

Lesson Study Approach to Improve Skills Students' Critical Thinking in Heat Subjects

Marnita*, M. Tauifiq, Nanda Safarati, Asmaul Wardah

Department of Physics, FKIP of Universitas Almuslim, Bireuen - Indonesia

*Corresponding author email: marnita.fkip@gmail.com

ABSTRACT. Science, one of which is physics, is a subject that is always encountered in everyday life. Learning science should be able to provide direct experience for students to develop competencies and potential that exist in students, especially high-level thinking skills such as critical thinking skills. High-level thinking potential of high school students can be developed through a learning approach such as the Lesson study approach. This research is a study conducted on the first year high school students in odd semester of the 2019/2020 academic year using a qualitative descriptive method. The data in this study were obtained through research instruments in the form of item questions on students' critical thinking skills, teacher and student activity observation sheets, and teacher response questionnaires to learning collaboration with lesson study (LS). The results of research that have been conducted indicate that there is an increase in students' critical thinking skills after being taught using the lesson study approach. This can be seen from the significant difference in the results of the one-to-one test. So, it can be concluded that physics learning through lesson study can improve students' critical thinking skills in mechanics courses.

Keywords: Critical thinking skills, Heat, Lesson Study.

1. INTRODUCTION

Human nature is to study and to learn. Education can last a lifetime. Indonesia guarantees the right of every citizen to get a formal education with the legality of it is a diploma. Science is one that is often discussed for students and teachers from early childhood to college. Science includes physics, which is a collection of knowledge that contains many natural phenomena in everyday life, but most ordinary people do not realize it is part of science or physics. Science does not only consist of a collection of knowledge that is isolated from one another, but is a collection of knowledge that is systematically organized. This requires a teacher to be able to package and organize physics learning for students properly and attractively so that students will be motivated and have a strong sense of curiosity about the uniqueness of physics and can be used to face challenges in the era of globalization [1]. The ability to organize students properly in finding a physics concept will minimize the students' habit of thinking that physics is a very complex and unattractive subject to study and investigate, such a teacher's expertise is not only demanded when students are in high school or college, but also this needs to be mastered by a teacher since students are introduced to physics subject for the first time [10].

The learning process of physics requires strong mental activity so that the process of investigation, the process of remembering, the

process of naming or labeling a finding, or the process of solving problems in the investigation will be realized. However, this will not just appear out of the blue, if it is accompanied by the expertise of the teacher in carrying out the learning process in class and outside the classroom. One of the causes of low science mastery is due to the lack of maximum cognitive abilities of students, for example a lack of mental activity to name, symbolize, remember or show attitudes towards problem solving [8,1]. This is the effect of a teacher-centered learning process, where teachers solely dominate the delivery of products, so that students are less trained to develop their own thinking power [6]. In a learning activity, it will be difficult to get students to be active in mental activities if learning is still dominated by the teacher or the use of less than optimal learning strategies by the teacher [2]. Based on this opinion, the teacher or educator should be able to explore students' thinking skills through appropriate teaching patterns. Students' higher order thinking skills are basically owned by students, but inappropriate teaching patterns will drown their thinking abilities. This is because learning is a process that emphasizes providing direct experience to develop the competence and potential of students to understand the natural surroundings through a scientific process. Direct experience will be able to generate higher order thinking skills, one of which is students' critical thinking skills. One of the

competencies of students at college level is the ability to think at a higher level, which is the ability to think is a talent that must be developed in accordance with the nature of science learning [9,23]. As stated by [4], there are two main abilities in thinking skills, namely basic abilities and integrity abilities. Thinking skills are the systematic thinking of students to draw conclusions after first compiling, investigating, and considering their opinions or findings [1,15,24,2,5,]. Furthermore, [11], said that thinking skills, especially critical thinking skills, can be trained through various relevant teaching activities such as inductive and deductive reasoning, analyzing or synthesizing an idea or input. In a teaching- learning process, it is very necessary to develop critical thinking skills, because critical thinking skills will make it easier for students to understand concepts, understand how to solve problems and be able to apply concepts in everyday life [24]. Critical thinking skills can be explored by exploring students on environmental issues which will be able to foster enthusiasm for learning, both independently and collaboratively and be able to foster student creativity [5,7]. Critical thinking skills are one of the higher order thinking skills that must be developed in the era of modern life, so that students will be directed to get used to solving practical problems in the future [15, 12]. Furthermore, [15] states that the indicators or aspects of critical thinking skills are 1) *Interpretation*, 2) *Analyzing*, 3) *Explanatory*, 4) *Evaluation*, 5) *Concluding*, 6) *Self-Regulation*.

