

Lesson Study Among the Move of Educational Reformation in Indonesia

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Abstract-Since the year of 2000, Government of Indonesia (GOI) and JICA-Japan has been experienced initiating, developing and implementing lesson studies activities to improve teaching learning quality in primary schools, secondary schools, and in universities; it covers the teaching learning of mathematics, natural sciences, social sciences, and languages. The Lesson Study activities was proven to be effective in lifting students' enthusiasm in learning science, helping students to develop their experimental and discussion skill, and in giving opportunities to students in developing their own scientific concept by themselves. It was also noted that by using constructivism approach, the students may find out their best style of learning. Competition rises among groups of students in presenting the results of their work and in defending their presentations. This forces students to learn more theory more for their own sake. As a result of Lesson Study activities there were many teaching material developed either by lecturers or by teachers. Through lesson study activities lecturers and/or teachers developed the teaching materials after thinking extensively what and how to develop teaching materials for a certain topic, and then develop the materials. In sum, at the schools and implementation level, lesson study was the succes story of teachers' professional development in Indonesia. However, it seems it has its struggle to employ those success come into the higher level of teachers; professional development i.e. the government policies of educational development. Whilst, the ministry of education strives to implement the new curriculum for primary and secondary schools and also for universities, the lesson studies activities looks like the beautiful girls who loose its accountability and its narations. The challenge is to what extent that the lesson study is to be able to contribute its role to support government effort to improve the quality of teaching at all levels.

Keywords: lesson study, quality of teaching, teachers' professional development

I. INTRODUCTION

Nowadays, lesson study has become a worldwide movement to improve teacher's professional development. It rooted from the the old Japanesse educational practice i.e. in the Meiji period of Japan, in which the teachers were willing to develop and reflect their own teaching in collaboration with other teachers. Since the 1960s, lesson study has been developed rapidly in Japan as a school-based in-service training of the candidates of teachers. Following the world conferences and seminars of lesson studies e.g. supported by JICA, APEC, Walls, CRICED, and CRME, lesson study then spread out around the world. Some countries has developed lesson studies as the bases for improving the quality of teaching and teachers' professional development. United Kingdom, China, USA, Australia, Thailand Singapore, Russia, Eastern Europe contries, some Africa's, South East Asian countries including Indonesia has experiences conducting lesson studies with their educational contexts.

International Cooperation on Lesson Study was started with the meeting of the third APEC Education Ministerial held on 29-30 April 2004 in Santiago. The meeting suggested to conduct a collaborative study on innovations for teaching and learning mathematics in different cultures among the APEC Member Economies. The recommended project then was managed by the Center for Research in Mathematics Education (CRME) of Thailand and the Center for Research on International Cooperation in Educational Development (CRICED) of Japan. Some theme were chosen: Mathematical Thinking, Communication, Evaluation and Generalization. The purpose of project were to collaboratively share the ideas and ways of mathematical thinking which is necessary for science, technology, economical life and development on the APEC member economies, and collaboratively develop the teaching approaches on mathematical thinking through Lesson Study among the APEC member economies. In the document of "APEC – Tsukuba International Conference on Innovative Teaching Mathematics through Lesson Study

(II)- Focusing on Mathematical Thinking –“ it was organized to support specialist Lesson Study from Chile, China, Indonesia, Malaysia, Mexico, Papua New Guinea, Peru, Philippines, Russia, Thailand, and Vietnam.

All sides agree that one of the role of lesson study activities is to shift the old paradigm to the new ones.

Table 1: The Paradigmatic Changes Promoted by lesson study

Old Paradigm	Recommended Pradigm
Education as investment	Education as a need
Learning as an obligation	Learning as a need
Short-term orientation	Long-term orientation
Competiton	Cooperation
Instrumental curriculum	Interactive curriulum
Teachers as curriculum implementers	Teachers as curriculum developers
Dominant teachers/teacher-centred	Students' initiations/student centred
Very structured curriculum	Flexible curriculum
Product oriented	Process and product oriented
Uniformity	Diversity
Single method (lecturing)	Various methods (lecturing, discussion, eperiment, investigation, practical work)
Transfer of knowledge	Constructivist
Stressing on theories	Theories and practice
Cognition	Affective, cognition and skills
Text-book oriented	Life oriented
Objective test	Authentic assessment/portfolio
Exit national exam as an end	Exit national exam as a tool for improving the qualotu of education

Mixing from values beliefs and empirical evidences, there are currently demands in Indonesia, that any educational reform should handle the issues of: (a) how to promote interactive curriculum rather than instrumental curriculum?, (b) how to promote student centered approach rather than teacher centered approach?, (c) how to promote students' initiation rather than teacher's domination?, and (d) how to promote simple and flexible curriculum rather than crowded and tight-structured curriculum? While in term of observable good practice, there were demands that teachers need to have a chance to reflect their teaching in such away that they may move from older paradigm of teaching to the new one. Teachers may move from emphasizing the “teaching” to emphasizing the “learning”; they may move from the act of “transferring teacher's knowledge” to “constructing students' knowledge”.

The Decree of Sisdiknas No. 20 year 2003, Indonesian Educational System should develop intelligence and skills of individuals, promoting good conduct, patriotism, and social responsibility, fostering positive attitudes of self reliance and development. Improving the quality of teaching is one of the most important tasks in raising the standard of education in Indonesia. The programs which have been carried out to improve the quality of teaching are the improvement the quality of teachers; the provision of learning facilities and equipment; the improvement of the curricula for basic education; and, the development and utilization of communication technology for education, in support of the teaching learning process. The improvement of the quality of teaching, thus, has been one of the fundamental issues in the improvement of the quality of education in Indonesia. The quality of teaching learning process is closely related with what the students do in the classroom.

The School-Based Primary mathematics curriculum outlines that the aims of teaching learning of mathematics are as follows: to understand the concepts of mathematics, to explain the relationships among them and to apply them to solve the problems accurately and efficiently; to develop thinking skills to learn patterns and characteristics of mathematics, to manipulate them in order to generalize, to proof and to explain ideas and mathematics propositions; to develop problems solving skills which covers understanding the problems, outlining mathematical models, solving them and estimating the outcomes; to communicate mathematics ideas using symbols, tables, diagrams and other media; to develop

appreciations of the uses of mathematics in daily lives, curiosity, consideration, and willingness to learn mathematics as well as tough and self-confidence.

Since the 2014s, the Ministry of Education has implemented the new centralized curriculum, called Curriculum 2013. From its start, it seems that the implementation of the new curriculum faces the huge gap between the ideals and the practicality. By introducing the new curriculum, government wish to improve the quality of education. The curriculum consists of many concept of changes and revisison of the previous curriculum. Scientific method was introduced as the only single approach for teaching at all level and for all subjects. Through the new curriculum, the government let the teachers to employ the methods which is conform with the scientific approach, e.g problem-based method, project-based method, discovery method, and cooperative method. For the younger learner i.e primary schools, the government was also intruduced integratif and thematic approach.

