METACOGNITIVE STRATEGIES ON MATHEMATICS LEARNING TO IMPROVE STUDENT'S ENVIRONMENTAL AWARENESS

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Abstract

Metacognitive strategies in learning mathematics is the presentation of learning that can foster students' awareness and regulation of their knowledge to understand the concept or to solve mathematical problems. Through the application of metacognitive strategies, there will be a systematic learning process, structured, built on a logical framework, and allows to obtain the solution of the problems. To optimize the application of metacognitive strategies, it can be used contextual approach. Learning mathematics with a contextual approach is the learning that uses an object, phenomenon, or event that actually experienced by students to construct their own mathematical concepts. The activities were undertaken to construct students' thinking by using real objects, namely objects that exist in daily student life or also known as contextual objects. The use of this object will make mathematics more closely to the lives of students and they can easily engage in learning activities and construct his mind to get a new concept. Finally through the contextual mathematics learning, students can get involved physically and mentally in support maintaining the sustainability of resources and environment.

Keywords: metacognitive strategies, mathematics learning, environmental awareness

1. BACKGROUND

Improvement of mathematics teaching is a serious and sustained effort to obtain the quality of learning, including the process and the results achieved by students. However, there is the fact that learning at school still positioned students as objects of study. Students are directed to gain knowledge from teachers through taking attention when the teacher teaching in the class. This type of learning placing the student in a passive position to accept the lesson, while the active teachers give lessons. The result is the ability of students to carry out a variety of things that are taught, such as skills in performing activities that require math, for example, perform the operations of addition, subtraction, or other operations. Another result are the tendency of students to memorize, and less well in understanding the concept. Finally, when the form of problem changes, the student becomes difficult to solve. According to Marpaung, the traditional way of teaching had a negative impact on the attitudes of students looked at the mathematics which means that most students do not like math, and some of them are even afraid of math (Fauzan, 2002; 3).

In recent time, has developed an approach to learn mathematics named Realistic mathematics education (RME), that is the learning of mathematics uses objects that actually experienced by students to build their own concepts. RME brings positive impact on the formation of student mathematical thinking framework which implemented by utilizing objects actually encountered students in everyday life.

RME implemented with the belief that every student has a potential that is ready to be developed, so that the obligation of teachers to engage students in constructing thought which already had, to get a new concept independently. The process of constructing this thought can be accomplished by encouraging students to realize on its existing knowledge related to an object, phenomenon or a specific event, then adjust his thinking to construct new knowledge or to solve problems. This step is known as metacognitive strategies.

Metacognition is known as thinking about what people think. In relation to the process of thinking, metacognition is a form of cognition, a second or higher order thinking process which involves active control over cognitive processes "(Gama, 2004; 9). In general, metacognition includes two-dimensional of thinking, namely: (1) awareness about cognition and, (2) control or regulation of cognition processes.

Based on this understanding, it is clear that the application of metacognitive strategies in learning mathematics that uses contextual issues can encourage students to mobilize awareness and setting of thinking about objects that are used to understand math concepts. According to the

curriculum 2013 through the presentation of lessons like this, can be embedded skills and attitudes for sustain natural resources and the environment, accompanying cognitive outcomes.

2. METACOGNITION

In the 2013 curriculum of Indonesia, metacognition is one component of competency standards of High School. This decision indicates that education in Indonesia has realized the importance of metacognition abilities trained to students in order to obtain an optimal learning outcomes. Intended learning outcomes include cognitive, affective, and psychomotor. This confirms that metacognitive skills can increase academic learning outcomes, train the skills, and efforts to instill a positive attitude to the students.

Various studies have shown the metacognition positive impact on various applications, such as, in an effort to optimize students' skills in problem solving (De Corte, 2003), can optimize the learning outcomes achieved by students (Gama, 2004), increasing the ability to solve contextual mathematical problems (Anggo, 2011). In principle, the effort involves metacognition in a variety of learning activities can provide benefits in quality improvement processes and learning outcomes.

Early definition of metacognition was proposed by Flavell and Brown. Flavell (1979) suggests metacognition consists of (1) metacognitive knowledge, and (2) metacognitive experience or regulation. On the other hand, Brown also divides metacognition into: (1) knowledge about cognition, and (2) regulation of cognition (Gay, 2002). From these groupings can be seen that Flavell tend to view metacognition of aspects of a person's knowledge about his own cognition, while Brown tend to view metacognition as a process of arranging one's cognition.

Furthermore, Flavell (1987) defines: metacognition as the ability to understand and monitor one's own thoughts and the Assumptions and implications of one's activities. This view emphasizes metacognition as the ability to understand and monitor the activities of thinking, so the process of metacognition each person will vary according to ability. Meanwhile, Brown (1987) defines metacognition as an awareness of one's own cognitive activity; methods employed to regulate one's own cognitive processes; and a command of how one directs, plans, and monitors cognitive activity. Brown's opinion emphasizes metacognition as an awareness about the activity of cognition, metacognition in this case relates to how a person aware of his thinking process. That awareness will manifest in one's way of organizing and managing the activity of thinking.

