Learnt from *Lesson Study* in Indonesia and Japan to Promote the Better of Mathematics Teaching and Learning

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Abstract

The paper presented issues of concern related to the observation of lesson study activities, for three rounds in Sumedang, West Java, Indonesia, and comparing with the results of observation for several weeks at some state schools in Maebashi, Japan. Issues of concern focused on several possibilities to promote better mathematics learning in Indonesia, which can facilitate students to improve mathematical thinking or mathematical understanding. The result of observation indicates the presence of interesting issues that need to be considered in depth, among others: classroom settings, types of problem, group working, anticipation of didactical and pedagogical situation for enhance classroom communication, student's presentation, teacher's intervention, teacher's reflection, teacher's intervention, and teacher's reflection.

Ⅰ. Background

Lesson study is a continuation of previous cooperation activities called "piloting". It is an adaptation of the learning quality improvement program conducted in Japan, and considered as Japan's secret of success in improving the quality of education (Stigler & Hiebert, 1999). The main principle of lesson study is a gradual increase in the quality of teaching by learning from their own experience and others in learning activities.

In lesson study not only the teachers who implement the learning that can only reap the benefits, but even more so the observer namely another teacher or partners, students, lecturers and other parties are present at the time of learning. By observing the learning activity undertaken a teacher, the observer is encouraged to reflect on the implementation of learning and how to improve their quality. Therefore, the lesson study is really a forum for mutual learning with learning from experience to improve the quality of learning.

Activities implemented during the follow-up program provide opportunities for school communities such as math teachers, principals, teacher's group members (MGMP), and school supervisors to involve actively in such activities as piloting, workshop, seminar, and lesson study. By these activities, interaction among school communities and faculty members has been formed fruitfully so that the relationship has grown to be a learning community.

As a result of lesson study activities, there is a significant improvement regarding school academic culture as follows (Suryadi, 2005): 1) Teachers have better motivation to develop innovation on mathematics teaching, 2) Teachers self-confident tend to improve as indicate by the possibility to open their lesson to be observed and to discuss the lesson soon after the observation, 3) Through the activities of lesson study, teachers, school principals, MGMP members, and supervisors may learn from each other so that the *community* became a learning community that will be useful for developing teachers' professionalism, 4) Lesson study conducted by mathematics teachers has motivated other teachers to learn and implement the activities, 5) The success of lesson study implementation in pilot areas has attracted other school communities from other district.

Although Lesson Study maybe has been deemed successful encouragement of teachers to improve the learning process, but there are still other aspects of lesson study activity to be made the subject of analysis and learning. For example, known that most mathematics teachers still view mathematics as a number of tools made from the set of facts, rules, and skills, to be used skillfully trained workers in completing a job, the case in accordance with the opinion of Thompson which describes the condition as an instrumentalist conception. Exactly, to face various problems of mathematics education today, more is needed are teachers who have a conception of mathematics as problem solving view (Ernest, 1988) and look at learning as understanding, instead of learning as knowing . Other example, we could attention to teacher reflection as long as learning implementation. There for it is very important to be able to dig and uncover other facts of the lesson study activity. What aspects of lesson study that supports the achievement of junior high school students understanding of mathematics?

Ⅱ. Theoretical Review

Importance of Development Thinking Mathematically Schoenfeld's view on mathematics, which states that mathematics is an active and generative process undertaken by the proponent and user of mathematics as a dynamic and generative knowledge provides the possibility that by studying mathematics can improve the ability to think mathematically. Furthermore, according to Schoenfeld (1992) to think mathematically means (a) develop a mathematical view, assess the process of mathematization and abstraction, and have the pleasure to apply, (2) developing competence, and use them in the understanding of mathematics (mathematical sense-making).

The implications of the views expressed Schoenfeld math above is how should teachers design learning well, learning how to optimize the company so it can help students build their understanding significantly. Sumarmo (2002) states that no one an approach most suitable for developing all kinds of mathematical processes, that need attention are significant in the students' learning achievement.Because learning is the foundation for the establishment of meaningful mathematical connections (NCTM, 1989). One aspect that many are promoted to improve the ability to think mathematically is to increase students' mathematical understanding.

