IMPROVING STUDENTS’ ABILITY IN PROBLEM SOLVING THROUGH PROBLEM-BASED LEARNING IN LESSON STUDY ACTIVITIES

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Lesson study for Elementary Statistics subjects in Mathematics Education Study Program – Yogyakarta State University has been conducted twice. Five Statistics lecturers had collaborated in planning, conducting and doing reflection for the learning activity. Problem-based Learning (PBL) had been chosen in purpose of improving mathematics students’ ability to solve problems. With collaboration, lecturers felt that they got more knowledge in PBL, in choosing problems to lead the learning activities as well as in choosing questions to lead discussions, in getting some information about students’ problems in problem solving and in noticing students who needed helps. According to students, with PBL, the learning activities were more challenging, and there were more opportunities to make discussions.

Key Words: problem solving, problem-based learning, lesson study

Introduction

Lesson study, a professional teacher development process, recently has developed in many countries, not only in Japan, which is the origin country of lesson study development, but also in USA and in several countries. And so does Indonesia.

Since 2004, Mathematics & Natural Science Faculty of Malng University (UM), Indonesia University of Education (UPI), and Yogyakarta State University (UNY), through Follow-Up IMSTEP JICA program, had conducted lesson study for mathematics, physics, chemistry, and biology teachers in some secondary school. Since 2006, through SISTTEMS program, lesson study had been conducted in junior high school and Islamic junior high school (MTs) in three regencies in Indonesia. Those are in Sumedang (West Java), Bantul (Yogyakarta), and Pasuruan (East Java). By conducting socialization from three lesson study
development center in Indonesia, those are in UM, UPI, and UNY., nowadays, many schools try to implement it as efforts to increase teachers’ professionalism.

Although lesson study is commonly conducted in primary and secondary school, several lecturers try to implement it. Roback, Chance, Legler, and Moore had conducted it for Mathematical Statistics lecture in St. Olaf College in 2004 (Roback, Chance, Legler, & Moore, 2006). In Indonesia, lecturers in Mathematics & Natural Science Faculty, Yogyakarta State University had conducted it since 2006.

In Mathematics Education Department, in each semester, minimally there are two groups or lecturers’ team of certain field conducted lesson study. Each group consists of 5-7 lecturers, senior and junior lecturers. Explanation below is researcher’s experience when conducting lesson study in Elementary Statistics course in there on 2006-2007.

**Background**

Elementary Statistics course in Mathematics Education Department, Mathematics & Natural Science Faculty, Yogyakarta State University is given in second semester and it has three credits. Materials discussed are about Measures of Central Tendency, Measures of Dispersion, Frequency Distributions, Combinations and Permutations, Probability, Conditional Probability, Variable Random and their Distributions, The Normal Distributions, Student’s Distribution, Chi-Square Distribution, F-Distribution, Sampling Distributions, Estimations, and Testing Hypotheses. Most of them are advance materials of Probability and Statistics in secondary school.

One of problems faced by statistics lecturers’ team in there is a tendency of “data phobia” in most of the students. That is a tendency not to get in touch with data or its tabulation. Students commonly are not enthusiastic enough if they are given problems related with data presentation, computing statistics score, and Testing Hypotheses.

Another problem faced in this lecture is students’ problem-solving abilities are weak, especially for topics Combinations and Permutations, Probability, and
Conditional Probability. Their weaknesses are identified from the way they complete their examination. If they got questions which are a little bit different with questions in their textbook or questions in the previous years, most of them felt hard to complete it immediately.

We can not let these problems, considering these students are mathematics teachers’ aspirant. They have to teach those materials to their students next time. Therefore, a lot of attempts had been carried out to solve those problems. One of the efforts to solve lack of students’ enthusiasm in learning statistics problems and students’ weaknesses of problem-solving ability is by choosing Problem-based learning (PBL) strategy. By facing challenging and contextual problems, and having chance to discuss with their friends, hopefully, the lecture will be more interesting and increase their problem-solving ability.

Nevertheless, it does not mean that there will not be problems when implementing PBL. Because the base of PBL is problems, choosing accurate problems is important thing to make the implementation easy. The problems which would arise then are that they are hard to choose. Condition, beginning skill, thinking rapidity, and other aspects come from students in heterogenic class, they all can become a problem.

Solution offered to lecturers’ limitation in planning and implementing PBL is by collaborating it with other lecturers. Collaboration between them and their colleagues to increase lecturers’ quality, including plan-do-see stages, is well-known as Lesson Study. Through this, lecturers have chances to cooperate with their friends in planning lecture (including choosing problems and media, arranging handout, and making evaluation instruments), and in observing how students learn each other. Lecturer model will also get input from lecturer observer about problems commonly faced by students or group of students. Through this, lecturers have chances to do reflection and discuss with others in order to solve existing problem or to increase the quality of next lecture.

