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Lesson Study in Astrophysics to Improve the Quality of Learning

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ABSTRACT
This study aimed at describing the quality of astrophysics teaching and learning during the implementation of lesson study, including the students' activity and the impact of the lesson for improvement in students' learning outcome. The type of research was case study with descriptive qualitative analysis. The study was done in 3 cycles of Plan, Do and See. The subject was 3 lecturers in science education study program and the 4th semester students of Science Education Study Program Universities Education Ganesha. The data about learning activities and learning outcome was gathered during the learning process which is assessed from the observation sheet, interview and written questionnaire. Also, the students' learning outcome was gathered from the written test. The results showed that the lesson study was conducted in good category and the students' learning activity can be classified as active.

Keywords: *Astrophysics, Lesson Study, Learning Activity, Learning Achievement*

1. INTRODUCTION

Recently, a number of innovative methods had been applied by the lecturers who teach the astrophysics course. However, according to the data, the students' learning outcome was still lacking. It can be seen from the number of students who achieve grade A on the course in 2018/2019 was only 15% (SIAK Undiksha, 2019). Hence, it is necessary to reveal the factors that prohibit the optimum result of students. This is in line with the research results on reff [1] whereas the implementation of the collaborative ranking-task model could improve the students' concept mastery of the Earth and Space Science starting from the 'low' category to 'sufficient' category .
The preliminaries studies found that most of the classes in astrophysics was done through direct teaching with one-way communication pattern direction from lecturer to the students. The course evaluation was not done intensively and the result of the test was not returned to the students. Hence, the students barely got feedbacks to establish their conceptual understanding. Also, the problems used in the teaching and learning were not related to daily life. The worksheet to support the students in learning was rarely used. It leads to the meaningful lessons full of remembering formulas and facts which contribute to the students' lack of motivation and participation in the classroom. Most of the students confirmed that they learn most not in the classroom, but from the after-class discussion with their classmates.
Reflect from the aforementioned problems, there is an urgency to improve the quality of teaching and learning astrophysics. To support the process, the Science Education Study Program conduct a lesson study which is enabling lecturers to build a team work to plan, implement and evaluate the learning process. Lesson study continues teachers' professional development approach which carried out collaboratively in constructing the lesson plan, implementing the lesson plan, observing the lesson, and reporting the experience [2]. Lesson study is an activity that can be used to encourage consistent and systematic learning community aiming at self-improvement [3]. It is a comprehensive approach that aiming to making use the life-long learning principles in order to improve the quality of teaching and learning. In the implementation of lesson study, the lecturer will facilitate the students to actively engage in the classroom activities.

The success of the implementation of lesson study had been proved by a number of previous studies. that lesson study is able to improve the teacher's professionalism and enhance the students' learning achievement [4]. According to Lewis (2002), lesson study has a number of strength points since lecturer has a chance to: (1) formulate the short-term and long-term goals of the series of lesson, design the lesson collaboratively, (3) observe the lesson in team, (4) discuss the findings during the learning process and use the important information to improve the quality of the lesson, and (5) implement the revised learning program in other classroom and do the cycle again [5].
Considering the benefits of lesson study, in this study we employed it to improve the activity and learning outcome of science education students in learning astrophysics. This paper will describe the quality of the astrophysics teaching and learning during the lesson study and how the students' activity was improved. This study benefits the students since they learn how to work in group and see the implementation of astrophysics in real life. For the lecturers, this study motivates them to develop other learning strategies innovatively and willing to establish an open, reflective and positive culture in receiving feedback.

2. METHODOLOGY

In this research we employed a case study method. Case study is an in-depth and intensive study of a symptom, organization, or institution. The analysis used in this research is qualitative description. The study was conducted for 2 months from June to July 2020.
The subject of this research is the team of science education lecturers and a class consist of 18 students. The location of the study was in a state university in Bali, Indonesia. The number of research subjects are 3 physics lecturers and 1 (one) student class consisting of 18 people. The subject was chosen using purposive sampling. The consideration of choosing subject is the lecturer who selected as the model and the class that was taught by the lecturer. The data about the quality of lesson study showed by students' activities, learning outcome and responses toward the lesson; was gathered from the test, questionnaire, observation and interview. After that, the analysis was done qualitatively using descriptive method. The step-by-step activity of the study can be seen in the following Figure 1.

