IMPLEMENTATION OF LEVELS OF INQUIRY ON SCIENCE LEARNING TO IMPROVE JUNIOR HIGH SCHOOL STUDENT'S SCIENTIFIC LITERACY

PENERAPAN LEVELS OF INQUIRY PADA PEMBELAJARAN IPA UNTUK MENINGKATKAN LITERASI SAINS SISWA SMP

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ABSTRAK

Literasi sains merupakan hasil belajar kunci bagi semua siswa. Berdasarkan hasil observasi, literasi sains siswa kurang difasilitasi dalam proses pembelajaran IPA di kelas. Pembelajaran levels of inquiry merupakan salah satu alternatif solusi untuk meningkatkan literasi sains. Oleh karena itu, tujuan penelitian ini adalah untuk meningkatkan literasi sains siswa SMP melalui penerapan levels of inquiry pada pembelajaran IPA tema pemanasan global. Penelitian ini menggunakan metode eksperimen lemah dengan desain penelitian one group pretest-posttest. Sampel dalam penelitian ini adalah 35 siswa kelas VII SMP pada semester genap tahun pelajaran 2014/2015. Data penelitian diperoleh melalui tes literasi sains. Temuan dalam penelitian ini adalah kompetensi menjelaskan fenomena ilmiah dan kompetensi menginterpretasikan data dan bukti ilmiah meningkat secara signifikan. Sedangkan, kompetensi mengevaluasi dan merancang penyelidikan ilmiah tidak meningkat secara signifikan. Selain itu, pada domain pengetahuan menunjukkan bahwa ketiga aspek pengetahuan yaitu pengetahuan konten, pengetahuan prosedural, dan pengetahuan epistemik meningkat secara signifikan.

ABSTRACT

Scientific literacy is the key learning outcomes for all students. Based on observation, scientific literacy of student is less facilitated in science learning. Learning of levels of inquiry is one of solution alternative to increase science literacy. So that, that aim of this study to improve scientific literacy for junior high school students through implementing levels of inquiry in science learning with the theme of global warming. This study used a weak experimental with one group pretest-posttest design. The sample in this study are 35 student at 7th grade at junior high school in Second semester in academic year 2014/2015. The data of this study is taken by scientific literacy test. The results showed that explain phenomena scientifically competence and interpret data and evidence scientifically competence has increased significantly. Meanwhile, evaluate and design scientific enquiry competence is not significantly increased. In addition, the domain knowledge indicates that the three aspects of the knowledge which consist of content knowledge, procedural knowledge, and epistemic knowledge has increased significantly.

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Keywords: global warming, levels of inquiry, scientific literacy

INTRODUCTION

Scientific literacy is the ability to think scientifically and to use the knowledge and the process of science to understand the natural phenomenon that is able to take decisions to solve the problems facing science. Holbrook & Rannikmae (2009) looked at the scientific literacy as a condition that must be owned by the students in adjusting the challenges of rapid changing times so that science literacy learning drilled in parallel with the development of life skills. Science literacy means the ability of a person to understand the science, communicating science (oral and written), and apply the scientific knowledge to solve problems that have the attitude and the high sensitivity of the self and the environment in making decisions

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based on considerations of science (Toharudin et al. 2011). In this case, students who have scientific literacy able to apply the concepts or facts obtained in the classroom to solve natural phenomena that occur in everyday life.

The importance of scientific literacy relates to how the students were able to appreciate nature by utilizing science and technology has been mastered. Wenning (2006) argues that scientific literacy is the key learning outcomes in education for all students. Students who have scientific literacy has the characteristic of scientific literacy. Characteristics of scientific literacy among maintain and respect nature, to know the purpose and boundaries between science and technology, determine the relationship between science and technology, have a common ground and key ideas of science; able to interpret numerical data, had the idea to provide solutions on issues relating to science and technology (Millar, 2007). Scientific literacy provides an opportunity as well as the limits of scientific knowledge in the context of current issues. To have the characteristics of scientific literacy, a person is required to not only have a positive attitude towards science in order to master the knowledge of science well, but also has the ability to form scientific ability and cultivate themselves with the values of science in every dimension of life. If these aspects are owned, and strengthened again by learning science with a positive attitude towards science, scientific literacy characteristics as stated above will be embedded in students (Osman et al. 2007).