However, there are significans finding that the implementation of Curriculum 2013 has many fundamental problems related to teachers'competencies and class, school management and leaving examination system. The teachers has its culture with conventional teaching, and it is not easy to change the teachers' mindset of teaching. The problems also emerge from how to manage teachers' competencies and teachers backgrounds in order to match with the structure of curriculum; some big changes heppened from this matter due they are also related with the teachers'certification. Some teachers perceive and argue about the relevant and significant of the final examination; they think that national examination system does not really concord with the methods of teaching and students activities to be promoted.

From the stated curriculum, it can be learned that teaching learning mathematics involves the teaching of many different areas of knowledge, and of many skills. When new knowledge or skills are required for problem solving, the students need to develop their mathematical attitude. Katagiri, S. (2004) suggests that, to develop mathematical attitude, students need to realize which previously learned, to "sense the necessity of" and "perceive the need or desirability of using" new knowledge and skills. It concludes that it is important to conduct classroom-based research to investigate the necessary driving factors towards the required knowledge and skills. It is also important to make sure that students first understand the benefits of using knowledge and skills when they possess and utilize such a drive. This leads them to fully acquire the knowledge and skills they have used. Cultivating the power of students to think independently and to perform mathematical attitude and mathematical thinking will be the most important finding in this research.

In Indonesia the Lesson Studies were developed in which the teachers, in collaboration with Lecturers and Japanese Experts, tried out some teaching models at schools. The Lecturers of Teacher Training Program and School Teachers worked collaboratively, composes some numbers of Lesson Studies. The grounds of the Lesson Study activities were reflecting and promoting the new paradigm of the secondary mathematics and science education, in which learning activities are not only perceived pragmatically and short-time oriented but also to be perceived as a long-life time purposes. Lesson Study activities let the teachers to reflect and evaluate, in cooperation with lectures or other teachers, their paradigm of teaching. Approaches of Lesson Studies covered (a) students cooperation with others in their learning, (b) contextual teaching and learning, (c) life-skill, (d) hands-on activities, (e) interactive process oriented curriculum and syllabi development, and (f) teachers and students autonomous. From those three sites of study, there can be produced the notions of educational improvement, in term of teacher, student and lecture.

In general, the implementation of lesson study indicated improvements of (a) teachers' competencies (creativity, questioning skills, experiemental methods), and (b) teaching and learning processes, and (c) students' activities, motivation, enthusiasm and performances. Besides, the project also resulted in the developments of CAIs for Chemistry, authentic assessment methods, student worksheets, and constructivist approach. However, the evaluation also identified that: (1) teachers have varied in their perceptions of the new paradigm of mathematics and science education; (2) the new approaches take much more time than conventional ones; (3) Enculturing innovation needs time; (4) the existing curriculum is found to be too crowded; (5) the existing class is still too big for the new approaches; (6) most teaching and learning processes were still oriented to the exit national exam; and (7) teachers were resistant to changes. However, its contribution to the accountability and sustainability of educational development is still a crucial issue.

II. LESSON STUDY SUPPORTS EDUCATIONAL REFORM

Under cooperation between Government of Indonesia (GOI) and JICA-Japan, three universities UPI Bandung, UNY Yogyakarta and UM Malang carried out project called IMSTEP-JICA for pursuing good practice of mathematics (and sciences) teaching by empowering and developing teacher education. Starting in 1999 and lasting in 2005, the extending of the project resulting piloting activities through Lesson Studies for good practice of secondary mathematics teaching in three cluster site West Java, Central Java and East Java. Results of the studies significantly indicated that there are improvements of the practice of secondary mathematics teaching learning processes in term of teaching methodology, teacher competencies, students achievements, alternative evaluation, teaching learning resources and syllabus. However, some misconceptions of counterpart made Lesson Study through IMSTEP was not effective yet. The following Lesson Study activities were conducted under the schema of SISTTEM, stand for Strengthening In-Service Teacher Training of Mathematics and Science Education at Junior Secondary Level, was born from the cooperation between JICA (Japan International Cooperation Agency) and MONE / Depdiknas (Ministry of National Education / Departemen Pendidikan Nasional) of Indonesia. The Overall Goal of SISTTEM is to develop the model of in-service teacher training primarily through MGMP activities applying lesson study; to continue teacher professional development in the target province; and to improve the level of student learning ability in mathematics and science in the target districts. At the national level, the *Lesson study* project can be a statewide movement for professional development of primary and secondary education. Through IMSTEP and SISTTEM, since 2001, DGMPSE (Directorate General of Management of Primary and Secondary Education, in cooperation with JICA-Japan, has initiated Lesson Study as a model of professional development designed to assist teachers produce quality lesson plans and gain a better understanding of student learning in primary and secondary mathematics and science.

A. *Lesson Study is the Way to Reform Teaching Practice*

Previous study by IMSTEP indicated that to encourage mathematics teachers' professional development, all sides in educational system should consider the promotion of: (1) good atmosphere for teaching and learning, (2) various teaching methods and teaching learning resources, (3) chances for the teachers and their students to perform their initiatives, (4) cooperative learning, (5) research class as a model for educational innovations (as Japanese teachers do), (6) teachers' role to develop their curriculum, (7) school and teacher autonomy (8) school-based management, and (9) contextual teaching. Since the early of 2000, there are cooperations among universities, teacher training institutes and MoNE's Directorate of Secondary Education to improve teachers' competencies to support the implementation of the proposed competent-based curriculum (Curriculum 2004).

Government agenda for implementing the new curriculum lead to the need for socialization the philosophy and the concepts of school-based curriculum as well as the results of lesson Study activities. Such socializations and workshops in which results of Lesson Study had been socialized. In the fiscal year 2001-2003, a medium scale of piloting of Teaching Learning Model of secondary mathematics and sciences through Lesson Study has been carried out by IMSTEP-JICA in collaboration with UPI Bandung, UNY Yogyakarta, and UM Malang, in which Japan Government supported facilities, training as well as Educational Experts. The objectives of the Lesson Study activities were to contribute the improvement of secondary mathematics education by pursuing good practice of mathematics teaching. Lesson Studies for secondary mathematics were carried out by mainly Classroom Action Research approach. Teachers carried out to improve the teaching learning practices and to find more appropriate methods for facilitating students learning. Teachers' experiences have been shared with other teachers and the lectures. The specific objectives of Lesson Study activities are: (1) to develop instrument and equipment for teaching learning process, (2) to develop teaching method and model for teaching learning process, (3) to develop teaching material for teaching learning process, and (4) to develop teaching evaluation for teaching learning process.

The results of Lesson Study could be inferred from the view of students, teachers, and of lecturers. Evidences were collected through observations, questionnaires and interviews. Teachers perceived that Lesson Study gave positive results because it could improve teachers' professionalism in finding variations of teaching approaches, and teaching methods. It introduced the new model of teaching in which teachers were able to increase the variation of alternatives on how to conduct classroom teaching

and learning process. There were evidences that Lesson Study improved teachers' skill to communicate, to deliver questions, to carryout discussion as well as teachers' creativity. Teachers perceived that Lesson Study activities were useful to support the implementation of competence-based curriculum. Research conducted by SISTTEM found that Lesson Study through IMSTEP have two fundamental limitations i.e. problems observed in the follow up period and, challenges newly emerging in the forthcoming program. In the first place, one of the observed tasks throughout the follow up period is how to deepen the quality of LS. Observing and understanding realities and facts of students' learning and reflecting lessons based on such evidences are really difficult to conduct. The viewpoints of counterparts of IMSTEP tended to address only "how teachers teach" and fail to scrutinize "how students learn". The limitations in observers' viewpoints and positions are likely to limit the directions of discussion in teaching, rather than learning of students. Moreover, reflection tends to finish with criticism against the teachers who have opened their lesson for observation, not fostering learning from the observed practices. However, if teachers cannot develop learning relationship among themselves, LS will become a place for teachers only to "bash" each other for their faulty practices.

