Improving student learning activities in microbiology through lesson study activities

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Abstract. Lesson study is an educator development program through collaborative and continuous learning based on the principles of collegiality. Lesson study can be implemented at various levels of education from primary schools to universities. The 4 cycles-lesson study presented here is aimed to improve students’ learning activities in microbiology subject in the Biology Education Department, Universitas Muhammadiyah Bengkulu. Students who engaged in this activity as much as 28 students. The lesson study activities were conducted in three stages: plan (plan), implementation (do) and reflection (see). Selected topics in this activity were infection and viruses. In addition to those topics, a practical class for (1) preparation of microorganism culture media and its sterilization; and (2) the proliferation of fungi and bacteria was also accomplished. The results showed that there is an improvement in the students learning activity by conducting a lesson study program on a microbiology course. The obtained results prove that lesson study can improve lecturer professionalism. This improvement in lecturer professionalism then will have an impact on the effectiveness of learning activities and on improving the quality of education overall.

1. Introduction
Lesson study is a quality improvement program for learning that originally practiced in Japan as an effort to improve the quality of learning both in higher education and at school [1]. A lesson study is conducted to help the lecturers improve their skills in carrying out lecture activities. To overcome the weaknesses of the low quality of learning in tertiary institutions, especially in the Biology Education Study Program of FKIP Universitas Muhammadiya Bengkulu, alternative solutions must be sought. One of the ways is the need for experience sharing forum among lecturers to establish a learning community that is programmed through a professional coaching model for the lecturer known as lesson study.

In the lesson study activities, conducted collaborative and sustainable learning assessments based on the principles of collegiality and mutual learning to build the learning community [2]. Lesson Study is a vehicle for lecturers/teachers to develop their professionalism. The main principle of Lesson Study is the improvement in the quality of learning by learning from one's own experience and those of others in conducting learning activities [3]. Student performance in learning becomes the most important part of the learning process, the interaction between student-student, student-lecturer, student-instructional material, and student-environment, are matters of concern. Lesson studies follow the Plan-Do-See pattern. In the plan phase, the lecturer prepares a learning plan The preparation of the learning plan is usually carried out together with other lecturers (discussion plan). In the Do phase, the lecturer appointed as the model lecturer implements learning (open lesson) while others observing the learning process.
According to Myers, there is no literary evidence that shows the teacher usually observes other than lesson study activities in the learning process [4]. According to Ylonen and Norwich states that lesson study can improve learning outcomes in schools and the ability of teachers to teach [5].

After the open lesson, the see phase is conducted, as a reflection from the implementation of learning in the open lesson [6].

Direct learning observation in lesson study is very beneficial for lecturers and educators. The assessment of student development and learning outcomes is not enough to be seen from the test results sheets and lesson plans, but also needs to be seen directly in the learning process. Making direct observations in class during the learning process takes place, will be far more accurate and complete, even to the details even though it can be known. The use of video in the learning process can be done as a compliment and not as a substitute [7].

Microbiology course has 3 credits (2 credits theory, 1 practice credit) is one of the compulsory courses for all Biology Education students at University Muhammadiyah Bengkulu. In the learning process, microbiology courses need to improve learning methods so that students do not experience difficulties in the learning process. Based on the experience of microbiology lectures from the previous year, lecturers used the lecture learning method in collaboration with the use of LCD media (PowerPoint). This causes difficulties for students to understand the material. The characteristics of the objects studied in this microbiology course are very small and the majority cannot be observed directly. Commonly, the object being studied is about bacteria, algae, fungi, protozoa, and bacteria. The study of microorganisms is not only covered the size of microscopic objects but also related to aseptic techniques applied to the media to grow them. Therefore, it requires learning media that are different from other subjects.

The problems found in the learning process need to be addressed immediately to achieve optimal results. The quality of learning in Microbiology courses needs to be improved, one of the ways have taken is to carry out lesson study.

2. Methods
This research uses a qualitative design with a problem-based approach and case studies. The problem-based approach and case studies in this study require the researcher to be present in the middle of the research setting. Data collection techniques used in this research are observation and direct observation techniques. The data collected was then analyzed descriptive-qualitatively. The research was conducted at the Biology Education Study Program, Faculty of Teacher Training and Education, University of Muhammadiyah Bengkulu. The lesson study was carried out in the odd semester of 2013/2014 in Microbiology Course with selected learning materials, namely infection, and viruses. The practicum carried out in this lesson study are (1) Making microorganism breeding media and sterilization, (2) Propagation of fungi and bacteria. The learning model used in the learning process is problem-based learning (PBL) with variations in the media. The class in the implementation of the lesson study was Semester III C 2013/2014.