Based on observations and interviews with science teachers, obtained the fact that science learning is done in the classroom did not facilitate students to develop scientific literacy. It is caused by several things. First, science learning that conducted in schools do not depart from the scientific phenomena that are familiar to the students. Second, less science learning through scientific investigation in the form of experimental activity that is meaningful. Experiment activities conducted so far tended to be experimental verification. Students are not trained in designing experiments to be conducted and identify the variables in the experiment. Students tend to do activities that are experimental verification in accordance with worksheets provided by the teacher. Third, science learning tend to emphasize the aspect of understanding memory. Still very rare science learning undertaken to build analytical skills such as the ability to translate, connect, explain

and apply scientific information based on the data source. Based on this, almost certainly not happen science process of learning, in which students are trained to formulate scientific questions for investigation, using the knowledge that is taught to explain natural phenomena, and draw conclusions based on the facts observed. Fourth, students are less trained in work on the problems that promote scientific literacy capabilities. Instrument questions used in assessing the ability of students are less associated with the real life that faced by students that do not provide students the opportunity to use the knowledge and the science they have learned optimally. In addition, a science teacher also complained about the turn of the curriculum happens. Substitution curriculum which takes place in a short time impact on the confusion felt by the teacher. This makes teachers tend oriented material. The material will be delivered tends to be unconventional without being accompanied with experimental activities to train the students' analytical skills.

Table 1. Hierarchy Level of Inquiry

Levels of Inquiry	Intellectual sophistication	Locus of control
Discovery learning	Lower	Teacher
Interactive demonstration		
Inquiry lesson		
Inquiry lab		
Real word application		
Hypothetical inquiry	Higher	Student

The weaknesses of the Indonesian students must be overcome so that students have a better scientific literacy. One solution is deemed to overcome the problem and can improve scientific literacy of students is to implement levels of inquiry (LOI). LOI is an approach to learning that takes into account the development of intellectual abilities and skills systematically through the process of scientific inquiry elections systematic and comprehensive pattern. LOI is a hierarchy of learning that starts from the stage of discovery learning, interactive demonstration, inquiry lesson, laboratory inquiry, real-word application, and hypothetical inquiry. The sixth stage is sorted by the intellectual capability and the controllers involved in learning. Intellectual ability is the ability possessed by the students in the following study with a particular method, while the controller is the party that controls learning activities such as the party that dominates in implementing each stage of learning, play a role in finding problems,

attempted to formulate conclusions (Wenning, 2005; 2010; 2011). The higher stage of LOI is the higher of intellectual ability of students involved in learning. However, the lower stage involvement of teachers means that students increasingly active in taking the role when the process of learning and scientific investigation. LOI hierarchies can be illustrated by Table 1.

Scientific literacy that referred to in this study is scientific literacy framework that refers to the PISA 2015 (OECD, 2013). Characteristics of scientific literacy divided into four interrelated domains, namely domain contexts, competencies, knowledges and attitudes. Assessments of science literacy context. But assessing the competence and knowledge in that context. There are three competencies in the domain of competence, namely explain phenomena scientifically, evaluate and design scientific enquiry, and interpret data and evidence scientifically. Meanwhile, the domain knowledge consists of three aspects: content knowledge, procedural knowledge and epistemic knowledge.

Based on the background and literature review that has been described, the formulation of the problem in this study is whether the implementation of the LOI on the theme of global warming in science learning can improve scientific literacy of junior high school students. Based on the formulation of the problem, then the purpose of this research is to improve the junior high school student's scientific literacy through the implementation LOI on science learning on the theme of global warming.

METHODS

This study used a weak experimental method. This method aims to compare the scientific literacy of students before and after the implementation LOI on science learning with the theme of global warming. The method usage in this study is because of LOI is in development stage to be implemented in science learning. In this study, there are two variables, namely the independent variable that is science learning with LOI, while the dependent variable is the scientific literacy of students.