Under the schema of SISTTEM, Lesson Study were carried out in three different sites i.e. in Kabupaten Sumedang (West Java), Kabupaten Pasuruan (East Java), and Kabupaten Bantul (DI Yogyakarta); they jointly carried out by the Indonesian counterpart team and the JICA Expert Team in cooperation with the three universities, i.e. UPI, UNY and UM, which were the counterparts of the IMSTEP. In this schema, Lesson study is defined as a practice-oriented method for improving teaching skills by teachers themselves; in which, it usually includes: developing lesson plans (planning), practicing the lesson plans in real classes while peer teachers observe the lessons (open lesson), and reflecting on the lessons together to give feedback to the teachers (reflection). To implement Lesson Study, SISTTEM employs the results of previous schema i.e. IMSTEP especially in term of human resources. SISTTEM carries out some trainings for schools principals, leader of MGMP (teachers club), and supervisors. The content of training covers the concept of learning community, lessons study, and lessons innovation. The implementation of Lesson Study at entire school level is scheduled for two and a half years i.e. May 2006 -October 2008.

B. Lesson Study is to Reform Mathematics Teaching

In the first research of lesson study (Marsigit, 2007) the aim was to picture of mathematical thinking that is students thinking on the concept of Lowest Common Multiple (LCM) at the 4th Grade Students of Primary School in Indonesia. With the ground of the New School-Based Curriculum we, in collaboration with teacher, prepared teaching learning of LCM with Realistic Approach. The search in this lesson study strived to uncover the idea of mathematics as a human activity that is stressed in realistics approach. Teacher organized the class as a process of *guided reinvention* (De Lange, 1996, in Zulkardi, 2006) that is to step in learning LCM by developing instructional environment e.g. let the students to freely chose and develop their methods and aids to solve the problems. The teacher let the students to work individually and in group less formally to perform horizontal mathematization; and then anticipating the structure to more formal raise mathematization activities.

From the analyses of videotaped lesson, it was indicated that the students strived to develop horizontal mathematization through some activities. The students strived to represent daily problems in a related mathematical formula and strived to prove regularities of consisting concepts. Some students performed vertical mathematization by employing different models and formulated mathematical model to solve the problems. The striking results of the study illustrated that : 1) Students' thinkings of the concept of LCM were much contributed by teacher's employing real-life contexts as a starting point for their learning; 2) Students' thinking of the concept of LCM simultaneously affected by the use of their own productions of formulas and strategies; 3) In thinking the concept of LCM, interactions between teacher and students, students and students are the essential activities; and 4) Students' thinkings of the concepts of LCM were influenced by the connection among the strands of mathematical concepts developed previously e.g. the concept of factor of numbers and by the connection with meaningful problems in the real world.

The second research of lesson study (Marsigit, 2008), the aim is to reflect the promotion of students to develop mathematical method in learning the total area of a right circular cylinder and sphere, and the volume of a right circular cone. Specifically, the expected results of the research is to describe students'

attempts or efforts in Katagiri S. (2004): inductive thinking, analogical thinking, deductive thinking, integrative thinking (including expansive thinking), developmental thinking, abstract thinking (thinking that abstracts, concretizes, idealizes, and thinking that clarifies conditions), thinking that simplifies, thinking that generalizes, thinking that specializes, thinking that symbolize, thinking that express with numbers, quantifies, and figures. At small group discussion Students learned that the lateral area of right circular cylinder is equal to the area of its rectangle i.e. mathematical thinking of analogy of concept and induction). Students learned that the total area of right circular cylinder is equal to the area of its rectangle plus the area of its two circles i.e. mathematical thinking of analogy of concept and induction.

In developing teaching learning methods, the teachers need to: plan the scenario of teaching, plan students activities, plan teachers' roles, distribute the assignments, develop assesment methods, and monitor the progress of students achievements. To develop their experiences, the teachers also need to participate frequently in such kinds of workshops or seminars. By using those teaching materials teachers could conduct the teaching and learning process more efficiently. Students enjoyed their learning process because they were involved in observing and doing things. Those teaching materials also improve students' motivation and interest in learning the materials. Although there were may kinds of teaching materials that have been developed through those Lesson Study activities, there still more topics that need to have or to have better teaching materials. Therefore lecturers from three universities need to have further collaborative work to develop more teaching materials in the future.

Further, the study also recommended that to improve the quality of mathematics and sciences education, the central government needs to: (1) implement more suitable curriculum i.e. more simple and flexible one, (2) redefine the role of the teachers i.e. teachers should facilitate students' need to learn, (3) redefine of the role of principals; principals should support the professional development of teachers by allowing them to attend and participate in scientific, meetings and trainings, (4) redefine the role of schools; schools should promote school-based management, (5) redefine the role of supervisor; the supervisors need to have similar background with the teachers they supervise in order to be able to do academic supervision, (6) improve teachers' autonomy to innovate mathematics and science teaching and learning, and (7) promote better collaboration between school and university; communication among lecturers and teachers should be improved; these could be done through collaborative action researches and exchange experiences through seminars and workshops, (8) redefine evaluation system, and (9) to extend project for promoting new paradigms and educational innovations.

The Lesson Study project was proven to be very effective in lifting students' enthusiasm in learning science, helping students to develop their experimental and discussion skill, giving opportunities to students in developing their own scientific concept by themselves. It was also reported that by using constructivism approach, the students may find out their best style of learning. Competition rises among groups of students in presenting the results of their work and defending their presentations. This forces students to learn theory more on their own. As a result of Lesson Study activities there were many teaching material developed either by lecturers and teaching together or by lecturers or teachers themselves. Those materials were either developed by lecturers or teachers in their own classroom or by lecturers and teachers together during Lesson Study activities. In general lecturers and/or teachers developed the teaching materials after thinking extensively what and how to develop teaching materials for a certain topic, and then develop the materials. Further they try out the teaching materials in their classroom and revise those according to the result of the try out.

C. Lesson Study Develops Learning Community

Successful implementation of SISTTEMS has promoted and attracted educators and education institutions across the archipelago to perform it. The Ministry of National Education (MONE) under the auspices of JICA through PELITA (Peningkatan Kualitas Tenaga Pendidikan SMP/MTs or the Improvement of Junior High School Teachers) extended the piloting of lesson study from 2009 to 2013 in the following three other districts/cities: Padang City under the supervision of State University of Padang in Sumatra island, the Banjar Baru District under the supervision of University of Lambungmangkurat in Borneo island, and the North Minahasa District under the supervision of State University of Manado in Sulawesi island. MONE has also initiated to facilitate 52 TEIs all over the country to implement lesson study for improvement of pre-service program since 2008. In addition, Indonesia University of Education has succeeded dissemination of lesson study in 16 districts of West Java

Provinces through school-university partnership project. Now, Jambi Province in Sumatra island is interested to adopt West Javas' success story of lesson study.

