



## Development of Integrated Science Learning through Lesson Studies Using A Problem-Based Learning Model

Getrudis Kerans<sup>✉1</sup>, and Khristoforus Palli Ngongo<sup>2</sup>

<sup>1</sup>Lecture, Science Education Study Program, STKIP Weetebula, Southwest Sumba.

<sup>2</sup>Lecture, Primary School Teacher Education Study Program, STKIP Weetebula, Southwest Sumba.

✉ [getrudiskerans@yahoo.com](mailto:getrudiskerans@yahoo.com)

**Abstract:** Science teachers at secondary schools are required to have interdisciplinary competence to apply the integrated concept in teaching science. This is a challenge for science teachers, and not to mention the fact that many science teachers at secondary schools graduated from Physical Education, Chemistry and Biology. This study aim: 1) to obtain an integrated science learning model based on the most appropriate problems through lesson study, to improve students' scientific work. 2) to determine the effectiveness of the integrated science learning model by using the Problem Based Learning model in improving scientific work skills and students' activity. The research strategy used in this study is Education Research and Development. This study is qualitative research and the data analysis technique used in this research is descriptively to analyze the development of science learning and the results of student activity observations. The result of the study shows that 1) through lesson study, science teachers can share experiences and exchange ideas for solutions to various problems that are often faced in their respective schools and collectively compile lesson plans. 2) The application of the learning process planned through lesson studies with using the Problem Based Learning model improves students' scientific work skills and activeness. The conclusion of this study is the development of learning through lesson studies using a problem-based learning model can improve students' scientific work skills and activeness.

**Keywords:** Development, Integrated Science, Lesson Study, Problem Based Learning.

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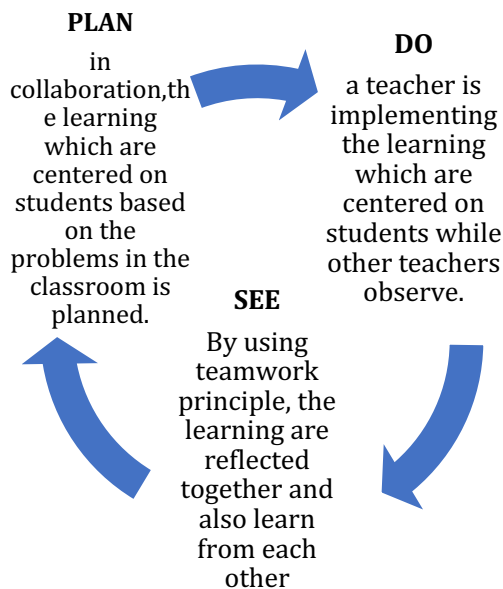
### INTRODUCTION

In the 2013 Curriculum Development Guidelines (*Pedoman Pengembangan Kurikulum 2013*), science learning in junior high school is based on integration. This requires science teachers at the secondary school level to have interdisciplinary skills. Science teachers must be able to combine science matters such as Biology, Physics, and Chemistry to teach integrated into science subjects. In integrated science learning, several obstacles are often encountered, including the inability of teachers to teach integrated science which is caused by the teachers are graduated from only one major (Biology, Chemistry, and Physics) study program. Based on Table 1, we can see that the science teachers in 18 junior high schools in Southwest Sumba are graduated from Biology Education, Physics Education, and Chemistry Education study programs. This becomes a challenge for the teachers because they have to teach integrated science concepts while they do not have

expertise in this integration. To overcome these problems, the steps that can be chosen are through lesson study.

Lesson study was first developed in Japan and has become a well-known model as an effort to improve the quality of education through improving the quality of learning. Lesson Study becomes a model to develop the educational profession through collaborative and sustainable learning based on the principles of collaboration and mutual learning to build a learning community (Hendayana, 2006). Lesson study is a learning improvement approach that was originally developed in Japan (Stepanek, 2003). Lesson study is an activity carried out by teachers which are done by working together and plan activities to improve the quality of learning and will make teachers professional with good implementation designs (Rahayu et al, 2012). The three main parts of the lesson study are 1) the identification of the research theme; 2) the implementation of several research lessons

that will explore the research theme; and 3) a reflection of the process of implementing the lesson study. Lesson Study has three stages, namely preparation (plan), implementation (do), and reflection (see). Teachers who collaborate in the preparation of a learning implementation plan can exchange ideas to find solutions to the problems.