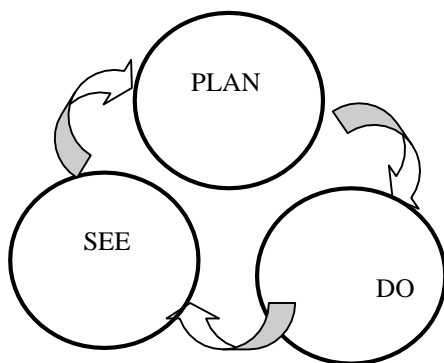
Critical thinking skills that will be explored in this study is by using the Lesson Study (LS) approach. Lesson study (LS) is one of the learning management improvement programs that prioritizes activity and collaboration. Through lesson study a teacher can find out the weaknesses during the learning process, and can fix them through observer information, the teacher can also lure students to be active in the learning group [17]. In addition, through the Lesson Study (LS) approach, a teacher can observe students' scientific activities carefully with the help of an observer. According to [20] argued that "student activity is a real symptom that appears in students and can be observed and can be measured by observers of education, in this case the most involved is the teaching teacher". Therefore, lesson study (LS) is very appropriate if used as a solution in physics subjects. Lesson study (LS) is also a solution to create student activity in building students' thinking. This is in line with the constructivist understanding expressed by [14]

which says that "active student involvement in solving problems will give birth to quality learning, so that the development of students' cognitive abilities will be easier to emerge".

Furthermore [18], said that Lesson study (LS) is applied as a student guidance model for prospective teachers which aims to train the professionalism of prospective teacher students while working as a teacher. Thus it can be said that lesson study (LS) can be a model of professional teaching by means of collaborative and continuous learning studies, based on the principles of collaboration that help each other in learning to build a learning community. The principle of collaborative, sustainability, study groups or learning communities, this collaboration can then be developed by the teacher in the learning process for students. Various problems faced by teachers in teaching have resulted in the low thinking ability of some students, making the practice of lesson study (LS) the right solution, because the main characteristic of lesson study (LS) is *Batton-Up*. Lesson study (LS) is one solution to improve the quality or learning activity of students. In the open lesson study teachers will carry out the overall open lesson activities collaboratively and continuously by a group of teams or teachers [13,22]. Thus, it can be said that in lesson study (LS), the cohesiveness of a team of pursuers is needed for the realization of learning objectives.

Furthermore [13,22], revealed that lesson study (LS) is a model that can train teacher professionalism from a series of activities that can improve the quality of learning carried out by teachers and student activities. The lesson study (LS) approach has three main stages, namely *Plan*, *Do*, and *See* [16] explain these three stages, namely the first part is the identification of research themes, the second part is the implementation of a number of research lessons that will explore the research theme, the third part is a reflection of the process of implementing lesson study (LS).

Plan, *Do* and *See* are three stages which are interrelated with each other. The following can describe the three main components in the lesson study (LS) approach that is applied to SMA Negeri 1 Peusangan students in Physics subject matter temperature and heat. The pictures are as follows:



A piece of writing must, of course, have a direction of goals and targets to be achieved. The lesson study (LS) approach used by the author is packaged into a study with the following problem formulations:

- How to improve students' critical thinking skills through the application of the Lesson study (LS) approach to temperature and heat learning materials
- How are the activities of teachers and students in applying the Lesson Study (LS) approach to temperature and heat learning materials.
- How does the physics subject respond to the implementation of the lesson study (LS) approach on temperature and heat material

Furthermore, the objectives of this study are:

- To determine the improvement of students' critical thinking skills through the application of the Lesson study (LS) approach to the temperature and heat learning material
- To find out the activities of teachers and students in the application of the Lesson Study (LS) approach to temperature and heat learning materials.
- To find out the response of the physics subject teacher to the implementation of the lesson study (LS) approach on temperature and heat learning material.

