UNIVERSITAS SEBELAS MARET
BIOEDUKASI: JURNAL PENDIDIKAN BIOLOGI
https://jurnal.uns.ac.id/bioedukasi
1693-265X (Print) | 2549-0605 (Online)

The Effect of Implementing Problem-Based Learning in Lesson Study on Students' Critical Thinking Skills

Melania Ernanda[1], Suharsono[2], Samuel Agus Triyanto[3] *

Biology Education, Faculty of Teacher training and Education, Universitas Siliwangi, Tasikmalaya-Indonesia
[1] melaniaernnd02@gmail.com; [2] suharsono2255@yahoo.com; [3] samuel.agus@unsil.ac.id
* Corresponding author: samuel.agus@unsil.ac.id

Submission : 25/05/2022

Revision : 19/07/2022

Accepted : 20/07/2022

ABSTRACT

This study aims to investigate the effect of implementing problem-based learning in lesson study on students' critical thinking skills, especially of the topic human respiratory system. The research method used is a true experiment with a posttest-only control design. The population in this study were students of class XI MIPA SMAN 1 Tasikmalaya which consisted of 8 classes with a total number of students was 273. The samples used in this study were 2 classes, class XI MIPA 8 an experimental class with 35 students, and class XI MIPA 7 a control class with 33 students. The sampling technique was carried out by cluster random sampling technique. Data collection techniques in the form of critical skills test a total of 15 things. The instrument is used to test critical thinking skills on the material of the human respiratory system. The data analysis technique was carried out by using a t-test. The results significance value is 0.023<0.05 can be said that there is an effect of problem-based learning models on students' critical thinking skills in the human respiratory system

This is an open-access article under the CC-BY-SA license

Keywords: Problem Based Learning, Lesson Study, Critical Thinking

Introduction

Each learning activity has learning objectives that must be achieved to obtain the predicate of successful learning, all parties involved in learning have a role in achieving this success. One of the roles played by educators is to be able to analyze the learning needs of students. Educators must able to be critical to analyze the learning needs of students in the classroom (Triyanto & Prabowo, 2020). The learning needs of students in the modern pedagogical era are indicated by student-centered learning activities. Learner-centered learning seeks to improve the learning system that emphasizes learning directly based on the needs of students (Prasetyo, 2021). Learner-centered learning activities encourage them to be proficient in facing the challenges of the 21st century.

Student-centered learning activities are the characteristics of learning in the 21st-century era. These characteristics aim to equip students to face increasingly complex life challenges and find solutions to the problems they face. Students in the 21st century are encouraged to be able to develop competencies to face the challenges of complex life. Competencies that must be developed by students in the 21st-century era include critical thinking, problem-solving, creative thinking, communication, and collaboration (World Economic Forum, 2015). Efforts to develop these competencies must be balanced by educators with personal expertise and improve the quality of learning by improving the teaching system and pedagogical competencies such as creating an active, innovative, and creative learning atmosphere. (Kono et al., 2016). The development of 21st-century competencies in students is one of the priorities of the educational program held at SMAN 1 Tasikmalaya. Learning created by educators includes seeking to develop 21st-century competencies, in biology subjects. One of the competencies development carried out at SMAN 1 Tasikmalaya is critical thinking.

Observation results show that biology learning is carried out using the Discovery Learning model. The use of the Discovery Learning model at the time of learning allows students to discover concepts and meanings on their own about the topics given by the educator. However, the use of the Discovery Learning model has problems including still having difficulty finding answers to questions given by educators, especially questions related to real problems in their environment, students receiving the latest information always receive it directly without thinking the information is true or not, and students in finding facts are less reinforced by other supporting reasons. These obstacles cause students to be unable to answer questions from educators which affects their low critical thinking. The problems above show that there is a need for the development of critical thinking in students (Rachmedita et al., 2017).

Educators feel worried about students because in biology learning students find it difficult with the usual learning model causes the level of critical thinking is still low. Several biology learning materials bring together students with problems. One of the biological materials that are considered difficult by students is the material of the human respiratory system.

The topic of the human respiratory system is the topic with the 1st most difficult rank in the Difficult to Understand category or material that is difficult to understand with a percentage of 54.5%(Fauzi & Mitalistiani, 2018). The topic for the respiratory system is material that discusses organs, functions, mechanisms, respiratory capacities, and diseases or disorders that occur in the human body. So on the material of the human respiratory system, students need a detailed explanation so that students can understand the material presented.

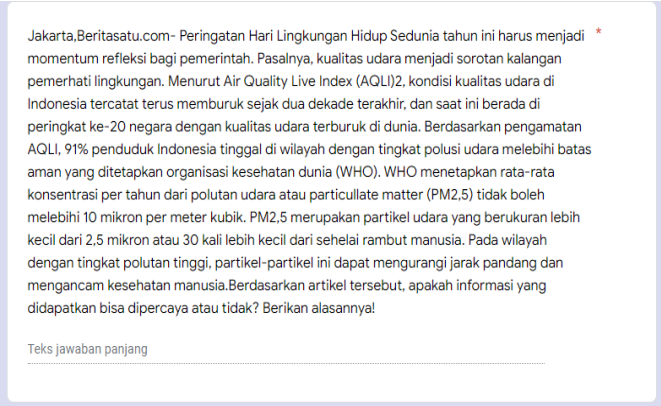
Improving students' critical thinking skills can be done with problem-based learning (Widodo, 2017). Problem-based learning provides opportunities for students to think critically and find solutions to problems that are relevant to everyday life. One of the learning models that can accommodate problems as a learning stimulus is Problem Based Learning PBL. The PBL model is a learning model that brings together students' authentic problems that are closely related to everyday life and helps students understand the learning material achieving