This study was used design of one-group pretest-posttest design. On this design, a group is measured or observed not only after given a treatment, but also before given a treatment (Fraenkel et al. 2012). This design usage is based on the main purpose of this study that is to determine the increase of scientific literacy

of students after the implementation of LOI, it is not to compare to another model. One-group pretest-posttest design described as follows.
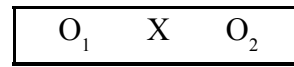
$$O_1 \quad X \quad O_2$$

Figure 1. *One-Group Pretest-Posttest Design*

The population in this study were all students of sevent grade student in one of the Junior High School in Lembang. Meanwhile, the sample in this study were students in seventh grade student amounted 35 students in the academic year 2014/2015. The sampling method used in this study is nonrandom sampling. The sampling technique used was purposive sampling that is taking samples from the members of the population carried out by certain considerations. Consideration of sample selection based on information from the science teacher who stated that the response to learning and participation of students in learning well enough so that the research process is expected to run smoothly as expected without any technical problems such as the difficulty to condition students to learn.

The research instrument used a matter of scientific literacy test. Scientfic literacy tests used to assess the scientific literacy of students before and after the implementation of LOI on science learning with the theme of global warming. Based on sampling methods and techniques so that the test score data were analyzed using non-parametric statistical test of Wilcoxon. This is done because the data distribution of pretest and posttest scores were not normally distributed. Wilcoxon test was also used to determine the increase of scientific literacy that occur after the implementation of LOI on science learning with the theme of global warming.

This study was conducted during three meetings. The first meeting is study the sub-themes related to the temperature and the heat of global warming. The second meeting studied the sub-theme of the greenhouse effect. The third meeting studied the effects of global warming. Science learning on global warming theme developed in this study used a model of integration of the integrated type. Integration model of integrated type is integrated learning model which is used integrated approach across fields of study. Integrated type also referred to as thematic learning. Type of integrated cultivated by combining several fields of study by defining curricular priorities and find

the skills, concepts and attitudes that overlap in some fields of study (Muqoyyanah et al. 2010). Theme that taken in this study is global warming. Integrated typeis choosed because theme of global warming is an integration of some of the material content of biology, physics, and chemistry subject.

RESULTS AND DISCUSSION

Science literacy as Overall

The implementation of LOI on science learning with the theme of global warming done during three meetings. Before the subjects given a treatment, firstly given pre-test that aims to identify the early scientific literacy of the students. After given a pre-test, subjects are given treatment of the implementation of LOI on science learning with the theme of global warming for 3 meetings. Based on the analysis of curriculum and characteristics of junior high school students, the implementation of LOI at the junior level is done until the inquiry lab stage. LOI which used from discovery learning, interactive demonstration, lesson inquiry, and inquiry lab stage. The four stages are implemented systematically, gradually and comprehensively in a one meeting with the allocation time of 80 minutes for each meeting. In the discovery learning, students are given the opportunity to state a fact and describe the phenomena based on facts. At this stage of interactive demonstration, students are given the opportunity to be able to make predictions and use their knowledge. At the inquiry lesson, students are trained to design an investigation to identify the principles or relationships. At the stage of inquiry lab, students are given the opportunity to establish an empirical law based on the measurement variable. The stages in the LOI in line with scientific literacy competency domain covering explain phenomena scientifically, evaluate and design scientific enquiry, and interpret data and evidence scientifically (OECD, 2013). After being given a treatment for three meetings, then the subjects given post-test to determine the scientific literacy of students.

In obtaining the data of scientific literacy was used the value of the pretest and posttest of the 26 questions that were developed in the form of multiple choice questions. was given before and after the implementation of LOI in science learning global warming theme. Based on the results of the pretest and posttest, conducted hypothesis test used Wilcoxon test. The following are the results of hypothesis testing used Wilcoxon test.

Table 2. Results of Pretest and Posttest on Scientific Literacy

Test	Pre-Test	Post-Test
N	35	35
Mean	7,94	3,04
SD	13,23	4,04
Z		-4,597
P-value		0,000

Based on the research results, scientific literacy of students has increased after implementation of LOI on science learning with global warming theme. Based on Wilcoxon test results can be concluded that the value of posttes is better than the pretest score after applied LOI on the theme of global warming. This result showed that after the implementation of LOI on science learning with the theme of global warming, scientific literacy of students has increased significantly if compared to before the implementation of LOI on science learning with the theme of global warming.

