Improving Students' Higher Order Thinking and Environmental Attitudes through Implementation of Teaching Materials Based on Scientific Literacy and Conservation

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Article Info	Abstract
	Higher Order Thinking (HOT) ability and environmental attitudes was needed in facing challenges, demands, and the rapid development in the 21st century. Conditioning students in learning requires good teaching materials in accordance with students' need and global demans, current or future. One of the teaching materials needed was content-based on scientific literacy and conservation. The purpose of this study was (1) to analyze the improvement of HOT ability and environmental attitude of students through the implementation of teaching materials based on scientific and conservation literacy. (2) to analyze the differences of improving students' Higher Order Thinking Ability and environmental attitudes using scientific-based literacy and conservation as the teaching materials and not using it. This research was an experimental study conducted by pretest-posttest and group control design. The reseach subject was 30 students in grade VIIC (experimental group) and 30 students in VIIA grade (control group) in SMP N 1 Kaliwiro. We used written test to gather students' HOT ability improvement, and Likert scales for students' environmental attitude data. The data analysis technique used was using the N-gain test and t-test. The results of the study obtained that N-gain value of the experimental group on the aspect of Higher Order Thinking ability 0.70, the control group 0.40 which has the results of the t-test -7.83. The results of the environmental attitudes obtained the N-gain value of the experimental group 0.50 and the control group 0.18 which has the results of the t-test -7.19. The results showed that teaching materials based on scientific literacy and conservation can be used to improve Students' higher order thinking ability and environmental attitude.

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INTRODUCTION

The 21st century was seen as a century which information spread widely and technology developed very rapidly. Almost every aspect of life problem was solved by utilizing information and communication technology. According to Sedyawati et al. (2010) that one of the most prominent traits in the 21st century was the increasingly intertwined world of science, so that the synergy between them is become faster. In 21st century requires certain abilities from students in order to survive in it. One of ability that must be has in the 21st century is to be able to solve problems. This ability is very influenced for students to think higher than usual.

The importance of HOT ability in 21st century was also revealed by Trilling & Hood (1999) that the ability that should be possessed by in this century of knowledge is the ability to work together, to think highly, be creative, having skills, able to understand various cultures and have communication ability and capable to be life along learning (life long learning). On the other hand, the rapid development of science and technology has also increasingly triggered large environmental damage as stated in Sedyawati et al. (2010) that damage to natural resources continues to occur due to planned natural exploitation without regard to the damage to nature in the long term.

This 21st century is needed the next generation who not only having higher order thinking ability but also caring their environment. In fact, as a result of Trends in the International Mathematics and Science Study (TIMSS) in 2015, Indonesia received an average score of 397 and was ranked 4 th in the bottom of 43 countries that participated in TIMMS (Mullis et al., 2015). In addition, according to Setiowati et al. (2018) the results of the 2018 National Examination showed that students were still weak in higher order thinking abilities such as reasoning, analyzing, and evaluating. The study of environmental attitude from Nugroho et al. (2016) from the provision of the New Ecological Paradigm Scale (NEPS) in class VII students of SMP Negeri 3 Karanganyar scored an average score of 48.39.

This was reinforced by the results of research on Higher Order Thinking Ability and environmental attitudes in SMP N 1 Kaliwiro, Wonosobo District, which were still relatively low. From 10 HOT multiple choice questions given to students, the average score was 42.2 (low category). Whereas from the results of the adaptation instruments of the New Ecological Paradigm Scale (NEPS) and Azwar (2003) which were used to measure environmental awareness with 15 statements about the attitude of caring for the environment was found: from 30 students, there were 2.2,% had the criteria of carelessness, 60% cared enough, 34% cared and 3.8% care deeply.