student learning goals. (Etherington, 2011; Nofziarni et al., 2019; Wood, 2003). Authentic problems are the strength of PBL which is used as a learning stimulus (Triyanto et al., 2016). The use of the PBL model to improve the quality of learning and the competence of educators needs to be studied on an ongoing basis. The lesson Study-based PBL model provides advantages in carrying out the learning process because the Lesson Study students can improve pedagogically and educators can improve the quality of learning that is carried out collaborative so that suggestions and recommendations from observers affect the course of the next learning process. Lesson study is a model for fostering the teaching profession through collaborative and sustainable learning assessments, based on peer-to-peer principles and mutual learning to build a learning community. (Susilo, 2013). Lesson study can also be used to assess the effect of the learning that has been implemented (Triyanto & Prabowo, 2020). This lesson study focuses on improving the quality of an educator's learning through three stages, namely Plan, Do, and See (Asyari et al., 2016; Susilo, 2013). Lesson study is needed by educators in improving learning processes and outcomes (Jusuf, 2018; Rahayu et al., 2012) and its potential in supporting efforts to improve 4Cs skills with critical thinking being a part of it (Fujii, 2019; Putra & Nurlizawati, 2019). Based on the description above, this study aims to determine the effect problem-based learning model based on lesson study on students' critical thinking skills on the topic of the human respiratory system

Methods

This research is True Experiment research. The population in this study were students of class XI MIPA SMAN 1 Tasikmalaya which consisted of 8 classes with a total of 273 students. The research sample used 2 classes totaling 68 students, consisting of 35 experimental class students and 33 control class students with sampling using the Cluster Random Sampling technique. The research design used Posttest Only Control Design. There are two types of research variables used in this study, namely independent variables, and dependent variables. The independent variable is a problem-based learning model based on lesson study and the dependent variable is the students' critical thinking skills.

The data collection technique used is a critical thinking skill test given to the experimental class and the control class at the posttest. The research instrument used a description test with a total of 15 questions according to the indicators (Ennis, 1985) including elementary clarification, basic support, inference, advanced clarification, dan strategy, and tactics. The data analysis technique used an independent t-test which previously tested the normality of the data using the Kolmogorov-Smirnov test and test of homogeneity of variances using the Levene test. All data analysis was carried out with the help of SPSS Windows version 25 software. One example of critical thinking questions is shown in Figure 1.


Jakarta,Beritasatu.com- Peringatan Hari Lingkungan Hidup Sedunia tahun ini harus menjadi momentum refleksi bagi pemerintah. Pasalnya, kualitas udara menjadi sorotan kalangan pemerhati lingkungan. Menurut Air Quality Live Index (AQLI)2, kondisi kualitas udara di Indonesia tercatat terus memburuk sejak dua dekade terakhir, dan saat ini berada di peringkat ke-20 negara dengan kualitas udara terburuk di dunia. Berdasarkan pengamatan AQLI, 91% penduduk Indonesia tinggal di wilayah dengan tingkat polusi udara melebihi batas aman yang ditetapkan organisasi kesehatan dunia (WHO). WHO menetapkan rata-rata konsentrasi per tahun dari polutan udara atau particullate matter (PM2,5) tidak boleh melebihi 10 mikron per meter kubik. PM2,5 merupakan partikel udara yang berukuran lebih kecil dari 2,5 mikron atau 30 kali lebih kecil dari sehelai rambut manusia. Pada wilayah dengan tingkat polutan tinggi, partikel-partikel ini dapat mengurangi jarak pandang dan mengancam kesehatan manusia.Berdasarkan artikel tersebut, apakah informasi yang didapatkan bisa dipercaya atau tidak? Berikan alasannya! *

Teks jawaban panjang

Figure 1. Examples of Critical Thinking Skills

Results and Discussion

The data obtained from this study are post-test data for the experimental class and the control class which can be seen in Table 1.

Table 1. Posttest Statistics Data for Critical Thinking Skills of Students in Experiment Class and Control Class

Statistics	*Experiment Class*	*Control Class*
	36	36
Maximum score	18	15
Minimum score	18	21
Range	27.62	25.06
Mean	4.57	4.64
standard deviation	20.88	21.62
variant		

Table 1. This shows that the post-test average score of critical thinking skills in the experimental class is 27.62 greater than the post-test average score of critical thinking skills in the control class, which is 25.06.

Based on the analysis precondition test, the data has met the analysis precondition, namely population data with normal distribution using the Kolmogorov-Smirnov test and data with a test of homogeneity of variances using the Levene test. Overall the results of the analysis precondition test are presented in Table 2 and Table 3

Table 2. Data Normality Test (Kolmogorov-Smirnov Test)

One-Sample Kolmogorov-Smirnov Test

		Unstandardized Residual
N		33
Normal Parameters[a, b]	*Mean*	.0000000
	Std. Deviation	8.06554915
Most Extreme Differences	*Absolute*	.134
	Positive	.134
	Negative	-.122
Test Statistic		.134
Asymp. Sig. (2-tailed)		.140 [c]

The results of the analysis precondition test in Table 1 obtained the Asynp value. Sig. (2-tailed) that is equal to 0.140. This value has a significance of> 0.05. Following the rules of normality testing, it can be concluded that Ho is accepted, which means that the post-test data on students' critical thinking skills have been taken from a normally distributed population. While the test of homogeneity of variances with the Levene test has a significance value test rule of> 0.05 is presented in Table 3. The results of the homogeneity of variances test analysis are 0.848 which can be concluded that the data taken has homogeneity of variances.