Increased scientific literacy of students as a whole also can be seen by the average percentage posttes value compared with the pretest. The average percentage of the overall scientific literacy of students as shown in Figure 2.
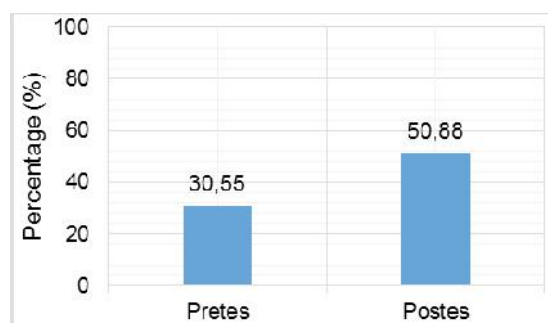

Figure 2. Diagram Percentage Score of Scientific Literacy

Based on the diagram above obtained a description that the percentage average of scientific literacy of students has increased by 20.33%. This result showed that scientific literacy of students has increased after the implementation of LOI. This increase can occur because during the implementation of LOI on science learning with the theme of global warming, students are encouraged to explain phenomena scientifically that can be observed in everyday life in the phase of discovery lear-

ning. Then, students evaluate the scientific investigations that carried out by the teacher in the interactive demonstration stage. After that, students are trained to design scientific experiments through inquiry lesson stage. In addition, students are also trained to interpret data and scientifically evidence based on the results of experiments conducted in the inquiry lab stage.

The overall implementation of LOI on science learning with the theme of global warming could increase the scientific literacy of students. This finding is consistent with research conducted by Gormally et al. (2009) which states that the inquiry-based learning can enhance students' scientific literacy. In addition, inquiry-based learning makes students more confident in using scientific literacy of its capabilities after implementation of inquiry-based learning.

Increasing illustration of scientific literacy of students after the implementation of LOI on science learning with the theme of global warming can be described in more detail by analyzing each domain includes the domain of competencies and knowledge. The result study of each domain can be described as follows.

Competencies Domain

Competencies domain consists of three competencies that is explain phenomena scientifically, evaluate and design a scientific enquiry, as well as interpret the data and evidence scientifically were assessed using multiple choice questions that have been developed. Improvement of this competencies domain during implementation of LOI on the theme of global warming science can be presented in Table 3.

Based on the table above, the result of study showed that phenomena scientifically has increased significantly after the implementation of LOI on science learning with the theme of global warming. This can be demonstrated through a p-value of 0.000 (<0.05). Evaluate and design a scientific enquiry competency did not a significant increase after the implementation of LOI science learning with the theme of global warming. This can be demonstrated through a p-value of 0.059 (> 0.05). Meanwhile, interpret data and evidence scientifically competency has increased significantly after the

implementation of LOI on science learning with the theme of global warming. This can be demonstrated through a p-value of 0.000 (<0.05). The increase of each competency can also be seen by comparing the percentage of the pretest and posttest scores. In Figure 4, presents the percentage of student scores in each competency.
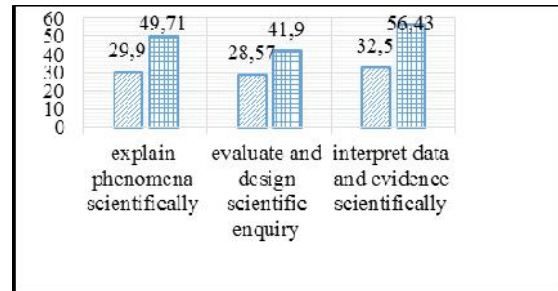

Figure 4. Diagram Percentage Score of Scientific Literacy Competencies

Based on the diagram above, it can be seen that the scientific literacy of students in the domain of competence increased in all three competences. For explain phenomena scientifically increased by 19.81%. For evaluate and design scientific enquiry increased by 13.33%. Interpret data and evidence scientifically competency has increased by 23.93%. Interpret data and evidence scientifically of the highest increase. The increase was 23.93%. It is showed that students have a high increase in terms of changing data from one representation to another representation, analyze and interpret data and draw the appropriate conclusions, and evaluate the scientific arguments and evidence from various sources (eg, newspapers, the internet, and journals). This is the positive effect that arises because students are trained using science learning with LOI on the theme of global warming. Students are trained in interpreting the experimental data in graphical form. Then, students are trained to draw conclusions based on the graph that has been created. This is in line with the results of Kurnianti et al. (2010) which states that the data interpretation skills increased after implementation of the experimental method guided.

