At the level of specific problems, the steps in problem solving according to Polya's, that is:

1. *Understand the problem*, the main in this step is to be able to determine what is known and what is asked. To make problem solving process more easily, then the first thing to do is make a note about key points can be either pictures, diagrams, charts or other. If the record key points have been made then the direction of solving the problem it will become clear
2. *Planning solution*, things to do in this step is to find the relationship between the data and the question. The selection of concepts that have been learned. So it can be used to resolve the problems facing it. So the necessary rules in order to make during the process of problem solving takes place. It is certain there will be no need for an alternative that is overlooked.
3. *Implement the plan*, based on the plan, the settlements issue that already planned it. In resolving the problem, each step checked. The step is correct or not.
4. *Check back*, the stage looking back-solving results obtained may be the most important part of the problem solving process. After the completion of the results obtained, to be seen and checked back to make sure all the alternatives are not overlooked for example by way of, looking back at results, looking back on the reasons that have been used, find other results, use the results or the methods used for other issues, interpret back issues, interpret the results, solve new problems, and more

E. Improve Analytical Thinking Skill and Mathematical Representation of The Students Through Math Problem Solving

A problem-solving usually contains a situation which may encourage someone to solving but do not directly know how. If a child is exposed to a mathematical problem and direct the child know how to solve it properly, then the problem can not be classified in the category of problem-solving.

According to Mursel and Nasution [15] learning begins with a problem, then the problem is solved in earnest by analyzing and understanding the relationship between these problems, then that learning is a effort to searching, finding, looking of something, and it will give the pure result if through an experiment.

Solve a problem can be used to stimulate the skills of high order thinking skills in an oriented problems situation. On the learning process in solving a problem, the role of the teacher is presenting problems, ask questions, and facilitate the investigation and dialogue. Problem solving requires students doing the investigation to seek a real solution. They must analyze and define the problems, develop hypotheses, plan, collect and analyze information, do the experiments if needed, and make the inference. After that, students are expected to represent the result of problem solving that has been resolved so that teachers will be able to find out the extent to which students can analyze, and as a proof they had been unable to resolve a problem that has been given.

In solving a problem, more students discuss and cooperate with peers or his group compared to listening to an explanation of the materials from the teacher. Students engage actively in discussion process, exchange of opinions and ideas that they have deals group to find solutions to problems that they discuss.

According to Suhartanto [16] analytical thinking, is to think that using a phase or logically steps and systematically steps. Analytical thinking step is to test a questions or evidence with objective standards. Look beneath the surface until the roots of the problem, make a decision the basis of logic. Through analytical thinking we can elaborate on problems like the tangled threads of outlines

According to Rose and Nicholl [5] analytic thought processes can be reviewed from the process of analytical thinking in solving a problem that is, defining exactly what the real problem, have lots of ideas. Get rid of the most alternative and less efficient throw away those choices that do not meet the criteria that have been set previously, specify option is ideal to look at the best solution that meets the specified criteria, knowing the consequences and impact in resolving the problem.

Mathematical problem solving in the process demands the students to think not only to listen but also to analyze the problem and find a solution to solve the problem, then through discussion with peers or groups making them can exchange opinions or ideas and can represent the completion of mathematically they have, this makes the students gain knowledge or information more and increase the skills to think analytically and mathematical representation of them.

Problem solving systematic in analytical thinking skills and mathematical representation as follows:

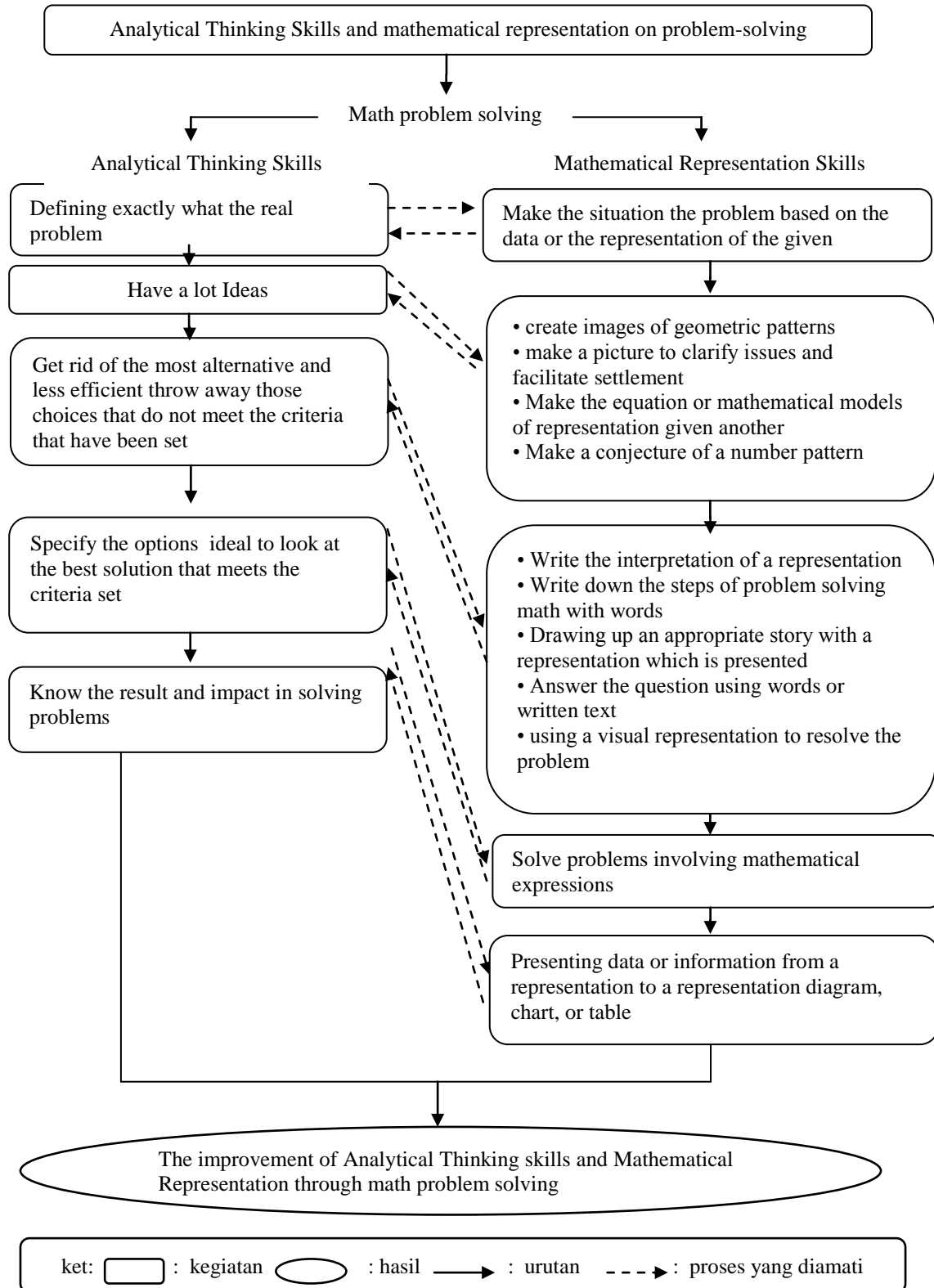


Figure 2. Systematic problem solving in analytical thinking skills and mathematical representation

III. CONCLUSIONS AND SUGGESTIONS

A. Conclusions

Based on several studies of the above theories can be drawn the conclusion that the math problems have strong linkages in improving analytical thinking skills and mathematical representations. As with the granting of a problem student forced to solve the problem of Connection through problem-solving that students start to get used to think analytically. The skills to analyze a problem indirectly will be increase And then the students representation capabilities will be visible. Because through analytical thinking skills would be the skills to represent something.

B. Suggestions

Expected results of the study in this paper will be a concern for teachers and interested parties to be utilized to enhance analytical thinking skills and mathematical representation of students in learning mathematics. Teachers are expected to foster analytical thinking skills through problem-solving. Solving problems can make the learning meaningful and be processed had more independent in his education, so students themselves will find concepts, and create analytical thinking skills and its mathematical representation increased.

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