Table 3. Homogeneity Test (Levene's Test)

Test of Homogeneity of Variances

		Levene Statistic	**df1**	**df2**	**Sig.**
Critical Thinking	*Based on Mean*	.037	1	66	.848
	Based on Median	.127	1	66	.723
	Based on Median and with adjusted dF	.127	1	65,323	.723
	Based on trimmed mean	.032	1	66	.859

The t-test was used to test the research hypothesis. The t-test was carried out because the data had met the analysis precondition. The complete hypothesis test is presented in Table 4.

Table 4. Hypothesis Test (Independent T-Test)

Independent Sample Test

		Levene's Test for Equality of Variances		***t-test for Equality of Means***						
		F	***Sig.***	***t***	***dF***	***Sig. (2-tailed)***	***Mean Differences***	***Std. Error Differences***	***95% Confidence Interval of the Difference***	
									Lower	***Upper***
Critical Thinking	*Equal variances assumed*	.037	.848	2,327	66	.023	7.2175	3.1022	1.0238	13.4112
	Equal variance not assumed			2,326	65,641	.023	7.2175	3.1035	1.0205	13.4145

The results of data analysis using the t-test according to Table 4 show that the hypothesis test is less than 0.05, so it can be said that the hypothesis in this study is accepted (Ho is rejected). So that there is an effect of the PBL-based lesson study on students' critical thinking skills on the topic of the human respiratory system in class XI MIPA SMAN 1 Tasikmalaya. In line with research by Yunita et al., (2020) that the PBL model based on lesson study can improve students' critical thinking skills. This influence exists because the use of the lesson study-based PBL helps the teacher plan, do, and see so that teacher collaborates with the lesson study team to provide an increase in the quality of learning, especially in improving the quality of critical thinking in line with one of the demands. 21st-century skills.

In the experimental class, the PBL stages are made in more detail based on lesson study, such as the planning stage before the model teacher implements the learning activities, the model teacher makes a design related lesson design that will be used in a meeting accompanied by an observer, the do (implementation) stage the model teacher implements according to the syntax of PBL starting with (1) student orientation, (2) organizing student learning activities, (3) guiding investigations, (4) presenting the work, (5) analyzing and evaluating the results and at the see stage (reflection). Model teachers and observers share valuable experiences gained after reviewing learning, findings obtained during the learning process, and discuss alternative solutions for the next meeting. Students in the experimental class carrying out learning activities were seen to be more active and the enthusiasm of

students was higher than in the control class using the DL model. It can be seen in the comparison diagram an interpretation of the results of students' critical thinking skills in the experimental class and control class is presented in Figure 2.

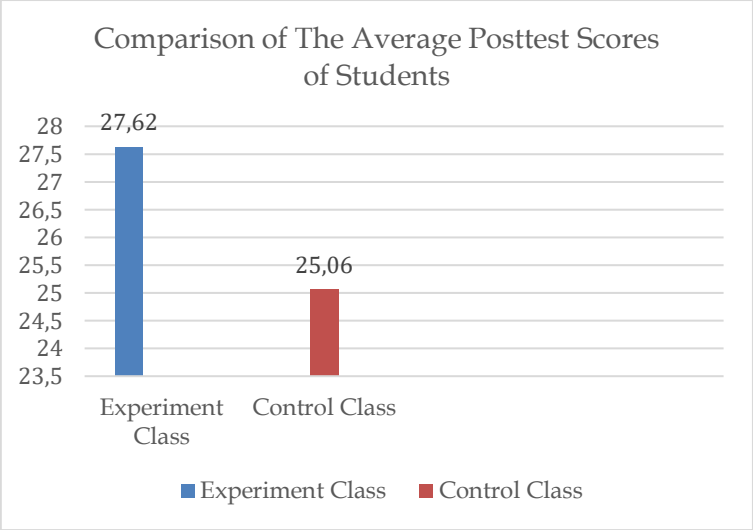


Figure 2. Comparison of the Average Posttest Score of Critical Thinking Skills in Experiment Class and Control Class

Figure 1 shows that the achievement of the post-test average score in the experimental class using the lesson study-based PBL model obtained an average score of 27.62. While the post-test average score in the control class using the Discovery Learning model obtained an average score of 25.06. The post-test average score in the experimental class was higher than the control class post-test average score with a difference of 2.56. The average post-test scores in the experimental class and control class from each question indicator are presented in Figure 3.

