ME -2

JUST QUESTIONING IN TEACHING MATHEMATICS

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Abstract

Naturally, teaching is about accompaning and facilitating students for studying. Teachers have to create the learning environment for students convenience and focuses in constructing their understanding. Eventhough it is difficult, questioning is possible teachers choice when they are teaching any concepts of mathematics in Junior High School and Senior High School. Teachers are able to explore students' ideas, to guide students in constructing definitions, formulas or properties, and "accept" students' arguments without blaming them. Questioning can be provided classically or individually but still considering the complexity and students's ability. Avoid giving difficult questions that are possibly unanswered by students for keeping the convenience of learning process. The complexity of question corresponds to the lowest cognitive dimension until the highest one in order to make students easier in concept understanding. Teaching while questioning also is in line with "Kurikulum 2013" that uses scientific approach as the main option in every mathematics teaching and learning process. This paper tries to give an example about teaching by questioning in the topics linear inequality in one variable for Junior High School and logarithm in Senior High School.

Key words: Teaching Mathematics, Questioning, Linear Inequality in One Variable, Logarithm

INTRODUCTION

Is there any things that can not be reached by questioning? By questioning, the lost one will be discovered, the unknown one will be known, and the quiet one will think even contemplating. Elsewhere, a scientist develops knowledge through creative answered systematically. How about teachers? Are they already using question to help students in constructing knowledge and convenience during learning?

Mathematics is one of the hierarchy knowledge that for understanding certain topic, firstly understand constrain topics. If not, it will be difficult to understand those topics entirely. According to Russell (in Sumantri, 2012), logic is called in young age, otherwise in adult called mathematics. Meanwhile, Fehr (2012) said that mathematics is the highest logic form of human creation. Thus, mathematics teaching and learning process has to concern topic's hierarchy and logic that included.

The main point of teacher in teaching and learning process is about accompaning and facilitating students for studying. Teachers have to create the learning environment for students convenience and focuses in constructing their understanding. Students' convenience will be reached if teachers are able to design not only an interesting learning but also appreciating the various students' ability in learning activities, including introduction, main activity and closing

activity. Students will be on full-concentrate in constructing understanding when teachers are able to design assignment for challenging students to be active. Both of them can be conducted by teacher during teaching and learning process.

Hierarchy-logic characteristic and mathematics advantages are very helpful for teacher in arranging question list that be used in learning acitivity. Hierarchy of teachers' understanding about topics that will be taught as a starting point in arranging that question list. Logic and academic characteristic of the students have to be considered too. Teachers are possible using contextual things around students or using *mathematics in context* book for arranging question list.

Question list will guide teachers to organize learning process eventhough there are noisy students who disturb learning process. Rosyidi, dkk, 2013 said that teachers' energy is almost used to make students calm but not wisely. Teachers are able using question to make students calm. If there is noise sign in class, teachers may giving question about topics to students nearby. Hopefully, students will think that they may be asked next so that they focus again on learning.

Teachers also have to consider for whom those questions will be asked based on students' academic ability. If goes to wrong target, there is no attention but the motivation of students will be decreased. At this time, questioning of teachers go to wrong target and mean to hurt their feeling (Rosyidi, dkk. 2013). Techers often ask students using difficult question such that they can not answered.

Teachers have to give proportional feedback for every students's answer and avoid blaming them. That is important for students to be given such positive appreciation in each effort that be done in order to have convenience and focussed learning. Posing new questions are possible choice to help students for realizing their mistakes. Questioning in teaching and learning process is very recommended because it is one of the learning goals in "Kurikulum 2013". Reasoning activity, conjecture making, concluding activity as the learning goal of Kurikulum 2013 make teachers arranging question list creatively in order to develope and facilitate the activity. This paper tries to discuss how to use question in learning activity about linear inequality in one variable for Junior High School and logarithm in Senior High School.

DISCUSSION

1. Questioning Skill

Questioning skill of teachers is one of the success learning factor. Eventhough it is often used by teachers during class, but the variation and optimalization questioning usage must be improved. Recently, teacher's questions still tend to be classicaly and not yet stimulate higher-order thinking skill of students. Is there any question, do you understand, is there any opinion, what is the value of $log\ 8$, is 5 solution of inequality $x - 2 < 3$, are some questions that teacher ofetn asked. Not too many analytical questions used, such that is the value of $log\ x$ always positive if x positive, how many smallest integers that are the solution of inequality $x - 2 < 3$. Open questions also are not too many used by teachers in learning For example, (1) determine 3 examples of logarithm with value is 4, (2) determine 3 different inequalities that have similar solution.