Table 3. Results of Pretest and Posttest on Scientific Literacy Competencies

Competencies	Pretest		Postest		Wicoxon signed ranktest	
	Mean	SD	Mean	SD	Z	p-value
Explain phenomena scientifically	4,49	1,85	7,46	2,65	-4,636	0,000
Evaluate and design scientific enquiry	0,86	0,69	1,26	0,89	-1,888	0,059
Interpret data and evidence scientifically	2,60	1,54	4,51	1,82	-4,109	0,000

Table 4. Results of pretest and posttest on Scientific Knowledge

Aspect	Pretest		Postest		Wilcoxon signed rank test	
	Mean	SD	Mean	SD	Z	p-value
Content knowledge	5,77	2,33	9,49	3,23	-4,338	0,000
Procedural knowledge	0,97	0,75	1,74	1,19	-2,768	0,006
Epistemic knowledge	1,20	0,93	1,91	0,85	-3,082	0,002

The competence of evaluate and design a scientific enquiry is the competence which is has increased in lowest level compared to other competencies. Increase occurred only 13.33%. This result showed that students have difficulty in answering the questions related to how to evaluate and design a scientific investigation. This is related to the finding that students are not accustomed to identifying variables in the experiment. Students have difficulty in determining the variables in the experiment. This is due to several factors, including the weakness of the student's ability to identify the variables in a scientific investigation. During the implementation of science learning, teachers always provide assistance to students to identify the variables, whether that identifies the independent variable, the dependent variable and the control variables. This happens not out of habit when science learning that had occurred did not facilitate the students in activities to identify variables when designing a scientific investigation. This indicates that the implementation of LOI at this stage can't practice optimally to evaluate and design a scientific enquiry. Students not yet optimally facilitated in developing these competencies.

Identify the variables activity is the first step in designing an experiment. If the students make a mistake in identifying the variables that will affect in the next trial procedure. The findings of the weaknesses of students in identifying the variables in line with the results of Anggraini, et. al (2014) which states that the acquisition of the student scores less well in controlling variables. This happens because the students are not used to determine the independent variables and the dependent variable in an experiment. Therefore, the necessary corrective measures to overcome it.

The steps that teachers can do to improve student weaknesses in identifying the variable is to provide simple examples. Simple examples are given to students through meaningful discussions. Discussion using simple examples provide early knowledge to the students how to specify the variables in the experiment. This is done by starting discussion of choosing a research question, variables,

experimental procedures, data collected and analysis. Accustom students to think and act systematically in an experiment is a must do teachers in teaching students through inquiry. Inquiry gives students the opportunity to learn to understand the independently concepts and structured. Concepts that the students learned will shape the student knowledge. This knowledge is used by students in understanding and solving problems related to the phenomena that occur in everyday life. Thus, the students have scientific literacy which is showed by the students knowledge usage to understand the phenomenon that occur and then take a decision to address the phenomena and find solution to the phenomenon. Inquiry-based learning is the best way to achieve scientific literacy because it provides an opportunity for students to discuss scientific ideas (Gormally, et al. 2009).

Scientific Knowledge Domain

In this study also analyzed to determine the increase that occurred on the knowledge domain after the implementation of LOI on science learning with the theme of global warming. Improvement of knowledge domain after implementation of LOI on the theme of global warming can be presented in Table 4.
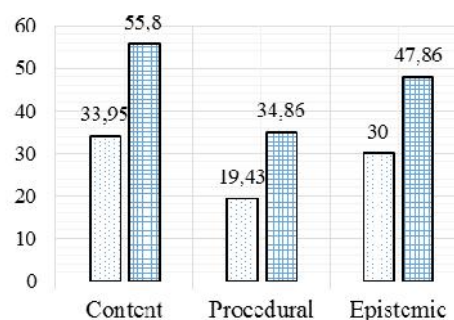
Figure 5. Diagram Percentage Score of Scientific Knowledge

Based on the Table 4, it is found that three aspects in the domain of knowledge has increased significantly after the implementation of LOI on science learning with the theme of global warming. This can be demonstrated through a p-value of 0.000 (<0.05). Improvement in every aspect of knowledge also can be seen by comparing the percentage of the pre-

test and posttest scores. In the Figure 6 below are presented the percentage of student scores in every aspect.