HOT ability were comparable to students' scientific literacy abilities. This can be seen from the research of Yuriza et al. (2018) in three of Junior High Schools in East Jakarta with the result that there was a positive relationship between Higher Order Thinking ability and the level of intelligence simultaneously with scientific literacy ability in students of Junior High School. This was similar to the results of the study from Anggraini (2014) that the ability of scientific literacy was directly proportional to the Higher Order Thinking ability possessed by students.

The relationship between scientific literacy and HOT ability can also be explained through thought processes. Bruner in Dahar (2011) states that Learning involves three processes that take place almost simultaneously, the three processes were: 1) acquiring new information, 2) transforming information and 3) testing the relevance and accuracy of knowledge. The process of thinking about human beings requires scientific knowledge. This was expressed by Smith et al. (2012) The existence of scientific literacy will make students reflective, critical, and intelligent, students will use scientific knowledge in the learning process. This is also supported by the thought process found in the holistic model of information literacy, called 'Colvin-Keene Model' (Keene et al., 2010).

Indonesian children's science literacy abilities were still low, from the results of the 2015 Program for International Student Assessment (PISA) study showing the level of scientific literacy of students ranked 3rd from the bottom

with scores obtained 403 and this score was below the standard average of PISA (PISA, 2015).

The attitude of caring for the students' environment can be obtained by providing elements of conservation in learning. This is in accordance with the research conducted by Susilo et al. (2016) with the results that the design of scientific learning with conservation vision has a significant effect on environmental care attitudes.

In order to be able to improve the ability to think in a higher direction and an attitude of caring for the environment a means is needed in the learning process. One of the facilities that can be used by teachers is to use teaching materials based on science and conservation literacy. Teaching materials are one of the most important components besides students and teachers in a learning process. According to Soegiranto in Arlitasari et al. (2013) teaching materials are materials or material arranged by the teacher systematically that are used by students (students) in learning. Teaching materials can be packaged in print, non-print and can be visually auditive. Based on the background of the problem above, the purpose of this study was to analyze the magnitude of the improving students' Higher Order Thinking ability and environmental attitude through the implementation of scientific literacy-based and conservation teaching materials.

METHODS

This research was conducted at SMP N 1 Kaliwiro, Wonosobo in April-June 2019. This research was an experimental study with a pretest-posttest control group design. The sample used was a VIIA class which has 30 students as a control group and there were 30 students of VIIC class (as an experimental group). The instrument used to measure students' Higher Order Thinking ability was 20 HOT questions on aspects of analysis, evaluation and creation. Environmental attitude was measured by using a Likert Scale which contains 20 statements of environmental care attitudes which was a modification of 5 aspects of NEPS and cognitive, conative and affective aspects in Azwar (2003). Data analysis techniques using the N-gain test and t-test.

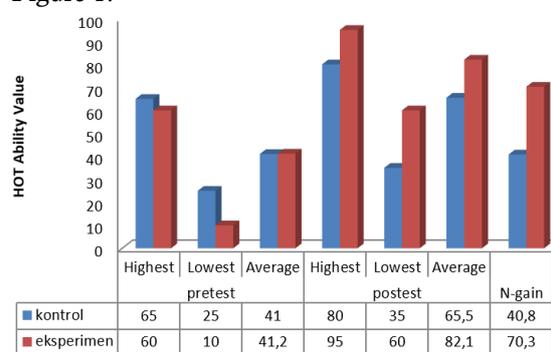$$N-gain = \frac{(posttest\ score) - (pretest\ score)}{(maximum\ score) - (pretest\ score)}$$

$$t = \frac{\overline{x}_1 - \overline{x}_2}{s\sqrt{\frac{1}{n_1} + \frac{1}{n_2}}}$$

Ho criterion testing were rejected if −t table < t count < t table with the table of Level 5% which means the data tested has a large increase that was not the same data.

RESULTS AND DISCUSSION

HOT Ability

Based on the results of the study, pretest and posttest values for HOT Ability can be seen in Figure 1.