Lesson study activities were carried out in 4 cycles. The observer involved are 8 people and one person as a lecturer model in the Microbiology Subject group in the Expertise Group (KBK). The observation sheet of learning activities was aimed at 38 students taking Microbiology courses. Students were divided into 7 groups randomly. The lecture material was about infection and viruses. In the practicum that carried out in this lesson study are (1) Making microorganism breeding media and sterilization, (2) Propagation of fungi and bacteria. The learning model used in the learning process was problem-based learning (PBL) with variations in the media. The observation sheet of this learning activity is filled by the observer when learning takes place in cycles 1-4. The observation sheet of student learning activities consists of 7 indicators, namely 1) Visual activities: reading, paying attention to pictures, conducting experiments/demonstrations, 2) Oral activities: storytelling, question and answer, discussion, argumentation, etc. 3) Listening activities: listening to the teacher's explanation, friends, etc., 4) Drawing activities: drawing, making patterns, tables, etc. 5) Motor activities: conducting experiments, conducting demonstrations, assembling tools, etc. 6) Mental activities: responding, solving problems,
analyzing, making decisions, etc., and 7) Emotional activities: interested, brave, happy, etc. The rating scale consists of: Very Good (SB) = S (76-100%), Good (B) (51-75%), KB = Poor (26 - 50%) and TB = Not Good (0-25%). Data were analyzed by calculating the percentage of students in each of these indicators. At the end of the research, the observers and the lecturer model held a reflection, discussing the findings in the learning process based on the observations taken place.

3. Results and discussion
Before carrying out the lesson study cycles, the researchers made the observations. The results of observations were (1) identified problems found in the microbiology course at Biology Education Study Program; (2) formulated problems to find solutions and supporting data; (3) found and determined alternatives to improve the quality of learning in microbiology courses; (4) developed an action plan; (5) prepared instruments to observe the learning process.

The results obtained by carrying out lesson study through 1-4 cycles and the reflection in lectures of the Microbiology Course in the Biology Education Study Program as follows. This lesson study activity able to increase student learning activities in the Very Good (SB) category from Cycle 1 to 70.27% in the second cycle and in the Good category from cycle 1 to the second cycle 63.41%. In the 4th cycle, there was an increase in student learning activities in the Very Good category 47.61%, and the Good category 17.81%. For more details, you can see in the table below.

| NO | ACTIVITIES LEARNING | OPEN LESSON CYCLE |
|----|----------------------|-------------------|
|    |                      | I SB | II B | III KB | IV SB | IV B |
| 1  | Visual activities    | -    | 15   | 8      | 22    | -     | 12 | 24 | 1 |
| 2  | Oral activities      | -    | 8    | 5      | 20    | 5     | 12 | 23 | 4 | 15 | 16 | 4 |
| 3  | Listening activities | -    | 8    | -      | 11    | 18    | 1   | 5  | 32 | -  | 12 | 24 | 1 |
| 4  | Drawing activities   | -    | -    | -      | 3     | 8     | 2   | 4  | 15 | -  | 9  | 23 | 1 |
| 5  | Motor activities     | -    | -    | -      | -     | 8     | 1   | 18 | 16 | 4  | 16 | 16 | 1 |
| 6  | Mental activities    | -    | -    | -      | 3     | 23    | -   | 9  | 27 | 3  | 14 | 21 | - |
| 7  | Emotional activities | -    | 8    | 1      | 7     | 23    | 1   | 9  | 29 | 1  | 15 | 19 | 1 |

Table 1. Summary of student learning activity.

Description:
Guidelines Seeing Student Learning Activities:
1. Visual activities: reading, taking pictures, doing experiments / demonstrations
2. Oral activities: storytelling, question and answer, discussion, argument, etc.
3. Listening activities: listening to the teacher’s explanations, friends etc.
4. Drawing activities: drawing, making patterns, tables, etc.
5. Motor activities: conducting experiments, demonstrations, assembling tools, etc.
6. Mental activities: responding, solve problems, analyze, make decisions, etc.
7. Emotional activities: interested, brave, happy, etc.
*SB = Very Good (76-100%), B = Good (51-75%), KB = Less Good (26-50%), and TB = No Good (0-25%).

3.1. Cycle I
Table 1 above describes as follows. In the cycle I observer activities have not been so good at observing students who are learning, this can be seen from the small amount of data obtained, only a total of 43 Observation Sheet items can be observed by observers. This is perhaps the observer's not very well-
intentioned Observation Sheet and how to observe it. In the reflection discussion activity, it was explained again how to observe. From the Table it can be seen that the learning activities of new students are in the Good category of 15.3%, the Poor category is very few and the very good category has not yet appeared.

