

The Effectiveness of Global Warming Worksheet Sets Vision to Improve Students Critical Thinking Skills

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Abstract: The ability to think critically can be improved through a learning process that uses teaching materials in the form of worksheets specifically designed on the material of global warming to increase students' critical thinking abilities. The purpose of the study was to describe the effectiveness level of SETS vision global warming worksheets in improving critical thinking skills. The research method used is quasi experiment with non-equivalent control group design. Test Hypothesis difference in N-Gain control class with experimental class using independent sample T-test statistical test and test the hypothesis of the difference in the average pretest and posttest using paired T-Test samples. The experimental class uses SETS vision worksheets, while the control class uses conventional worksheets. The test subjects were high school students in one of the city districts in Lampung Province. Experimental class N-Gain results are higher than the control class. In the experiment class the average posttest score was higher than the pretest. Learning about global warming using SETS vision worksheets is effective in improving the critical thinking skills of high school students.

Keywords: Worksheet, SETS, Global Warming, Critical Thinking.

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Introduction

Learning is essentially an interaction between the teacher and students. A physics subject teacher not only teaches theory, concepts and formulas that must be memorized, but physics learning requires understanding, because teaching is an activity that a teacher creates a learning environment, so that students can develop intelligence to be independent (Arends, 2008). Education carries out the mandate to answer the challenges of life in the future. The 2013 curriculum aims is to prepare Indonesian people to have the ability as individuals and citizens who are faithful, productive, creative, innovative, and affective and able to contribute to world life, nation, state and world civilization. Improving critical thinking competence among students is very important in the global competitionera, because the level of complexity of the problems in all aspects of modern life is getting higher. Critical thinking is important for dealing with complex local, national and international issues.

Critical thinking is a directed and clear process that is used in mental activities such as solving problems, making decisions, persuading, analyzing assumptions, and conducting scientific research (Kartimi and Liliyasi, 2012), in addition according to Snyder and Snyder, (2008) critical thinking is a skill learned requires instruction and practice. The most valuable skills that can be passed on by the school to its graduates and learning goals for teachers are critical thinking (Thompson, 2011). Learning activities of the concepts, principles, and theories are well structured can be used as a way to improve critical thinking skills.

According to Duron *et al.*, (2006) students' critical thinking skills can be optimized through the learning process of learning through five learning steps that are student-centered, namely a) determining learning objectives, b) teaching through questions, c) practice before you assess, review, improve, and increase, d) provide feedback and e) learning assessment, so that critical thinking skills and learning outcomes of students can improve. For students and teacher worksheets can be one of the guidelines in the implementation of learning and as an evaluation tool to find out the achievement of learning outcomes. Learners need worksheets that lead to critical thinking indicators. Five indicators of critical thinking are (a) providing simple explanations, (b) building basic skills, (c) concluding, (d) providing further explanations, (e) managing strategies and tactics (Ennis, 1996). The worksheet directs the learning process of students to find concepts, theory of conclusions (Astuti and Setiawan, 2013). Where learning produces positive effects on students and is accustomed to thinking science / scientifically so that students can find several ways to solve problems encountered (Birdsall, 2013).

Global warming is a new material in the curriculum that is used today. One of the environmental problems of living today, the impact of global warming is climate change that can affect rainfall patterns and sea level rise (Shepardson *et al.*, 2011). According to Meehl *et al.*, (2005) sea level rise reached 32%. The current perceived impact on island nations, Indonesia is the most vulnerable to rising sea levels climate change and sea level rise are implications of global warming, caused by increases in greenhouse gases, especially carbon dioxide (CO₂) and methane (CH₄). The impact of global warming can be reduced by understanding the basic concepts of global warming right so that students know what impacts will occur due to global warming, so students can determine the right coping solutions.

Understanding the concept of global warming of students in Indonesia is still low (Rosidin and Suyatna, 2017) and in the Midwest according to Shepardson *et al.*, (2011) high school students are still confused in understanding the material that causes global warming, namely the greenhouse effect. Most of the children interviewed are unable to answer the greenhouse effect questions correctly (Taber and Taylor, 2009). Natural conditions today are inseparable from the influence of technological developments (Hadzigeorgiou and Skoumios, 2013).