	Highest pretest	Lowest pretest	Average pretest	Highest postest	Lowest postest	Average postest	N-gain
kontrol	65	25	41	80	35	65,5	40,8
eksperimen	60	10	41,2	95	60	82,1	70,3

Figure 1. Results Value of Higher Order Thinking Ability

Based on figure 1 we can see that in the control and experiment class have the average of pretest score were almost the same. Meanwhile, the post-test value has difference for the control class which has a posttest average 82.1 while the control class 65.5. It was showed that there were a difference in the results of learning between those who used teaching materials based on scientific and conservation literacy in the experimental class and those who do not use them in the class. After the N-gain Test was done, it can be seen in Figure 1 that the two classes have different N-gain values. The N-gain value in the experimental class was 70.2 (high) while the control class was 40 (medium).

From the results of the N-gain test in both classes, it was seen that in the experimental class there was a high N-gain criterion for increasing students' higher order thinking ability. This was because the use of teaching materials based on scientific and conservation literacy was very helpful in learning about environmental pollution material. In addition to facilitating mastery of

teaching materials based on scientific literacy and conservation, this greatly helped to train students to think higher.

Research on the application of teaching materials based on scientific literacy was also conducted by Paramita et al. (2015) using a gain test with results that showed the scientific literacy ability of the experimental class by 0.63 while the control class was 0.38. Research from Millar (2011) also concluded that the application of scientific literacy significantly increased students' interest and involvement in learning.

An understanding of facts, concepts, theories, principles in the matter of environmental pollution is greatly helped by the existence of "Let's Learn" and factual environmental information in teaching materials. Investigations in "Let's Investigate" can train students to ask questions, analyze, conclude, evaluate and make solutions and communicate, so they can train students in their thinking. The way of higher thinking was also obtained by students through "Let's Think scientifically", here, students were trained to analyze, evaluate and make a solution to a problem through research results, graphs and tables. This aspect strongly supports the creation of a higher way of thinking. The interaction of science, technology and society in "Science and Technology in Human life" strongly encourages students to be creative in develop an idea or

product in overcoming the consequences of environmental pollution. This was reinforced by the efforts and call for doing conservation action that encourage students to think higher.

The scientific-based literacy in teaching materials helped to improve students' scientific literacy ability. The results of research from Budiningsih (2015) states that the use of teaching materials oriented to scientific literacy can improve student learning outcomes in scientific literacy is characterized by an increase in student learning outcomes in scientific literacy. If students' scientific literacy abilities were high, they will also increase their Higher Order Thinking because both were support each other or have simultaneous relationships. In accordance with the research conducted by Yuriza et al. (2018) in three of Junior High School, East Jakarta with the result that there was a positive relationship between Higher Order Thinking and the level of intelligence simultaneously with scientific literacy ability in Junior High School students. This was similar to the results of the study from Anggraini (2014) with the results that the ability of scientific literacy was directly proportional to the Higher Order Thinking abilities possessed by students.

The results of the t-test analysis can be seen in Table 1 with a significant level of 0.05 with the Ho testing criteria accepted if $t - t_{table} < t_{count} < t_{table}$

**Table 1.** T-test Calculation Results of Higher Order Thinking ability

Class	$\sum$	n	$\overline{X}$	S_{x1}^2	S_{X2}^2	S	t_{hit}	$t_{tab(0.05;58)}$
Control	12.33	30	0.411					
Experiment	21	30	0.7	0.027	0.01	0.1433	-7.832	2.00 7

From Table 1, it can be seen that the results of t hits for students' Higher Order Thinking abilities were -7,832 while the t-tables for the significance level 0.05 were 2,007. It showed that the <t hit tab <t tab means that t hit was in the rejection area which means that Ho was rejected means that there was a significant difference enhancement in Higher Order Thinking ability between the control and experimental group.