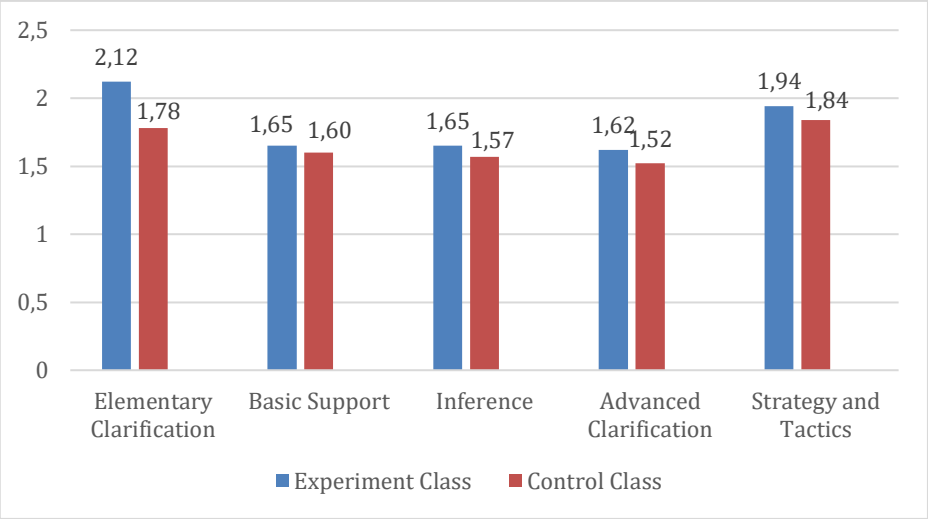


Figure 3. Average Posttest Score Critical Thinking Skills Experiment Class and Control Class Each Indicator.

Based on Figure 3, it can be seen that the average score of the experimental class is superior to the average value of the control class calculated for each indicator of critical thinking skills. Indicators of critical thinking skills, including elementary clarification in the experimental class which is 2.12 higher than the control class at 1.78, basic support in the experimental class is 1.65 which is higher than the control class at 1.60, inference in the

experimental class is 1.65 higher than the control class at 1.57, advanced clarification in the experimental class is 1.62 higher than the control class at 1.52, and strategy and tactics in the experimental class are 1.94 higher than the control class of 1.84. This can indicate that the lesson study-based PBL model can improve critical thinking skills. This research has proven to show that the lesson study-based PBL model can be applied and used as an alternative in student learning activities.

Critical thinking skills using the lesson study-based PBL model have increased because the PBL model is an ill-structured learning model that demands a high level of knowledge and skills based on real or authentic problems in solving problems, besides that PBL expands the teacherroleles student facilitation (Mugla, 2011). Therefore, the problem-based learning model is included in the student-centered learning model (Yuan et al., 2008).

Learning with Lesson Study gives more attention in terms of planning between the model teacher and the observer, conducts discussions first with the model teacher, has prepared lesson plans in lesson design, teaching materials, and LKPD to be discussed if there are some suggestions or input from the observer to improve the planning that has been prepared before being stimulated in class (Susilo, 2013). Input/suggestions from observers that should be changed in lesson design must include jumping tasks and sharing tasks, the allocation of LKPD work is carried out for 15 minutes, some students have to present the work of LKPD, and the teacher provides stimulation from pictures/videos to provoke questions students, if the learning is done online at a zoom meeting, the model teacher must try to get students on camera, work on LKPD is done in a breakout room so that students can discuss according to groups.

In the Lesson Study, do (implementation) stage, the first meeting and the second meeting were conducted offline in class XI MIPA 8, while the third meeting was conducted online through a zoom meeting. The model teacher and observer must record the findings during the learning activities to be discussed together in the See stage (reflection). The focus of this observation is on the activities while learning in the classroom, not on the appearance of the model teacher who is teaching (Susilo, 2013). The Do stage follows the syntax of Problem Based Learning which begins with the model teacher greeting, checking the attendance of students, doing apperception, motivating, and explaining the learning objectives. Next, Problem Based Learning syntax begins with student orientation to the problem where students are given a stimulus such as an image displayed on the PowerPoint, the teacher asks according to the image displayed then students answer from the model teacher's question. The problems given to students are problems that are relevant to everyday life.

Organizing student learning activities are carried out with the model teacher asking questions related to the material to be delivered, then the group is divided into 4 groups randomly to work LKPD. The model teacher distributes LKPD to each group in the form of a hard file to make it easier for students to work on questions. Each group that has received the LKPD questions is done together with their group friends. The next stage is guiding the investigation, after students are given LKPD to do, then educators must be able to guide students in the investigation. At this stage, the model teacher helps students determine the tasks that must be done, and students are guided by the model teacher in collecting appropriate information. (Shofiyah & Wulandari, 2018). Investigation efforts help students to think critically in analyzing a problem (Herzon et al., 2017). The stage of guiding the investigation raises students' critical thinking skills to be better so that this syntax is included in the main syntax in influencing students' critical thinking.

In the stage of developing and presenting work, the model teacher asks representatives from each group to present the results of working on the LKPD, and the final stage is analyzing and evaluating the results, where the model teacher provides opportunities for students if there are responses from different answers from students. Presenting the results of the work trains students to think critically because students convey ideas or ideas obtained to find

solutions to problems. This stage makes students practice critical thinking so that it is included in higher-order thinking (Oktavianto et al., 2017). The model teacher must assist students in presenting the results and reflecting on the processes used (Shofiyah & Wulandari, 2018).

The last stage is analyzing and evaluating the results. This stage is the stage of reflection in critical thinking. Students try to be able to evaluate the results of working on the LKPD if there are answers that are different from other students, the model teacher must also help clarify a concept that is being studied if students experience errors in filling out the LKPD. The process of analyzing and evaluating results includes the final form in finding solutions or making decisions made by students (Herzon et al., 2017). Then the model teacher gives questions that are considered a jumping task to students and students are asked to answer these questions. Before the meeting was closed, the model teacher asked the student representatives to convey the lessons learned after carrying out the learning process about the human respiratory system.

In the see (reflection) stage, the model teacher and observer share valuable experiences obtained after reviewing learning, findings obtained during the learning process, and discuss alternative solutions for the next meeting. Model teachers and observers are allowed to convey the lessons learned from learning (Susilo, 2013). Students in the experimental class carrying out learning activities were seen to be more active and the enthusiasm of students was higher than in the control class which used the Discovery Learning model.

