

GOOD PRACTICE OF MATHEMATICS TEACHING THROUGH LESSON STUDY AND TEACHERS PROFESSIONAL DEVELOPMENT

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Starting in 1999 and lasting in 2005, under cooperation between Government of Indonesia (GOI) and JICA-Japan, three universities of UPI Bandung, UNY Yogyakarta and UM Malang carried out a project called IMSTEP-JICA for pursuing good practice of mathematics and sciences teaching by empowering and developing teacher education. The extension of the project resulting piloting activities through Lesson Study for good practice of secondary mathematics teaching in three cluster site of West Java, Central Java and East Java. The 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 achievement, alternative evaluation, teaching learning resource and syllabi. However, some misconceptions of counterparts made Lesson Study through IMSTEP not effective yet. The current Lesson Study activities are conducted under the schema of SISTTEM, stand for Strengthening In-Service Teacher Training of Mathematics and Science Education at Junior Secondary Level, was established under the cooperation between JICA (Japan International Cooperation Agency) and MONE (Ministry of National Education). 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.

A. OVERVIEW

Mixing from value 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 a way 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, promote good conduct, patriotism, and social responsibility, should foster 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 of 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 supporting the teaching learning process. The improvement of the quality of teaching, thus, has become one of the fundamental issues in the improvement of the quality of education in Indonesia. The quality of teaching learning process is closely related to what the students do in classroom.

Based on the Ministerial Decree No 22, 23, 24 year 2006, it's started in June 2006, Indonesian Government committed to implement the new curriculum for primary and secondary education, called KTSP "School-Based Curriculum". This School-Based Curriculum combines two paradigms in which, one side stresses on students competencies while the other side, concerns students' learning processes. The School-Based Primary mathematics curriculum outlines that 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 in solving the problems accurately and efficiently.
2. to develop thinking skills in learning patterns and characteristics of mathematics, to manipulate them in order to generalize, to prove and to explain ideas and mathematics propositions.
3. to develop problem solving skills which cover understanding the problems, outlining mathematical models, solving them and estimating the outcomes.
4. to communicate mathematics ideas using symbols, tables, diagrams and other media.
5. to develop appreciations of the uses of mathematics in daily lifes, curiosity, consideration, and to develop willingness in learning mathematics as well as tough and self-confidence.

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 firstly 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.

B. PROMOTING LESSON STUDY IN INDONESIA

Lesson Studies was 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 and composed some numbers of Lesson Study. 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 perceived as long-life time purpose.

Lesson Study activities let the teachers to reflect and evaluate, in cooperation with lectures or other teachers, their paradigm of teaching. Approaches of Lesson Study covered (a) cooperation among students in 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' autonomy. From those three sites of study, they produced the notions of educational improvement, in term of teacher, student, and lecture.

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 in producing qualified lesson plans and gaining a better understanding of student learning in primary and secondary mathematics and science.

1. Lesson Study as one of the Ways for Mathematics Teachers Professional Development

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.



Picture 1: Socialization and Workshop of School-Based Curriculum in Semarang, Central Java, 2007

In early 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 competence-based curriculum (Curriculum 2004). Government agenda for implementing the new curriculum leads 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 were:

1. Validation and Socialization of the Guideline of Syllabi and Evaluation System of Competent-Based Curriculum for Mathematics in Manado, North Sulawesi, 2002.
2. National Semiloka for Socialization on the Development of Competence-Based Curriculum for Junior High School Mathematics in Yogyakarta, 2002.
3. Validation and Socialization of the Guideline of Syllabi and Evaluation System of Competent-Based Curriculum for Mathematics, Yogyakarta, 2002.
4. National Level of Training of Trainer (TOT) for Basic Science, in Yogyakarta, 2003
5. Monitoring and Evaluation of the Piloting of Competence-Based Curriculum for Mathematics in State Junior High School I and III, Binjai, North Sumatra, 2004.
6. Monitoring and Evaluation of the Piloting of Competence-Based Curriculum for Mathematics in Padang, West Sumatra, 2005.
7. Socialization and workshop of school-based curriculum for Secondary Teachers in Riau, Sumatra, 2006
8. Socialization and Workshop of Lesson Study for Junior High School teachers from Central Java and Kalimantan in Yogyakarta, 2006
9. Socialization and workshop of school-based curriculum for Secondary Teachers in Semarang, Central Java, 2007
10. Socialization and workshop of school-based curriculum for Secondary Teachers in Surabaya, East Java, 2007

2. Lesson Study through IMSTEP

In the fiscal year 2001-2003, a medium scale of piloting of Teaching Learning Model of secondary mathematics and sciences through Lesson Study had been carried out by IMSTEP-JICA in collaboration with UPI Bandung, UNY Yogyakarta, and UM Malang, in which Japan Government supported the facilities, training as well as Educational Experts. Following are the three cluster:

	West Java (Bandung)		Central Java (Yogyakarta)		East Java (Malang)	
	Year 2001/2002	Year 2002/2003	Year 2001/2002	Year 2002/2003	Year 2001/2002	Year 2002/2003
Number of school	1	2	1	3	1	1
Number of teacher involved	1	2	3	3	1	1
Number of lecture involved	4	4	4	3	4	4

Table 1: Three cluster sites of Lesson Studies of Mathematics Teaching (IMSTEP-JICA Project)

The objective of those Lesson Study activities was to contribute the improvement of secondary mathematics education by pursuing good practice of mathematics teaching. Lesson Study for secondary mathematics was carried out by mainly Classroom Action Research approach.



Figure 2: A group of teachers was preparing Lesson Study

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 lecturers. The specific objectives of Lesson Study activities were: (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 lecturers. The data 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 a new model of teaching which enables teachers to increase the variation of teaching on how to conduct classroom teaching and learning process. There were evidences that Lesson Study improved teachers' skill to communicate, to deliver questions, to carry out discussion, and teachers' creativity as well. Teachers perceived that Lesson Study activities were useful to support the implementation of competence-based curriculum.

2. Lesson Study through SISTEM

Research conducted by SISTEM (2006) found that Lesson Study through IMSTEP has 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 Lesson Study. 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 failed to scrutinize "how students learn" (ibid.). It was uncovered that the limitations in observers' viewpoints and positions are likely to limit the directions of discussion in teaching, rather than learning of students. Moreover, reflection tended to finish with criticism against the teachers who have

opened their lesson for observation, not to foster learning from the observed practices. However, if teachers cannot develop learning relationship among themselves, Lesson Study will become a place for teachers only to criticize 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 are 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. Below is the schema of Lesson Study by SISTTEM:

Figure 3: The Schema of Lesson Study by SISTEMMS
(Source: Inception Report Program SISTTEMS, <http://www.sisttem.org>)

In this schema, SISTTEM (2006) defined Lesson study as a practice-oriented method for improving teaching skills by the teachers themselves; in which, it usually includes developing lesson plans (PLAN), practicing the lesson plans in real classes while peer teachers observe the lessons (DO), and reflecting the lessons as well as giving feedback to teachers (SEE). To implement Lesson Study, SISTTEM employed 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, lesson study, and lesson innovation. The implementation of Lesson Study at entire school level of SMP/MTs in Kabupaten Bantul is scheduled for two years i.e. May 2006 -October 2008.

C. LESSON STUDY IN ACTION

The objective of the following Lesson Study activities is to contribute the improvement of secondary mathematics and science education by developing teaching models in the schema of Lesson Study. Lesson Study for secondary mathematics was 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 lectures. The specific objective of Lesson Study activities is to promote mathematical thinking

1. Promoting Student's Thinking on the Concept of Lowest Common Multiple (LCM) Through Realistic Approach in the 4th Grade of Primary Mathematics Teaching

The study was aimed at encapsulating, through Lesson Study, the 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 the teaching learning of LCM using Realistic Approach. The

search of this lesson study strived to uncover the idea of mathematics as a human activity stressed on 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 work individually and in group informally to perform horizontal mathematization; and then to anticipate the structure into more formal mathematization activities.



Mathematical thinking in Group Discussion:

- The teacher let the students have group discussion to solve the problem..
- Analysis:
*Most of the group employed calendar to find the multiple of 7 days and the multiple of 8 days in one year.
 Most of the groups constructed the complete one year calendar.*

From the analysis 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 were simultaneously affected by the use of their own production 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 real world.

2. Developing Mathematical Methods in Learning the Total Area of a Right Circular Cylinder and Sphere as well as the Volume of a Right Circular one of the 8th Grade Students of Junior High School

The aim of the study is to promote students to develop mathematical method in learning the total area of a right circular cylinder and sphere and also the volume of a right circular cone. Specifically, the expected result of the study 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.



Group Work and Discussion:

Executing Solutions

- Students learned that the lateral area of right circular cylinder is equal to the area of its rectangle. (*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. (*Mathematical thinking of analogy of concept and induction*)

D. CONCLUSION

In developing teaching learning methods, the teachers need to plan the scenario of teaching, to plan students activities, plan teachers' roles, to distribute the assignments, to develop assesment methods, and to 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 many kinds of teaching materials already 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 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 as the teachers whom they supervise in order to be able to do academic supervision, (6) improve teachers' autonomy to innovate mathematics and science teaching and learning, (7) promote better collaboration between school and university; communication between 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, and in 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 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. Those materials were either developed by lecturers or teachers in their own classroom 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 develop the materials. Further, they tried out the teaching materials in their classroom and revised those based on the result of the try out.

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