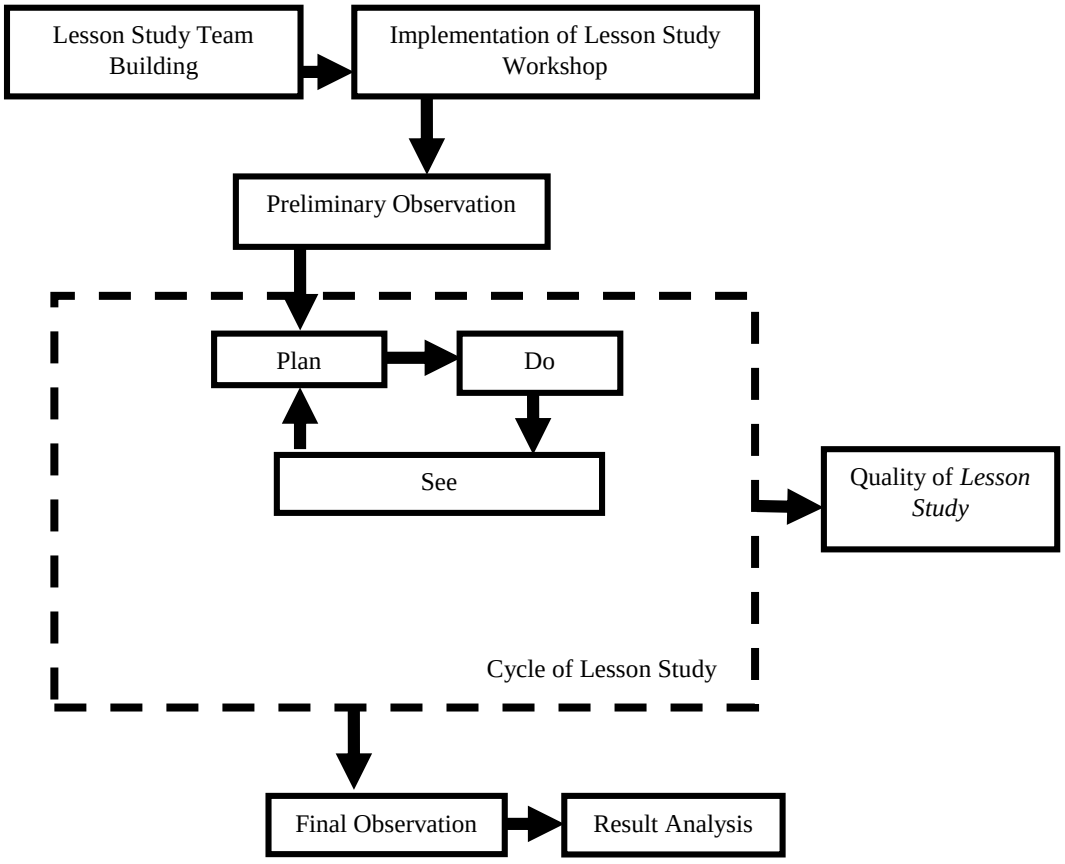

Figure 1. Scheme of Lesson Study

3. RESULTS AND DISCUSSION

3.1 Result

In general, this section describes the quality of lesson study implementation at the stage of the plan, do and see by presenting the data about students' activity and learning outcome before and after the implementation of lesson study.

3.1.1 The Quality of Lesson Study

The lesson study in astrophysics was done in science education study program. The first meeting was done on June 1, 2020. The agenda of the meeting was to discuss the topic of the learning, further meeting schedules, create the observation sheet and guideline, prepare the presence form and minutes the important findings and also formulate the questionnaire to gain the students' responses. The result of this meeting become the foundation for the implementation of the lesson study.