The learning process in the control class was carried out in class XI MIPA 7 for three meetings using the Discovery Learning model. The first and second meetings were conducted offline in class XI MIPA 7, while the third meeting was conducted online via a zoom meeting. Students who learn well are active, and conducive but not as active as experimental class students. The reason for this difference is because the learning model applied, namely the Discovery Learning model, has been very often applied to biology learning by the biology teacher concerned. But the teacher still strives for active and conducive learning activities such as conducting learning in the experimental class.

The Discovery Learning stage begins with a stimulus. Students are allowed to observe the image that has been displayed which aims to stimulate the curiosity of students and will build knowledge and relate the image observed to the knowledge that has been previously obtained. But some students have not been able to focus on giving the stimulus so when observing the picture they feel confused. Students learn to observe an object that has been displayed to stimulate critical thinking so that they can find the concept of an object being observed (Khofiyah et al., 2019).

The second stage is identifying the problem. After students are given stimuli related to an image that is displayed, students are asked to formulate problems from the image so that students will begin to actively ask questions to the teacher and other students. The purpose of this question and answer is to bring up the focus of the problem being studied. This question and answer process has a good impact on students because it stimulates critical thinking skills. Students have started to dare to ask questions to other students but some answers still need to be perfected. Some students do not follow the course of activities at this stage so this process needs to be improved again. At this stage, students are encouraged to be able to think critically through questions and answers from other students (Khofiyah et al., 2019).

The third stage is data collection. At this stage, students are divided into groups and then given LKPD which must be done by each group. Students conduct discussions to find answers related to the LKPD given, either from literature sources or the internet. However, during the discussion, some students did not follow the discussion. The results of the discussion are used as the basis when analyzing an idea (Khofiyah et al., 2019). At the data processing stage, students express their opinions to each other to encourage students to understand a concept. Students who at the data collection stage did not follow the course of the discussion had an impact on data processing, these students were unable to express ideas or opinions to answer LKPD questions.

The next stage is verification. At this stage, students try to present the results of the LKPD answers through presentations in front of the class. However, when their group made their presentations, some students did not pay attention, causing them to be unable to provide feedback or rebuttal. Some students did not dare to express their opinions properly. The role of the teacher at this stage is to straighten the understanding of students who are less precise so that students do not understand an appropriate concept (Lieung, 2019). Another role is to encourage students to be more active in expressing opinions according to the given LKPD. The last stage is that students are required to be able to draw conclusions obtained after carrying out the learning process.

The influence of the PBL model on students' critical thinking indicators appears to increase in each learning process because it experiences adaptations that can be accepted by students. Problem Based Learning can facilitate students to improve the quality of critical thinking skills, and active learning (Putri et al., 2019). Problem Based Learning also increases knowledge, students are trained to be able to find solutions to authentic problems, and there are discussions for each student who tries to find solutions based on the results of each individual's thinking. The use of Lesson Study in the learning process is one of the efforts to achieve educational goals as stated in Law Number 20 of 2003 concerning the National Education System (Mustofa et al., 2016).

The value of students' critical thinking skills is obtained from tests conducted after all the material on the human respiratory system has been delivered. In the post-test experimental class, questions that can be answered correctly are found on indicator elementary clarification with a score of 2.12 because during the learning process by the Problem Based Learning syntax, namely the orientation of students to problems in the learning process the teacher Asks students to identify as many problems as possible. Students feel challenged because of curiosity about a given problem so that students can identify problems or focus on questions better. Problem orientation begins with problems regarding the human respiratory system related to everyday life. Students are trained to identify problems by themselves (Salbiah, 2017). If students are trained to identify problems, then the relevant problems according to the material provided will help students find appropriate solutions.

The score that students answered at least correctly was found in the indicator providing a further explanation (advanced clarification) with a score of 1.62, students were able to define a term and identify assumptions, but some of the students' answers were incomplete. There are still students who do not understand in understanding a problem and have not found the focal point of the problem so the causes of the low indicator to provide further explanation. In addition, the cause of the low indicator is because there is a factor in students' laziness in reading, some students in the learning process still do not pay attention to the teacher in delivering learning material. Therefore, the skills of students in providing further explanations must be improved again by increasing students' scientific literacy which allows students to be more communicative. (Ridho et al., 2020).

The results of other critical thinking skills indicators such as building basic skills (basic support) obtained a score of 1.65. This aspect indicates that students must improve their basic skills in considering the truth of sources and considering the results of observations. The factor causes this indicator is low because students in analyzing a given problem still receive information directly without thinking that the information is valid or not, students also consider the value of observations incomplete and still need time to analyze the problems raised. These factors need to be improved again so that students can have a good flow of thinking. Critical thinking skills direct students to pay attention to the results of observations by looking at things that are following the procedure (Ridho et al., 2020).

The inference indicator has a score of 1.65 students learn to make and consider the value of decisions, but some students are hesitant in making decisions from a given problem, and students who are also in the learning process must be more careful involved so that students

can make generalizations well. Students only conclude briefly without relating it to the material obtained, so students are less than optimal in critical thinking (Hidayati et al., 2021). The ability to conclude can be improved by applying concepts, principles, and skills to conclude (Fakhriyah, 2014).