**Figure 1.** Preparation of A Learning Implementation

On the Plan Stage, a collaborative process of group teachers aims to identify a learning problem and design a learning scenario. On Do Stage, the teachers provide the learning process to students according to the scenario that has been prepared. This stage is carried out by one teacher, while the others observe, then at the See stage, the teachers carry out reflection activities and then evaluate and revise the learning scenario. The next stage, which may not be carried out immediately in the same class and school, but can be done in another class or school is to re-teach the revised learning scenario, re-evaluate the learning and share the results with other teachers (Stepanek, 2003).

Lesson Study is a way for teachers to exchange ideas in developing lesson plans, especially in integrated science subjects. Sudrajat (2008) suggests that Lesson Study is an effort to improve the learning process and results developed collaboratively and continuously compiled by teachers. In his

research, Rustono (2007) states that the Lesson Study which is applied to the student as teacher candidates shows an increasing students' ability to apply learning strategies. In addition to these steps, teachers must consider the methods or models which are applied in the integrated science learning process so that students can understand what is being taught by the teacher.

Integrated learning is an approach used in a teaching and learning process where the process will involve some knowledge from several fields of study to provide meaningful experiences for the students. Integrated learning makes students understand the concepts to be learned through direct observation and connecting with other concepts they understand easier. Integrated learning always links a particular subject or theme with other subjects through a scientific work process so that it becomes meaningful.

Integrated science learning currently implemented in Indonesia for junior high school students is a science learning process which is a package of the lesson including biology, physic, and chemistry lesson and those are mutually supportive knowledge. To be able to teach science in an integrated way, teachers must be able to package the learning process using an appropriate model so that it becomes meaningful and meet the expected goals. Problem-based learning by John Dewey is an alternative that can be used in the integrated science learning process.

Problem Based Learning is a method of learning which is marked by the existence of real problems, a real-world problem as a context for students to learn critical and problem-solving skills and gain knowledge (Punaji, 2006). Problem Based Learning encourages teachers to involve students in various oriented problems projects and help them investigate a problem. Graaff and Anette (2003) state that Problem Based Learning has main two characteristics which are 1) learning must be student-centered 2) there is a group (the teacher acts as a facilitator who helps students organize problems). Problem Based Learning is related to various educational theories

including constructivism, meta-cognitive, and contextual learning.

Based on the description above, research on the development of integrated science learning through lesson study was carried out using the Problem Based Learning model. The objectives of this study are 1) to develop integrated science learning through lesson study using the problem-based learning model. 2) to obtain an integrated science learning model with appropriate problem-based lessons through lesson study, that can help to improve students' scientific work and activity. 3) to find out the effectiveness of the integrated science learning model collaborated with the problem-based learning model in improving scientific work skills and student activity.

## METHOD

The type of research used is Educational Research and Development. It is done by developing integrated science learning through a Lesson Study approach with the Problem Based Learning model. Lesson Study is done by junior high school science teachers in *Loura* District and *Kota Tambolaka*.

### 1. Preparation Stage

In the preparation stage, observation is done to see the problems. Based on the problems found, the researcher tries to compile a research proposal that will then be submitted and uploaded to the Ministry of Research, Technology, and Higher Education. This stage was carried out by the research team.

### 2. Implementation Stage

The implementation stage is divided into 2 stages, namely the Pre-Development stage and the Development stage. The pre-development stage is carried out with a process of preparation and the Development Stage is Conducted in 3 stages of the process to get a product in the form of a Learning Implementation Plan (*RPP*) with the PBL Model. The stages of the process follow 3 steps in the Lesson Study, namely 1) Plan 2) Do, and 3) See.

**In the first stage (Plan)** the teachers state the problems faced in integrated science learning. Next, the teacher works together to look for solutions and compile a lesson plan (*RPP*) using the Problem-based learning model. The finished *RPP* is then reviewed and checked again. Besides making the lesson plans, the teachers' team also compiled student activity observation sheets during the learning process. At this stage, the researcher acts as a guide and companion.

**In the second stage (Do)**, the lesson plans that have been designed are then applied to a class in one of the partner schools. The school teacher serves as a teacher, then other teachers are expected to attend as observers. At this stage, the researcher acts as an observer.