In Yogyakarta the Lesson Study began with a limited number of schools and teachers of mathematics and sciences only, but has expanded to reach more schools and teachers of other subjects. Involvement of MGMP, which stands for Musyawarah Guru Mata Pelajaran. MGMP is organized in each kabupaten/kota and the MGMP Committee members are elected from among member teachers. The Committee consists of Chairperson, Secretary, Treasurer, Coordinator for activity program, Coordinator for material development, and Coordinator for Reporting/Publication. The MGMP activities have been arranged as follows: Monday for Civics, Indonesian Language, and Religious Education; Tuesday for English; Wednesday for Mathematics; Thursday for Social Studies, History, Geography, Economics, Anthropology; Friday for no LS activity; and Saturday for Science, Chemistry, Biology, Physical Education.

The MGMP-based lesson study was conducted in 2007, participated by 331 JHS teachers of Mathematics and Science from 34 JHSs located in 17 sub-districts of the Bantul District. The activities were organized as follows: teachers of Mathematics met once in two weeks on Thursday (08.00-13.00), while teachers of Science on Saturday with the same duration. These teachers conducted the Lesson Study in eight home bases, with each home base being supervised by two teacher educators from Yogyakarta State University.

It is non-structural organization of teachers, whose establishment is stipulated in the Government Regulation No. 38/1994 on Education Personnel. It is a professional forum for subject teachers at the kabupaten/kota (district/city) level. According to the guidelines issued by the then Directorate General for Primary and Secondary Education, Ministry of National Education (now the Ministry of Education and Culture). Through lesson study activities, MGMP has noted some achievement of teachers' professional development: encouraging of teachers to improve their ability and skills to plan, implement and evaluate teaching and learning activities; developing of discussion activities to solve the problems faced by teachers to carry out their daily responsibilities and to propose solutions in accordance with the characteristics of the subject matter teachers, school conditions, and communities; providing teachers with opportunities to share information and experience about the curriculum implementation and the development of science and technology; providing teachers with opportunities to express their ideas at MGMP meetings to improve their professional skills; and developing cooperation with other institutions to develop a conducive, effective and enjoyable teaching and learning processes.

In Yogyakarta the Lesson Study began with a limited number of schools and teachers of mathematics and sciences only, but has expanded to reach more schools and teachers of other subjects. This is summarized in the Table 2 below.

Table 2: Data on the Developments of the Lesson Study in Yogyakarta

Year	Number of Schools (JHS and SHS)*	Subjects Studied	Comment
2001	21	One school for one subject only	Piloting Lesson Study simultaneously supported by Teaching Material development at University It seemed to emerge the culture of collaboration and communication among faculty members
2002	42	One school for one subject only	
2003	3 JHSs + 3 SHSs	Mathematics and Basic Sciences in each school	In this phase, the data were collected as the results of <u>monitoring the Piloting</u>
2004	105 new schools in one regency	Mathematics, Natural Sciences, Biology, English, Social Science, Javanese Language, Civics, Islamic Religion, Art and Culture, Physical Education	Involvement of Subject Teachers' Organizations It seemed to emerge the commitment of all sides to implement Lesson Study
2005	115 school in two regencies	The new scheme of : Plan-Do-See was developed i.e. one Plan for some Do	The new scheme is perceived as local creativity. It seemed to emerge the culture of collaboration among the teachers
2006	All public and Islamic JHSs in the Bantul Regency	Up to the devastating earthquake	Due to the earthquake, the culture of collaboration among the teachers was extended and intensified. Islamic School-based Lesson Study is perceived as

			nurturant effect of the implementation of Lesson Study.
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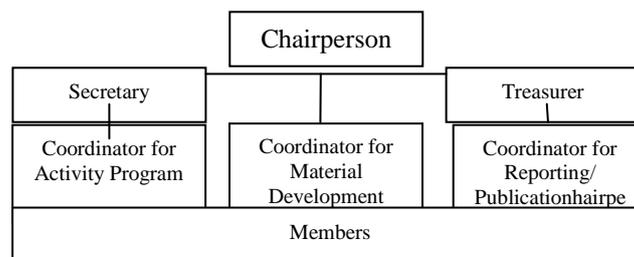
*) JHS = Junior High School; SHS = Senior High School

Table 2 shows the involvement of MGMP, which stands for *Musyawah Guru Mata Pelajaran*. It is non-structural organization of teachers, whose establishment is stipulated in the Government Regulation No. 38/1994 on Education Personnel. It is a professional forum for subject teachers at the *kabupaten/kota* (district/city) level. According to the guidelines issued by the then Directorate General for Primary and Secondary Education, Ministry of National Education (now the Ministry of Education and Culture). MGMP has five objectives:

1. To encourage teachers to improve their ability and skills to plan, implement and evaluate teaching and learning activities;
2. To discuss problems faced by teachers to carry out their daily responsibilities and to propose solutions in accordance with the characteristics of the subject matter teachers, school conditions, and communities;
3. To provide teachers with opportunities to share information and experience about the curriculum implementation and the development of science and technology;
4. To provide teachers with opportunities to express their ideas at MGMP meetings to improve their professional skills; and
5. To develop cooperation with other institutions to develop a conducive, effective and enjoyable teaching and learning processes.

As mentioned before, MGMP is organized in each *kabupaten/kota* and the MGMP Committee members are elected from among member teachers. The Committee consists of Chairperson, Secretary, Treasurer, Coordinator for activity program, Coordinator for material development, and Coordinator for Reporting/Publication. The MGMP organizational structure is illustrated in Figure 1 below.

Table 3 : The Organizational Structure of MGMP



The MGMP activities have been arranged as follows: Monday for Civics, Indonesian Language, and Religious Education; Tuesday for English; Wednesday for Mathematics; Thursday for Social Studies, History, Geography, Economics, Anthropology; Friday for no LS activity; and Saturday for Science, Chemistry, Biology, Physical Education.

III. LESSON STUDY PROMOTES TEACHERS' PROFESSIONAL DEVELOPMENT

In the academic year of 2008/2009 up to the present time, the lesson study scheme has been developed. As has been mentioned before, it consists of three main steps: *Plan* (preparation), *Do* (Implementation and observation), and *See* (reflection/review). The Plan stage covers the following activities: reviewing the syllabi, developing the lesson plan, developing student's worksheets, developing the observation sheet, and preparing class management. The teachers do the planning through workshops. In the Do stage, one of the teachers in a group implemented the lesson plan, while other teachers observe. They observe what the teacher is doing, what the students are doing, the teacher-students and student-student interaction patterns, the students' activities either as their being responsive to the teacher tasks and as initiators. In the See Stage, teachers are involved in a meeting attended by model teachers, supervisors, observers, and stakeholders. This meeting is aimed at providing the participants to reflect on the lesson implementation and then find ways of improving the teaching and learning quality. In the period from April 2007 to June 2008, each Lesson Study Home Base carried out 12 Lesson Study activities

as planned. Since the results were found promising, a new scheme was developed, i.e. 3-4 Plans to be followed by 6-7 Do and See activities.

