PROSIDING ICTTE FKIP UNS 2015
Vol 1, Nomor 1, Januari 2016
Halaman:

ISSN: 2502-4124

THE STUDY OF HIGH SCHOOL STUDENTS'S SCIENTIFIC ATTITUDES ON LEARNING HEAT AND TEMPERATURE WITH *COOPERATIVE INQUIRY LABS* MODEL

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Abstract: Scientific attitude is an approach to investigations that benefits from certain traits namely; curiosity or inquisitiveness, objectivity, open-mindedness, perseverance, humility, ability to accept failure, and skepticism. Scientific attitude is one of benchmarks for the success of science learning process especially the level of understanding of the concept of physics. This study aims to analyse the students' scientific attitude on learning heat and temperature with *Cooperative Inquiry Labs* (CIL) model at SMAN 6 Banda Aceh. This is a quasi experimental research with the class subject of X-MIA1 as a control class and X-MIA2 as an experimental class. Data collection technique used was by giving a questionnaire containing seven kinds of scientific attitude indicators to each student. The questionnaire in this study used a Likert scale with four categories of responses. Data tabulation was done by testing the average difference of two independent samples, indicated that t_{count} (10.94) > t_{table} (2.01) at the significant level of 5%, which means that there are significant differences in outcomes between the experimental and control classes. The results of questionnaire analysis showed that in the control class, there were four scientific attitude indicators which had high category, and the three other indicators were in medium category, whereas in the experimental class, there were five indicators with high category and two indicators with medium category. Based on the data of the analysis result of t test showed the scientific attitude of the students in both classes were t_{count} = 2.09 which was bigger than t_{table} = 2.01, and because of the significance of <0.05, it can be said that there was a significant difference after the learning process with CIL model.

Keywords: *Students's scientific attitudes, heat and temperature, CIL model*

1. INTRODUCTION

Currently, the efforts to improve the quality of education in Indonesia are very keen to do, especially by the government. One of these efforts can be seen through curriculum development innovation from basic education to upper secondary education which have produced a product in the form of 2013 curriculum. This curriculum is disigned to be oriented in the application of modern pedagogical concepts in learning a subject in which it uses a scientific approach. Scientific approach is an approach that combines the learning aspects of attitudes, skills, and knowledge to the development of learners's quality which is needed to undergo their future lives. This is also in accordance with the statement of Shah (2010) that in fact education is an effort to develop human potentials as a whole through learning certain amount of knowledge and life skills that are needed.

Physics is part of the science that studies the natural phenomena and events as well as trying to uncover all the secrets and laws of the universe scientifically (Depdiknas, 2003). According to Istikomah, et al. (2010), one of learning objectives of science is teaching learners to gain experiences through the application of scientific methods (experiments), so they are trained to be a scientist. Scientific attitudes is vital for learners to be able to improve their critical thinking towards the natural phenomena that occurs (Ksheerasagar and Kavyakishore , 2013; Kaur, 2013; Singh and Mishra, 2014). According to Wahyudiati (2010), learners are always faced with various problems of phenomena of nature, and in order to face these problems, not only do they need theoretical knowledge, but also do they require scientific attitudes as a benchmark of their level of understanding. Scientific attitude is very meaningful in social interaction, science, and technology. If this attitude has been mould in the learners' personality, it will be reflected through their behaviour and caracter when carry out the investigation or when interact with other people and the surrounding communities (Sardinah and Noviyanti, 2012).

Until now, physics learning carried out at school, generally, tends to only transfer theoretical concepts or apply less practival activities, so it gives less learning experiences to students. Inquiry learning is used to develop the skills of thinking, working, and scientific attitude as well as

ISSN: 2502-4124

communication as one important aspect of soft skill. Therefore, the implementation of learning Physics in senior high school becomes important to seek the provision of direct instruction through the use of students' critical thinking skill and scientific attitude. According to Dewey and Rustaman (2005), the skill is vital to be developed in learning Physics in every educational level as it allows people who are learned and are taught to develop and to use high order thinking skill in solving problems. Students' scientific work ability need to be developed in learning Physics so that they do not only understand the concepts, but also can apply the ways in obtaining them and be able to voice out their scientific findings. Having the scientific work ability can develop students'creativity in solving problems and also develop students' attitudes and scientific value.

Based on the observation result of case study conducted in SMAN 6 Banda Aceh, it was found that the learners had lack of sense of curiosity and critical attitude in studying Physics which led to being passive learners who had less improvement in applying scientific attitudes. Based on the data in the academic year of 2010/2011, 2011/2012, and 2012/2013, it was found that the average value of daily test of the topic of heat and temperature at these years were 65.42, 67.51, and 69.35 respectively. However, their average completeness level was still less than 75%. These data indicate that the assessment result to this topic is still in low category as many students did not complete it yet. The decreasing value of students's learning outcomes were caused by several factors, one of which was less variation of earning model applied by teachers. In terms of the learning facilities in this school, it was adequate, but the teachers still apply learning inside the classroom with limited laboratory used.

The improvement of learning Physics learning outcomes can be achieved through scientific approach and the application of appropriate learning model which includes attitudes dimension. According to Gusriana et al. (2014), scientific attitude is an attitude that should be owned by a scientist or academician when facing various scientific problems. Attitudes will be obtained through a process such as experience, learning activities, identification, role play (teacher-pupil, parents-child). Through new experiences constantly, they can influence the attitudes of students, for example, a change in behaviour. The level of students' scientific attitude can be known from having high curiosity, understanding new concepts without having difficulty, having critical sense towards the problems that need to be verified and evaluating their own performance (Kaur, 2013; Ksheerasagar and Kavyakishore, 2013). According to Kusuma (2013), the higher the scientific attitude of students towards physics learning, the higher the students' learning outcomes. The scientific attitude can be identified at least from 7 aspects, namely, curiosity, respect for facts/data, critical thinking, discovery and creativity, open-minded and like to work together, diligent, and sensitive to the environment (Anwar, 2009). For these purposes, it requires a learning model that can encourage the occurrence of positive scientific attitude of the students so that they are able to understand and mastered the concepts learned.

