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Lesson Study to Improve Students' Scientific Literacy Abilities on Respiratory System Material

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Abstract: Less varied learning method result in low scientific literacy of students. This study aims to determine whether the application of lesson study in learning can improve students' scientific literacy skills in the Respiratory System material. This research is action research carried out at SMA Negeri 1 Lohbener. The subjects in this study were students of class XI IPA 1 with a total sample of 22 people. The instrument used in this study was HOTs-based literacy question sheets which were given in each cycle to measure students' scientific literacy improvement. The results of data processing obtained an average score of scientific literacy skills in cycle I of 53.0 with a percentage of 53% and in the very low category, the average score in cycle II of 57.0 with a percentage of 57% and in the low category, and the average score in cycle III of 67.0 with a percentage of 67% and in the moderate category. The main factor causing an increase in students' scientific literacy skills only reaching the moderate category was students who were not used to answering HOTs-based literacy questions and were used to answering LOTs-type questions, so they experienced difficulties in doing the formative tests given. Even so, the application of lesson study in learning material on the respiratory system is proven to be able to improve students' scientific literacy skills at each level. Based on the results of observations of teachers and students during the implementation of cycle actions, it appears that the implementation of actions has reached the predetermined performance indicators.

Keywords: Hots; Lesson Study; Respiration System; Scientific Literacy

Introduction

Science literacy is one of the keys to success in facing obstacles in the 21st century. Individuals with literacy skills can use scientific news to solve anxiety and problems in everyday life and produce useful scientific products (Nofiana & Julianto, 2018). Science teaching is important in preparing individuals who can utilize scientific concepts, work skills, and interact with the environment, technology, and society in both social and economic aspects of development (Nofiana & Julianto, 2018). Scientific literacy according to PISA (2010), is distinguished in three dimensions, namely content (knowledge of science), implementation/process (competence of science), and context (application of science). Based on data released by PISA 2018, Indonesian students' scientific literacy score of 396 ranks 71 out of 79 countries (OECD, 2019). Indonesian students' low scientific literacy achievements can be caused by several factors, such as a lack of training in solving questions at the same level as PISA questions (Mentari, 2021; Rita Novita et al., 2012). The questions tested in the national exam still tend to be memorizing or understanding basic concepts (Kertayasa et al., 2014; Mentari, 2021). Therefore, in the PISA test, students are unable to answer questions with a high level of difficulty (Mentari, 2021; Stacey, 2011). The questions tested in PISA are applicable questions that require understanding concepts and critical and creative thinking skills in solving questions (OECD, 2019). The low English language skills of Indonesian students are also one of the obstacles for Indonesian students in solving PISA questions which are presented in English as an international language (Kertayasa et al., 2014). Apart from that, Holbrook's 2009 research (Nofiana & Julianto, 2018) shows that science lessons have been less

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relevant and popular in the eyes of students. This is because the current curriculum emphasizes theory and concepts first rather than application.

The results of observations regarding the level of students' scientific literacy abilities at SMA Negeri 1 Lohbener show that students' scientific literacy in terms of content, context, and process is still relatively low. Low scientific literacy causes students to be less responsive to developments and problems in the environment, especially those related to natural phenomena and problems in the surrounding environment. Students also do not pay attention to the teacher's explanation in the learning process. Apart from that, most students have limitations in answering HOTs-type questions, which indirectly shows the low level of students' scientific literacy. Therefore, it is necessary to optimize a strategy to increase scientific literacy, one of which is utilizing an interesting and high-quality learning activity strategy that is able to activate and optimize student involvement in the teaching and learning process, the relationship between students and learning objects, and can also help carry out evaluation of learning outcomes and take advantage of feedback.

Lesson study is real learning in the classroom with students being observed and evaluated by other teachers as observers with reflection activities at the end of the learning process (Elliott, 2019). Lesson study is a model that can be applied to guide and shape students who are "scientific literate" (Ratnawati, 2019). In addition, students who have scientific literacy are required to be competent in communicating and collaborating, as well as competent in using scientific knowledge to identify questions, draw evidence-based conclusions to understand, and help make decisions and solve problems (Shaffer et al., 2019). In addition, scientific literacy skills are related to four fundamental 21st-century competencies, namely problem-solving abilities, critical thinking, communication, and collaboration (Afandi et al., 2019; Muyassaroh & Nurpadilah, 2021). Abdul Razak et al., (2021) stated that lesson study which is integrated with the use of HOTs-based literacy questions can be applied to increase scientific literacy in students.