Submitting the material of global warming certainly requires a media that can lead students to think critically. The selection of appropriate media is also a contributing factor to the success of learning. According to Nugraha *et al.*, (2013) by using SETS visionary instructional materials can provide students 'footholds and lures to look for relationships between elements so that students' critical thinking skills can improve. The concept of global warming can be easily understood and lasts a long time if learning is related to everyday life and is packaged interestingly, (Duron *et al.*, 2006).

Based on the problems faced, it is necessary to learn global warming using worksheet SETS visionary that can improve students critical thinking. Worksheet is one of the teaching

materials that are important for achieving success in learning global warming. Worksheets are teaching materials that have been packaged in such a way that students are expected to be able to study the teaching material independently (Damayanti, 2013). By using worksheet victionary SETS-enabled worksheets, the teacher can provide footholds and lure students to look for relationships between elements in SETS so that students' critical thinking skills can improve. SETS visionary learning that connects the theories learned with their application in the form of technology, their impact on society and the environment is a form of learning that is real and contextual (Nugraha *et al.*, 2013).

Based on the analysis of student responses to the questionnaire given to 30 high school students, it is known that as many as 93% of students stated that students need worksheets to make it easier for global warming material. The results of the questionnaire analysis of 4 teachers at SMAN 3 Metro found that 60% of teachers agreed if a worksheet with SETS vision is developed to improve students' ability to think critically, because the worksheet is not yet available to support the learning process.