2. METHOD

This research was conducted in collaboration with one of the physics teachers at SMA N 1 Peusangan. The research site is SMA N 1 Peusangan, Bireuen Regency, which lasted from the end of August 2019 to the end of September 2019. Next, the subjects of this activity were class I.1 students of SMA N 1 Peusangan, Bireuen Regency. The number of students who became the research sample was 20 students. For the direction of the research carried out, the authors determine several

factors to be examined, namely students' critical thinking skills which are measured using the items of critical thinking skills, teacher and student activities measured using an activity questionnaire, and the response of the physics teacher at SMA N 1 Peusangan. This research was conducted through several stages, namely planning, implementing, acting, observing and reflecting. This research took place in two cycles with four meetings, each cycle consisting of two meetings or face to face. Furthermore, the data that has been obtained is processed using several equations, namely:

- Calculating the increase in students' critical thinking skills, analyzed using a percentage, namely:

$$P = \frac{f}{N} \times 100 \quad [10] \quad (1)$$

P = Percentage number

f = the frequency of student activity that appears N = Total activity count

The criteria for the success rate of the action determine the following 75% < NR ≤ 100% : Very Good

50% < NR ≤ 75% : Good

25% < NR ≤ 50% : Enough

0% < NR ≤ 25% : Poor

- Calculating the activities of teachers and students and calculating the responses of the physics teacher at SMA N 1 Peusangan were analyzed using percentages, namely:

$$P = \frac{f}{N} \times 100 \quad [10] \quad (2)$$

3. RESULTS AND DISCUSSIONS

This research has been carried out in collaboration with the lecturers of the Al Muslim university education study program with physics teachers at SMA N.1 Peusangan, which is one of the items of the MoU between the study program and formal institutions that use graduates of the Muslim university physics education study program. Furthermore, the implementation of classroom learning is carried out with the lesson study (LS) approach. This research activity will produce a product of student abilities in the form of critical thinking skills and the response of the physics teacher at SMA N 1 Peusangan. Through the approach of Lesson study (LS) which has the stages of plan, do, and see, it is hoped that it will have a good impact on the critical thinking skills of students at SMA N 1 Peusangan, Bireuen Regency, Aceh. The implementation of the teaching and learning process using the lesson study (LS) approach is carried out with several face-to-face

meetings which are divided into two cycles (each cycle consisting of 2 meetings).

3.1 Analysis of Cycle I and II

3.1.1 Plan

Before this stage by stage began, at first the researchers sat down with fellow physics teachers from SMAN.1 Peusangan, Bireuen Regency, Aceh. This meeting is intended to discuss the class that will be the subject in the implementation of this research. Furthermore, the research team determined the material to be discussed and planned the amount of face-to-face class with students.

Furthermore, at the planning stage, the researcher who acts as a model teacher makes plans with the teacher team to prepare the necessary learning tools in the form of lesson plans, worksheets, preliminary test items and learning media. The initial test items were designed to get input for the team about students' critical thinking skills on heat material. After the device has been prepared, the researcher then continues planning to determine the date and time of the implementation or the first open lesson.

3.1.2 Do

The Do stage is the open lesson stage using all the learning tools that have been prepared. At this stage, it involved 2 observers consisting of 3 lecturers from the physics education study program and 1 class I.1 physics teacher. The task of this observer is to observe student activity in each group and observe teacher activity. Furthermore, the research team, gave 40 minutes for students to answer the pretest questions that had been prepared. This question aims to determine students' critical thinking skills before the first open lesson takes place. The giving of pretest questions was only done at the first meeting. After the pretest was carried out, the authors started the first agreed-upon open lesson activities. All students present are directed to be able to solve the problems raised by the teacher at the beginning of the lesson. Students are trained to use their thinking skills to find the concept of understanding "heat temperature (meeting 1)" and "expansion (meeting 2)" in the first cycle. Furthermore, the concept of "heat capacity (meeting 3)" and "how to transfer heat" (meeting 4) in the second cycle (two face-to-face meetings).