The lesson study activities covered developing teaching materials and utilized a mathematical modeling of the disaster processes and impact so that students could learn both mathematics and the nature of the disaster. The Lesson Study activities proved to be effective in lifting students' enthusiasm in learning science, helping students to develop their experimental and discussion skills, and in giving opportunities to students in developing their own scientific concepts by themselves. It was also reported that by applying the constructivism approach, the students could find out their best style of learning. Competition rose among groups of students in presenting the results of their works and in defending their presentations. This forced students to learn more theory for their own sake. As a result of Lesson Study activities there were many teaching materials developed either by lecturers or by teachers. Those materials were either developed by lecturers or teachers in their own classrooms or by lecturers and teachers altogether during Lesson Study activities. In general, lecturers and/or teachers developed the teaching materials after thinking extensively what and how to develop teaching materials for a certain topic, and then developed the materials. Further, they tried out the teaching materials in their classrooms and revised those based on the result of the try out. Success stories of the implementation of the lesson study to the teaching of mathematics and science have encouraged teachers of other subjects to implement it in their classrooms. This has changed the ways teachers and students think and do during the teaching and learning processes. They become ready to learn from one another and share what they have learned for more effective learning. In short, improvement has been achieved together and the achievement has been achieved collectively.

To provide evidence of the lasting impact of the lesson study activities, a research study has been conducted in 2013. In this study data on the impact of the lesson study activities were collected through questionnaires to be filled in by teachers, students, and principals, interviews with teachers, students and principals, observations of the lesson study activities cycles, and achievement testing. Through lesson studies activities, the indicators of teachers' professional development seemed to be improved, i.e.: teachers participation 60% – 75 % , the teachers be more concerned about their students differences; the teachers strived to facilitate students activities; the teachers employed various method of teaching; the teachers employed various method of evaluation; the teachers strived to connect the relationship among Subject-Matter; the teachers developed Contextual Teaching Learning (CTL) approach; the teachers developed various interaction; the teachers employed small group discussion; the teachers developed the scheme for competences achievement; the teachers facilitated their students to be more active; the teachers employed various teaching aids; the teachers employed various learning resources; the teachers strived to implement new paradigm of teaching; the teachers were more passion to facilitate their students; the teachers have their habit to reflect their experiences of teaching; the students were more interested to learning object; the students were more motivated to engage in teaching learning processes; the students were more active in the class.

With these findings, both teacher educators and teachers may be more convinced that improvements in both pre-service and in-service teacher education may be achieved through the Lesson Study strategy by empowering the MGMP. Lesson Study was to be perceived as a useful and effective framework to develop teachers professionalism by performing their accountability and sustainability of teaching, through collaboration among the sides of educational practices consist of teachers, supervisor, lectures and stakeholders. The seminar on the results of the lesson study activities have been found useful as a means of: sharing the results of the lesson study for all groups, teachers, lecturers, and stakeholders; sharing any common problems found during the lesson study implementation; sharing any good solutions to the above problems, and reporting and writing the final results of the lesson study implementation as well as its possibility to expand it into a wider scope of both teachers and schools.

IV. LESSON STUDY AND CURRICULUM DEVELOPMENT

In the School-Based Curriculum, it was stated that mathematics in primary and secondary school should encourage the students to think logically, analytically, systematically, critically, creatively and be able to collaborate with others. The implementations of primary and secondary mathematics curriculum in class-rooms need to develop problem solving skills covering both closed and open problems. In solving the problems, students need to creatively develop many ways and alternatives, to develop mathematical models, and to estimate the results. Contextual and realistic approaches are recommended to be developed

by the teachers to encourage mathematical thinking in primary schools. With these approaches, there is a hope that the students step-by-step learn and master mathematics enthusiastically. To make their teaching learning of primary mathematics more effective, teachers also need to develop resources such as information technology, teaching aids and other media.

The curriculum outlines the aims of teaching learning of mathematics are as follows: (1) to understand the concepts of mathematics, to explain the relationships among them and to apply them to solve the problems accurately and efficiently, (2) to develop thinking skills to learn patterns and characteristics of mathematics, to manipulate them in order to generalize, to proof and to explain ideas and mathematics propositions, (3) to develop problems solving skills which covers understanding the problems, outlining mathematical models, solving them and estimating the outcomes, (3) to communicate mathematics ideas using symbols, tables, diagrams and other media, and (4) to develop appreciations of the uses of mathematics in daily lives, curiosity, consideration, and willingness to learn mathematics as well as tough and self-confidence.

A. *Developing the Scheme*

National Standard of Education suggests that the teachers need to develop their teaching in such that their students are able to learn mathematics optimally. It also encourages the teachers to develop various methods of teaching; they are expected to develop teaching aid, student's work sheets, and assessment method. Teachers need to be able to facilitate students' learning mathematics. Therefore, contextual teaching approach and realistic approach are recommended to be used. As the impact of government programs to innovate education and international trend of educational reform, the teachers are also expected to develop many kinds of educational research. Observing students' behaviors when they interacts with surrounding objects or people, may be the starting point to discuss about the mechanisms of their mathematical thinking. In the classroom activities the students may look at the object, take hold of it, listen to the sound or talk to the people; more than just these, she may also categorize, memorize or even make the plan for a certain mathematical thinking. Such behavior is taken for granted, much is automatic, yet for it happen at all requires the utilization of complex cognitive processes.

A series of Lesson Study activities may be thought of as constituting a set of culturally organized activities carried out by teacher or a group of teacher to promote children's mathematical thinking. Many small group activities are flexible and do not have a clear end point, predetermined by the teacher. However, small group discussions offer an interesting context in which to explore the participation of children interacting among the others in naturally occurring open ended thinking. In general, when a task has a clear end point, it has been assumed that the children were thinking towards that point. These series of studies were particularly interested in the attitude and method to which the students develop mathematical thinking to learn mathematics. Experience indicates that teachers can employ Lesson Study to promote mathematical thinking. Teacher is perceived to be the subject of the research as well as to be the researcher. By proposing planning, doing and seeing, the study expected to uncover the aspects of students' mathematical thinking.