The efforts that can be made to increase students' scientific literacy are by using various varied and student-centered learning models. Some of these learning models include Inquiry, Problem-Based Learning (PBL), and LOK-R (Literacy, Orientation, Collaboration, and reflection). The application of the inquiry learning model makes students practice and develop process skills, thinking skills and scientific attitudes (Maryam et al., 2020). Apart from that, the inquiry learning model can influence and improve students' scientific literacy (Mardianti et al., 2020; Adi et al., 2017). Meanwhile, the use of the PBL model can actively stimulate students to be able to seek answers to problems given by educators and help students actively construct knowledge and increase and develop students' scientific literacy (Purwanto & Siregar, 2016; Dahlia, 2022; Rismawati et al., 2020). Meanwhile, by using the LOK-R model, students are encouraged to think critically so that students have the ability to manage information and communicate creatively, both verbally and in writing, even digitally and visually. Pasongli et al., (2022), said that each stage in the LOK-R learning model can increase student learning activities. In addition, collaborative learning has added educational momentum from two converging forces, namely: (1) the practical realization that life outside the classroom requires collaborative activities in life in the real world; (2) raising awareness of social interaction in an effort to realize meaningful learning (Nofridawati, 2018; Suyatno, 2012). This research aims to find out whether the implementation of lesson study which is integrated with use in learning can improve the scientific literacy skills of class XI students in Respiratory System material.

Method

This research is an action research conducted at Lohbener 1 Senior High School and the subjects in this study were students of class XI IPA 1 with a total sample of 22 people. The research implementation procedure is divided into three research cycles. Each cycle is divided into three stages of action, namely the planning stage, the implementation stage, and the reflection stage. Each cycle action uses a different learning model, namely Guided Inquiry in Cycle I, Problem-Based Learning in Cycle II, and LOK-R (Literation, Orientation, Collaboration, and Reflection) in Cycle III. The learning model in each action cycle is carried out through several stages as shown in Table 1.

The data collection instruments used in this study were Test Instruments and Learning Observation Sheets. The test instrument used is a HOTs-based literacy question sheet which has been integrated with three scientific literacy indicators according to PISA 2018, including: 1) Explaining phenomena scientifically, 2) Evaluating and designing scientific investigations, and 3) Interpreting data and evidence scientifically. Test instruments that have been integrated with scientific literacy indicators are used to measure the increase in students' scientific literacy, especially in Respiratory System material. The increase in students' scientific literacy is measured by the results of the description test given in each cycle. To answer the description questions, students are expected to be able to complete them based on the results of literacy activities, and by providing complete, correct, and appropriate answers. The scoring rubric is used as a reference in giving scores/grades to each question answered by students. The learning observation sheet is used as an instrument to assess the learning process carried out in each cycle. The results of the assessment of the learning process are used as data to evaluate and correct deficiencies and errors in the learning process carried out in each cycle so that the implementation of actions can achieve predetermined performance indicators.

Table 1. The steps for implementing the learning model in each action cycle

Stages of the Learning Process	Steps		
	Guided Inquiry	*Problem Based Learning*	LOK-R
Opening	Saying opening greetings, praying before studying, and attending to students. Apperception, Motivation, & Learning Objectives		
Core Activities	Identification of problems	Problem Orientation	Literacy
	Formulate the problem	Organizing students	
	Formulate the hypothesis	Guiding the investigation	Orientation
	Collecting data	Develop and present the results	
	Analyze data	Analyze and evaluate processes	Collaboration
	Draw conclusions	Solution to problem	
	Communicating results		Reflection
Closing	Delivering conclusions, evaluating student learning outcomes, reflections, assignments And close the lesson		

The analysis in this research uses a quantitative research pattern. The data obtained from Cycle I, Cycle II, and Cycle III were then processed using Ms. Excel to determine the increase in students' scientific literacy. The analysis of students' scientific literacy data processing is as: (1) Give a score to each student's answer according to the answer key/assessment rubric; (2) Calculate the raw score for each answer; (3) Convert the score into a value in percentage form by using the formula Purwanto, (2009) in Mentari, (2021):

$$NP = \frac{R}{SM} X\ 100\% \quad (1)$$

Information:
NP : The percent value sought or expected
R : Raw score obtained by students
SM : The ideal maximum score of the test concerned

Interpret the percentage of students' scientific literacy mastery based on the calculation results above. This interpretation is carried out based on category according to Purwanto, (2009) in Mentari, (2021) as show in Table 2.