Mathematical understanding can be interpreted as the degree of one's knowledge of mathematical concepts that have been learned. Level of

understanding can vary between one with other people despite having the initial conditions, age, or equal opportunity in learning something. In this case will relate to what is learned, what strategy is used, and what model is used to study them.

Based on Bloom's taxonomy of objectives, according Sumarmo (1987), understanding can be classified into three different, namely an understanding of translation, interpretation, and extrapolation. Translational understanding is the ability to understand an idea expressed by other means than the original statement which was known previously. Understanding of the interpretation is the ability to understand or be able to interpret an idea that changed or arranged in other forms such as similarity, graphs, tables, diagrams and so forth. Comprehension skills of an extrapolation is to predict the continuation of existing trends according to certain data. Meanwhile, according to Skemp and Pollatsek (Sumarmo, 1987:24) there are two types of understanding concept, ie understanding of instrumental and rational understanding. Instrumental understanding can be interpreted as a mutual understanding on the concept of separate and just memorized the formula in doing simple calculations, whereas in rational understanding contained a single scheme or structure that can be used on a wider settlement of the problem. An idea, facts, or mathematical procedure can be fully understood if it is associated with a network of a number of power connections.

According Kinach (2002), in mathematics there are five stages of understanding the content-level understanding, concept level of disciplinary understanding, problem-solving, the level of understanding, epistemic-level understanding, and inquiry-level understanding. Stage of understanding related content with the ability to give correct examples of the vocabulary (terminology and notation), given basic facts, and skillfully using algorithms or replicating strategy thinking in certain situations that have been taught previously. Knowledge at this stage is the knowledge that "accepted" students, given to them in the form of information or isolated skills, rather than students actively obtained. Such understanding is the most superficial understanding of mathematics.

Level of understanding of the concept at a higher level of understanding of content, where students engage actively identify, analyze and synthesize the patterns and interconnections in acquiring knowledge. The characteristics of this level are the ability to identify patterns, develop definitions, concepts relate to each other.

The next three stages of understanding Kinach (2002), is problem-solving level of understanding, epistemic-level understanding, and inquiry-level understanding. Problem-solving level interpreted as an analysis tool and the scientific method and learners use them to propose and solve math problems and dilemna. Characteristic of problem solving level is the ability to think to find a pattern, working backward, solve a similar problem, applied a strategy in a different situation or to create mathematical representations in the physical or social phenomena.

Epistemic level of understanding, construed as providing valid evidence in mathematics, including the strategy in testing a mathematical statement. Epistemic understanding at this level thinking that is used to strengthen the level of comprehension and problem solving concepts. Level of understanding of inquiry, interpreted as a lowering of knowledge or theory is really new, rather than reinvent. Understanding of inquiry include the beliefs and strategy, both generally and specifically in working to expand knowledge.

As has been stated before, that mathematics competence is the main purpose of mathematics education in schools according to Kilpatrick, Swafford, and Findel included cognitive domains are conceptual understanding, procedural Fluency, strategic competence and adaptive reasoning. Kinach (2002) argues that the instrumental understanding of Skemp (1987) equivalent to content-level

understanding, while understanding the relational include understanding concepts, problem solving, and epistemic understanding, not including the understanding of inquiry. Furthermore, the mathematics can be understood if the mental representation is part of a network representation. Level of comprehension is determined by a number of strong connections. For higher levels, such as students, the understanding is certainly a little different with an understanding for middle school students.

Some studies acknowledge and agree that includes understanding the connectivity between parts of the information. Network of mental representation can be built gradually, as any information that is associated with an existing network or as a new connectedness is constructed between previously unrelated information. Understanding develops as a network and become bigger and more organized. So understanding is not a phenomenon. Understanding can be limited if there are only a few of the potential mental representation are linked, or if the connection is weak.