Table 4: Developing Scheme for Teaching Learning Processes

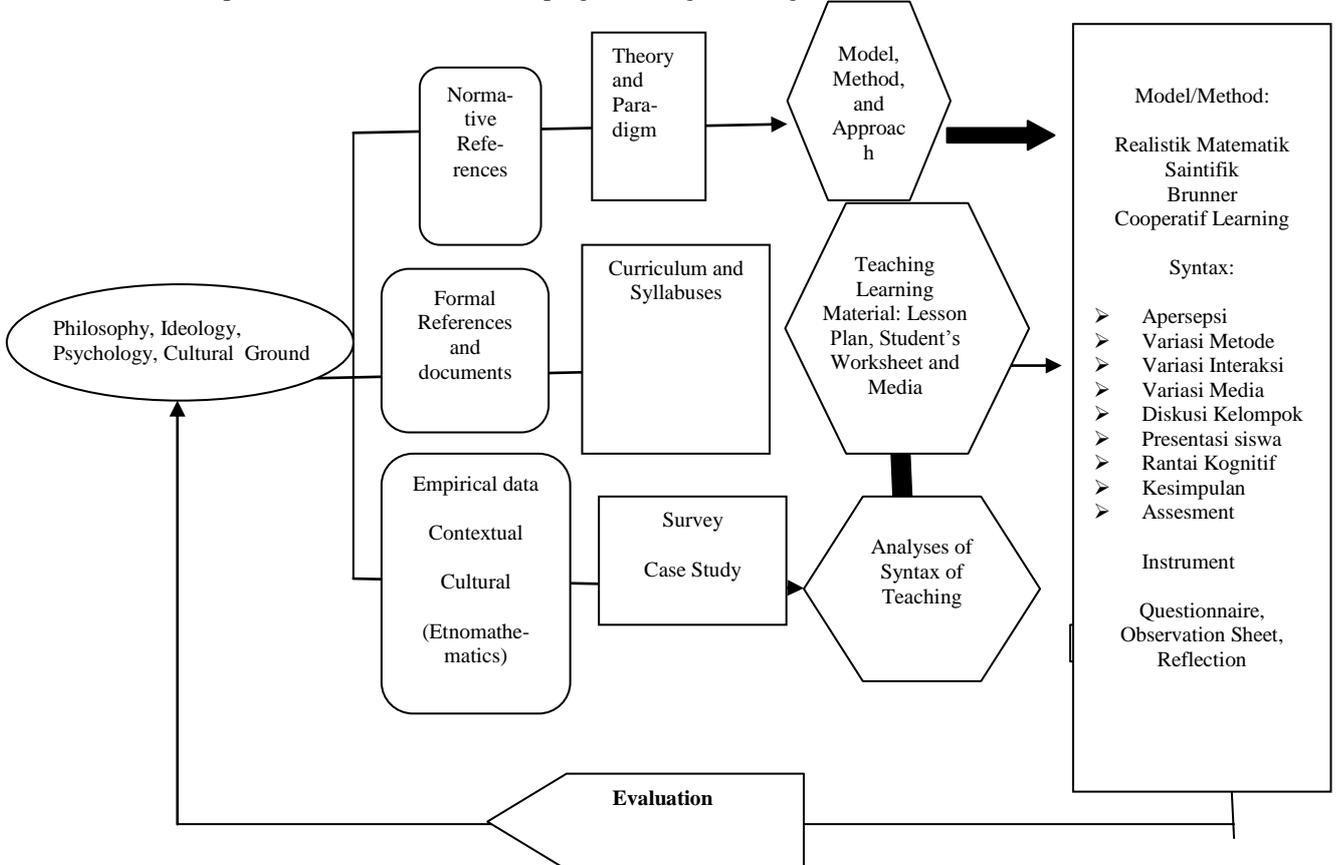
Ground/Foundatic		Reference		Paradigm /Theori	Approaches/Strategy	Model Te Learning	Teaching/Learning Resources	
Philosophy of Education	Ideology of Education	Normatif References	Book Journal Research	Legal Formal Formal References PP, Permendikbud Kur 2013	Paradigm / Theory 1	Approaches/ Strategy/ Method 1	Model T/L 1	Lesson Plan Student Worksheet Assessment 1
					Mix	Mix	Mix	Mix
					Paradigm / Theory 2	Approaches/ Strategy / Method 2	Model T/L 2	Lesson Plan Student Worksheet Assessment 2
					Mix	Mix	Mix	Mix
					Paradigm / Theory 3	Approaches/ Strategy/ Method 3	Model T/L 3	Lesson Plan Student Worksheet Assessment 3
				etc	etc	etc	

				Paradigm /Theory 2013	Approaches/ Strategy/ Method Kur 2013	Model T/L Kur 2013	Lesson Plan Student Worksheet Assessment Kur 2013
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B. Implementation

Students’ interactions with adults and among themselves may promote complex cognitive processes in the form of mathematical thinking. The context in which tasks are performed has begun to form a significant aspect of analysis, it has been interpreted in a variety of ways, sometimes in very local terms, to refer to the conditions under which a particular task is performed, or a particular mathematical thinking is produced. A wider view suggested that the aspect of students’ mathematical thinking offers a variety of potential meanings and interpretations, and that mathematical thinking involves a negotiation of shared context. Mathematical thinking happens in the context of teaching learning processes. Group discussion based on principles of promoting children’s growth and development through play activities may encourage the students to explore, experiment, question, and talk. Teacher’s efforts to facilitate their students to find various patterns of mathematical content can be seen as consistent with extending the students’ experiences of mathematical thinking and encouraging social interaction among them.

Table 5: Operational Scheme for Developing Teaching Learning Processes



Marsigit (2010) aimed the study of lesson study to promote *mathematical thinking* of primary and secondary students. The study provided teachers the opportunity to see teaching and learning in primary and secondary mathematics classroom in a real context. The study guided the teachers to focus on planning, implementation, observation, and reflection of their mathematical teaching in such way that their students were to perform *mathematical thinking*. By looking at real contexts of mathematical teaching learning processes, the researcher and the teachers were able to develop a common understanding of what should be planned, done and reflected to promote mathematical thinking. The study also provided opportunities for teachers to carefully examine students' *mathematical thinking* by observing and discussing real mathematics problems. The study was in the form of *School-Based Lesson Study* in which some teachers of Primary and Secondary Schools were participated to establish lesson study goal and develop lesson study cycles by developing common vision of systematic and consistent pedagogical approach to facilitate students need in performing their mathematical thinking. The steps of developing School-Based Lesson Study covered recruiting teachers, developing the theme, planning the Lesson Study, preparing observation and reflecting the results.

1. First Lesson

At the first lesson study activities composed of 4th-grade teachers and 5th-grade teachers of Primary Schools and 8th-grade teachers of Junior High Schools who work in three different schools: SD MIN I Yogyakarta, SD Percobaan Bulaksumur Yogyakarta and SMP N II Depok Yogyakarta. The researcher facilitated the teachers to provide perspective and a broader view of the issues as well as to serve as outside commentator, evaluator, or outside advisor. The researcher emphasized that the selected teachers should come in with the mindset of being a learner and ready to share and to communicate findings. The researcher and the selected teachers built open communication and set time-table for the related activities. The lesson study theme captures the school goals as well as the academic content goals for students to develop approaches and to perform *mathematical thinking*. The researcher exposed the important of mathematical thinking in the sense of students' thinking, educational theories, and international trends. The selected teachers choose a subject area in which to focus on *mathematical thinking*. They needed to identify a unit or lesson on which to focus on *mathematical thinking* and thoroughly discuss the unit and agree about what they are trying to achieve with the lesson. They also needed to expect what did they want students to know and be able to perform mathematical thinking. The researcher strived that the selected teachers must understand how their lesson would significantly supporting and facilitating mathematical thinking. To achieve this goal the researcher carried out firstly the socialization of Katagiri's notions of mathematical thinking. Prior the study implementation, the researcher shared and discussed with the teachers to prepare lessons related to the topic. The researcher and the selected teachers developed the lessons and set the stage for the observation in which the lesson and the learning processes would be reflected. A piece of planning the lesson included the schema of student responses to various aspects of the lesson and preparing appropriate teacher responses as well as the logical implication of mathematical thinking.