Researchers' directions to students at each meeting to solve problems and to find out for themselves the concepts being taught had an impact

on the high enthusiasm of students in learning. This can be seen from the members of each group who try hard to complete the student worksheets (LKS) on time and even faster. For groups that can finish faster and correctly, the research teacher gives rewards in the form of mentos and applause. This is one of the tricks that makes students very enthusiastic and feels absorbed in the ongoing learning activities. Learning activities like this were carried out by researchers in two cycles with 4 face to face times. Each meeting session, the researcher provides lesson plans, worksheets, and different learning media according to the material presented. Furthermore, after the meeting at the second meeting ended, the researcher asked students to attend the next day and take the post-test as data for researchers to determine the increase in students' critical thinking skills. The following week, after going through the see stage (reflecting) the researcher continued the second cycle, namely the 3rd and 4th meetings. The nextpost test was given after 4th meeting ended.

3.1.3 See

The see stage is carried out by the researcher and the appointed observer. This activity is carried out outside the classroom. The entire research team who acted as teachers and observers studied and reflected on what weaknesses the observers encountered during the first conducted open lesson. Weaknesses and strengths are used as patterns for researchers to prepare for the next open lesson activity. In the first open lesson (cycle I), observers found weaknesses in learning, it seemed that most students were not confident in the presence of 3 observers in their study room. The observer also found one sentence of instruction on the student worksheet (LKS) that the students could not understand. This insecurity causes students to be unable to explore their abilities so that researchers must repeatedly provoke the courage of students to explore freely in their groups to be able to solve problems and find concepts according to the guidelines in student worksheets (LKS).

Furthermore, in the second cycle (meetings 3 and 4), the research team found that students' self-confidence looked better, even though it was not optimal. In the open lesson activities in the second cycle, observers found that one student did not arrive on time, so that group activities were a little disturbed. However, in terms of time and material mastery, students have shown excellent mental activity in the learning process. The learning process that took place at this second meeting was very good, the level of student care and activity was very high.

3.2 Analysis of Students' Critical Thinking Skills

As previously explained, this research is a collaboration between lecturers of the physics education program Almuslim University with physics teachers at SMA N 1 Bireuen by applying the lesson study (LS) approach. In essence, the implementation of lesson study (LS) activities is more bottom-up, collaborative, sustainable, and mutual learning. Therefore, the lesson study (LS) approach can be a smart solution to improve students' higher thinking skills. One of these high-level abilities is critical thinking skills. Researchers or teachers find many different things in the teaching and learning process that takes place in the classroom with the Lesson Study (LS) approach, the main thing that is most amazing is the ability of the research team to arouse students' mental activity as a whole so that the teacher is able to generate and improve students' critical thinking skills. At the first meeting, it showed that there were several weaknesses from both teachers and students, but these weaknesses were collectively able to be overcome by the researcher.

At the second meeting, the researcher, observed by 3 observers, was able to mobilize students to be able to find the concept being discussed, then analyze and explore their ideas through activities in the learning group that had been formed. Then the teacher asks representatives of each group to post and present their findings in front of the class. At that time a tough discussion

will form between one group and another. At the end of the presentation, the research team consisting of teachers and lecturers gave a report to the group that was able to complete the worksheets more quickly and correctly.

Some of the routine activities from cycles 1 and 2 then have an impact on being able to develop and improve students' critical thinking skills. This can be seen from the emergence of all the students' critical thinking indicators during the worksheets completion and discussions. In addition, the results of data processing showed that 89% of students were able to complete pretest items in the form of critical thinking skills items properly and correctly. The results of data processing have also shown an increase in the activity of teachers and lecturers who teach using the lesson study approach as well as an increase in student activity during the teaching and learning process. The enthusiasm of students at work has shown an increase in the activities of lecturers / teachers and students. The indicators of critical thinking skills that have been observed in this study are 1) Interpretation, 2). Analyzing, 3). Explanatory, 4) Evaluation, 5) Concluding, 6) Self-Regulation.