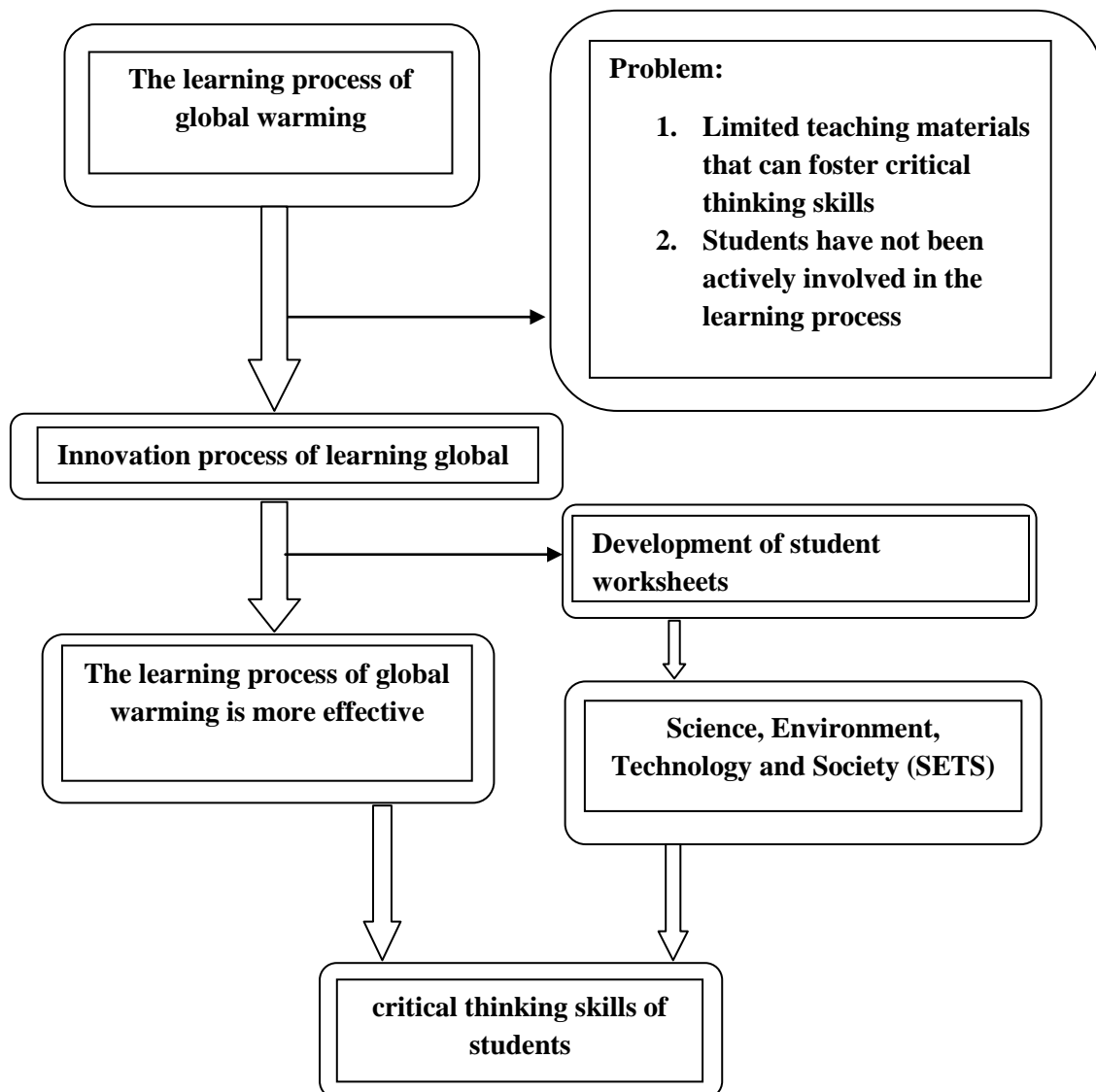


Figure 1. Flowchart of SETS vision for global warming worksheets

Worksheets designed specifically for global warming material so that learning in this material can be more efficient because one of the causes of the lack of success in understanding the learning material in learning is due to the absence of teaching materials (special worksheets supporting the learning of global warming material). This study aims to describe the effectiveness of SETS visionary global warming worksheets to improve the thinking skills of high school students.

Material of global warming is easy to understand and lasts long when packaged learning is interesting (Duron *et al.*, 2006). Students' critical thinking abilities can be optimized through 5 steps: determining learning goals, teaching through questions, experimenting before drawing conclusions, providing learning feedback and assessment, so that critical thinking skills and student learning outcomes can improve, the 5 steps are written on the worksheet global warming by using SETS vision worksheets, the teacher can provide footholds and lure students to find the linkages between elements in SETS so that students' critical thinking skills can improve. SETS visionary learning that connects the theories studied with their application in the form of technology, their impact on society and the environment is a form of learning that is real and contextual (Nugraha *et al.*, 2013).

Method

The research method used is quasi experiment with non equivalent control group design. The effectiveness of the learning process using the worksheet is seen from the results of the Pretest and Posttest. Implementation of research in high school in the city of Metro Lampung province. The subjects of the study are the experimental class XI IPA1 and the control class XI IPA2. Subjects are determined through purposive sampling by considering aspects of specific research objectives. The research design is illustrated in table 1.

Table 1. Design of pretest-posttest of control class and experimental class

Student Group (class)	Pretest	Treatment	Posttest
Experimental	Pretest	SETS vision worksheet	Posttest
Control	Pretest	Conventional Worksheet	Posttest

Fraenkel and Norman E. Wallen (2006)

Before the effectiveness level analysis is carried out, to find out that the data produced is normally distributed and come from the same variance, the normality test and homogeneity test are first carried out. The effectiveness of the learning process is seen from the results of the Pretest and Posttest. Data analysis used independent sample T-Test and pretest-posttest mean difference test to measure the effectiveness of SPSS assisted at a significant level of $\alpha = 5\%$. The effectiveness of the learning process using a worksheet based on the average normalized gain value can be calculated using the following equation:

$$\mathbf{N-gain} (< g >) = \frac{(\%<S_f> - \%<S_i>)}{(100 - \%<S_i>)}$$

Note :

S_f = posttest value

S_i = pretest value

S_m = maximum value

Classify normalized N-gain as follows: (1) if the g value ≥ 0.7 , then the resulting N-gain is in the high category, (2) If $0.3 \leq g < 0.7$, the resulting N-gain is in the medium category, (3) If it is < 0.3 , then the resulting N-gain is in the low category (Hake, 1999).