**In the third stage (See)**, after doing the learning process, the students are given a final test. The test results and observation sheets will be analyzed. The data analysis technique used in this research is descriptive analysis. It aims to analyze the development of science learning and the results of student activity observations. The results of the data analysis are used as material for discussion and reflection which are then used as evaluation materials to correct lacks in implementation through the improvement of the lesson plans.

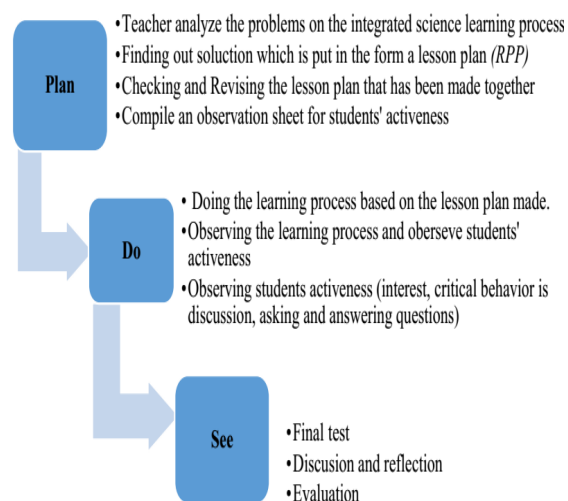


Figure 2. Diagram of the steps of research

## RESULTS AND DISCUSSION

Lesson study consists of three phases which are collectively referred to as "plan-do-see".



**The planning stage** begins with an analysis of the problems in integrated science learning by science teachers. The science teachers who present then revealed the various problems faced during the integrated science learning process in their respective schools, the problems happen because of 1) the educational background of the teachers who are specific program teachers. Therefore, it is difficult for teachers to implement integrated science learning 2) students often are not active in the learning process 3) students 'critical thinking skills and scientific work are very low 4) students' attention during the learning process is still lacking. From the results of this problem analysis, the teachers discussed to find a solution which then produces learning tools consisting of integrated *science* lesson plans using the Problem Based Learning (PBL) model. The integrated *science* lesson plan produced by three groups of integrated science teachers consists of three different sub-materials, namely Movement and Style (*Gerak dan Gaya*) with a time allocation of 60 minutes, Frames and Joints (*Rangka dan Sendi*) with a time allocation of 60 minutes and Business and Simple Plane (*Usaha dan Pesawat Sederhana*) with a time allocation of 60 minutes. The agreed time allocation is an allocation of time that is adjusted to three schools that have been decided as schools that will conduct trials on the lesson plans that have been designed. This time allocation has been adjusted due to the COVID-19 situation. The lesson plans produced by each group are presented and receive input and suggestions from other group members. Inputs and suggestions will be used as material for reflection in each group to improve the previously prepared lesson plans. The final result of this stage is a lesson plan which is ready to be tested.

**At the implementation stage (do)**, a classroom learning process is done using the lesson plans that have been compiled together at the planning stage. The implementation of the learning process will be carried out in three schools, namely *SMPK St. Paulus Karuni*, *SMPN 1 Tambolaka City*, and *SMPK St. Josef Fredementz*. In the learning process, the teachers follow each step of the Problem Based Learning model according to the lesson plan scenario which is prepared through Lesson Study. to ensure its implementation, the research team makes observations in these schools during the learning process. Observations will be made by the research team with two points being observed which are 1) Observing the implementation of learning with the PBL Model and 2) Observing the Student Activities. The result of this stage is that all teachers who do the trials apply to learn with the PBL model according to the agreed stages and the PBL model learning steps are based on the results of the teacher's reflections that affect student activity. This can be seen from the results of student activity observations where students observe the initial problems presented by the teacher, then the teacher discusses these problems and conveys the results of the discussion well. In this process, there are still some weaknesses where students had not given opportunities for other students to ask questions about the materials that they have not understood from the results of their presentations. However, questions will be asked by the teachers. The summary results of the reflection on the implementation of each lesson plan at each school can be seen in table 1.

**Table 1.** Summary of Results Reflections on the implementation of the lesson plan

Lesson Plan 1	Lesson Plan 2	Lesson Plan 3
Movement and Style ( <i>Gerak dan Gaya</i> ) Frames and Joints ( <i>Rangka dan Sendi</i> )	Frames and Joints ( <i>Rangka dan Sendi</i> )	Business and Simple Plane ( <i>Usaha dan Pesawat Sederhana</i> )
1. Learning process according to the allocation of time	1. The learning process exceeds the specified time allocation.	1. The learning process exceeds the specified time allocation.