The general description of the results of research on improving students' critical thinking skills, lecturer activities, and student activities through the Lesson Study (LS) approach in physics subjects for class I SMAN. 1 Peusangan are as follows:

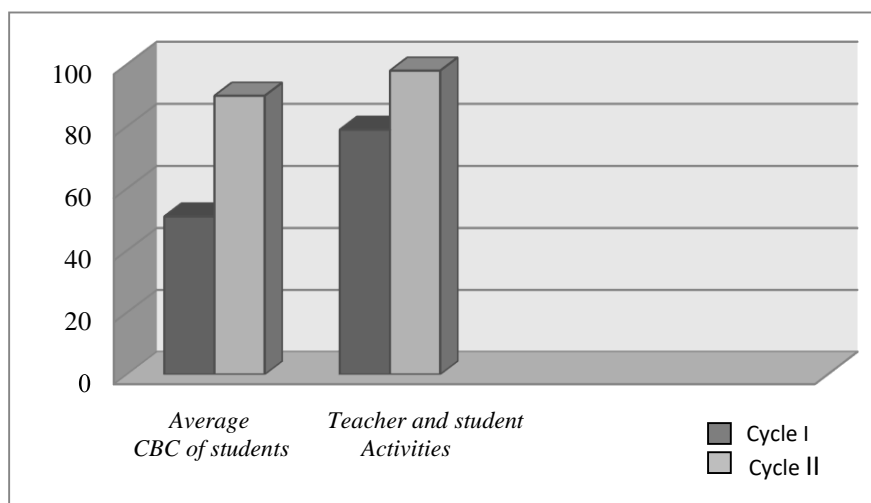


FIGURE 1. Overview of Research Results

From Figure 1, it can be seen that the average acquisition of creative thinking skills (CBC) of

students at the first meeting was 51.04 and the second meeting was 89.91. Lecturer activity at

cycle 1 was 79%, the second meeting was 98%. The data in the figure shows in general an increase in students' critical thinking skills through learning activities with the lesson study (LS) approach in Physics subjects at SMA N.1 Peusangan Bireuen Aceh.

As a tangible result of the research that has been carried out, the researchers also conducted an analysis of each indicator of students' critical thinking skills. This analysis is intended to make it clear that there is a change in learning outcomes, especially students' critical thinking skills in a

better direction. This is also done by the author by considering that students are essentially part of the compulsory student body and must be able to use high-level thinking, one of which is critical thinking skills. This ability is expected to support their professionalism when they become graduates and be able to make them alumni who are ready to compete in an increasingly modern world. The following is a picture presentation that will provide an overview of the improvement of students' critical thinking skills in each indicator.