Indicators for strategy and tactics have a score of 1.94 students were able to determine actions but some students were less sure of the actions taken in a problem taken and students were also able to interact with other people but students were less precise in providing supporting reasons. Students must be able to choose criteria to find solutions to problems and then must provide logical explanations. Low understanding related to the concept of the material being studied makes students feel doubtful in deciding an action, with reading or scientific literacy activities will help students in applying daily life according to what is learned in class. (Ridho et al., 2020). based on this research in the experimental class, Problem Based Learning provides space for students to solve a problem based on the material presented and supported by Lesson Study so that Problem Based Learning based on Lesson Study affects students' critical thinking skills.

In contrast to the control class posttest using the Discovery Learning model, each indicator of critical thinking skills has a different difference from the experimental class. Most of the students who answered the correct questions were found on indicators of strategy and tactics with a score of 1.84. Students are quite good at mastering the concepts given so that in determining actions according to the questions given, they immediately focus on problems and find solutions to these problems. But this indicator must be improved so that students who still feel doubtful in determining actions can learn continually. Scientific literacy activities are then analyzed to link concepts and can then be applied in everyday life (Oliveras et al., 2013). The goal is for students to better understand how to determine an action with various sources used (Nurrohmi et al., 2017).

The score that is at least answered correctly by students is found in the indicator providing a further explanation (advanced clarification) with a score of 1.52. The cause of this low indicator is the poor flow of students thinking, in the learning process students are still less focused on analyzing the problem points given, and they lack students scientific literacy so that when given questions that are long enough students read only half of it, especially the questions that are required to answer questions, define terms and identify assumptions that cause students' answers to be incomplete and the answers still need to be improved. Therefore, as educators, they must train repeatedly by providing suggestions or improvements to students (Salbiah, 2017).

Meanwhile, the results of other critical thinking skills indicators such as providing a simple explanation (elementary clarification) obtained a score of 1.78. In this indicator, students have the second-highest score in the control class. Students begin to learn to practice critical thinking skills from the questions that have been given by educators, students also learn to formulate questions according to the Discovery Learning syntax, namely problem identification. Students' answers related to this indicator have honed their critical thinking level of students but still, need to be developed again so that the flow of students' thinking is good according to the right and clear concept. To be in line with indicators providing simple explanations, educators must encourage students to think critically through problem identification (Khofiyah et al., 2019).

The indicator of basic support has a score of 1.60. Students still feel they are not free to explore the results of observations given by educators so that in finding solutions related to the problem it is still not appropriate, also in determining the truth of the students' source in the flow of thinking is still not right, some receive information directly without supporting reasons, but some students received information along with the right reasons. Learning process activities to hone students' critical thinking skills need to be carried out continually (Khofiyah et al., 2019). Especially in analyzing an object based on observations that trigger critical thinking skills so that a concept will be built in real terms.

The indicator of concluding (inference) obtained a score of 1.57. This is because students have difficulty in the learning process, students are less active in asking questions about the material presented, and students must try to be active in finding their knowledge. Students in giving conclusions must be related so that the conclusions obtained will be easily understood and easily accepted also in making the value of decisions, there are still students who are hesitant in answering questions related to the material provided. This low score is due to improving critical thinking skills not only memorizing material but having to master concepts so that students can meet the indicator criteria of critical thinking skills. (Qurniati et al., 2015).

Problem Based Learning model is included in the student-centered learning model (Yuan et al., 2008). PBL with Lesson Study is an effort to improve the quality of learning which was proven to influence the critical thinking skills in class XI MIPA. Improved critical thinking skills are certainly influenced by the conditions of the learning environment created by the teacher with Problem Based Learning which is directly assessed in the Lesson Study at each meeting and has findings that must be studied and from these findings must be improved for the implementation of the next meeting. The focus of the Lesson Study includes improving the quality of learning and the quality of educators (Triyanto & Prabowo, 2020).

Based on the description above, the PBL model studied with lesson study as an effort to improve the quality of learning has been proven to influence the critical thinking skills of students in class XI MIPA. Improved critical thinking skills are certainly influenced by the conditions of the learning environment created by the teacher with problem-based learning directly studied with lesson study. The focus of lesson study includes improving the quality of learning and the quality of educators (Triyanto & Prabowo, 2020). There is the use of a lesson study-based PBL model so that students are required to solve a problem and provide a solution to a problem so that they can hone students critical thinking skills. Not only concepts must be obtained but problem solutions based on concepts appropriate in real life.

The use of the lesson study-based PBL model is considered a good model to influence students' critical thinking skills. The use of the lesson study in this study can improve the quality of learning and improve pedagogical competence which is carried out in collaboration, so that other educators can follow the example by using lesson study consistently in the learning process and then jointly discuss the findings during learning and reflect on them so that they can become a new habit for educators in carrying out the learning process by the principle of lesson study which is sustainable, educators can continue to do lesson study in learning activities. These efforts are a benefit in the use of lesson study.

Conclusion

Based on the results of research and data analysis, it can be concluded that there is an effect of the PBL model based on lesson study on students' critical thinking skills on the topic of the human respiratory system in class XI MIPA SMAN 1 Tasikmalaya the 2021/2022 academic year. This is indicated by the hypothesis test that has been carried out that Ho is rejected, which means a significance value <0.05 to be more precise (0.023 <0.05). The existence of a lesson study-based PBL can make it easier for students to gain knowledge based on solutions to problems faced so that it can be applied by all educators in improving critical thinking skills.