Socratic Questioning can be a teacher's reference when decide using questioning to help students build the concept. Socratic questioning is open question and also arranged for investigating and having evaluative critiques that as good as the great new ideas. Socratic questioning can be classified as follows.

a. Questions of clarification
   E.g. What do you mean by _____, How does ____ relate to _____? Could you put another way? Could you give an example? Would you say more about that? Why do you say that?
b. Questions that probe assumption
   E.g. What are you assuming? What is assuming? All of your reasoning is dependent on the fact that _____. Why do that you have based your reasoning on ____ rather than ____?
c. Questions that probe reason and evidence
   E.g. What would be an example? Why do you think that is right? What led you in that belief? How does that apply to the case? What would convince you contrary? What reason did you have to that conclusion? What is the good evidence to believe that?
d. Questions about viewpoints or perspective
   E.g. Is there anyone that disagree? What is an alternative?
e. Questions that probe implications and consequences
   E.g. What do you imply by that? When you say _____, do you imply? But if that happen, is there any other solutions? Why?
f. Questions about questions
   E.g. Is this the similiar issues? Does this question ask us to evaluate something? Is this question easy or hard to answer? Why?
   (http://www.i-learnt.com/Thinking_Socratic_Questioning.html)

Those socratic questioning will help teachers to develop students' dimension of cognitive process and knowledge. Cognitive process dimension consist of remembering, understanding, applying, analyzing, evaluating, and creating. Meanwhile, knowledge dimension consist of factual knowledge, conceptual knowledge, procedural knowledge, and metacognitive (Anderson, Krathwohl et.al, 2001).

While questioning in class, teachers have to consider these following points: (1) questioning in clear and brief way, (2) centralization, (3) turns rotation, (4) dispersion, (5) giving time for thinking, and (6) guidance giving (Tim UPT-P4 Unesa). The first two points, making sure that students capture what the questions are, and the next two are possibble to teacher for controlling all students' attention during lesson. The 5th point has to be teachers' attention since it is about the duration of available time for thinking by observing the compelxity questions. This point also signs teachers to avoid asking students to come forward in class before then ask them questions. Last point, asking teachers to prepare other similar questions (analog) even other simpler questions.

2. Questioning in Teaching Mathematics

Well-structured mathematics topics help teachers to arrange question list that will be used in learning. Teachers have to consider every question that asked about understanding concept that will be taught. Repetiting "similiar" questions only used if teachers realize when their students do not understand yet.

a. Linear Inequality In One Variable Learning By Questioning

There are many linear inequality in one variable context and can be used to asking questions when starting the lesson. In main activity, teachers may use inductive questions to

generalize procedur in solving linear inequality in one variable. Otherwise, in closing activity teacher may ask questions for learning reflection.

1) Introduction
   - Teachers ask students about meaning of the statement, "highways are only available to four wheels or more vehicles".
   - Teachers suppose the numbers of vehicles is r (unit), then ask about what is the mathematics model of previous statement?.
   - In the bridge, there is sign "Max. 1,5 ton". Teachers ask the meaning of that sign.
   - If the weight of a vehicle b(tons), teachers ask, how is b that may pass through that bridge?
   - Teachers say that those two things are example of linear inequality in one variable in daily life then ask students to mention another context about linear inequality in one variable.
2) Main Activity
   - Teachers present example and non example about linear inequality in one variable. Teachers also ask student to give other example and non example.
   - Teachers ask again, how is the solution?
   - Teachers ask students to guess the answer of that question,
     (1) Akira has a natural number.
     (2) If it is subtracted by 2, then will be more than 7.
     (3) What is Akira's number?
     (4) Is there any natural number that may Akira had?
     (5) What is the smallest natural number that may Akira had?
     (6) What is the smallest natural number that you got from point (5)?
   - If Akira has natural number a, then teacher ask students to state in a,"if it is subtracted by 2 then it will be more than 7".
   - From answer number (6) , students are guided that $a > 9$.
   - From answer two previous steps, ($a - 2 > 7$ dan $a > 9$, teachers ask, what steps that used in both inequality sides such that $a - 2 > 7$ becomes $a > 9$?
   - Teachers guide to the conclusion that both inequality sides can be added by similar number with similar inequality sign.
   - Teachers clarify by asking students to memperhatikan ketaksamaan $8 > 5$.Then, teachers ask, is that right or wrong that inequality? If both inequality sides are added by 2, is that inequality right?
   - To conclude that both inequality sides are able to be subtracted by similar numbers, teachers relate that substraction means add by the inverse numbers. Teachers ask, is every substraction can be stated as addition? Is both inequality sides can be subtracted by similar numbers?