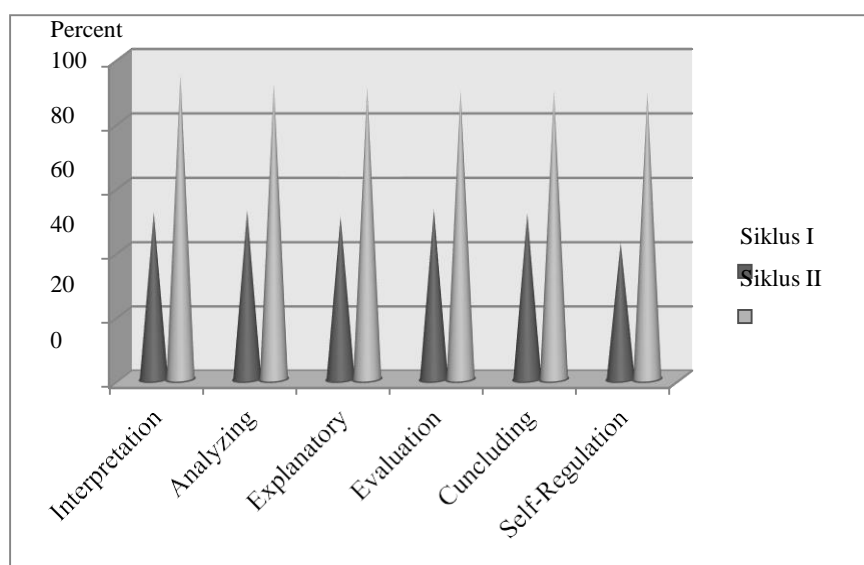


FIGURE 2. Analysis of Students' Critical Thinking Skill Indicators

Based on Figure 2, it is clear that the comparison of the percentage of students who are able to complete the indicators of critical thinking skills (interpretation, analyzing, explanatory, evaluation, concluding, and self-regulation) from cycle one and cycle two. Thus we can say that the learning that occurs with the Lesson Study approach has significantly improved the critical thinking skills of SMA N 1 Peusangan students. This shows that the physics teaching and learning process which only emphasizes the aspects of mastery of concepts and is more teacher centre learning, is not effective to be applied. In the application of the lesson study approach has changed student learning patterns, namely by involving students actively in scientific investigations designed by the teacher has been able to have an impact on students to find their own physics concepts that are being discussed.

The improvement of students' critical thinking

skills at SMA N.1 Peusangan is strongly supported by the application of the Lesson Study approach at the student learning stage. At this stage the teacher has prepared everything perfectly at the plan stage. Furthermore, when carrying out the do stage students are first faced with the process of building or compiling new knowledge, then they are directed to find the basic concepts of temperature and heat. The learning activity was continued, with the teacher acting as a guide for students so that from the findings they could analyze and explore their ideas through questions and resolved in their groups. Furthermore, the lecturer together with the teacher, who is the research group, conducts reflection activities on all events, teacher and student activities that have been passed. And the final stage the teacher gives an assessment and appreciation of the teaching and learning process that has been taking place. The existence of treatment in learning activities that have been

conceptualized by the teacher step by step in implementing this lesson study approach, it turns out to be able to make a big contribution to the improvement of students' critical thinking skills, this is because students are first faced with problems that can build new knowledge and can explore skills critical thinking. These findings are in accordance with what was expressed by [5], namely learning carried out on a problem-based basis is very supportive of developing student creativity, arousing student curiosity so that they will try to carry out investigative activities and think to find solutions to the problems posed.

Thus, the lesson study approach greatly contributes to the success of learning in the classroom, such as being able to improve students' critical thinking skills. This is supported by the results of previous research conducted by [17], which found that "Lesson studies have a very big influence on the development of TPACK (Technological Pedagogical Content Knowledge), because model teachers get valuable experience from teachers who have wider experience". Furthermore, the results of research by [3] found that "lesson studies are able to encourage prospective physics teachers to foster student participation through inquiry or discovery activities. Lesson studies are also able to construct and build new and better learning in the classroom based on reflections from the model teacher and the observer team".

3.3 Analysis of lecturer and students activities

The success described in point B shows that

the points in the teacher's and student's activities during the learning process to catch up have gone well. Although there were several weaknesses at the beginning of the implementation of lesson study, especially at the first and second meetings, these weaknesses did not cause the percentage of teacher and student activity to decrease. The success of lesson study in increasing the activities of teachers and students is in line with research conducted by [21] who found that "(1) Lesson studies can develop pedagogic knowledge of mathematics teachers in several lesson study cycles starting from planning activities, do, and see, (2) the features developed in the open lesson activities can improve the quality of learning in each cycle".

Furthermore, the results of teacher and student activity in this study were obtained based on the results of the analysis of the teacher and student activity questionnaire observed by three observers. The questionnaire had been designed beforehand by the teacher and before it was used, it was discussed at the plan stage with the entire research team, some of which acted as observers during the open lesson activities. The results of the analysis show that the average percentage acquisition of teacher and student activity in the first cycle is still in the poor category, namely 69.72%, while the average percentage acquisition in the second cycle has reached the very good category, namely 97.22%. The results of the overall recap of the analysis of teacher and student activities from meetings one to two through lesson study activities are presented in the following table:

TABLE 1. ANALYSIS OF LECTURER AND STUDENTS ACTIVITY DURING PBM

Learning Activities through Lesson Study Approach	Cycle I				Cycle II			
	SP	SM	%	Ket.	SP	SM	%	Ket.
Compiling new knowledge	8	12	66	Good	11	12	92	Very good
Discovery activities	6	12	50	Low	12	12	100	Very Good
Provoke students to analyse and to explore	12	75	33	Good	11	12	92	Very Good
Reflecting activity results in study group	4	12	33	Low	12	12	100	Very Good
Assessment	3	4	75	Good	4	4	100	Very Good
Appreciation	2	2	100	Very Good	2	2	100	Very Good
Percentage Average (%)			59,7					97,22

