THE MODEL OF PROBLEM SOLVING IN MATHEMATICS LEARNING IN INDONESIA

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Abstrak

Most in learning mathematics in Indonesia, students are familiarized with the write-down is known, asked, and the answer to resolving the issue. Conditioning is different from the theories of problem-solving, such as Polya provide problem resolution with understand, plan, implement, and re-evaluate it (looking backward). The difference between theory and practice applied mainly drew attention in the study of logic and the set. Results of the study indicate that there are two modes of representation of problem solving in Indonesia. The first model of mathematical problem solving is writing the note, asked, and answered. The second model is the solution to math problems in Indonesia is taking the example, will be demonstrated, and evidence.

Key Word: *Model of learning; Problem Solving; Mathematics Learning;*

1. INTRODUCTION

One of the skills or capabilities gained from learning mathematics is the skill or ability in solving problems. Skills i.e. the ability to use the intellect, thoughts, ideas and creativity in doing, change or make things become more meaningful so that produces a result value of the work. The ability is the totality of powers as to do such a thing or activities in order to achieve the desired goals. It is accordingly Permendiknas No. 22 on the year 2006 about content standards, namely: understanding math concepts, explains the relation between concepts and apply concepts or algorithms, for flexible, accurate, efficient, and precise, in problem solving (Depdiknas, 2006).

Cannot be denied that in the learning of mathematics, problem solving is an important thing. Every day student given problem to be solving by teacher or lecture. Teacher or lecturers often give problems in the form of quizzes, assignments, exam questions, or homework. It is the Government's expectation of according that the learners are expected to achieve a range of competencies or skills HOTS with the application of higher-order thinking: the critical thinking, creative and innovative, the communication skills, the ability of working together (collaboration) and confidence (Ariyana, 2018). Students are expected to solve problems that are given by the teacher for a learning tool.

Data of Badan Penelitian dan Pengembangan (Balitbang) Kemdikbud on the year 2015 shows that the value of the PISA mathematics competency for Indonesia is still lower than the OECD average (Kemdikbud, 2016). Such data are certainly very apprehensive world education especially mathematics

education. Mathematical scientists certainly moved to increase the competence of mathematics students. Some of the student thesis research shows that most students solve the problem by writing the note, asked, and answered. Most data obtained showed that the students had not planned and are not checking back. Even some of the data show that students only understand and answer questions. students impressed mechanistic in answering because it does planning a settlement and not re-examine the issue.

The importance of the issue became the focus of important in learning mathematics. Dewey provide troubleshooting steps: awareness of the existence of the problem. Formulate the problem, looking for data and formulating hypotheses, testing hypotheses, and receives the correct hypothesis. Polya provides four stages of problem solving: see (understand), plan (plan), do (implementing the plan) and check (test the answer) (Zubaidah, 2015). So, developing some of the terms in the learning of mathematics, such as problem solving, problem posing, problem, problem-based learning, open problems, and so on (E. A. Silver, 1941). The novelty of this paper is to discuss the problem solving that is usually done in the learning of mathematics in Indonesia. Thus expected it can to be input or consideration in the implementation of learning at school.

Preliminary observations indicate that in learning mathematics at several levels of the primary school and secondary school, even to the College, the students in Indonesia familiarized with writing down the known, writing down the asked, and answers in solving the problem. With writing down the known, the students expected to understand of the problem that given. With writing down the asked, the students expected to knows that asked. By writing down the answers, the students are expected to give the idea of solving problems. Some teachers more focus to answer as the image or representation of the idea of solving problems. So, it does not require writing a note and asked. Vygotsky believed that people and their cultural environment plays a role in the system of social interaction. Through communication and action, those who are in the child's environment teaches tools to the child to acquire competence. Thus, students develop higher cognitive functions like problem solving (chunk D H. 2012).

It is contrast to the learning of mathematics in higher levels, such as at the University level, in learning of introduction to the basics of mathematics or logic and sets, real analysis, or algebraic structures. Conditioning renders is known, asked, and the answer is to be taking for the example, will be demonstrated, and evidence. The existence of differences model can be understood because the model demands answers to desired. One model is demands an answer while the other model is demands of proofing. In General, adults have a personality and character different from typical children. In the study, children should be cared for by the teacher. Adults learn more departures from the knowledge and experience in itself because it has a lot of knowledge and experience that they have gained, both in ways that are systematic or by natural means. Adults have a lifetime of a readiness to learn as a result of his social role (Maliki Z. 2014).