There was conformity among the goal of the overall Lesson Study, the aim of teaching and the aim for student learning. The researcher and the selected teachers developed lesson design and lesson plan to bring these goals. The developed Lesson Plan referred to the School-Based Curriculum (KTSP). The selected teachers implemented teaching learning processes while the researchers collect data on students' mathematical thinking and their aspects. Some other teachers and the researcher were set to observe the study lesson in a scheduled time and place. The researcher and the selected teachers shared the data collected covering of the evidence that goals for promoting students' mathematical thinking; and then found out the solutions of how to improve the lessons. Lesson debriefing was proposed to give the chance for the selected teacher to reflect his/her teaching; while getting inputs from other teachers or researcher. In while teaching, the researcher collected the data that need for debriefing. The data covered the comments of students and the work students produce during the lesson. At some occasions the researcher needed to observe closely the work and comments of particular students. The researcher and the selected teachers prepared copies of the lesson plan, teaching aids, and any students' worksheets that students would be using. The study prepared the classroom so that the observers can circulate freely among students during whole-class teaching. The researcher

developed instrument to investigate the structure of lesson, the schema of interaction, and the schema of mathematical thinking in the frame of the effort of achieving the mathematical competences.

It was not always easy for the teacher to start initiating the students to think mathematically on the problems of understanding the Least Common Multiple (LCM) and determining the Least Common Multiple (LCM). At a certain occasion, the students seemed to not be able to grasp teacher's expectation of *mathematical thinking*. When the students were not able to take examples, the teacher posed the prepared problems. In group discussion, *mathematical thinking* was always started when the teacher posed the prepared problems written in the Work Sheet. There was a high spirit when the students found out the relevant references and resources to solve the problems. The students employed their pre-requisite knowledge of Calendar to find the pattern and relation i.e. from the problem of finding *the multiple of 7 days and the multiple of 8 days in one year*. Additional skill might have been a supporting factor that the students by themselves employed various aids to solve the problems such as calendar, hand-phone, and blank table prepared by the teacher. In the effort of identifying or describing the specific mathematics, the students found the routine activities there are the concept of addition and subtraction i.e. $7 + 7 + 7 + 7 \dots$ or subtracting by 7 (for swimming); $8+8+8+8\dots$ or subtracting by 8 (for gardening). The concept of "frequency" emerged when there was a question of "how many times common activities". The concept of "frequency" was interpreted as the concept of "repeating addition or subtraction" i.e. the concept of multiple of number such as - *For 10 month, Shinta goes to swim $10 \times 5 = 50$ times; - For 10 month, Shinta goes to gardening $10 \times 4 = 40$ times*. In the effort of schematizing, formulating and visualizing, the students employed different ways to indicate that there are various ways in determining the multiple number of 7 and 8 e.g. using calendar, using series of numbers, using calculator and manipulating different symbols for 7 and 8. The students employed different schemas on determining the common multiple of 7 and 8 i.e. some students calculate the multiple of 7 for the whole year first then multiple for 8; and followed by counting the number of common activities in one year. Some students indicated first the common multiple of 7 and 8 (i.e. 56) and then counting the number of common activities in one year.

In the effort of to think mathematically on the problems of understanding the Least Common Multiple (LCM) and determining the Least Common Multiple (LCM), the series of sentences produces by the group indicated first *horizontal mathematization* then followed by *vertical mathematizaion*. Most of the students employed subtraction, addition, multiplication and division to list multiple of 7 and 8. They indicated Common Multiple, as the mathematical concepts to answer the common Shintas activities in one year. Students' reflection of *mathematical thinking* employed transition from daily language of mathematical language i.e. from common activities to common multiple. There was a student who jumped their concept to LCM due to he got it from "*informal private lesson*". In performing the *Vertical Mathematization* the students need the assistances from the teacher. The teacher encouraged the students to list more the multiple of 7 and the multiple of 8 and encouraged them to indicate the common multiple of 7 and 8. In the effort of discovering relations, the students discovered the relationship between "common activities" and "common multiple" i.e. 7 days and 8 days compare with "multiple of 7 and 8 = 56". In the aspect of discovering regularities, the students found that the concepts of regularities arouse from the concepts of "routine activities". The students recognized the isomorphic aspect in different mathematics problems i.e. the regularities emerged from isomorphic activities such as "swimming" and "gardening", "study club", "laboratory activities" or "going to library". There are the key concepts reflecting by the key word of how the students can transfer the real world problems to mathematical problem e.g. the concepts of "common", "regular", "routine", "number of", etc. Students' thinking of the concept of LCM were much contributed by teacher's employing real-life contexts as a starting point for their learning and simultaneously affected by the use of their own productions of formulas and strategies. In thinking the concept of LCM, interactions between teacher and students, students and students are the essential activities. Students' thinking of the concepts of LCM were influenced by the connection among the strands of mathematical concepts developed previously e.g. the concept of factor of numbers and by the connection with meaningful problems in the real world.

2. Second Lesson

At the second lesson study activities The subjects of the study were the 5th grade students of Primary School. The aim of the research was to promote mathematical attitude through teaching learning the Volume of Cube and Rectangular Parallelepiped. The aim of the lesson was to encourage the students to find the volume of Cube and Rectangular Parallelepiped and applying them to solve related problems. The specific aim of the lesson were to find the volume of Cube and Rectangular Parallelepiped and to solve the problems related to the volume of Cube and Rectangular Parallelepiped. Most of the students strived very hard to understand the concepts of Pyramid, Prism, Cone and Cube (Lesson Object). There are some ways in which the students strive to understand the concept: manipulation of the Model of Three Dimensional Geometrical Object, questioning to the teacher, questioning to other students, manipulation of mathematics net. Some students got the concept of geometrical shapes from informal learning i.e. from their parents or from additional lesson outside the school. The students were able to indicate the similar of geometrical shapes in daily lives; they also tried to identify the function of identical geometrical shape in daily live. The students perceived that their teacher has important role in helping them to perform *mathematical thinking*. Different geometrical shapes have different level to be understood. The concept of a cone was the most difficult for the students to understand. The students have difficulties how to calculate the number of the side of the cone. To solve the problems some students delivered the questions to the teacher and the other asked to their classmates. The students tried to employ their pre-requisite knowledge in clarifying the difficult concepts. Some students developed the step in order to understand the difficult concepts i.e. by asking first about the nature of the concept of a cone and then to ask to the teacher about its characteristics. However, some students inevitably jumped without any pattern due to have no systematic knowledge of geometrical shapes. There were the students who tended to be silent and passive if they still do not understand the difficult concepts. Students' effort to understand the difficult concept of geometrical shapes depended on the context and the schema of teaching. If the teacher communicate with the students in less formal, the students felt have no constraint to ask to their teachers. Some students perceived that their teacher should provide the complete and good quality of teaching aids. However, they also perceived that they enjoy getting assignments from the teacher. Most of the students employ inductive thinking i.e. by trial and error to answer teacher's questions; some of them tried to sketch the geometrical shapes and compare with different size of the models. The students tended to re-state the explanations and get attention from their teacher and their classmates to confirm whether their ideas were true.