Based on that background, we as statistics lecturers’ team in Mathematics Education Department, Mathematics & Natural Science Faculty, Yogyakarta State University welcome positively faculty’s plan to conduct lesson study.
Implementation of Lesson Study

Generally, there are some articles state that stages of lesson study’s implementation are as follow: (1) Identifying the problem and establishing the overarching goal, (2) Developing the research question in the Lesson Study Group, (3) Designing the research lesson, (4) doing and observing the lesson, (5) debriefing, reflecting, and revising the lesson, and (6) sharing what you’ve learned. Richardson (2004) for instance, suggests seven steps in the implementation, such as, “(1) Form a Lesson Study team, (2) Focus the Lesson Study, (3) Plan the study lesson, (4) Prepare for the observation, (5) Teaching and observing the lesson, (6) Debriefing the lesson, (7) Reflect and plan the next step”.

Base on their experience in implementing lesson study for Mathematical Statistics lecture in St. Olaf College in 2004, Roback et.al. (2006) suggests some aspect considered as important things in its implementation, especially for newcomers. The suggestions are: (1) Read the literature, (2) Find a committed group to participate, (3) Be realistic about the time commitment, (4) Sketch a timeline for your entire process to unfold, (5) Develop a broad goal and specific objectives, (6) Run efficient meetings, (8) Record thorough notes at each meeting, (9) Avoid being overly judgmental in planning meetings, (9) Create a detailed four-column lesson plan, (10) Maintain a student focus, (11) Embrace the research lens, (12) Maintain flexibility with respect to time, (13) Schedule classroom observes and videographers, (14) Revise and repeat the lesson, and (15) Share your experiences.

Referred to some references to apply lesson study as stated above, lesson study for Elementary Statistics in Mathematics Education Department, Mathematics & Natural Science Faculty, Yogyakarta State University, especially in 2007, was held through these steps as follow. The team consisted of Djamilah BW, M Si. (as a team coordinator), M. Susanti, M Si., Elly Arliani, M Si., Kana Hidayati, M Pd., dan Prof. Suryanto, Ph. D.
a. Preparation

Meeting to make preparation was held in the beginning of March 2007. In the first meeting, on March 6th 2007, the team discussed topics, approaches, methods, and media for Elementary Statistics subject which would be used in lesson study. Considering statistics problems usually faced during this time, especially “data phobia” problem and weaknesses of students’ mathematics problem-solving ability, we decided these things.

Topics Combinations, Probability, and Conditional Probability was chosen because students were weak on this topic’s problem solving. Therefore, they should have problem solving ability undoubtedly. Moreover, National Council of Teachers of Mathematics (NCTM, 2000) states that

“Solving problems is not only a goal of learning mathematics but also a major means of doing math. By learning problem solving in mathematics, students should acquire ways of thinking, habits of persistence and curiosity, and confidence in unfamiliar situations that will serve them well outside the mathematics classroom”.

Bell (1978) also states that,

“Mathematical problem solving can help students improve their analytic powers and can aid them in applying these powers in diverse situations. Solving problems can also help students learn facts, skills, concepts and principles by illustrating the applications of mathematical objects and the interrelations among objects”

Lecturing approach which was considered appropriate to increase problem solving ability is PBL. Tan (2004) states that, “PBL is recognized as a progressive active-learning and learner-centred approach where unstructured problems are used as the starting point and anchor for the learning process”. While Roh (2003) states that,

“PBL describes a learning environment where problems drive the learning. That is, learning begins with a problem to be solved, and the problem is posed is such a way that students need to gain new knowledge before they can solve the problem”.

Same with both opinion above, Duch, et.al (2000) expresses that,

“In the problem-based approach, complex, real problems motivate students to identify and research concepts and principles they need to know in order to progress through the problems. Students work in small learning teams, acquiring, communicating, and integrating information in a process that resembles of inquiry”.

Problem-based learning was chosen as an lecturing approach because of several reason as follow: (1) PBL better prepares students to apply their learning to real-word situations, (2) PBL enables students to become producers, rather than consumers, of knowledge, and (3) PBL can help students develop communication, reasoning, problem solving, and critical thinking skills (CIDR, 2004).

If compared with conventional learning, PBL has more advantages. According to Smith, Ericson, dan Lubienksi, cited in Roh (2003) states that,

“In contrast to conventional classroom environments, a PBL environments provides students with opportunities to develop their abilities to adapt and change methods to fit new situations. Students in PBL environments typically have greater opportunity to learn mathematical processes associated with communication, representation, modeling, and reasoning”.

By choosing PBL as lecturing approach, discussion method was chosen as lecturing approach during lesson study. To take students’ interest and also to give them knowledge about media which could be used to teach probability and statistics, we choose media comics, students’ worksheet, and power point.