Student characteristics i.e. have high learning readiness, bring a lot of experience, are less flexible in the interaction, want to be treated in accordance with his maturity, initiative, and independent. Six characterize behavioural learning students are: define your own direction and purpose of their learning, has a set of life experiences, oriented to the objective and relevance, tends to be practical as well as requires (Lieb, S, 1991). Kolh split phase learning students in four phases i.e. departing from experience, use that experience for observation and reflection, the assimilation of observations into the conceptual framework of or connected with the concept of previous knowledge, tested and applied in different situations.

Problems on different learning courses set logic and mathematics so that students had traffic in argumentation. One way to argue is using algebraic propositions that have been developed using the table of truth to the implications, associative, comutative, associative, idempoten, and de Morgan. Academic Guidelines of Program Studi Pendidikan Matematika FKIP Universitas PGRI Madiun describe student learning product that is capable of using the manipulate operation and algebraic in nature and problem solving related with logic and mathematical sets (The Team Compiling, 2017). The ability of arguing is not only important in solving problems in learning, but also in everyday life.

The problem often encountered is the term used in the discussion of the theoretically does not correspond to the terms used in the study. This paper discusses the resolution of mathematical problem solving in learning theory in mathematics. This discussion is important to increase the quality of education in Indonesia. College quality improvement efforts are continuously made. One of the efforts to that end is to develop quality assurance (quality assurance) so that is expected to grow a culture of quality ranging from, how to set standards, implement standards, evaluating implementation, and continuous quality improvement (Ismanto H S, 2014). The results of this research is more of a means of sharing knowledge between cultures or countries.

2. RESEARCH METHODS

The subject of research is the study of mathematical education course students teaching faculty of Science University of PGRI Madiun with criteria 1 semester of the academic year 2018/2019 and follow the course of mathematical logic and the set. Thus, guaranteed authenticity and the breadth of data. The respondents of the research obtained from two classes that add up to a total of 58 students. Students came from Bojonegoro, Cepu, Madiun, Magetan, Kalimantan, Pacitan, Trenggalek, Wonogiri, Sragen, and Ponorogo.

The main research instrument is the researchers themselves. The researchers are required to have a responsive properties i.e. able to immediately catch and process the information provided, i.e. capable of Adaptive immediately clarify if there are errors of delivery of information, i.e. are able to immediately develop a holistic or summarize the information provided, and conscious in the context of the

unspeakable that is able to immediately explore and understand the answers. A researcher requires two basic characteristics to develop theoretical sensitivity; namely: 1) should be able to improve the analytical distance, tolerate confusion and setbacks at a time when experience circumstances that are still open, the belief in the process of early awareness (preconscious) and at the onset of conceptual; and 2) should have the ability to develop insights into the theory of the research so that it becomes knowledge.

Auxiliary instruments for this research is the issue sheet. The problem was appointed as a research instrument is as follows.

> *Prove that the statement "If the older brother got the rain then he will be sick or if the younger brother got the rain then he will be sick" the same meaning with the statement "If the older brother and the younger brother got the rain then they will be sick".*

Respondents or student be required to resolve the issue of the above using algebraic propositions as a task.

Data retrieval is done with the interview-based tasks. An interview conducted in great depth with a semi-structured format. In-depth interviews are conducted on a subject chosen in hopes of giving the required data. Interview in depth is needed because the cognitive processes take place very efficiently and accurately, effectively deal with information that is meaningful, cannot be observed directly, inter-related amongst one another, become more effective due to exercise, can influenced by the context of the task, and is influenced by the emotions that the middle of the experienced person (Suharnan, 2005).

Validation of data triangulation used the time triangulation and subject triangulation to get valid data at once guarantee saturation data. The time triangulation required to get data that was saturated. The subject triangulation was done to get the General information. But, the data presented only one data and notes required field.

The valid data is analyzed with the coding, reduction, categorization, exposure, so that they obtained conclusions. The coding is done to facilitate researchers in data search. Data reduction is done by selecting the relevant data while the data is not relevant is not used. Data categorization is done to get the patterns and stages the given problem solving. Exposure data is given by considering the naturalness and depth data. The conclusions are about the description of solving problems that are usually done and problem solving is done.

3. RESULTS OF THE STUDY

Results of the study showed that a large majority student's answer or explanation with three stages as follows.

The first stage of the students is taking the example. Representation of the activity of the students in taking the example is as follows.

"e.g.

p = *the older brother got the rain*

q = *the younger brother got the rain*

r = *they will be sick....*"

More in-depth interview results indicate that taking the example activity is done based on the activity of understanding a given problem. So, another representation of the activity of taking the example is "know". So some students represent this activity as follows.