Based on the diagram above, it can be seen that the results of scientific literacy of students in three aspects contained in the domain of knowledge has increased. For content knowledge aspect has increased by 21.85%. For procedural knowledge aspect has increased by 15.43%. For epistemic knowledge aspect has increased by 17.86%. Based on the study result showed an increase in the percentage of the value of the greatest scientific literacy is the aspects of content knowledge that is equal to 21.89%. These findings indicate that students are able to master the knowledge of its content to solve the problem that given by the teacher. This is the positive effect that arises because students are trained in the discovery learning stage to recognize the phenomena based on the knowledge of students. The smallest percentage of the value of scientific literacy aspect of procedural knowledge that is equal to 15.43%. It is showed that the increase of students' ability to identify variables, formulating research questions, measurement, display tables have not been increased in an optimal observation compared to other aspects of knowledge. This indicates that the implementation of LOI at this stage is not optimally practiced the student to use their procedural knowledge to solve a problem. This happens because the students are not accustomed to solving problems that require students to analyze procedural stages. In addition, from these findings indicate that students have difficulty in answering the questions that promote procedural knowledge. This procedural knowledge required to carry out a scientific investigation that could produce a scientific evidence. The scientific evidence can be use to help the student to solve the problems that given by the teacher. From this knowledge, students are required to identification the variables involved in a phenomenon. This is the difficulty that forced by students during science learning using the LOI. The findings on this aspect of procedural knowledge in line with the findings on the evaluate and design scientific enquiry. At competency of evaluate and design scientific enquiry get the smallest result among other competencies.

The low increase in procedural knowledge for learning because students are not used to identify variables in the experiment. Students are not optimal in developing the concept in terms of the variables measured, the me-

asurement of both quantitative and qualitative, grouping variables, displays and abstracts data using another representation. These students weakness will be seen when students are faced with problems that require students to use its procedural knowledge. Rahayu (2015) in his research stated that the student has not been able to identify the variables and logical relationships among variables. Students are not able to describe, explain, and predict phenomena scientifically, especially in the receiving, observing, and preparing questions that related to global warming. Students are not optimal in using procedural knowledge that is used to obtain the valid and reliable data. The knowledge required to carry out a scientific investigation that could produce scientific evidence. The scientific evidence can be used to support a scientific statement. From this knowledge, it is expected that students will know that there is a difference of a measurement result and they can explain why it happened.

Overall, the implementation of LOI on science learning is capable to develop scientific literacy competence on the theme of global warming. It is an impact of LOI implementation start discovery learning through inquiry lab. Through the stages of discovery learning students are given the opportunity to understand the concept of temperature and heat along with the measurement, the greenhouse effect and global warming. It is showed that the stages of learning discovery can practice scientific literacy of students in competency explaining phenomena scientifically. With the knowledge and the science process that have by the students, the student is able to explain scientific phenomena that observed by students. Whereas, at interactive demonstration provides an opportunity for students to be able to explain the demonstration and make predictions about the relationship with the temperature of the expansion of gas agent, predictive relationship greenhouse effect in the bottle, and predictions of the temperature relationship with the expansion of the liquid. It is showed that interactive demonstration stages can practice scientific literacy of students in scientific investigations to evaluate competency. In inquiry lesson stage is train students to design a scientific investigation that starts from defining the purpose of the experiment, hypothesis, variables in the experiment, tools and materials used in the experiments, experimental procedures, and tables of experimental results. It is showed that the inquiry lesson stage can practice competence to

design a scientific investigation. At the stage of inquiry lab gives students the chance to prove the empirical law on the heat ($Q = m.c.\Delta T$), the combustion reaction produces CO_2, and the impact of global warming on aquatic life. Empirical law of evidence is based on the measurement of variables and analysis of experimental results. This indicates that the inquiry lab stage can practice the competence to interpret the data and scientifically evidence. Students by gradually and systematically been able to construct their knowledge during implantation of LOI on science learning with the theme of global warming. This is in line with the opinion of Wenning (2011) which states that the systematic learning can help students to develop their to think independently and structured.