Understanding high-level and higher-order thinking can be achieved by involving mathematical tasks which, according Sumarmo (2002), marked by activities such as: search for and find patterns to understand the structure of mathematical relationships, using available resources effectively to formulate and solve problems; understand the mathematical idea ; think and reason mathematically as: generalization, using inference rules, make conjectures, give reasons, to communicate mathematical ideas; define or examine whether the results obtained answers to a mathematical sense. Subsequently according Sumarmo (2002) and Grouws (1992), some relevant activities that need to be taken by teachers / lecturers are: (1) selecting mathematical tasks such that motivate students and increase interest in learning basic math competency of students, (2) provide an opportunity students to deepen their understanding of products and processes of mathematics and its application, (3) creating a classroom atmosphere that encourages ongoing interaction between students and between students and teachers (4) uses the understanding of students and other sources to rediscover the idea of mathematics, (5) helping students to find the relation between the original knowledge with new knowledge or the idea that one with other mathematical ideas, (6) to guide individual students, small groups, and classical.

Learning based on learning as a process view of construct information new experience seems to make a more meaningful understanding of if, (1) give priority to the class as a learning community than as a collection of individuals, because in the learning community is more likely going discussion between individuals, (2) prioritizing mathematical logic and events serve as verification rather than teacher / lecturers as the sole ruler in obtaining the correct answer, because the habit through the actual examination or prove themselves, students more receptive to the truth of the theory directly; (3) prioritizing math reasoning from the recall procedure, or algorithm, because the reasoning used to be receptive to avoid the dubious assumptions or opinions, (4) give priority to the preparation of conjecture, invention and problem solving in mathematics from the emphasis on obtaining a mechanical response, because with frequent means used to compile conjecture inspect and test that is not necessarily a correct and acceptable, and with problem solving activities can enhance high-level intellectual skills. Type of learning problem solving is the highest of the eight types of learning are presented Gagne (Ruseffendi, 1991), and problem solving can also lead students to gain experience in actual mathematics (Santos, 1995).

Giving priority to find the relationship between mathematical ideas (mathematical connections), and how to communicate than on mathematics as a mutually exclusive set of concepts is another hallmark of the effort to achieve meaningful understanding,

because the connection can be an instrument of mathematical problem solving (Hodgson, 1995), and communication mathematics is a verbal explanation of mathematical reasoning (Kramarski, in Ansari, 2003). According to NCTM (2000), to achieve a meaningful understanding of the learning of mathematics should be directed towards developing the following capabilities: (1) consider using a fiber mathematical connections among various mathematical ideas, (2) understand how mathematical ideas are interrelated to one another so awakened thorough understanding, and (3) notice and use mathematics in contexts outside of mathematics.

Ⅲ. Lesson Learnt from Lesson Study Activities in Indonesia and Japan

Lesson Study activities on mathematics in Indonesia have been implemented since 2006-2010. During this period, junior secondary mathematics teachers in Sumedang (West Java) districts have been trying to improve the quality of mathematics teaching by utilizing the scheme of lesson study activities including Plan, Do, and See session. In this period, they have tried to make improvements on some aspects of classroom activities including classroom setting, Types of problem, anticipation of didactical and pedagogical situation for enhance classroom communication, group working, student's presentation, teacher's intervention, and teacher's reflection. Although mathematics teachers have tried to make some improvements, it seems that several critical issues especially related to the improvement of students' mathematical understanding need to take into consideration.

Ⅳ. Classroom Setting

To facilitate the freedom of students in mathematical thinking, the classroom setting is one alternative that might be needed. If students are required to work independently, then the classical setting is necessary, if then required students to discuss as a group, the change in the classroom setting needs to be adjusted. Needs classroom setting, is because all students have equal opportunities to think and explore as well as receive information, guidance, and support from teachers.