Based on the definitions presented above, it can be said that metacognition is awareness and self-regulation of cognition processes. Furthermore, according to the grouping that has been stated

before, in general there are two dimensions of metacognition when learning or solving problems, namely: (1) awareness about cognition and, (2) control or regulation of cognition processes. Awareness about cognition include an assessment of what is known and unknown, as well as the methods used to regulate the process of cognition. While the control or regulation of cognition processes include plan and monitor the activities of cognition.

3. METACOGNITIVE LEARNING STRATEGY

Involvement metacognition in the learning process and in problem solving is important, both to obtain the exact solution of the problem being solved, or to establish a mathematical framework. In the problem-solving process, students needs metacognition when deciding what to do and where we are heading to recognize and overcome the shortcomings (Lee & Baylor, 2006)

As discussed in the previous section, the dimensions of cognitive regulation, development is not affected by age but is more influenced by the situation and tasks. This means that one can not acquire or improve cognitive settings without going through a process of preparation for it. This is where the role of the teacher is required to be able to prepare for learning that can excite and encourage students to be able to regulate their cognition by taking into account the situation and tasks assigned. In addition, the ability to control one's cognition is unstable, so that this capability needs to be raised continuously.

Importance arouse students' metacognition ability also has the attention of cognitive psychologists, namely by suggesting that metacognitive strategies need to be provided to students through the experience of learning mathematics (Desoete, 2007). For these reasons, teachers are expected to raise students' metacognitive ability in mathematics learning, including in problem solving. In order to do this, the teachers are required to have the skills in encourage students to have it.

Metacognitive strategies in which there are elements (planning, monitoring and evaluation of their own learning) can bring students to understand and absorb of a variety of information to learn math, so understanding of facts, concepts, and principles, would be better. In its application to the study of mathematics, Chamot, Dale, O'Malley and Spanos (1992) suggested that students are able to absorb the lessons of mathematics at the highest level and to obtain information about training in metacognitive strategies (such as planning, monitoring, and evaluating their own learning) has better ability to regulate their learning.

From the above facts, it is clear that the application of metacognitive strategies in learning mathematics allows students to master the subject matter well. Mastery of the subject matter is an important factor shaping the ability of mathematics. Conversely a low metacognition abilities will result in less optimal mathematical skills.

4. LEARNING MATHEMATICS

Education in Indonesia has now been realized that use of the environment as a bridge to understanding the concept of knowledge is an important thing to note. This situations arise because of the benefits that can be obtained not only in the aspect of knowledge, but also in the attitudes and skills. Learning that utilizes environment is known as contextual learning. In mathematical learning, contextual lesson presentation is one thing that is crucial, because math is a subject that has the abstract object. In these circumstances it is clear that contextual object would contribute important for students to understand abstract mathematical concepts through the use of contextual objects that are already well known.

One important breakthrough in the study of mathematics is a realistic mathematical education (RME). RME rooted in the Fruedental view that mathematics as a human activity (Gravemeijer, 1994; 82). This view makes the experience of learning mathematics is inseparable from the experience of students in performing daily activities. Based on this view, doing mathematics means learning mathematics, that is solving daily life problems (contextual problems) is an essential part (Gravemeijer, 1994, 91). Fruedental argues, that using math in organizing daily life activities referred to mathematizing. Mathematization is the process of rearranging everyday problem situations into mathematical relationships. In view Frudental, mathematization associated with an increase in the level of mathematical understanding (Gravemeijer, 1994; 82).

The basic idea in realistic mathematics education is children should be given the opportunity to reinvent mathematics under the guidance of an adult (teacher) (Fauzan, 2002; 33). This indicates that the center of learning are at the student, and the teacher is expected to provide opportunities and guidance necessary for students to find their own concepts. The invention itself can be achieved by implementing the contextual issues that are well known in the students' everyday life.

Contextual issue is the starting point in building understanding of concepts. This approach is in contrast to the structural approach that is often used by teachers in conventional learning, where students are given definitions, theorems or properties and then followed by examples. By making the contextual problems experienced by students in everyday life as the first step of learning, the

students can build a strong understanding of the issues that it faces and can build their own concept based on the problem. Thus, the resulting concepts will be embedded more strongly in the memory of students.

5. METHODS

Learning mathematics developed focused on the development of metacognitive strategies by utilizing the contextual issues. The development of a learning strategy development model of learning is done using 4-D are presented Thiagarajan, Semmel and Semmel (1974: 5), which consists of four stages. Those stages are: define, design, develop, and disseminate. This model was chosen because it is more detailed and systematic making it easier to make the process of learning development.

Learning strategies that have been developed subsequently tested in the learning activities in the classroom. The purpose of testing is to obtain direct input from the field in order to revise learning strategies.

The strategy is piloted in two series of activities consisting of test 1 and test 2. Test 1 was conducted in a limited and more emphasized to see the fit between the theoretical formulation of learning strategies with actual learning situations. Results of trial 1 were analyzed for the purpose of improvement of the learning strategy. After the revision process is complete, the next step is test 2. This activity is carried out in a wider scale by taking into account the diversity of the learning situation. The goal is to obtain more complete information about the suitability of the learning device with a variety of learning situations.