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|---|---|--|
| 2. 80% of students observe the problems given by the teacher well.                            | 2. 80% of students observe the problems given by the teacher well.                      | 2. 100% of students observe the problems given by the teacher well.                      |
| 3. 80% of students answer students' questions well  | 3. 80% of students answer students' questions well.                                     | 3. 80% of students answer students' questions well                                       |
| 4. 100% of students are involved when working on the worksheets in groups and thoroughly.     | 4. 80% of students are involved when working on the worksheets in groups and thoroughly | 4. 100% of students are involved when working on the worksheets in groups and thoroughly |
| 5. 100% of student work presented is correct and as what has been expected                    | 5. 80% of student work presented is correct and according to expectations.              | 5. 80% of student work presented is correct and according to expectations                |
| 6. Students are responsible for their group work.   | 6. Some students are still indifferent and irresponsible when doing group assignments.  | 6. Students are responsible for their group work.  |
| 7. Several students in the active group ask the teacher about the worksheets they were doing. | 7. Evaluation is in the form of individual assignments.                                 | 7. Some students actively ask questions when they experience difficulties.               |
| 8. Evaluation is in the form of individual assignments.                                       | 8. 80% of students do the assignment properly and correctly.                            | 8. Evaluation is in the form of individual assignments.                                  |
| 9. 80% of students do their assignments properly and correctly.                               |   | 9. 100% of students do the assignment properly and correctly.                            |

**In the Reflection stage (see)**, a reflection process is carried out by providing reflection sheets to the teachers and the summary results of the teachers' reflections on this activity can be seen in table 2.

**Table 2.** Summary of Reflection Results of Science Teachers

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| <ol style="list-style-type: none"> <li>1. Lesson study activity is really helpful for the integrated science teacher in developing integrated science learning.</li> <li>2. Lesson study activity is helpful for the teacher who has a specific lesson background study to develop integrated science together and discuss many ideas to be a good input for the teachers.</li> <li>3. Lesson study activity should be done in the beginning of the semester and invite more teacher to enrich them with knowledge and ideas in order to develop the integrated science lesson. Model PBL sangat membantu guru untuk membuat kelas menjadi lebih hidup dan siswa lebih aktif</li> <li>4. By using the PBL model as what has been designed together, students'</li> </ol> |
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activeness is increased.
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Lesson Study activities aim to improve teacher professionalism through a process of improving both teaching methods, learning steps to select the right model for a taught theme. This activity is also considered to be very effective for teachers with scientific backgrounds to share knowledge about the best steps to implement science learning which is carried out in an integrated manner. The lesson study involved science teachers in *Tambolaka City* and *Loura* district as well as a research team who then work together to produce a common goal. The lesson study begins with a presentation by the research team to explain what, why, and how the science learning development process through lesson study will be implemented. In a further implementation, lesson study then produces learning tools in the form of a lesson plan.

The lesson plans compiled by the teacher through lesson study are effective in their application in the learning process because they are compiled by the teachers together by first analyzing the problems that teachers



often face. Through lesson study, teachers can add insight and share ideas about the best steps in increasing student activity in the learning process. Yumiko and Johanna (2010) in their research have shown an increase in the knowledge of teachers involved in lesson study. Rahayu, et al. (2012) also explained that lesson study can help teachers to develop a set of learning tools and provide better and meaningful learning.

The learning tools that are arranged are the results of the analysis of science teachers according to their experiences they face during the teaching and learning process in class. The preparation of the lesson plan then uses a PBL learning model that is deemed appropriate to increase student activity. PBL is applied to raise contextual problems, meaning that the problems raised in each lesson plan that are compiled are problems that students often encounter in everyday life. This is necessary so that the learning process becomes more meaningful for students.

Increased student activity in implementing lesson plans compiled through lesson study using the PBL model shows that the PBL model is effective in increasing student activity. The use of the PBL model in integrated science learning can create learning conditions that are student-centered activity. Therefore, students can construct their knowledge and can integrate the lessons learned at school in their daily life. A learning process that begins with the provision of a problem and the process of looking for answers in learning can help the student remember the material being studied easier. Therefore, students can understand the material better (Phee, 2002).