Carried out in Indonesia over the years, in many cases open the lesson, the teachers select group students more in learning, generally there are 7-8 groups, at other times found in classroom settings in a U shape, but found almost no classroom settings in form classical individual, as if to be taboo to regulate classroom where students sit on their own. While in Japan, the settings in form of individual or class of its own is still a lot, not a taboo subject. According to information received, the occurrence of such an arrangement has been tailored to the needs and conditions of the class, for classes that students have learned that independence is high enough, then the individual settings is never a problem, and encountered during the observation in Japan can be predicted that most Japanese students have a high level of *self-regulated learning.* While in Indonesia, *self-regulated learning* students still must be investigated further, although in a number of research results show that *self-regulated learning* of Indonesian students increased if the process of learning is done cooperatively with the contextual approach (Ratnaningsih, 2007).

Ⅴ. Group Working

An environment that is conducive to promote discussion in which students could share ideas, explain their understanding, and compare different solutions, is frequently arised in teachers' discussions. They propose group working as an alternative approach to facilitate collaboration among students. However, some teachers are commonly focused their attention to just looking for the correct unswers. They some time forgot to consider students' contributions including to elicit incorrect ideas and asking students

to justify and explain their methods for solving the problems. In fact, incorrect ideas are some times very important to strart whole-class discussion. Asking students to provide justification can encourage them to reorganise their thinking so that finally come up with better understanding. By exposing their thinking, students may have to negotiate the meaning of mathematical ideas with others, and to explain and justify their reasoning so that they can convince others of the legitimacy of their ideas. Through this process of negotiation and justification, students will have higher motivation to think more deeply about their own ideas and those of other students.

Ⅵ. Didactical and Pedagogical Situation

Didactical and pedagogical situations that occur in an event that learning is a very complex, the teachers or lecturers need to develop the ability to be a comprehensive look at these events, identify and analyze the important things that happened, and perform appropriate actions so that the stages of learning to walk smoothly and as a result, students learn optimally.

To create didactic and pedagogic situation, the appropriate lesson plan in preparing teachers need to look at the learning situation as a whole as an object (Brousseau, 1997). Thus, various possible response require both didactic and pedagogical action, to be anticipated, such that in reality the dynamics of the learning process can create didactic and pedagogical changes in the situation according to the capacity, needs, and accelerate the learning process.

Ability of the teacher that has to be hereinafter referred to as Suryadi (2008) as *metapedadidaktik* which can be interpreted as the ability of teachers or lecturers to: (1) considers the didactic components as a unified whole, (2) develop action so as to create didactic and pedagogical situations according to needs, (3) identify and analyze the response of students or students as a result of didactic and pedagogic action taken, (4) didactic and pedagogic action continued response analysis based on students or students towards achieving learning targets.

In some open events observed lesson, the teacher has not been able to anticipate optimal didactic and pedagogic situation that happened, so that often occurs void or empty space appears between the learning scenario plots. This often led to many comments from the observer, on the other side of the observer is not even fully understand what happened, namely the presence of the gap between theory and practice, which happens in practice can't be meaning theoretically. These spaces provide the opportunity to be a research problem, but many teachers and lecturers have not noticed.

According to Toom (2006) tacit knowledge acquired pedagogical teachers or lecturers for conducting the learning process is very valuable knowledge as a material reflection for the improvement of the quality of subsequent learning. Toom also explained that the process of didactic and pedagogic thinking can occur in three events, before the learning took place, at the time of learning going on, and after learning progress. However, didactical and pedagogical tacit knowledge can only be acquired through learning events experienced by the teachers directly

If a teacher or lecturer is able to identify, analyze, and relate to events prior to the thought processes of learning (didactic and pedagogic anticipation), tacit knowledge acquired in learning events, and the result of reflection post-learning, then it will be a winning strategy very good for self-development so that the quality of teaching from time to time can always be improved.