3. Third Lesson

At the third lesson study activities, the subjects of the study were the 8th grade students of Junior High School. The aim of the lesson was to understand the characteristics of cylinder, cone, sphere and to determine their measures. The specific aims of the lesson were to identify the formula of the total area of right circular cylinder and to identify the formula of the area of sphere. The students manipulated *Concrete Model* of the *Right Circular Cylinder, Sphere and Right Circular Cone* in order to identify its components. They performed *mathematical abstractions* when the teacher gave them some questions or when the teacher let them to work in group. Some students defined the *concept* of *Right Circular Cylinder* as its *functions* in daily life e.g. "*A Right Circular Cylinder is the storage to keep something like pen, pencil, etc.*" There were students who defined a *Sphere* by giving the example in daily life e.g. ball, tennis-ball, etc. Students' *abstractions* of *Sphere* resulted the investigation of its components i.e. the *radius* and *diameter*. There were many ways in which the students *idealized* the geometrical concept. They mostly confirmed the concept to the teacher and asked to their mates. Sometimes they performed their *idealization* by commenting others work. Some students asked to the teacher why the *lateral area of cylinder is equal to the area of its rectangle* and why the *volume of cylinder is equal to three times the volume of its cone*? *Analogical thinking* happened when the students perceived that finding the lateral area of *Right Circular Cylinder* is similar to finding the area of its rectangle; and, finding the area of *Sphere* is similar to finding the area of its surface i.e. covering its surface by twisting around with the rope. In sum, the concepts of geometrical shapes are mostly perceived to be analogical with examples in daily life e.g. the *right circular cone was perceived as a traditional hat*. In performing their *analogical thinking*

the students frequently used strategic terminologies such as “*similar to*”, “*compare with*”, “*the example of*”, and “*the function of*”. Students’ *inductive thinking* involved *Concretization and method of abstraction* in the area of *problem formation and comprehension*. When the students, they who had known the certain concepts, were paced to perform *inductive thinking* they tend to reconfirm their concepts. *Inductive thinking* was spread from the beginning activities to the ultimate accomplishment when the students were paced to do so. The students developed *method of abstraction* to observe the given model of right circular cylinder and strived to identify the components of the right circular cylinder in order to define the concept of right circular cylinder. Students’ *inductive thinking* were also related to *establishing perspective* in which the students employed concrete model to search the total area of right circular cylinder and brook-down the model of right circular cylinder into its components: two congruent circles and one oblong.

Logical organization of mathematical concept happened in all context of mathematical method: *idealization, abstraction, deduction, induction and simplification*. *Logical organizations* of mathematical concept can be indicated from the following example of students’ questions: Why the lateral area of cylinder is equal to the area of its rectangle?, Why the volume of cylinder is equal to three times the volume of its cone?, What happened if we do not carefully cover the surface of the sphere in which we use the rope for twisting around?, and Is it true that that the area of the surface of sphere is equal to 4 times the area of its circle? *Problem formation and comprehension* emerged when the students: observe given model of right circular cylinder, observe given model of Sphere, and observe given model of right circular cone; identify the components of the right circular cylinder, sphere and right circular cone; define the concept of right circular cylinder, sphere and right circular cone; and get questions and notices from teacher to search the concepts. The evidences indicated that, in term of the realistic approach, mathematical thinking can be performed through identifying or describing the specific mathematics, schematizing, formulating and visualizing a problem in different ways, discovering relations, discovering regularities, recognizing isomorphic aspect in different problems; transferring a real world problem to a mathematical problem. Mathematical thinking was always started when the teacher posed the prepared problems written in the *Work Sheet*. The students employed their pre-requisite knowledge to perform mathematical thinking. The students employed different ways to perform *schematizing, formulating and visualizing*. The series of sentences produces by the group indicated first *horizontal mathematization* then followed by *vertical mathematization*. In performing the *vertical mathematization* the students need the assistances from the teacher.

The students recognized the *isomorphic aspect* in different mathematics problems i.e. the key concepts reflecting by the key word of how the students can transfer the real world problems to mathematical problem. Students’ thinking of the concepts of mathematics was influenced by the connection among the strands of mathematical concepts developed previously. The students tried to employ their pre-requisite knowledge in clarifying the difficult concepts and developed the step in order to understand the difficult concepts. Most of the students employ *inductive thinking* i.e. by trial and error to answer teacher’s questions; some of them tried to sketch the geometrical shapes and compare with different size of the models. The students tended to re-state the explanations and get attention from their teacher and their classmates to confirm whether their ideas were true. There were many ways in which the students *idealized* the geometrical concept. Students’ *inductive thinking* involved *concretization and method of abstraction* in the area of *problem formation and comprehension*. When the students, they who had known the certain concepts, were paced to perform *inductive thinking* they tend to reconfirm their concepts. *Inductive thinking* was spread from the beginning activities to the ultimate accomplishment when the students were paced to do so. Students’ *inductive thinking* were also related to *establishing perspective* in which the students employed concrete model to search the total area of right circular cylinder and brook-down the model of right circular cylinder into its components: two congruent circles and one oblong. *Logical organization* of mathematical concept happened in all context of mathematical method: *idealization, abstraction, deduction, induction and simplification*. *Problem formation and comprehension* emerged when the students observe mathematical models.

V. RESULTS

The implementation of the lesson study proves the improvement of teaching mathematics and teachers professional development. Lesson study activities promotes the new perspective of teaching in term of its philosophy, ideology, psychology and cultural ground. This has changed the ways teachers and students think and do during the teaching and learning processes. They become ready to learn from one another and share what they have learned for more effective learning. In short, improvement has been achieved together and the achievement has been achieved collectively. The impact of the lesson study activities to mathematics teachers covers its readiness and its competencies of teaching i.e. the validity of its lesson plan and students worksheets, students' motivation and apperception, flexible method and approach of teaching, small group discussion, various method of teaching, various media, various interaction, teaching scheme, assessment, students' reflection, students' initiation, and students effort in constructing their mathematical concepts. With these findings, both teacher educators and teachers may be more convinced that improvements in both pre-service and in-service teacher education may be achieved through the Lesson Study strategy by empowering the MGMP. It can be concluded that through lesson study, the teachers are to perform better in managing classroom and in promoting their professional development. The teachers have the clear picture on the effective framework to develop teachers professionalism by performing their accountability and sustainability of teaching, through collaboration among the sides of educational practices consist of teachers, supervisor, lecturers and stakeholders. Good atmosphere for teaching innovation can be maintained through various activities e.g. by sharing the results of the lesson study for all groups, teachers, lecturers, and stakeholders; sharing any common problems found during the lesson study implementation; sharing any good solutions to the above problems, and reporting and writing the final results of the lesson study implementation as well as its possibility to expand it into a wider scope of both teachers and schools.

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