Environmental Attitudes

Based on the result, the pre-test and post-test values of Environmental Attitudes can be seen in Figure 2.
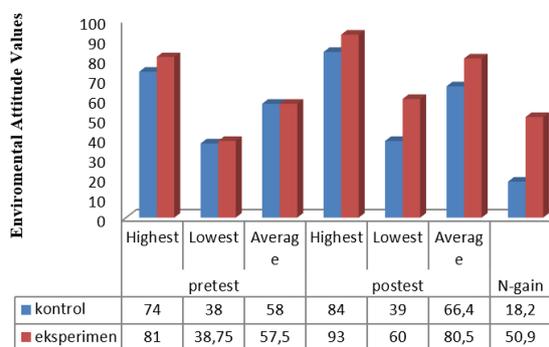
Figure 2. The Result of Environmental Attitude Values

In Figure 2, we can see that the control and experimental classes have almost the same pretest

values of environmental care attitudes. Whereas, the post-test value has difference for the control class which has a post-test average value of 66.4 while the experimental class 80.5. It indicated a difference in the results of learning between those who use teaching materials based on scientific literacy and conservation in the experimental class and those that do not use them. N-gain test, if we see in Figure 2, the two classes have different N-gain values. The N-gain value in the experimental class of 50.9 showed the enhancement at $30 \leq$ N-gain <70 which means medium. Whereas, in the control class was 18.2. It showed that the enhancement at N-gain <30 which means low.

The results of the N-gain test in both classes showed that in the experimental class there were moderate N-gain criteria for increasing students' caring attitude. This was because the use of teaching materials can provide direct information about the pollution that occurs in the environment from the causal factors to the consequences of the pollution. Environmental information which was a conservation aspect helped students understand the consequences of what will happen if students do not care about the environment.

Investigations in "Let's Investigate" the consequences of environmental pollution will provide clear information and evidence of the dangers of pollution to life. The existence of this evidence stimulates students to make efforts and call for conservation of the consequences of environmental pollution. Efforts and conservation invitations form ways of thinking about the environment (cognitive), feelings they have about the pollution that occurs (affective) and the tendency to behave towards the environment (konasi) as found in Azwar (2003). Cognitive, affective and conative will be able to improve students' environmental care attitude. This is in accordance with the research conducted by Susilo et al. (2016) with the results that the design of science learning with conservation vision has a significant effect on environmental care attitudes.

Widiyatmoko (2014) who implemented a science learning module with the theme "conservation" to grow students' character and have the results The research on the character of students who love nature experienced a significant increase. A similar study was also carried out by Taufiq et al. (2014) by developing conservation-themed learning media which as a whole could improve learning outcomes by 0.85 with an average total score of character indicators for environmental care was 93.75.

The t-test analysis of the environmental attitude was a real level of 0.05 with the Ho testing criteria Accept if $t - t_{Tabel} < t_{hitung} < t_{Tabel}$. The results of t-test calculations from environmental care attitudes can be seen in Table 2.

Table 2. t-test Results of the Environmental Attitude

Class	$\sum$	n	$\overline{X}$	S_{x1}^2	S_{X2}^2	S	t_{hit}	$t_{tab(0.05;58)}$
Control	5.93	30	0.198	0.026	0.03	0.1675	-7.1955	2.00171
Experiment	15.3	30	0.51			466		

From the results of the t-test of the environmental attitude using N-gain value, the two classes can be seen in Table 2 showed that t_{hit} of the environmental attitude was -7.19 while the t_{tab} for the significance level of 0.05 was 2.00 7. It showed that the $-t_{tab} < t_{hit} < t_{tab}$ which means that t_{hit} was in the rejection area, which means that there were differences in the increase in environmental attitude between the control and experimental group.

CONCLUSION

Based on the results of data analysis, it is known that teaching materials based on scientific and conservation literacy can improve students' high order thinking ability and environmental attitudes.Based on the results of research and discussion, the suggestion that teaching materials based on scientific and conservation literacy can be used as an alternative in learning to improve students' higher order thinking ability and environmental attitudes. Motivation for the importance of environmental concerns must also be strengthened by the teacher.

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