Table 2. Criteria for Students' Scientific Literacy Scores

Persentase	Category
85% - 100%	Very high
76% - 84%	High
60% - 75%	Medium
55% - 59%	Low
≤ 54%	Very low

(Source: Mentari, 2021)

Result and Discussion

The results of the lesson study assessment were obtained from the description test results data given in each cycle. The description test given aims to determine the increase in students' scientific literacy. Observation results are also used as material for reflection to improve and enhance learning in the classroom. The following is a description and learning outcomes.

Overall Student Science Literacy Data

The scientific literacy of students referred to in this study is the use of variations in learning models in lesson study which are applied in every lesson on the Respiratory System material. From the test results data conducted at the end of each cycle, an analysis is carried out which aims to obtain an overview of the achievement of learning completeness. The level of scientific literacy of students is presented in Table 3.

Table 3. Student Science Literacy Level

Information	Student Science Literacy Test Scores		
	Cycle I	Cycle II	Cycle III
Average scientific literacy score	53.0	57.0	67.0
Percentage of scientific literacy	53%	57%	67%
Scientific literacy category	Very low	Medium	Medium

The scientific literacy level of students in Table 3 shows that the average student test score in cycle I is very low. Classified as low in cycle II, and moderate in cycle III (Figure 1). Based on the test results data, it can be concluded that the application of lesson study with three different learning models in each cycle also influences students' scientific literacy abilities in the respiratory system material. This is in line with Razak et al., (2021) who stated that there is an influence of implementing lesson study on students' scientific literacy abilities in ecology and environmental material. The application of lesson study is also known to be able to develop the potential quality of teachers in carrying out learning activities between one teacher and another (Junaid & Baharuddin, 2020) Apart from that, Dewi et al., (2016) also said that students who apply lesson study will interact more easily and collaborate in learning activities.

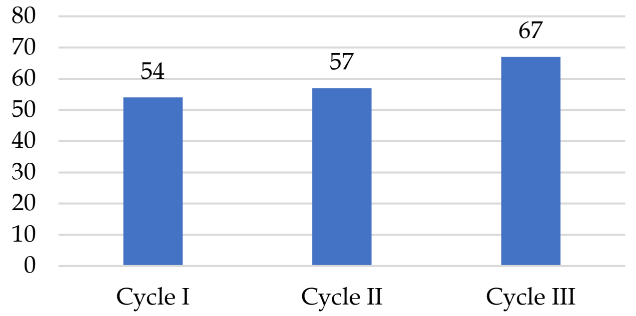

Figure 1. Percentage of Scientific Literacy of Class XI IPA I Students

Scientific Literacy Data Based on 2018 PISA Indicators

There are three indicators tested in this scientific literacy problem, namely:

LS 1 : Explaining phenomena scientifically;
LS 2 : Evaluating and designing investigations scientific; And
LS 3 : Interpreting data and evidence scientifically.

The results of the analysis of the level of students' scientific literacy abilities based on indicators from each cycle action showed the following results.

1) The level of students' scientific literacy abilities is based on indicators in cycle I action

Based on the results of the analysis of student's answers to the 6 scientific literacy questions tested on the human respiratory system material in the first cycle of action, the results were obtained as in Table 4.

Table 4. Students' scientific literacy level based on indicators (Cycle I)

Indicator	Question	Student scores	Max score	(%)
LS 1	2, 3, 5	152	264	57.6
LS 2	4	47	88	53.4
LS 3	1, 6	81	176	46.

The level of students' scientific literacy ability in Table 4 shows that students' ability to explain phenomena scientifically is in the low category, students' ability to evaluate and design scientific investigations is in the very low category, and students' ability to interpret data and evidence scientifically is in the very category. low.

The application of lesson study in cycle I uses the Guided Inquiry learning model with learning steps to identify problems, formulate problems, develop hypotheses, collect data, analyze data, make conclusions, and communicate results. In the first cycle, the observer noted that there were still deficiencies that needed to be corrected in subsequent cycles, students found it difficult to understand the meaning of the questions posed by the teacher, difficulties in formulating problems and compiling hypotheses, students also found it difficult to identify existing problems. in student worksheet, students had difficulty recording/capturing the meaning of the information conveyed by the video and students were not used to answering HOTs-based scientific literacy description questions. There are also other deficiencies in the teacher, namely the teacher cannot manage the class when studying in groups and does not provide opportunities for students to take notes.