"*Note:*

p = *the older brother got the rain*

q = *the younger brother got the rain*

r = *they will be sick....*"

The results of the in-depth interviews on students who represent this activity with the phrase in mind is to understand. Usually, to resolve problems using known, asked, and answered. Thus, the activity of taking the example is actually identical to the activity of knowing, i.e., activities that are performed to understand.

Student activity after taking the example or know is part of the activities the following activities are understood.

".... then, the statement *"If the older brother got the rain then he will be sick or if the younger brother got the rain then he will be sick"* can be presented in the form of the following proposition$(p \rightarrow r) \vee (q \rightarrow r)$. The statement *"If the older brother and the younger brother got the rain then they will be sick"* can be presented in the form of the following proposition$(p \wedge q) \rightarrow r$. ... "

Several students represent this activity in a different way, that is, just write down the form of the proposition, namely:

$(p \rightarrow r) \vee (q \rightarrow r)$ and $(p \wedge q) \rightarrow r$

This way is used for more simple according to the student. Students answer more in-depth interview results indicate that the activity is done to solve the problem because the injunction proved with algebraic propositions. This means that these activities are not part of activity understand however is a representation of the students in the activities planned. This is emphasized by the next activity, namely:

"... It will be proofing that the $(p \rightarrow r) \vee (q \rightarrow r) \equiv (p \wedge q) \rightarrow r$ with algebra proposition ... "

This activity is synonymous with activity renders asked. However, the representation of the activity write asked tailored to a given problem that is asked to prove it. Students do not use the term plan because not familiar or not knowing the terms used in the theoretical problem solving.

Student activity after the plan is proving to answer. One of the student description at this event are as follows.

"...*Proof:*

$$
\begin{aligned}
(p \rightarrow r) \vee (q \rightarrow r) &\equiv (\sim p \vee r) \vee (\sim q \vee r) && \textit{(Implications)} \\
&\equiv \sim p \vee (r \vee \sim q) \vee r && \textit{(Associative)} \\
&\equiv \sim p \vee (\sim q \vee r) \vee r && \textit{(Commutative)} \\
&\equiv (\sim p \vee \sim q) \vee (r \vee r) && \textit{(Associative)} \\
&\equiv (\sim p \vee \sim q) \vee r && \textit{(Idempotent)} \\
&\equiv \sim (p \wedge q) \vee r && \textit{(De Morgan)} \\
&\equiv (p \wedge q) \rightarrow r && \textit{(Implications)....}"
\end{aligned}
$$

This activity is carried out according to plan that is proved by using algebra proposition. This activity is synonymous with activity replied on problem solving in general. It is appropriate the results of in-depth interviews on a student who explained that this activity is thus essential to answer the problem. Students do not use the term answer due to orders given is proved.

Student activity after implementing a plan is concluded. The representation of these activities is as follows.

".... Thus the statement "*"If the older brother got the rain then he will be sick or if the younger brother got the rain then he will be sick"* " the same meaning with the statement " *If the older brother and the younger brother got the rain then they will be sick*".

Interview results indicate that deeper before the activity is done, students recapitulate the results into evidentiary problems or answer. This means that when students recapitulate the results answer or evidentiary problems that the students have been given, feedback, i.e. check the suitability of the results of the responses to the problem are given. The results of that check back description in the form of conclusions. For some problems, the activity check back there that description orally, there is represented in the form of writing, but some are not represented.

4. DISCUSSIONS

The first phase is done by students in solving a problem is to write a note or write taking the example. With the write down or write a known taking the example are used, the student or students are expected to understand the given problem. Taking the example is used to simplify the problem so it is easy to understand. Conditioning activity write down the known is a stimulus so that students understand the problem. Activity write down the known or taking the example is a representation of students understand the problem given.

But not denied that some students represent the stages write the note or the description. But after being asked more or deep against students who do not represent or not to write a note or description, apparently the students deliberately writing down for several reasons. Some students said, deliberately because it is not commanded to write the note. Most of the other students answered because usually a direct answer. Based on a more in-depth interview is, it can be concluded that basically all students understand, only partially represented and most others are not represented. The cognitive processes cannot be observed directly (Suharnan, 2005).

The second stage is done by students in solving a problem is jot down asked. With jot asked expected students focusing the mind to solve the problem. Activity write down who asked a stimulus so that students planning problem solving. However it cannot be denied that some students represent stages of plotting with write asked or all.