The lesson study was conducting in three cycles and the implementation was done in every Friday of June 12, 19 and 26, 2020. The last cycle is called Open Lesson in which we invited the lecturers outside the lesson study team to participate in the Plan, Do, See.

3.1.2 Implementation of Lesson Study in Plan Stage

From the observation, it was found that the Plan stage run well. It can be seen from the convention among the team member to determine the model of lecturer, collaborative design of lesson plan and the agreement of the schedule for the implementation meeting. In the first Plan stage, we also agreed that we will involve only one class in 3 cycles. Even though all participants actively involved in the discussion, there were some obstacles in designing the lesson plan since not all team members were fully understood the main goals of the study and there were no draft of design to be discussed. It makes the process of designing the lesson plan was started from scratch.

In Cycle 2, the Plan stage was improved since the draft of lesson study was prepared before the meeting. It enables the team member to focus on commenting for the improvement. In Cycle 3, the Plan stage run well and all team member participate actively to discuss the Open Lesson.

3.1.3 Implementation of Lesson Study in Do Stage

In Do stage, the designed lesson plan was implemented. The lesson was done virtually using Google Meet and Google Classroom. The model lecturer acted as the teacher while other lesson study members acted as the observers. The observers were observing the learning process especially the interaction among lecturer and students; and among students. The observers were not allowed to interrupt nor to intervene the lesson. The task of the observers was to collect the data, not to help the students in learning.

Based on the observation, it can be seen that the Do stage run well. It can be seen from several indicators, including: (1) the attendance of the lesson study team, (2) the lesson was in line with the design, (3) the materials were in accordance to the learning indicators, (4) the lecturer was able to guide the lesson according the learning indicators, (5) the lecturer was able to deliver the materials properly, (6), the lesson was bridging the text, context and reality, (7) the lesson was connecting facts, principles, concepts and procedures related to the topic, (8) the discussions were multi-direction, (9) all students were actively engage in the lesson, (10) the learning environments were fun, (11) all learning indicators were achieved and (12) the observer did not interrupt the lesson and have no contact among them during the lesson.

Even though the lesson run well, it still has some weakness since there were difficulties in observing the students in depth due to online-setting classroom and it also impacted the students' interaction. Also, the students required more guidance in solving the worksheet.

3.1.4 Implementation of Lesson Study in See Stage

The third stage of Lesson Study was See which is reflective stage. Here, all of the lesson study team was discussing their findings during the Do Stage. The chair of the discussion was a moderator chosen from the lesson study member. During Open Lesson, more people were involved such as the lesson study team, head of the department and the administrative staff of Faculty of Mathematics and Natural Sciences.

In the beginning of reflection stage, the moderator introduced all of the participants of the event. After that, the lecturer model was presenting the experiences of conducting the class in lesson study. It was followed by the observation results of each observers. After that, there were a discussion about the findings, including the strength points and weakness or difficulties encountered during the implementation. In the end of the discussion, the suggestions from the observers were gathered and concluded as the notes to improve the next lesson.

In general, the See stages were performing well. It can be seen from the findings during the observation that: (1) all of the lesson study members was introduced properly by the moderator, (2) the lecturer model had the chance to reflect the lesson first, (3) the observers' comments were based on the fact that happen during the lesson, (4) all observers had chances to provide feedback, (5) observers

provided more positive feedback, (6) the observers' comments were followed by proposed solution, (7) the reflective stages were not dominated by one person, (8) the observers' comments were focused on the students' learning activity, (9) the lecturer model had the chance to reply or react towards the comments, and (10) all of the comments were written by a minutes taker.

3.1.5 Quality of the Lesson Study

The effectiveness of the lesson study was observed using the observation guidelines consisting of 42 items of statement distributed in Plan (11 indicators), Do (17 indicators) and See (14 indicators) stages. In general, the observers gave positive responses at each stage of the implementation of lesson study as can be seen in Table 1.

Table 1. The Average Score of Each Cycle in Lesson Study

Cycle	Result	
	Score	Category
Plan	90,9	Very Good
Do	80,88	Good
See	88,6	Very Good

Table 1 showed the lesson study was running well. Stages of plan and see at the lesson study, showed very good qualification and stage Do showed good qualification. This means, the lesson study was conducted in good category.