Reference

Asyari, M., Muhdhar, M. H. I. Al, Susilo, H., & Ibrohim. (2016). Improving Critical Thinking Skills Through The Integration of Problem Based Learning and Group Investigation. *International Journal for Lesson and Learning Studies*, *5*(1), 36–44. https://doi.org/10.1108/IJLLS-10-2014-0042

Ennis, R. H. (1985). A Logical Basis for Measuring Critical Thinking Skills. *Educational Leadership*, 44–48.

https://jgregorymcverry.com/readings/ennis1985assessingcriticalthinking.pdf
Etherington, M. (2011). Investigative Primary Science: A Problem-Based Learning Approach. *Australian Journal of Teacher Education*, *36*(9), 36–57. http://dx.doi.org/10.14221/ajte.2011v36n9.2
Fakhriyah, F. (2014). Penerapan Problem Based Learning dalam Upaya Mengembangkan Kemampuan Berpikir Kritis Mahasiswa. *Jurnal Pendidikan IPA Indonesia*, *3*(1), 95–101. https://doi.org/10.15294/jpii.v3i1.2906
Fauzi, A., & Mitalistiani, M. (2018). High School Biology Topics That Perceived Difficult By Undergraduate Students. *Didaktia Biologi: Jurnal Penelitian Pendidikan Biologi*, *2*(2), 73. https://doi.org/10.32502/dikbio.v2i2.1242
Fujii, T. (2019). Designing and Adapting Tasks in Lesson Planning: A Critical Process of Lesson Study. *Theory and practice of lesson study in mathematics*, 681–704. https://doi.org/10.1007/978-3-030-04031-4_33
Herzon, H. H., Budijanto, & Hari Utomo, D. (2017). Pengaruh Problem-Based Learning (PBL) terhadap Keterampilan Berpikir Kritis. *Jurnal Pendidikan: Teori, Penelitian, dan Pengembangan*, *3*(1), 42–46. http://journal.um.ac.id/index.php/jptpp/
Hidayati, A. R., Fadly, W., & Ekapti, R. F. (2021). Analisis Keterampilan Berpikir Kritis Siswa pada Pembelajaran IPA. *Jurnal Tadris IPA Indonesia*, *1*(1), 34–48. https://ejournal.iainponorogo.ac.id/index.php/jtii/article/view/68
Jusuf, R. (2018). Peningkatan Kualitas Pembelajaran Melalui Lesson Study. *Primaria Educationem*, *1*(1), 8–19. https://core.ac.uk/download/pdf/229695012.pdf
Khofiyah, H.N., Santoso, A., & Akbar, S. (2019). Pengaruh Model Discovery Learning Berbantuan Media Benda Nyata terhadap Kemampuan Berpikir Kritis dan Pemahaman Konsep IPA. *Jurnal Pendidikan: Teori, Penelitian, dan Pengembangan*, *4*(1), 61–67. https://doi.org/10.17977/jptpp.v4i1.11857
Kono, R., Mamu, H. D., & Tangge, L. N. (2016). Pengaruh Model Problem Based Learning (PBL) Terhadap Pemahaman Konsep Biologi dan Keterampilan Berpikir Kritis Siswa Tentang Ekosistem Lingkungan di SMA Negeri 1 Sigi. *Jurnal Sains dan Teknologi Tadulako*, *5*(1), 28–38. http://jurnal.untad.ac.id/jurnal/index.php/JSTT/article/view/6958/5595
Lieung, K. W. (2019). Pengaruh Model Discovery Learning Terhadap Keterampilan Berpikir Kritis Siswa Sekolah Dasar. *Journal of Primary Education*, *1*(2), 73–82. http://ejournal.unmus.ac.id/index.php/primary/article/view/1465
Mugla. (2011). Overviews on Inquiry-Based and Problem-Based Learning Methods. *Western Anatolia Journal of Educational Sciences (WAJES)*, 303–310. http://hdl.handle.net/20.500.12397/5185
Mustofa, Z., Susilo, H., Heni, M., Al, I., Biologi, P., & Malang, P. N. (2016). Penerapan Model Pembelajaran Problem Based Learning Melalui Pendekatan Kontekstual Berbasis Lesson Study untuk Siswa SMA. *Jurnal Pendidikan*, *1*(5), 885–889. http://journal.um.ac.id/index.php/jptpp/article/view/6298
Nofziarni, A., Hardiyanto, Fitria, Y., & Betri, A. (2019). Pengaruh Penggunaan Model Problem Based Learning (PBL) Terhadap Hasil Belajar Siswa di Sekolah Dasar. *Jurnal Basicedu*, *3*(4), 2016–2024. https://doi.org/10.31004/basicedu.v3i4.244
Nurrohmi, Y., Utaya, S., & Utomo, D. H. (2017). Pengaruh Model Pembelajaran Discovery Learning Terhadap Kemampuan Berpikir Kritis Mahasiswa. *Jurnal Pendidikan: Teori, Penelitian, dan Pengembangan*, *2*(10), 1308–1314. http://journal.um.ac.id/index.php/jptpp/
Oktavianto, D. A., Sumarmi, & Handoyo, B. (2017). The Effect of Project-Based Learning Assisted Google Earth to Spatial Thinking Skills. *Jurnal Teknik*, *21*(1), 1–15. https://jurnalteknodik.kemdikbud.go.id/index.php/jurnalteknodik/article/view/227
Oliveras, B., Márquez, C., & Sanmartí, N. (2013). The Use of Newspaper Articles as a Tool to

Develop Critical Thinking in Science Classes. *International Journal of Science Education*, *35*(6), 885–905. https://doi.org/10.1080/09500693.2011.586736

Prasetyo, T. (2021). *Pendekatan Pembelajaran Berpusat Pada Siswa*.