Most of the other students who do not representing or not to inscribing the asked or that all. However, after further or deep asked questions toward students who do not represent or not to inscribe the asked or description,

apparently the students deliberately writing down for several reasons. Most students responded that deliberately did not write because not instructed to inscribe asked. Most of the other students answered because of usually a direct answer. The cognitive processes cannot be observed directly (Suharnan, 2005). Based on a more in-depth interview is, it can be concluded that basically all students noticed questions to plan for a settlement. It's just, for this activity, most students are represented and some others are not represented.

The third stage conducted by the students or students in solving math problems is to write down the answers or evidence. Activity write down the answer or evidence showing that the student or student implementing a plan. Conditioning wrote down the answers or evidence is a stimulus so that students or student implementing plans and represent ideas or solving problems of proof. Activity write down the answer or evidence is a representation of students or student implementing plans and represent ideas or solving problems of proof.

Most of the other students or students who do not represent or not to write the implementation process of the plan especially when facing a problem that's easy or are memorized. When students are given on the issue is a matter that is too easy or students already memorized, information processing occurs very quickly. So that, students no longer need to write the process as an answer. The cognitive processes cannot be observed directly (Suharnan, 2005).

A missing stage in resolving the problem is check back. Some students represent stages of checking back with writing down some of the other students did not represent or not to write the conclusion. Activity write down the conclusions is an attempt to establish that he has the right or is completed. To obtain such stability, students need to re-examine his work whether in accordance with a known/understood, whether in accordance with asked/planned.

Based on the results of further observations, students tend not to represent or not to write the conclusion if a problem gets too hard. Students tend to represent or write a conclusion when getting a problem or question is not too difficult. This can occur because the energy spend to process information given out run out to understand, plan, and execute, so didn't get to write the conclusion.

Based on the results of research, retrieved two model representations completion of math can be presented as follows.

Table 1. The comparison of settlement model 1 and model 2 with Polya theory

Polya's Theory	In Learning Mathematics	
	Model 1	Model 2
Understanding	Note	E.g.
Plan	Asked	Will be evidenced
Implement	Responsibility	Evidence
Check back		

Habits in resolving a problem with a known or just write down, write down dimisalkan who asked or that must be proven, and answer or evidence should be corrected because it can cause mental keterpakuan. The three mental stand can hinder the troubleshooting process in order to understand the definition; i.e. functional fixedness, mental set, and conceptual added frames (Suharnan, 2005). The functional fixedness in understanding the formal definition is the tendency to assume that the function and usability definition is fixed according the draft and the desire of the maker. Set mental showed a tendency to preserve mental activity repeatedly. The addition of perceptual frame occurs when the individual as if viewed frame disguised so as to limit the motion step in understanding the formal definition.

In fact there have been many learned problem solving theories being taught as the fundamentals of learning. Hayes provide problem-solving stages, namely: identifying problems, represent a problem, planning a solution, realization plan, evaluate, plan and evaluate solutions (Hayes, J. R, 1978). There are four-step problem-solving, namely: establishing the representation issue, the most likely resolution plan, trying to formulate a return of principal problems, implemented and evaluated its results (Glass, A. L., and Holyoak, K. J. 1986). Polya give four stages of problem-solving, namely: understand, plan, implement, and looking to back (Polya, 1973). There are theories that can be used as an alternative resolution offered and conditioned to the students.

The other alternative solution which can be given is appropriate the research results Darmadi (Darmadi,dkk, 2016). The research results give a profile of visual thinking student prospective mathematics teacher with a visual learning style in solving trigonometric problems, namely: 1. when a student's mind, understand prospective mathematics teacher with a visual learning style gets visual input from the reserved, directions, images are retrieved, and the knowledge that already owned so appropriate indication of mental processing activity. 2. When planning a prospective student, the thought of mathematics teacher with a visual learning style does not process the mental imagery so not retrieved profile when planning visual thinking is problem-solving. 3. When executing, the student mind prospective mathematics teacher with a visual learning style does not process the mental imagery so not retrieved profile visual thinking when pursuing a resolution of the problem. 4. When checking back, thought the student prospective mathematics teacher with a visual learning style gets a visual input from the results of the activities of pursuing a settlement plan so that mental imagery processing happens to get the conclusion.

5. Conclutions

There are two modes of representation of problem solving in Indonesia. The first model of mathematical problem solving is writing the note, asked, and answered. The second model is the solution to math problems in Indonesia is taking the example, will be demonstrated, and evidence. In

learning mathematics, preferably need of emphasis for students to familiarize plotting and re-examine the problem resolution provided.

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