3.4 Response Analysis (Impact of PDS on Teachers in the Field of Physics Education)

The results of the analysis show that the collaboration between physics education program lecturers and physics teachers at SMA N 1 Peusangan has a very good impact on teachers. This can be seen from the response questionnaire distributed to teachers in the field of physics after the teaching and learning process lasted for two cycles with two meetings in each cycle. The response numbers that were distributed at this last meeting contained several main questions, namely "(1) Increase my insight and knowledge in improving the quality of learning; (2) Together with the lecturer, I produce learning tools that are better than those used before; (3) I am inspired and motivated by the lessons conducted by lecturers in schools to continue to improve the learning process in schools using the lesson study approach; (4) I acquire new knowledge in the form of expertise in preparing relevant learning media; (6) I am able to better build student interaction in learning. After analyzing the five questions, it showed that 98% of physics teachers gave very good responses, the physics teachers at SMA N 1 Peusangan said that the collaborative activities which were the implementation of the MoU between schools and study programs had a very good impact both on teacher knowledge, on the learning process in class, on mastery of learning material for students, and on increasing student interaction in learning.

4. CONCLUSION

With the description of the research results above, it can be concluded that (1) learning activities using the lesson study approach can improve the critical thinking skills of grade I students at SMA N.1 Peusangan. (2). Teacher and student activities have a good category. (3) the teacher's response to the application of the lesson study approach by collaborating with the lecturers was in the category of 98% expressed being happy and enthusiastic about the whole series of learning activities with the lesson study approach.

REFERENCES

- [1] Asysyifa, D.S., Jumadi, I Wilujeng, and H Kuswanto, "Analysis of Students Critical Thinking Skills Using Partial Credit Models (Pcm) In Physics Learning" in International Journal of Educational Research Review, Vol 4(2), 2019, pp 245-253.
- [2] Y Bustami, D. Syafruddin, and R Afriani, "The Implementation of Contextual Learning to Enhance Biology students' Critical Thinking Skills" in Jurnal Pendidikan Fisika Indonesia, Vol 7 (4), 2018, pp 451-457.
- [3] Conceicao, M Babbista, J.P. da Ponte, "Lesson Study As A Trigger For Preservice Physics And Chemistry Teachers' Learning About Inquiry Tasks And Classroom Communication" in Internasional Journal for Lesson and Learning studies, Vol 8(1), 2019, pp 79-96.
- [4] M. V. Chabalengula, F Mumba, and S Mbewe, "How Pre-service teachers' Understand and Perform Science Process Skill" in Eurasia Journal of Mathematics, science & technology Education, Vol 8(3), 2012, pp 167- 176.
- [5] S. Fatimah. Devoting To Enhance The Critical Thinking Skill And The Creativity Of Students In Seventh Grade Through PBL Model With Jas Approachment in Jurnal pendidikan IPA Indonesia, Vol 4(2), 2015: 149-157.
- [6] S. Hermawanto, et al., "Pengaruh Blended Learning terhadap Penguasaan Konsep dan Penalaran Fisika Peserta Didik Kelas X" in Jurnal Pendidikan Fisika Indonesia, Vol 9 (1), 2013, pp 67-76.
- [7] A.N. Khasanah, Sajidan, and S. Widoretno, "Effectiveness of Critical Thinking Indicator Based Module in Empowering Student's Learning Outcome in Respiratory System Study Material" in Jurnal Pendidikan IPA Indonesia, Vol 6(1), 2017, pp 187-195.
- [8] Khoiriah, T Jalmo, and Abdurrahman. "The Effect of Multimedia-Based Teaching Materials in Science Toward Students' Cognitive Improvement" in Jurnal Pendidikan IPA Indonesia, Vol 5(1), 2016, pp 75-82.
- [9] Marnita. "Peningkatan Keterampilan Proses Sains Melalui Pembelajaran Kontekstual Pada Mahasiswa Semester I Materi Dinamika" in Jurnal Pendidikan Fisika Indonesia, Vol 9 (1), 2013, pp 43-52.
- [10] Muh Makhrus, Hadiprayitno, and Gito. 2012. "Penerapan Perangkat Pembelajaran Fisika Berorientasi Pembelajaran IPA Terpadu Tipe Connected" in Jurnal Pendidikan dan Pengajaran. Vol 19 (2), 2012, pp 238-243.
- [11] F. Mohseni, Z. Seifoori, Z., and S. Ahangari, "The Impact Of Metacognitive Strategy Training And Critical Thinking Awareness-Raising On Reading Comprehension" in