Problem Based Learning is a learning method that is based on problems which are used as a learning stimulus for students. Problems must be taken from real events that often occur in real life around students to make the students understand and interest in the materials (Desi et al., 2014). The advantages of Problem Based Learning are as follows: 1) Realistic with students' life, 2) the concept is based on student needs, 3)

Foster the nature of student inquiry, 4) Strong concept retention, 5) cultivating problem-solving abilities. This is in line with what the teachers do in this study wherein the preparation of lesson plans through lesson study, the teachers presented problems according to what students often encounter in everyday life. For example, it is about the situation that happens when pushing a table compared to when we push a wall or with the problem do you know why we can stand tall. The problems or problems raised according to what is often encountered by students make students more active and become the right knowledge for them because they answer students' daily problems.

Rustono (2007) in his research entitled *Improving Students' Ability to Implement Learning Strategies through Lesson Study in Elementary Schools* explains that lesson study is a collaborative and cooperative teacher coaching model that can be used as a teaching guidance model for lecturers to students. To become a professional teacher, understanding teaching academics is not enough. It requires experience in the form of guided practice activities. Through Lesson Study activities, students carry out learning practices that do not only involve lecturers but the elementary school. Students gain knowledge and experience in planning and implementing innovative learning. Students also get immediate feedback on reflection activities. In his research, Rustono (2007) presents several recommendations that can be used as reflection material for researchers, including:

1. Preparation must be well-prepared, especially regarding the description of the learning process, this can be done through simulation first
2. The coordination and role of primary school teachers must be improved.
3. Learning objectives must be clearly stated in advance and repeated in the learning process.
4. The teacher must reinforce students who answer and ask questions.
5. Worksheets should be distributed first and then the teacher provides an explanation



6. The teacher must repeat the explanation, especially in making conclusions so that students understand better.
7. Teachers should pay attention to the planned time and always convey the target time to students so that the students can work effectively.
8. Observers should observe outside the classroom because they often affect learning.

Another study conducted by Rahayu, et al. (2012) regarding the Development of Integrated Science Learning using the problem-based learning model through Lesson Study also found that the use of the problem-based learning model through lesson study can help teachers to develop a set of learning tools and provide better learning. In this study, there was also an increase in the results of observations on each test and the student's average score from the first to the third test. Scientific activities carried out on the problem-based model can help students to understand the science material provided by the teacher, and they can get a detailed understanding. Rahayu revealed that lesson studies that are done by junior high school science teachers and a team of experts helped teachers improve their abilities in preparing lesson plans, worksheets, evaluation tools, teaching materials, and the ability to deliver material in class. The results of the lesson study team's observations during the trial process in class helped the teacher to improve the learning tools that had been prepared. Learning tools support the ability of teachers to create effective learning so that students can learn in a scientific learning atmosphere and can understand the material well, therefore scientific abilities and learning achievement can be improved.

Maria (2010) in her research entitled Investigating How and What Prospective Teachers Learn Through Microteaching Lesson Study found that microteaching through lesson study is very important learning for prospective teachers where they can discuss then plan and practice based on the results of joint planning and get input, both from discussion members and experts (in this case lecturers) enrich their

knowledge and skills. Laurel and Ann (2006) also researched Efficacy: Stories from Two School-Based Math Lesson Study Groups found that planning and implementing the learning process done in lesson study had a positive impact on increasing student involvement in the learning process unconsciously.

Yumiko and Johanna (2010) in their research on *A Case Study of Continuing Teacher Professional Development Through Lesson Study in South Africa* explained that teachers who are involved in the lesson study process show an increase in their knowledge through the learning process. In their research also, Yumiko and Yohanna explained to get the sustainability and success of lesson study in the learning process several important points must be considered, including 1) the involvement of the principal and other stakeholders besides the teacher 2) in the professional development process, everyone who involved must be able to spend their time despite their own regular working time 3) empowering teachers with more math and science skills to become coordinators for other teachers 4) providing opportunities for teachers to be able to share in the process of implementing learning in class.

Based on interviews with several teachers in Japan, Caterine (2004) suggests that lesson study is very effective for teachers because it provides benefits and opportunities for teachers to:

1. Think more carefully about the objectives of the certain material that will be taught to students;
2. Think deeply about the learning objectives by considering students' future. For example, about the importance of a friendship, the development of students' perspectives and ways of thinking, as well as students' fondness for science;
3. Assessing the best things that can be used in the learning process by learning from other teachers (participants of Lesson Study);
4. Learn about the content or subject matter from other teachers so that they can



- increase knowledge about what should be given to students;
5. Develop skills in teaching, both when planning lessons and during learning activities;
  6. Build abilities through collegial learning, in the sense that teachers can learn from each other or if they make mistakes related to their knowledge and skills in teaching students;
  7. Develop "The Eyes to See Students" which is done by presenting the observers. The observation of student learning behavior can be more detailed and clearer.