Results and Discussion

Based on the results of preliminary studies to analyze problems that occur in the field and needs analysis. The results of the initial concept analysis of students about the subject matter of global warming on students are that 85% of students do not know about greenhouse gases and are unable to explain exactly how greenhouse gases can cause global warming, 87% of students cannot properly mention due to global warming and 77% of students do not understand the actions that must be taken regarding actions to reduce global warming. The results of the initial study of the questionnaire of teachers' needs on the material of global warming in high schools in the city of Metro obtained 83% of teachers need worksheets of science-based global warming that can foster critical thinking. Based on the analysis of the results of the preliminary research conducted, the researchers concluded that it is necessary to develop SETS visionary global warming worksheet to improve critical thinking skills at SMA Negeri 3 Metro to help facilitate teachers and students in the learning process of global warming material so that the learning process will better achieve the objectives of physics learning with effective and efficient. Learning needs of global warming material given to students is known that as many as 100% of students state that they need special worksheets in learning material such as Global Warming. The SETS learning process is shown in table 2.

Table 2. Results of Global Warming worksheet activities 1 with SETS vision

Worksheet	Critical Thinking Indicators	Student Activities
Science The worksheet displays a graph of temperature rise data.	Learners can provide a graphical explanation of the temperature rise of global warming.	Students discuss with group members to observe the graph of global warming temperature rise.
Environment The worksheet displays images of human activities that cause environmental pollution that causes global warming	Students can provide conclusions of the pictures / phenomena presented.	Students conduct discussions with group members to observe the image / phenomenon effects of human activities that cause environmental pollution so that these activities can cause global warming.
Technology The worksheet displays technologies used in human activities that can cause greenhouse gases that cause global warming.	Students can provide an explanation of the impact of the technology used for human activities on global warming	Students conduct discussions with group members so that they can provide an explanation of the impact of the technology used for human activities on global warming.
Society Learners are looking for ideas / ideas in reducing human activities that produce greenhouse gases that cause global warming.	Students can provide strategies or techniques (ideas).	Students conduct discussions with group members to look for ideas / ideas in reducing human activities that produce greenhouse gases that cause global warming.

Table 3. Results of worksheet activities 2 Global Warming with SETS vision

Worksheet	Critical Thinking Indicators	Student Activities
Science Teacher worksheets display videos of natural disasters, uncertain seasons, melting ice poles, fires and floods.	Students can observe and consider the results of observations, by recording things that are very necessary.	Students discuss with group members to observe videos of natural disasters, uncertain seasons, melting ice poles, fires, and floods.
Environment The worksheet displays images of unfavorable environments such as rising sea levels, cracked soil due to prolonged drought, extinction of some endangered species at the poles, and loss of coral reefs at sea.	Students can provide conclusions of the pictures / phenomena presented.	students discuss with group members to observe unfavorable environmental images / phenomena such as rising sea levels, cracked land due to prolonged drought, extinction of some endangered species at the poles, and loss of coral reefs in the sea also answer questions provided in the worksheet
Technology The worksheet displays actions taken using several technologies such as transportation, electricity generation	Students can provide an explanation of the impact of the technology used for human activities on global warming.	Students conduct discussions with group members so that they can provide an explanation of what actions should be taken if using excessive transportation, using excess electricity and some activities that can cause global monitoring
Society Learners are looking for ideas / ideas in reducing human activities that produce greenhouse gases that cause global warming.	Students can provide strategies or techniques (ideas / ideas).	Students conduct discussions with group members to look for ideas / ideas in reducing human activities that produce greenhouse gases that cause global warming.

The effectiveness test of SETS visionary global worksheet is done by analyzing the results of pretest and posttest critical thinking skills of students regarding the causes and effects of global warming and ideas to overcome the effects of global warming. The results of effectiveness analysis are presented in table 4.