From the results of the reflection, we can get the following conclusions: (1) Group III, V, and VI have partly emerged their learning activities, which mostly appear are visual, oral, and listening activities in the good category, while other activities have not yet appeared in the learning process. (2) It is necessary to arrange student seating so students are free to discuss. (3) It takes effort to arouse students’ enthusiasm in learning.

3.2. Cycle 2
Table 1 above describes as follows. In the second cycle, observers have been doing very well observing students who are learning, this is evident from the amount of data obtained, overall 168 Observation Sheet items can be observed by observers. There is an increase in student learning activities in lectures, visible learning activities in the category Very Good overall there were 37 items (13.9%), and the Good category increased sharply by 122 items (45.84%). This is an indicator of an increase in student learning activities, especially visual, mental and emotional activities, while other activities are already in the good category.

From the reflection are obtained:
- The screening of the learning video would be better if accompanied by an explanation with its voice.
- The pictures in the MFI are unclear, it's good that the pictures are colored so that they are interesting.
- There are still many students who pay less attention when representatives of other groups are presenting the results of their discussion.
- Lecturers should not only focus too much attention on students who are presenting but also pay attention to other students.
- There must still be a further explanation for the answers given by students during class discussions.
- The material discussed should be the issue/problem of the analytical learner.

3.3. Cycle 3
Table 1 above describes as follows. In the open lesson III activity, the data obtained, overall there were 250 items, there was an increase in the 2nd open lesson activity. There was an increase in student learning activities in lectures, seen learning activities in the Very Good category increased from 37 items (13.9%) to 63 items (23.68%), and the Good category also increased from 122 items (45.84%) to 174 items (65.41%). Learning activities that are greatly improved are visual, oral, and listening, while other activities are also in the good category.

From the results of the reflection discussion the following matters were obtained:
- Time is not enough because practicum is too long, some students are not accustomed to analytical scales, discussions are active, and information is obtained through internet browsing.
- There is not enough time allocation, and interaction between groups seems active.
- Pouring water into the glass beaker looking at it from above, academic basic skills need to be considered, weighing needs to be improved again, and sources of browsing information from the internet look for a good blog.
- Overall students are already active in learning, analytical thinking already exists.
- The students grind the bean sprouts well, beat them up, filter them out and are not used to it, in the group, there are two more small groups, one grind the sprouts, the other fills in the worksheets. Toge has not been liquid yet, it has already been filtered, groups III and IV are accustomed to discussing issuing opinions.
• If practicum must consider the skills (skills) needed by students, use the correct tools.
• The process of filtering sprouts by students is an error in folding the filter paper, in filtering the pulp should not be entered into the filter results.
• The concept that is accompanied by practice will be better, if not accompanied by the concept with the practice of students' skills that are not intact, they should develop physical (psychomotor) and cognitive (cognitive) skills.
• Formulate the learning problem first and then formulate the problem solving skills.
• The practicum materials and tools should be instructed by students to determine them and formulate the practical steps.
• Assignments are given one week before lectures begin.

3.4. Cycle 4
From Table 1 above can be described as follows. In the fourth cycle activities, a total of 245 Observation Sheet items were able to be observed. The increase in student learning activities in lectures is getting better, this can be seen from the learning activities in the Very Good category which is increasing from 63 items (23.68%) to 93 items (34.96%) and Good categories 143 items (53.75%).

From the results of the reflection discussion the following matters were obtained:
• Discussions are better, more active, already good at expressing opinions without textbooks, only a few misidentifications.
• There are students who still less willing to argue but in general, there have been many changes for the better.
• Significantly significant changes have occurred in student learning activities even though some are inactive but not too passive.

4. Discussion
The implementation of lesson studies in microbiology subject is carried out in 4 cycles, each cycle through the stages of Planning (Plan), Implementation (Do), and Reflection (See). The initial stage is choosing the topic to be implemented in the open lesson. Selected topics are 1) Infection of microorganisms; 2) Virus; 3) Making agar media and sterilization, and 4) Observation of bacteria and fungi. Determination of the topic at the beginning of the lecture aims to provide basic provisions in learning the next topics. The reason for choosing topics in the implementation of lesson study is to overcome the weaknesses of students in learning topics that are difficult for lecturers to teach, current subjects, for example, the novelty of the aspects of content, technology, and learning approaches, and focusing attention to the most important basic things that affect other learning [7].