6. RESULTS AND DISCUSSION

Learning activities carried out in this study is use the learning strategies to raise students' metacognition (called metacognitive learning strategy). In the formulation of metacognitive learning strategies, contained a link between learning with metacognitive indicators that can be raised on students equipped with metacognitive self-questions that must be raised by the students. In practice, for raising metacognitive self-questions is need to be assisted by the teacher through the submission of metacognitive questions.

Metacognitive questions provided can serve as scaffolding that teachers do to help students, especially when experiencing difficulties in the problem solving process. The assistance provided should be proportionate with the needs of students, and will be gradually reduced according to the

level of learning progress that has been achieved. So in the end the students can learn and solve problems without the help of a teacher.

The application of learning strategies supported by the provision of learning devices are made with attention to metacognitive learning strategies. An important factor that is emphasized in the training of students' metacognition is the implementation of learning in which the teacher asks metacognitive questions and ultimately led to the awareness of the students asking questions to himself (in the form of metacognitive self-questions) about the material being studied.

When students try to ask questions themselves and managed to answer these questions, it can be said that the student has been able to involve metacognition in the learning process. When students are accustomed to follow the lesson where the teacher is always asking metacognitive questions, it is expected that students will naturally always trying to ask himself which aim to gain the understanding in learning process.

In general, the inclusion of metacognition in learning can be accomplished when the activity begins with metacognitive questions. In the next phase, students will be familiar with these questions, so even though the teacher is no longer asking metacognitive questions, students will naturally ask questions to themselves (metacognitive self-question). This indicates the spirit of the students in understanding the subject matter for each step of the lesson is always based on the awareness and regulation of thought processes.

When the tests were held at the preliminary study, found the fact that in the early stages of learning to train students' metacognition is it runs a little slower, which is caused partly because teachers and students are not familiar with the situation, the lesson. There are some drawbacks that occurs in both the student and the teacher. The weaknesses include the teacher is still not able to submit questions metacognitive appropriate and necessary in order to arouse students' metacognition. On the other hand, students are still learning and solving problems in a straightforward manner on the answers, the result appears some difficulties, especially when the problem to be solved were present in the form of contextual issues.

Through the implementation of preliminary studies with various shortcomings that have been put forward, it gives good results on student participation in learning and the learning outcomes achieved. In the aspect of feasibility study, it appears that the speed of learning increases according to familiarity of teachers and students involved in the learning metacognition. Specifically on student learning outcomes were achieved, it is still not optimal at an average score of 68.14, and is only slightly higher than the average score of the control class 62.95. However, the

research team believes that the learning outcomes achieved emerge from better understanding of the subject matter.

To solve the above problem, researchers conducted intensive reflection through discussion with the teacher in charge. Furthermore, it was agreed to do some necessary repairs. The first improvement made on the Lesson Plan by adjusting the formulation of metacognitive questions to fit the learning situation and the material being discussed. Furthermore, it also made revisions to the worksheets used by adding the troubleshooting steps in more detail so that according to the metacognitive question formula.

To students, the team approach to improve the way learning is done by adjusting the type of assistance provided by the teacher in the order of learning undertaken. Improvement was made in the following manner: (1) at the beginning of learning, the teacher presents the subject matter in a way that is quite a lot of assistance in working through the worksheet metacognitive questions given. (2) The teacher gives a new assignment with the aid worksheets tailored to the needs of students, especially when students are having difficulty in solving the problem. (3) The teacher gives the next task with just a little assistance, only when students have difficulty. (4) In the end, the teacher gives the task without assistance.

In test 2, the learning of mathematics with metacognitive strategies make students more active during the learning process. The learning process can foster students' thinking skills through discussion, plan the problem-solving strategies, monitor the use of strategies, to evaluate the results of problem solving and to reflect on the lesson activities. These activities make students capable of managing processes of cognition, motivation, and learning behavior.

Students' math learning outcomes through the test in application of learning with metacognitive strategies is increase. The level of mastery learning reached an average 87.5. This situation shows that the result of improvements made to the strategy that has been developed were give adequate results.

At the behavioral aspects raised during the learning process takes place, is always presented problems related contextual environment that is well-known. Exploiting the object is intended to make students more familiar with their environment and understand the importance of maintaining the sustainability of the existing resources so that optimum benefits can be obtained.

According to the 2013 curriculum, students' attitudes toward the environment will emerge as an accompaniment of the cognitive learning. This result would be long-term result so that we did not measure it specifically. Through the use of contextual issues related with the natural resources

that exist in the environment around the student, then it implies that the students have studied the potential benefits as well as how to maintain it in order to remain sustainable.

7. CONCLUSION

Based on the results achieved in the implementation of the study, can be conclude as follows:

1. The Learning of mathematics for applying metacognitive strategies is very useful in improving student learning outcomes in aspects of knowledge, attitudes, and skills.

2. Metacognitive learning strategy emphasizes the emergence of self-awareness and knowledge of students to be able to use this awareness to solve a problem or to learn.

3. Application of metacognitive strategies can be used for raising students' awareness of the potential benefits of the natural resources available in the environment and awareness to support its sustainability.

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