In Japan, teacher or team teacher always has prepared a sheet of didactical and pedagogical anticipation, which contains some information about students, for example: students sitting position, prior knowledge of each student, who usually need help, and others. Consequently, when the learning progress, teachers (team) to provide scaffolding and help students more optimal, so the class room atmosphere

can be controlled and managed well. While in Indonesia, the teachers maybe still lack of ability for anticipating didactically or pedagogically, so often found some students demonstrate behaviors that are not relevant to learning objectives previously anticipated.

Ⅶ. Types of Problem

Rich mathematical tasks are key factors in classrooms that have communication as the main goal (NCTM, 2000). Open-ended and challenging problems that related to students' prior knowledge are conducive to discussions because they encourage students to think collaboratively. Based on current lesson study activities in Indonesia, some teachers still unaware of the fruitful of open and challenging mathematical tasks. They still need to be convinced that tasks with multiple levels of access will enable students with different levels of background knowledge and mathematical abilities to work on the problems. Besides, as they move through the solution process, collaboration among the sudents will be arised accordingly to share their own understanding and to negotiate meaning. When students are challenged to solve a problem, they would have opportunity to think about and try to solve it. Difficulties that students have to solve the problem, different ideas, and different solutions are potential resources to encourage students to share, compare, justify, explain, or discuss the problem. Interaction among students during whole-class activity provide opportunities to develop their mathematical abilities including conceptual and procedural understanding (Takahashi, 2006).

Refer to Matlin (1994: 360) stating that the problem can be divided into well-defined problems and ill-defined problems. Well-defined problem is a situation or problem that the original statement of origin, purpose and rules Specified, whereas problems that are not well defined otherwise the statement of origin, purpose and rules are not clear so it does not have a systematic way to find a solution. Foshay and Kirkley (2003) divides the problem in a continuum starting from a well-structured, structured with mediocre (*moderately-structured*), until that is not structured or incomplete (*ill-structured*). Obviously each type of problem has its own limitations, but the difference between the problems with each other very thin so difficult to be realized.

In lesson study activities in Indonesia, in general, the teacher presents the problem of the type of *well-defined* or *moderately-structured* problems, this seems very much associated with the most teachers in Indonesia are not used to present the problems that ill-structured or open-ended, whereas the results of research shows that the use of *ill-structured problems or open-ended problems* to Indonesian students proven to improve comprehension and other higher mathematical thinking (Herman, 2005; Ratnaningsih, 2007; Dahlan, 2003).

While in Japan, using *open-ended* problems have become demands and choice of many teachers, because the Open-ended approach is one way to innovate mathematics education which was first performed by Japanese mathematics education experts. This approach was born about twenty years ago from the results of research conducted Shigeru Shimada, Toshio Sawada, Yoshiko Yashimoto, and Kenichi Shibuya (Nohda, 2000), and the emergence of this approach as a reaction to the school of mathematics education at the time the class activity called the "Issei jugyow" (frontal teaching); teacher explains new concepts in front of the classroom to the students, then provide an example for the settlement of some matter. With applying *open-ended* approach and *lesson study* in Japan, the world has seen the success of Japan in math and many other things.

Ⅷ. Student's Presentation

When students are given challenging mathematical tasks, they immediately engaged in activities to resolve the issue, either individually or in

groups. Individuals or groups who are considered able to find the idea of completion immediately invited the teacher to present the results of their performance in front of the class.

Earlier presentations in general the teacher asked the students in groups to present their teachers. Aim of solution is to support student learning by encouraging them to communicate, explain, share, compare, and justify solutions or mathematical thinking to peers and their teachers orally. Define the types of activities in math class involves inviting students to share solutions and strategies, and ask the questions and answers. By showing their thinking, students may have to negotiate the meaning of mathematical ideas with others, and to explain and justify the reasons suggest, this case could encourage students to convince others with their ideas.

In Indonesia, solutions always presented by group leaders, who are sometimes forced to perform of tasks like this, but mostly because they are more confident than his companions. Another case when an individual is assigned duties as happened on several open-lesson in Japanese. Student presentations are truly due to the confidence and high self-confidence of students to express their ideas.