The first planning phase (plan) is carried out to plan the implementation of lectures including making LDM or LKM. LDM and LKM are made as a guide for students to carry out discussions so that students understand the lecture material. LDM is made in the form of open-ended questions to arouse students’ analytical skills and be more meaningful. The formation of groups needs to be done first after the first plan. One of the factors being considered is the ability or basic understanding of Microbiology of each student.

Innovations in the implementation phase (do) follow the learning scenario for each with a variety of learning methods. Topics 1 and 2 use the method of learning interactive lectures, discussions, and questions and answers. Topics 3 and 4 learning methods implemented are practicum discussion and question and answer. The variety of learning methods aims to improve the quality of lectures.

The methods used each have advantages and disadvantages. So that with variations in the method, the advantages of one method can cover the weaknesses of other methods. The lecture method is still used for the process of giving motivation by lecturers to students, summarizing important concepts learned to enable students to see more clearly the relationship between material with one another. The discussion method applied in which each group is assigned to discuss the material provided and is obliged to present the results of the discussion in the group. The question and answer method are applied so that the class becomes livelier and more active, allowing students to ask questions so that the lecturer
knows things that are not understood by students, and communication and interaction that occur is not only one way.

The results of reflection on open lesson 1 show that most students have appeared their learning activities, which mostly appear are visual, aural, and listening activities in the good category, while other activities have not yet appeared in the learning process. The need for student seating arrangements so that students are more open in discussion and there is an effort in the form of motivation to arouse students’ enthusiasm in learning.

The implementation of the 2nd open lesson shows several obstacles, namely (1) the learning media uses the screening of learning videos that are less able to be understood by students. Therefore, it would be nice if using video media coupled with an explanation with his voice. (2) The pictures in MFIs that are less clear, should be colored so that the images are interesting. The concept (content) must meet the criteria of accurate (correct), grouped according to logical sections, Topics according with the syllabus, including all the information needed, related to the material/concept before and in a series, using resources available and easily obtained by students, motivating students to learn, fostering systematic thinking in students, using examples following circumstances. (3) There are still many students who pay less attention when the representatives of other groups are presenting the results of their discussion, so the lecturer needs to designate one of the names of the other groups to refocus student attention on the discussion material.

The implementation of the 3rd open lesson, witnessed by Mr. Sumar Hendayana, P.hD [2]. In this activity, it was still found obstacles, especially the very limited time allocation used for the practicum, the students' basic motor skills when reading the scale on the test tube and the analytical scales slightly affected the outcome of the specified media object. But this does not affect the ability of students to discuss and solve problems in LKM. Most students tend to actively ask questions to deepen the concepts they receive during the practicum. Motivation and ability to analyze problems that are directly related to the stages of practicum also appear to be increasing.

The implementation of the fourth open lesson did not experience many obstacles, especially time. Students have a better discussion, more active, able to express opinions without reading the textbook, only a few errors in the identification of bacteria. On the other hand, there are still students who are not brave enough to argue. In general, the learning process has changed a lot for the better. Changes were seen significantly, student learning activities increased. This is indicated by the results of observations of the number of students heading to SB assessment standards reaching 93%. Lesson study can improve student concepts and understanding that is broader than the topic of learning [8]. Lesson study also improves the teacher's ability to teach [9]. The achievement of these values is in accordance with the statement by Rakhmawati et al., that learning is said to be successful and quality if all or at least 75% of students (students) are actively involved [7]. This involvement both physically, mentally and socially in learning. It also shows high learning activities, great enthusiasm, and self-confidence. While in terms of results, the learning process is said to be successful and quality if there is a positive behavior change in the students themselves or at least 75%. Lesson study is an evidence-based learning approach to teaching, so lesson study can improve student learning outcomes [10].

5. Conclusion

The implementation of the Lesson Study in the Microbiology Course in the Biology Education Study Program FKIP University of Muhammadiyah Bengkulu is as follows:

- The Lecturer Team (Model Lecturer and Observer) has been able and understand how to design lectures based on Lesson Study.
- The Lecturer Team can become an Observer and a Model Lecturer.
- An increase in student learning activities, especially visual, oral, and listening activities in lectures.
- The ability of student learning activities in both categories in the visual indicator from cycle 1 to cycle 4 increased from 5.63% to 9.02% an increase of 3.33%, oral activity from 3.0% to 6.0%
an increase 3%, listening activity from 3% to 9% an increase of 6%, Drawing from 3% to 8.64% an increase of 5.64%, and emotional learning activities from 3% to 7.43% an increase of 4.19%.

- The ability of student learning activities in general in both categories increased from 14.3% to 65.41%.

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