After topics, approaches, methods, and media were chosen, the next activities in this stage was choosing problems, making handout and media, and making lesson plan more detailed together with other lecturers.

b. Implementation

After those above were arranged, the dates for applying it were determined. First, topic Combination, with the lecture Kana H, M Pd., was conducted on March, 20th 2007. Next, about Probability, with M. Susanti, M Si., was conducted on March, 22th 2007. And the last, the topic was
Conditional Probability, with Djamilah BW, M Si., was conducted on March, 27th 2007.

Appropriate with arranged lesson plan, the lecture was begun by giving problems to students. Because of lack of facilities in the class, the discussion was carried out with their friends beside. Students and their friends only get one worksheet containing problems to be solved. After several minutes, some students were asked to present their result. When a student presented his/her work, he/she did not represented his/her group. This meant in order they discussed it more seriously. Some different problem solving then discussed together or other students gave comments about them. The lecture was closed by reinforcement or conclusion from the lecturer.

During the lecture, other lecturers would observe it. The focus especially was on the way students learned each other, not on the way lecturer taught. It was fit with suggestion came from Roback et.al (2006), quoted from Fernandez, Cannon, and Chokshi opinion. It states that the development of three new lenses for examining lessons, “a student lens, to understand student thinking, anticipate student behavior, and learn to build student understanding”.

Compared with lecturer who conducted lecturing separately (no observer), through lesson study, he/she had gotten many pairs of eyes and ears to help him/her observe students’ learning process, especially in observing the way students learn each other. This would help lecturer who taught the topic to help students who needed help, because during reflection, teacher observer not only expressed his/her observation, but also shared experiences hot to solve problems faced in that time.

Based on observation, generally most of students were quite enthusiastic following the lecture. Especially for topic conditional probability, most of them needed longer time than planned time. Besides, they were still not capable to write down what they knew and the question was in appropriate notation/table/diagram which would make them completing the problem easily. Things like this had to get attention more, considering the first step in problem
solving was, “understanding the problem”. According to Polya, it identified, "what is the unknown?, what are the data?, what is the condition?” (Alfeld, 1996).

c. Reflection

After lecturing ended, reflection had begun. Unfortunately, time allocation for reflection was limited, because of each lecturer’s bustle. For ideal lesson study implementation, it had to have same time allocation like for lecture minimally, in order each lecturer in this team got optimal advantages and input from observer based on discussion.

Several things arose during reflection’s discussion were: (1) there was misinterpretation from students toward given problems; (2) students were weak in the use of notation/table/diagram to present data/information; and (3) the use of time.

From reflection, it concluded that efforts should be done by lecturers to solve problems above were giving chance to students as many as possible to solve mathematical given problems and educating them to accustom to implement Polya’s problem-solving strategy.

Learning Process Evaluation from Students

To identify students’ comments toward the lecture, they were given questionnaires at the end of the lecture. From 48 students, 40 of them had filled questionnaires, and several things which needed more attention were as follow.

Things “considered” positively for all lectures were the clearness of lecture’s aims, the appropriateness of syllabus with the aims, the clearness of lecture’s conveyance, the accurateness of approaches’ usage, techniques, learning model, and lecturers’ effort usage in motivating students to get high achievement. Whereas special things related with lecture’s topic, students stated that the implementation of lesson study was continued, not only for the three topics, because those topic (using PBL) was challenging, having various problems, and having many opportunities to discuss together. These comments could indicate that
students felt challenging with the problems given and it was a good start to increase their problem solving ability.

Things “considered” negatively were little opportunities to consult lecturer outside lecturing, lack of media, and students’ readiness during following the lecture. Whereas special things related with lesson study which got criticism were time allocation for discussion and presentation, and the presence of other lectures and cameraman which made them a little bit uncomfortable.

Based on students’ comment above, it concludes that PBL is quite interesting for them to study more seriously. The uncomfortable atmosphere with the presence of other lectures and cameraman is normal, because it is the first time for them. If they are accustomed to, it will not become a problem.

Conclusion

In order the efforts through PBL in lesson study activities can increase students’ problem-solving ability significantly; this activity ideally is carried out continually during one semester. To measure the students’ development, appropriate instrument should be developed. Unfortunately, because of limited time, this ideal thing can not be implemented.

From this short time-lesson study, there are not many things which can be concluded. Nevertheless, lecturers involved in the team has gotten good experience that with collaboration, they got broader knowledge about PBL, how to choose appropriate problem, how to choose questions for discussion’s guide, and get information about students’ problems in problem-solving ability and know who needs help. All lecturers realize about the importance of collaborating with other lecturers in order to increase students’ problem-solving ability through PBL.

References