Based on the results of observations in cycle I, the implementation of lesson study with the Guided Inquiry model in cycle I has not been able to improve students' scientific literacy skills. This can be seen from the results of the formative test on literacy questions carried out at the end of the first cycle of action, which obtained an average score of 53.0 with a percentage of 53%, in other words, students' overall scientific literacy abilities after the first cycle of action were still in the very low category, especially on students' ability to interpret data and evidence scientifically which only got a score of 81 with a percentage of 46% and was in the very low category. From the results of observations in the first cycle of action, it can be seen what the effects are when teachers are used to implementing conventional learning models that only rely on book material and lecture methods. This is because conventional learning places more emphasis on the process of conveying material verbally from a teacher to a group of students with the aim that students can master the subject matter optimally (Alim, 2020). Conventional learning is teacher-oriented, the teacher plays a dominant role and students are not required to find the material. This will of course result in students being unfamiliar with expanding and deepening their knowledge so that students become passive (Dwi Apriliani et al., 2019). In section I, it appears that students are not yet accustomed to student-centered learning models, and more emphasis is placed on active learning processes in finding their own answers, as implemented in the guided inquiry learning model.

2) The level of students' scientific literacy abilities is based on indicators in cycle II actions

Based on the results of the analysis of students' answers to the 6 scientific literacy questions tested on the human respiratory system material in cycle II, the results were obtained as in Table 5.

Table 5. Students' scientific literacy level based on indicators (Cycle II)

Indicator	Question	Student scores	Max score	(%)
LS 1	1, 3, 4, 5	202	352	57.4
LS 2	2	49	88	55.7
LS 3	6	50	88	56.8

The level of students' scientific literacy ability in Table 5 shows that students' ability to explain phenomena scientifically is in a low category, students' ability to evaluate and design scientific investigations is in a low category, and students' ability to interpret data and evidence scientifically is in a low category.

The application of lesson study in cycle II uses the Problem-Based Learning learning model with problem-oriented learning steps, organizing students, guiding investigations, developing and presenting results, analyzing and evaluating problem-solving processes. The observer noted that there had been improvements indicating that the learning activities had been carried out properly, where the teacher had been able to make improvements to some of the deficiencies that existed in cycle I. However, there were still a number of things that needed to be improved in the next cycle, such as students still answering teacher's questions in groups, students rely on each other in the literacy process/not all students are involved in literacy activities, and it seems that students have difficulty answering literacy questions based on HOTs.

From the results of observations in Action Cycle II, it can be seen that students are starting to get used to the application of a student-centered learning model and more emphasis is placed on an active learning process in finding their own answers. There appears to be a slight increase in students' scientific literacy abilities after implementing lesson study with the Problem-Based Learning model in cycle II, where the results of the formative literacy test carried out at the end of the action in cycle II obtained an average score of 57.0 with a percentage of 57%, in other word Students' overall scientific literacy abilities experienced a slight increase after the second cycle of action was carried out, especially students' ability to interpret data and evidence scientifically which increased by 10.8%. Consistent with the findings of Rismawati et al., (2020) this study also shows that the PBL model has a considerable influence on the development of scientific literacy. The use of the PBL model, can actively stimulate students to be able to seek answers to problems given by educators and help students actively construct knowledge. Even so, after the action cycle II students' scientific literacy skills as a whole were still in the low category.

3) The level of students' scientific literacy abilities is based on indicators in cycle III actions

Based on the results of an analysis of student answers from 6 scientific literacy questions that were tested on the human respiratory system material in the third cycle of action, the results were as shown in Table 6.

Table 6. Students' scientific literacy level based on indicators (Cycle III)

Indicator	Question	Student scores	Max score	(%)
LS 1	1, 4, 5, 6	245	352	69.6
LS 2	3	38	88	43.2
LS 3	2	71	88	80.7

The level of students' scientific literacy abilities in Table 6 shows that students' abilities in explaining phenomena scientifically are in the medium category, students' abilities in evaluating and designing scientific investigations are in the very low category, and students' abilities in interpreting data and evidence scientifically are in the high category.

The implementation of lesson study in cycle III uses the LOK-R learning model with literacy, orientation, collaboration, and reflection learning steps. The observer noted that there had been improvements which showed that the learning activities had been carried out well, where the teacher had been able to make improvements to several deficiencies in cycle II. However, there are still several things that need to be improved in the next cycle, such as for example the students appointed to answer questions take quite a long time, the teacher does not ask questions evenly to most students, and it appears that students still have difficulty answering HOTs-based literacy questions, only a few students saw an increase in answering HOTs-based literacy questions.