Putra, M.D., & Nurlizawati. (2019). Lesson Study dalam Meningkatkan Keterampilan 4C (Critical Thingking, Collaborative, Communicative dan Creative) pada Pembelajaran Sosiologi yang Terintegrasi ABS-SBK di SMAN 1 Pasaman. *Jurnal Sikola: Jurnal Kajian Pendidikan dan Pembelajaran*, *1*(2), 139–146. https://doi.org/10.24036/sikola.v1i2.19

Putri, D.R., Anggraini, A., Milda, J., & Susilo, H. (2019). Penerapan Problem Based Learning (Pbl) Berbasis Lesson Study (Ls) Terhadap Kemampuan Berpikir Kritis Mahasiswa Magister Pendidikan Biologi. *ProsidingSeminar Nasional dan Workshop Biologi-IPA dan Pembelajarannya ke-4*, *September*, 569–575. https://www.researchgate.net/publication/347437606

Qurniati, D., Andayani, Y., & Muntari. (2015). Peningkatan Keterampilan Berpikir Kritis Melalui Model Discovery Learning. *Jurnal Penelitian Pendidikan IPA*, *1*(2), 58–69. https://doi.org/10.31603/edukasi.v11i1.2677

Rachmedita, V., Sinaga, R. M., & Pujiati. (2017). Peningkatan Kemampuan Berpikir Kritis Melalui Penggunaan Strategi Active Sharing Knowledge. *Jurnal Studi Sosial Program Pascasarjana P-IPS*, *5*(1). http://jurnal.fkip.unila.ac.id/index.php/JSS/article/view/12328

Rahayu, P., Mulyani, S., & Miswadi, S. S. (2012). Pengembangan Pembelajaran IPA Terpadu dengan Menggunakan Model Pembelajaran Problem Base Melalui Lesson Study. *Jurnal Pendidikan IPA Indonesia*, *1*(1), 63–70. https://doi.org/10.15294/jpii.v1i1.2015

Ridho, S., Ruwiyatun, R., Subali, B., & Marwoto, P. (2020). Analisis Kemampuan Berpikir Kritis Siswa Pokok Bahasan Klasifikasi Materi dan Perubahannya. *Jurnal Penelitian Pendidikan IPA*, *6*(1), 10–15. https://doi.org/10.29303/jppipa.v6i1.194

Salbiah, S. (2017). Profil Keterampilan Berpikir Kritis Siswa Menggunakan Pembelajaran Discovery Inquiry Pada Konsep Koloid. *JTK (Jurnal Tadris Kimiya)*, *2*(1), 109–115. https://doi.org/10.15575/jta.v2i1.1367

Shofiyah, N., & Wulandari, F. E. (2018). Model Problem Based Learning (PBL) dalam Melatih Scientific Reasoning Siswa. *Jurnal Penelitian Pendidikan IPA*, *3*(1), 33. https://doi.org/10.26740/jppipa.v3n1.p33-38

Susilo, H. (2013). Lesson Study Sebagai Sarana Meningkatkan Kompetensi Pendidik. *Seminar dan Lokakarya 2013 di Sekolah Tinggi Theologi Aletheia*, 1–32.

Triyanto, S. A., & Prabowo, C. A. (2020). Efektivitas Blended-Problem Based Learning dengan Lesson Study Terhadap Hasil Belajar. *Bioedukasi: Jurnal Pendidikan Biologi*, *13*(1), 42–48. https://doi.org/10.20961/bioedukasi-uns.v13i1.37960

Triyanto, S. A., Susilo, H., & Rohman, F. (2016). Penerapan Blended-Problem Based Learning dalam Pembelajaran Biologi. *Jurnal Pendidikan*, *1*(1), 1252–1260. http://journal.um.ac.id/index.php/jptpp/article/view/6526

Widodo, S. (2017). Pengembangan Keterampilan Berpikir Kritis Peserta Didik Dengan Menggunakan Model Pembelajaran Berbasis Masalah (Problem Based Learning) Melalui Isu-Isu Sosial Ekonomi Pasca Penggenangan Waduk Jatigede Dalam Pembelajaran Ips Di Smpn 2 Wado Kabupaten Sumeda. *International Journal Pedagogy of Social Studies*, *1*(2), 275. https://doi.org/10.17509/ijposs.v1i2.4712

Wood, D. F. (2003). ABC of Learning and Teaching in Medicine: Problem Based Learning. *BMJ : British Medical Journal*, *326*(7384), 328. https://doi.org/10.1136/BMJ.326.7384.328

World Economic Forum. (2015). *New Vision for Education: Unlocking The Potential of The Smart Grid*. https://widgets.weforum.org/nve-2015/index.html

Yuan, H., Kunaviktikul, W., Klunklin, A., & Williams, B. A. (2008). Promoting Critical Thinking Skills Through Problem-Based Learning. *CMU. J. of Soc. Sci. and Human.*, *2*(2),

55–99. https://citeseerx.ist.psu.edu/viewdoc/download?doi=10.1.1.169.9794&rep=rep1&type=pdf

Yunita, N., Zahara, L., & Syahidi, K. (2020). Pengaruh Model Problem Based Learning (PBL) Melalui Lesson Study Terhadap Kemampuan Berpikir Kritis Siswa. *Kappa Journal*, *4*(2), 233–239. https://doi.org/10.29408/kpj.v4i2.2756