Is student presentations provoke for discussions? This often depends on the type of assignment given. When all students seem enthusiastic to try to solve the problem yourself, then emerge from the students' ideas and discussions occurred during the presentation session, but when multiple solutions with varying levels produced by a small group, other groups are often not lack of enthusiasm in discussing it, especially if the solution given almost the same. So, the discussion about solutions and strategies will occur if presenter presents solutions quite different from most groups.

Ⅸ. Teacher's Intervention

During the learning progresses, it always colored by the attitudes and behavior of teachers and students varied. Teacher behavior is often associated with students how they intervene, the intervention may have done since the beginning of learning, in the midst of learning, or at the end of the lesson, the teacher is not even impossible to do an intervention for learning.

Viewed from the side of intervention, it appears that the learning atmosphere will be very varied, and very likely an effect on students' mathematical thinking, conceptions of students toward mathematics, student attitudes toward math and learning, and on students' learning habits, as well as on students' self-regulated learning.

Results of observation on the activities of the lesson study in Indonesia (in this case in West Java). Intervention teachers, just the coloring process of learning, especially in learning problem-solving oriented. Teachers often unconsciously to helps students find solutions in solving mathematical problems faced by students. For example a teacher expression, "you can try to accomplish by using this formula ..." or ... "is a better way ...". Expressions of such a teacher, a teacher who described the intervention too far, it does not develop students' thinking, do not invite students to discover new ideas. It would be different if the teacher used the phrase ... "formula or theorem, what do you think the problem is related to the expression ...", this will invite students to find connections between the problems faced with other mathematical ideas, allowing for the development of communication between students and teachers. The first phrase describes the intervention of the first kind of Brodie (2004) that intervention on the product, whereas the second expression describes the two types of intervention that is intervention in the process.

In a large part of learning the lesson study, intervention on the product is still the mode by teacher and even the observer. It concluded that the development of students' mathematical thinking has not facilitated an optimal manner. Whereas in Japan according to the observation of researchers, teachers

give more intervention process and students are given the freedom to find his own ideas. In one case open lesson, there is a teacher or an observer trying to help the students give a solution, Mr. Sato (LS expert from Japan) said, "in essence the nature of the teacher always wanted to help his students."

X. Teacher's Reflection

Reflection of an activities focused on two types of reflections from Schond (Bjuland, 2004), namely the reflection in-action, and reflection on-action. Reflection in-action into two parts, namely in the short term and long term basis, as well as reflection on-action, reflection is divided into immediate, and delayed reflection. Analytical results of teachers' reflection during planning, during the learning process, and after learning, can be characterized as follows: when the discussions of planning and producing a planning tool of learning, if teachers are planning to bring model-oriented learning as a process of problem solving, problems tend to be too difficult to put forward , this may be related with some pride that when the teacher can construct a difficult matter, indicating intelligence about the maker, certainly in marked contrast to when, where, and who will deal with the problem. When returned to the purpose of making trouble, fishing student thinking, to developing their mathematical thinking, teachers are increasingly aware that it is not easy to construct a problem that really suited to the needs and learning goals.

XI. Concluding Remarks

Lesson Study as teacher professional development activities are conducted in a more continuous, collaborative, and collegiate has shown some progress. Particularly in Indonesia, in the pedagogic aspects more of teachers skilled in improving communications with students while still giving many interventions. Teachers are also more skilled in designing learning models and apply them in class, but on the other hand teachers are still weak in establishing communication between students who can produce an optimal learning. In the didactical aspects of the teachers still need to develop it seems, especially the process of making instructional materials that are able to create cognitive complicit, and provoke students to think mathematically, so that when viewed comprehensively, relationships between teacher-student, teacher materials, student-student, student and the material it must be an unified whole.

In order to learn the lesson study process achieve better results, it should be considered to always pay attention to the classroom setting, type of issue presented, the situation didactic and pedagogical, student presentations, working groups, the level of intervention by teachers, and teacher reflection before, during, and after learning.

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