Table 4. Different test of pretest and posttest mean of critical thinking skills

Treatment	Protest Average Value	Posttest Average Value	N-gain	Paired Samples Test Sig. (2-tailed)
SETS visioned global warming worksheet (experimental class)	50,65	86,19	0,704	0,000
Available worksheets (control class)	57,16	74,06	0,370	0,633
Independent Samples Test (Sig)	0,00		-	-

The results of the independent sample t-test showed that there is no difference in the initial ability of the average students in the experimental class and control class ($p = 0.633 > 0.05$). After the experimental class learning process with the treatment using SETS vision global warming worksheet while the control class using conventional worksheet is done posttest to find out the final results. The learning process obtains the average posttest results of the experimental class using SETS visioned global warming worksheets 86.19 and the average value of the control class using conventional worksheets 74.06. Critical thinking ability of students who obtained learning using SETS vision work increased significantly at 95% confidence level ($P = 0,000 < 0,05$) from 50,65 to 86,19. The average posttest result of N-gain for the experimental class is 0.704 with the high category and the control class is 0.370 with the medium category. It appears that the use of SETS vision worksheet is more effective in improving students' critical thinking skills on global warming material. The effectiveness of SETS vision global worksheet to improve students' critical thinking skills can be seen in the analysis results on indicators thinking critically shown in table 5.

Table 5. Average N-Gain of Critical Thinking Skills for Each Indicator

No. Question	Critical Thinking Indicator	Class				P
		Experiment	Criteria	Control	Criteria	
1	Analyze arguments.	0.77	High	0.56	medium	0,00
2	Defining terms and considering a definition.	0.82	High	0.60	Medium	0,00
3	Consider whether the source can be trusted or not.	0.87	High	0.53	Medium	0,00
4	Ask and answer clarification questions and critical questions.	0.81	High	0.61	Medium	0,00
5	Inducing and considering the results of induction.	0.72	High	0.61	Medium	0,00
6	Decide an action.	0.81	High	0.55	Medium	0,00
7	Make and study the values of consideration.	0.62	High	0.55	Medium	0,00

8	Reduce and consider the results of deductions.	0.87	High	0.56	Medium	0,00
9	Analyze arguments.	0.72	High	0.56	Medium	0,00
10	Analyze arguments.	0.77	High	0.56	Medium	0,00
	Average	0,71	High	0,60	Medium	0,00

Broadly speaking, learning using SETS vision worksheet development results is quite effective in improving student learning outcomes. This is in line with the results of Yulistiana's (2015) study of SETS teachers and students alike having a role that determines the achievement of learning goals. The teacher is very instrumental in creating students to always think integratively, inviting students to think critically in dealing with something by referring to SETS. Learning media is a very important element in the learning process in addition to teaching methods. SETS (equipped with interactive multimedia in the form of animation and video) can improve learning outcomes, improve process skills and activity in each activity. There is a positive response from students to SETS-based learning, and a positive response from the teacher to the Science learning tool developed with SETS vision.

Based on the description that the use of SETS vision-based global worksheet has a positive impact on students' attitudes towards greenhouse gas contributors, and the attitudes shown by students from the experimental class are better than the control class. The more experience students get through learning activities, the more the students' understanding of the material increases, so that participants can determine their attitude (Rizqi *et al.*, 2013), because attitudes determine one's ability to think. Critical thinking is the most valuable skill that can be inherited by the school for its graduates and learning goals for teachers (Thompson, 2011).

In table 5 the indicators of critical thinking that obtain high category results are indicators defining terms and considering a definition, considering whether sources can be trusted or not, asking questions and answering clarification questions and critical questions, deciding an action, and deducting and considering results deduction. Of the nine critical thinking indicators, seven indicators have increased in the high category, while the two indicators that induce and consider the results of the induction and assess the values of consideration have increased with the medium category. This can be caused by the SETS visionary worksheet design that is still not able to direct students to induce and consider the results of induction, as well as making and reviewing the values resulting from consideration. Snyder and Snyder (2008) revealed that, critical thinking requires training, practice, and patience. The SETS vision-based global worksheet enables students to study problems systematically so that critical thinking skills can be grown (Kartimi and Permanasari, 2012).

Conclusion

A SETS visionary global warming worksheet that is valid and effective integrates a) science process that is presented in the form of learning activities to observe and interpret the temperature change graph, b) the process environment presented in the form of learning activities to draw conclusions on the picture of global warming phenomenon, c) technology presented in the form of learning activities how students give correct explanations of human activities, d) society which is presented in the form of learning activities that can provide strategies or ideas reduce human activities that can cause global warming.

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