- Similarly with previous activity, to conclude that both inequality sides can be divided or multiplied by positive numbers with similar inequality signs.
- Teachers ask students, is that possible to multiply or divide both inequality sides by zero?
- Teachers ask, is that possible to have three different inequalities such that the solution is integers and greater than 2?

3) Closing
   - Teachers asks, do you understand? Or do you not understand? Why don't you understand? Which parts that you don't understand?
   - Teachers asks students to make statement about (topic and learning process) on that day.

b. Logarithm Learning By Questioning

Logarithm learning is possible to teachers for relating to determine *acid degree* (pH) of solution in Chemistry. Also relating to calculate earthquake power in Physics.

1) Introduction
   - Teachers ask, is our daily usage water hygienic? What is your reasons?
   - Teachers inform one of the hygienic water standardization which is water pH $6{,}5 - 9{,}2$.That pH shows acid degree of water and measured by formula $pH = -log[H^+]$. What is log? Do you ever see that, for instance in calculator? How to calculate?
   - By questioning, teachers remind students about exponential. For example, what is the solution of $2^3, 5^2$?
2) Main Activity
   - By using calculator, teachers ask student to determine the value of ${}^2log\ 8$ and relate to 2^3. Students asked to determine the value of ${}^5log\ 25$ and relate to 5^2. Then, determine the value of ${}^{10}log\ 100$ and relate to 10^2.
   - From that activity, students observe the relation between logarithm and exponential. Then, teachers ask what is the value of ${}^3log27$, how do you know? Check it by calculator. (Teachers can use other logarithm).
   - Teachers ask question, could you state that $a^c = b$into logarithm form?. Teachers guide students to the logarithm definition.
   - To prove the constrains of the logarithm definition, (${}^alogb$ is defined if$a > 0, a \neq 1$ and $b > 0$), conducted teachers by asking these following questions.
     (1) Is that possible to determine the value of ${}^1log2$, why? How is about ${}^1log5$, etc. If $b > 0$, is that possible that $a = 1$? How is about ${}^1log1$? (The last form is the indifinite logarithm).

(2) Is that possible to determine the value of $^{-2}log16$, why? How is about $^{-3}log9$, etc. If $b > 0$, is that possible that $a < 0$? (Why $b > 0$, please check the history of logarithm).
(3) How is about $^{0}log2$?

- Teachers ask, is it possible three different logarithm (different base and numerus) have the similar value. Why?
- In order to prove the properties of $^{a}\log(bc) = {}^{a}logb + {}^{a}logc$, at first teachers ask these following questions.
  (1) Determine $^{2}\log 4$, $^{2}\log 8$, dan $^{2}\log 32$?
  (2) Is $^{2}\log 32 = {}^{2}\log 4 \times {}^{2}\log 8$?
  (3) State $^{2}\log 32$ in form of $^{2}\log 4$ dan $^{2}\log 8$?
  (4) State $^{3}\log 81$ in addition form of two logarithm with base 3.
- Teachers prove those properties by questioning.

3) Closing Activity
   - Teachers ask students to make a statement as conclusion of the topic that be learned today. Then teachers ask questions and respond that.

CONCLUSION

By questioning that consider hierarchy and logic, teachers can teach well linear inequality in one variable and logarithm. Teaching well means that students can be focus and comfortable when they build their own knowledge. Many contexts about those two topics are possible to teachers for questioning about the topics. In the main activity, teachers are able to ask logical questions that help students to understand the definition, find the properties and procedur about the topics. In this case, questions that asked by teacher are possibly open questions that facilitate creativity of the students.

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