Problem Based Learning was developed by Howard Borrow at Mc Master University in 1960. According to Borrow in Yuyum et al. 2019, PBL has two main characteristics, which are 1) learning must be student-centered; 2) there is a group (the teacher acts as a facilitator who helps students organize problems). PBL is related to various educational theories including constructivism theory, meta-cognitive, and contextual learning.

Selcuk (2010) states that PBL is a learning model that develops students' critical thinking skills and problem-solving abilities as well as develops students' understanding of the concepts needed to solve their life problems.

In his research, Selcuk (2010) reports that the application of PBL can increase students' interest in learning Physics. Huang's research (2005) states that 89.4% of students are more satisfied and more interactive in learning using the PBL learning model. Magdalena, et al., (2014) revealed that PBL has five syntaxes which are 1) student orientation towards problems; 2) organizing students to study; 3) guiding individual/group experiences; 4) developing and presenting the work, and 5) analyzing and evaluating problem-solving.

Problem-based learning also provides opportunities for students to conduct experiments related to the problems presented. This activity encourages students to be involved in the learning process, such as observing macro processes that occur and writing down the results of observations

correctly. Furthermore, students are also trained to work together and discuss with fellow group members to decide the result of observations and conclusions from the problems given. Related to this, students are required to be more creative and have the competence to connect the observed macro processes with the fundamental concepts so that the students can analyze and solve problems.

Another study conducted by Noordin (2011) stated that PBL provides opportunities for students to work together and solve problems that are given better. Putri et al, (2015) stated that the practicum method provides opportunities for students to experience/do it themselves, observe, analyze the objects, conditions, and processes that are being studied. Therefore, students are more involved in the learning process. Observations show that students are very interested in practicum activities. students also actively ask questions about their work and the results of their observations. Brilian and Triesninda (2015) in their research on *The Application of PBL to Improve Critical Thinking Skills and Problem-Solving Skills* found that critical thinking skills in cycle I were 79.42% and cycle II was 82.29%, it means the increase was 2.87%. While the solving problems skills in cycle 1 was 84.99% and in cycle two was 86.86%, the increase was 3.87%. Therefore, from this study, it can be concluded that the problem-based learning model could improve critical thinking skills and problem-solving skills in organizational behavior courses.

Desi, et al. (2014) researched *Improving Mathematical Problem-Solving Abilities Through the Application of PBL for Fifth Grade Elementary School Students*. This study succeeded in showing that the application of Problem Based Learning can improve the problem-solving ability of fraction counting operations. It can be seen from the results that show an increase in the class had an average score from 62.87 in the pre-cycle to 74.96 in cycle 1 and 84.43 in cycle 2. The number of students who completed the learning increased from 9 students (39%) in the pre-cycle to 17 students (74%) in cycle 1 and 20 students (87%) students completed





in cycle 2. This research is considered successful because it achieved success indicators. There are 85% of students complete their studies with a *KKM*  $\geq$  65.

Yunin and Wardan also researched the application of PBL to improve critical skills and student learning outcomes. This research found out that a) the application of the PBL model in learning repair material and PC resetting could improve students' critical thinking skills in learning. There are 24.2% students; (b) Students' critical thinking skills are increased after the application of PBL, there are 20 students (69%) with very high critical thinking skills, 7 students (24.2%) are in the high category, 2 students (6.9%) are on low category and 0 students (0%) is on the very low category, (c) the application of PBL can improve student learning outcomes by 31.03%.; and (d) Students' learning outcomes increased after the application of PBL. The number of students who reach *KKM* is 29 students (100 %). The conclusion of this study shows that the application of PBL can improve critical skills and student learning outcomes.

### CONCLUSION

Lesson study helps science teachers analyze science learning problems, plan, design, and evaluate the results of integrated science learning together. Development of Integrated Science learning through lesson study can help increase the knowledge of science teachers in the Integrated Science learning process. Integrated science learning using the Problem Based Learning model is effective in increasing student activity.

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