- Cogent Education, 7(1), 2020, pp 1-22.
- [12] L. Mutakinati, & I. "Anwari, Analysis of Students Critical Thinking Skill of Middle School through STEM Education Project-Based Learning" in *Jurnal Pendidikan IPA Indonesia*, 7(1), 2018, pp 54–65
- [13] P.J. Mynott, "Lesson Study Outcome: A Theoretical Model" in *International Journal for Lesson and Learning Studies*, Vol 8(2), 2019, pp 117-134.
- [14] C. Paolucci and H. Wessels, "An Examination of Preservice Teachers' Capacity to Create Mathematical Modeling Problems for Children" in *Journal of Teacher Education*, Vol 68 (3), 2017, pp 330 –344.
- [15] B.K.B. Putra, B.A. Prayitno Maridi, "The Effectiveness of Guided Inquiry and Instad Towards Students' Critical Thinking Skills on Circulatory System Materials" in *Jurnal Pendidikan IPA Indonesia*, Vol 7(4), 2018, pp 476-482.
- [16] P. Rahayu, S.S., Mulyani, and Miswadi, "Pengembangan Pembelajaran IPA Terpadu dengan menggunakan Model Pembelajaran Base Melalui lesson Study" in *Jurnal pendidikan IPA Indonesia*, Vol 1(1), 2012, pp 63-70.
- [17] D. Rochintaniawati, R. Riandi, J. Kestianty, N. Kindy, Y. Rukayadi, "The analysis of Biology Teachers' Technological Pedagogical Content Knowledge Development Lesson study in West Java Indonesia" in *Jurnal Pendidikan IPA Indonesia*, Vol 8 (2), 2019, pp 201-210.
- [18] S. Saleznyov, "Lesson Study beyond Japan: Evaluating Impact" in *International Journal for Lesson and Learning studies*, Vol 8 (1), 2019, pp 2-18.
- [19] Sudijono. *Pengantar Statistik Pendidikan*. Jakarta: Rineka Cipta, 2005.
- [20] B. Subali, A. Sopyan, and Ellianawati. "Developing Local Wisdom Based Science Learning Design To Establish Positive Character In Elementary School" in *Jurnal Pendidikan Fisika Indonesia*, Vol 11 (1): 2015, pp 1-7.
- [21] A.N. Shuilleabhain, "Developing Mathematics Teachers' Pedagogical Content Knowledge In Lesson Study: Case Study Findings" in *International Journal for Lesson and Learning Studies*, 5(3): 2016212- 226.
- [22] S. Shingphachanh, "Exploring the impact of lesson study through the views of lao mathematics teacher educators on the needs, learning and difficulties" in *International Journal for Lesson and Learning studies*, Vol 8 (2), 2019, pp 98-116.
- [23] Wahyudi., N.N.S.P Verawati, S. Aiyup, and S. Prayogi, "Conceptual Framework of Inquiry-Creative-Process Learning Model to Promote Critical Thinking Skills of Physics Prospective Teacher" in *Jurnal Pendidikan Fisika Indonesia* 15 (1), 2019, pp 5-13.
- [24] S. Wardani, L. Lindawati, and S.B.W. Kusuma, "The Development Of Inquiry By Using Android- System-Based Chemistry Board Game To Improve Learning Outcome And Critical Thinking Ability" in *Jurnal Pendidikan IPA Indonesia*, Vol 6 (2), 2017, pp 196-205