3.1.5 Affectivity of the Implementation of Lesson Study towards Students' Activity

In this study, the indicators used to determine the learning activities of the students were: (1) the enthusiasm of students in following the lesson, (2) students' interaction with lecturer, (3) students' interaction in group, (4) interaction of students between groups, and (5) students' activity in classroom discussion. All activities are observed during lectures. The learning activity scores obtained at each meeting as can be seen in the following Table 2.

According to Table 2, it can be seen that the average score of students' learning activity in Cycle I was 11.8, in Cycle II was 12.0 and in Cycle III was 12.4. In all cycles, the category was considered as active and it was improved from time to time.

3.2 Discussion

In general the quality of the implementation of the lesson study was good. It means, the lecturers are able to implement collaborative learning innovations. This can be seen from the seriousness of lecturers to implement the stages of lesson study and how well they receive feedback and support their fellow's development. By the implementation of lesson study, the lecturers maintain better relationship in the work place. It was happened since lesson study provide chance for the lecturers to share opinions and work collaboratively to solve a problem.

The implementation of lesson study in this study was in line with the definition of lesson study as model of professional development through collaborative learning and sustainable learning based on the principles of collegiality and mutual learning to build the learning community with general aim to improve the quality of learning [6]-[9].

In the Plan (goal-setting and planning) stage, the lecturers are complementing each other to identify the goals of the lesson, determine the learning indicators, scopes and the flow of the lesson, choose the learning media and model. This stage helps the lecturers to improve their professional competences. that the development of lesson plan during lesson study can be used as a teacher professionalism program [10].

Table 2. Score of Students' Activity in Each Cycle of Lesson Study

Scores	Cycle I		Cycle II		Cycle III	
	f	(%)	f	(%)	f	(%)
12.51 – 15.01	3	16.7	5	27.8	8	44.4
10.84 – 12.50	15	83.3	12	66.6	9	50.0
9.17 – 10.83	0	0	1	5.6	1	5.6
7.50 – 9.16	0	0	0	0	0	0
4.99 – 7.49	0	0	0	0	0	0
Total	18	100	18	100	18	100
M	11.8		12.0		12.4	
SD	5.02		0.86		0.86	
Category	Active		Active		Active	

In Do (lesson implementation) stage, the lecturer who appointed as the model were teaching the class according to the lesson plan. Here, the lecturer's professionalism was highly impacted by the mastery of content and their performance. The lecturer was trying the best to deliver the lesson contextually and integrally. It makes the lesson run well and effective. where the development of the learning process using lesson study can be used as a program to increase teacher professionalism [11].

In See (reflection) stage, the lesson study members discussed and analyzed the findings during teaching implementation. This step was important to improve the professionalism in every aspects of teaching including mastery of materials, structures, concepts and perspective of the astrophysics. the improvement of teaching's quality helps the students to understand the content better [12]. Therefore, it enhances the students' activity and learning outcome.

That the implementation of lesson study contributes to positive impact towards the improvement of teacher's competences [13],[14]. It happened due to the characteristics of lesson study in which the teachers are able to discuss the preparation, implementation and evaluation of the lesson. Therefore, the teachers can choose the best method and learning materials that support the students in learning effectively. also found that the lesson study provides an opportunity for teachers to reflect their lesson and it enables them to improve it [15].

4. CONCLUSION

According to the results and discussion it can be concluded that: (1) lesson study was running smoothly and can be categorized as "good" according to the indicators of implementation and (2) the students actively participated in the lesson. Therefore, it can be inferred that lesson study can improve the quality of astrophysics teaching and learning.

There are two recommendation based on the findings of the study. First, the head of Science Education study program and the head of Physics and Science Education department should encourage the faculty members to improve their performances, facilitate the competencies' development and provide learning facilities that enable lecturers in employing various learning models in accordance with the learning materials characteristics and students' needs. Second, the faculty members who plan for conducting lesson study should prepare for alternative if there is technical issues during the implementation by creating a details guideline and the standard operational procedure.

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