The activities of the student at each stage of LOI is proven can help students to construct their knowledge and make learning activity becomes meaningful. Meaningful learning activity can happen if students can connect between the new knowledge with the knowledge that has been previously owned. This is in line with the opinion of Piaget states that knowledge is the result of human thinking process (organizing and adapting) are constructed from the experience continuously and whenever possible reconstruction because of the new understanding gained through the adaptation process of learning (Haristy, 2012). Meaningful learning activity requires management of learning in ways that active learning towards learning independently. Self-learning ability is the ultimate goal of meaningful learning. In order to achieve this, the learning activities are designed so that meaningful for students. Meaningful learning activity occurs when students actively participate in the learning process and finally be able to decide what to learn and how to learn it (Yamin, 2007). Meaningful learning activity is useful to foster active learning skills in students. Through meaningful learning activity students are expected to be better able to recognize and develop all the knowledge they had. It is showed that good and ideal learning, especially in the process of science learning is learning by doing and considering the characteristics of the students.

Based on the explanation above, it proved by Wenning argumentation (2011) which states that LOI is an approach that considers the development of intellectual abilities and skills through the selection process of science inquiry systematic and comprehensive pattern. This finding is consistent with research conducted Gormally et al. (2009) which states that the inquiry-based learning can enhance student's scientific literacy. In addition, inquiry-based learning makes students more confident in using scientific literacy of its capabilities after implementation of inquiry-based learning.

Assessment of scientific literacy of students used questions test that begin with phenomena make the students read the context of the question firstly. This is done with a view to encouraging students to better recognize the phenomena that are often observed in everyday life. Reading is a process for activating the memories in the brain so that someone can use prior knowledge to understand the reading. Problem model which was preceded by certain phenomena associated with text can practice scientific literacy of students. This is because by reading students do science process and use their knowledge to solve problems that exist in the matter. This finding is supported by research that conducted by Fang and Wei (2010), which shows that scientific literacy of students increased after application of inquiry-based learning accompanied with reading. In addition, the results of Gormally et al. (2009) shows that scientific literacy of students has increased substantially because students spend more time to read popular scientific reports, evaluate, and evaluate the results of the students experiment. Provide test questions based on scientific literacy is one way to parctice scientific literacy to students.

CONCLUSION

Based on the results of research and discussion, can be obtained several research conclusions. First, the overall scientific literacy has increased after implementation of LOI on science learning with the theme of global warming. The increased of scientific literacy can be seen in the domains of competence and knowledge. At the domain of explain phenomena scientifically and interpret data and evidence scientifically has increased significantly. Evaluate and designi scientific competency is not significantly increased. In the domain of knowledge, the three aspects of the knowledge that is content knowledge, procedural knowledge, and the ability of epistemic has increased significantly.

Based on the results of research and discussion that has been described, researchers can recommend some things related to the research that has been done. This recom-

mendation is expected to be a material improvement of this research and may be considered for future research in order to generate research that can contribute to education in Indonesia, especially in science learning. First, implementation of LOI on science learning with the theme of global warming is expected to be implemented to other schools. This needs to be done in order to increase scientific literacy of Indonesian students to be able to compete with other countries in the international arena. Second, assessment of scientific literacy should be measure the students attitudes, not only the competence and knowledge in a particular context. It is not in spite that the students attitude is the end result for someone who is said to have scientific literacy. Third, for emphasize that increasing scientific literacy that occurred on the domain competency and knowledge domain is the influence of the implementation of LOI, for further study should use control group. Fourth, as further consideration study for the allocation of time in designing science learning using LOI. It is related to the inquiry lesson number of activities that must be carried out at each stage and limitations experienced investigator during the study. Fifth, for overcome the weaknesses of the students in identifying variables, before they should be given an introduction to the discourse that contains variables. This is done to underpin students about procedural knowledge before designing an experiment.

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