Based on the results of observations of teachers and students during the implementation of cycle III actions, it appears that the implementation of the actions has reached the predetermined performance indicators. In addition, it appears that there has been a slight increase in students' scientific literacy abilities after implementing lesson study with the LOK-R model in cycle III, where the results of formative tests on literacy questions conducted at the end of cycle III action obtained an average score of 67.0 with a percentage of 67%. in other words, students' scientific literacy abilities as a whole experienced a slight increase after the third cycle of action, especially in students' ability to interpret data and evidence scientifically which increased by 23.9% and is in the high category. In line with the results of research conducted by Pasongli et al., (2022), which shows an increase in student learning activities at each stage in the LOK-R learning model, where students are encouraged to think critically so that in the end students have the ability to manage information and communicate creatively both verbally and in writing, even digitally and visually. However, students' ability to evaluate and design scientific research decreased by 12.5% and was in the very low category. A decrease in one of these scientific literacy abilities can occur because most students have difficulty understanding the intent and order of the questions so most students get fairly low scores on the questions that are integrated with the scientific literacy indicators. The scientific literacy ability of students as a whole is in the medium category after Cycle III of action (Figure 2).

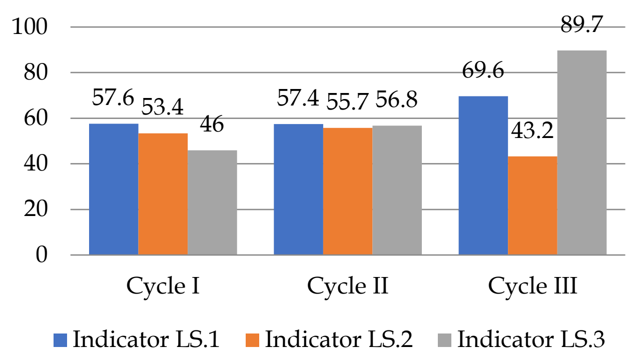

Figure 2. Science literacy abilities of class XI IPA 1 students based on PISA 2018 categories

The application of lesson study in Cycles I to Cycle III shows that it is effective in increasing students' scientific literacy abilities. This can be seen from the average score of the formative tests and the overall percentage which has increased with each cycle. In addition, the results of student literacy activities in student worksheet also show an increase in students' ability to understand and explain a phenomenon scientifically and interpret data scientifically. An increase in students' ability to understand and explain phenomena scientifically can be seen from their ability to understand information during literacy activities in textbooks, the internet, and videos and to explain back information that has been obtained both in writing in student workshtet and orally during presentations in front of the class. Meanwhile, an increase in students' ability to interpret data scientifically can be seen in their ability to understand and solve a problem based on data/information contained in the student worksheet.

Even though students' scientific literacy skills have increased after implementing lesson study in learning, they have not yet reached the high/very high category. The lesson study that has been carried out in learning the respiratory system material can only improve students' scientific literacy skills to reach the medium category. One of the main factors that causes students' scientific literacy skills to not be achieved in the high/very high category is that most students are not used to answering HOTs-based literacy questions, which have cognitive and difficulty levels of C3 (application), C4 (analyzing), and C5 (proving the truth of an information). Students are used to answering questions/questions at C1 and C2 cognitive levels/LOTs type, so they experience difficulties when taking formative tests with HOTs type literacy questions and get results/scores that are less than optimal.

Conclusion

Based on observations and results of data processing during the research which included data analysis to find out the increase in students' scientific literacy and observational analysis to find out student activities, a conclusion was obtained that the application of lesson study was able to improve students' scientific literacy skills in respiratory system material in class XI IPA 1 to medium category. The main factor causing an increase in students' scientific literacy skills only reaching the moderate category was students who were not used to answering HOTs-based literacy questions and were used to answering LOTs type questions, so they had difficulty in doing the formative tests given. Based on data on students' scientific literacy abilities, this indicates that teachers should pay more attention to improving students' scientific literacy skills through a contextual learning process by linking science and science applications in students' daily lives, using varied and student-centered learning models (Student Centered Learning), as well as getting students used to answering HOTs-based literacy questions.

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Author Contributions
Lesy Luzyawati: conceptualization, methodology, formal analysis, investigation, validation, visualization; Idah Hamidah: writing – review and editing, supervision; Aditya Fauzan: writing-original draft preparation, and resources; Erti Wiyati: Biology learning practitioners.

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Conflicts of Interest
The authors declare no conflict of interest

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