Learning model that can be applied to improve the scientific attitude of students is a model of *Cooperative Inquiry Labs* (CIL). CIL learning model is one of the learning models that not only empowers dimension of knowledge as a product of learning, but also is capable of empowering knowledge as a process, especially in order to improve critical thinking skills and scientific attitude. This model requires the learners to solve problems through the steps which include: problem formulation, formulation of hypotheses, hypothesis testing, hypothesis prove through experiments and or demonstration, recorded data from experiments, process the data, analyze the data and draw conclusions (Aalderen-Smeets and Molen, 2015). Laboratory activities in this model are integratedly held with learning in the classroom, so that the facts observed in the laboratory can be directly used in building and developing the concepts and principles. Therefore, the concepts built will retain or last longer in studets's mind.

Some researchers have reported that there was a difference in critical thinking skills and scientific performance between students who follow the model of inquiry learning and direct instruction (Nyoman et al., 2014). Furthermore, Nuril and Nurita (2010) state that learning Physics using the experimental method can be used for training scientific character attitudes on the learners at MAN Tlogo, Blitar. In addition, Dewi, et al. (2013) and Gusriana, et al. (2014) conclude that students' scientific attitude have positive and significant impacts on the mastery of Physics' concepts supported by *guided inqury* model. Therefore, one alternative that is expected to be a solution for this problem is through the implementation of CIL learning model to the topic of heat and temperature.

2. RESEARCH METHOD

This study used quasi-experimental research method. This method was chosen because the researchers wanted to find out the difference of scientific attitudes between the learners who received CIL models and the learners who received direct instruction. The study design was *Non-equivalent Control Group Design*, in which this design, two

ISSN: 2502-4124

classes involved were compared, there were the experimental and the control classes, even if these two groups were selected and placed without randomization.

This study was conducted in SMAN 6 Banda Aceh. Class X-MIA 2 was set as the experimental class with 24 learners, while X-MIA 1 was chosen as the control class with 27 students. The instruction of the heat and temperature topic for both classes were done during three meetings (sessions). In the experimental class, it was carried out by applying the CIL model, while in the control class, it was held by implementing direct learning.

Observation, that was conducted by two observers, was implemented in order to obtain the data about the scientific attitude of students in both classes during the lesson. The data were also obtained through the distribution of questionnaire to all students in both classes at the end of learning process. The aspects of scientific attitude that were measured refered to the research conducted by Anwar (2009), namely, 1) sense of curiosity, 2) the attitude of respect towards the facts/data, 3) the attitude of critical thinking, 4) the attitude of discovery and creativity, and 5) the attitude of open-minded and like to work together, 6) the attitude of being diligent, and 7) the attitude of being sensitive to the surrounding environment. The questionnaire used in this study using a Likert scale, with four categories of responses, namely, strongly agree (SA), agree (A), disagree (DA), and strongly disagree (SD). Furthermore, it was done the data analysis results of *N-Gain* and t-test for measuring the increased of the scientific attitude of the learners.

3. FINDINGS AND DISCUSSION

The data of students' scientific attitude in both classes were obtained by distributing scientific attitude questionnaire. This questionnaire was filled in by the students at the end of the lesson. This study also observed 7 indicators of scientific attitude of learners as mentioned earlier. The score calculation of the students' scientific attitude towards heat and temperature lesson was begun by calculating the average score of each statement. The data average value of scientific attitude of the learners for each indicator wass described in Table 1, Table 2, and Figure 1.

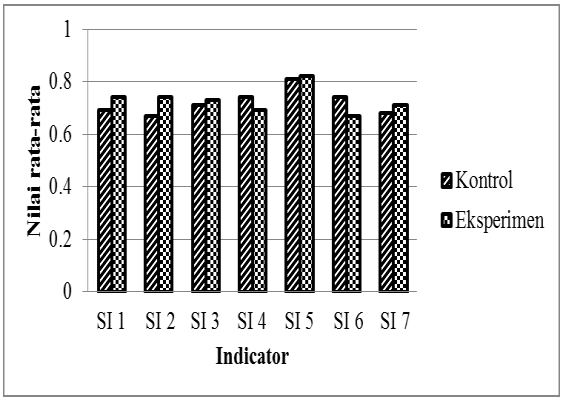
Table 1. The summary of scientific attitude qestionnaire for each indicator in control class

No	Scientific Attitude Indicators	Question Number	Average	Category
1	Curiousity attitude (SI_1)	1,2	0,69	Medium
2	Respect towards the facts/data attitude (SI_2)	3,4,5	0,67	Medium
3	Critical thinking attitude (SI_3)	6,7	0,713	High
4	Discovery and creativity attitude (SI_4)	8,9	0,74	High
5	Open-minded and cooperation attitude (SI_5)	10,11	0,81	High
6	Diligent/perseverance attitude (SI_6)	12,13	0,745	High
7	Sensitive to the surrounding environment Attitude (SI_7)	14,15	0,685	Medium

Table 2. The summary of scientific attitude questionnaire for each indicator in experimental class

No	Scientific Attitude Indicators	Question Number	Average	Category
1	Curiousity attitude (SI_1)	1,2	0,74	High
2	Respect towards the facts/data attitude (SI_2)	3,4,5	0,74	High
3	Critical thinking attitude (SI_3)	6,7	0,73	High
4	Discovery and creativity attitude (SI_4)	8,9	0,69	Medium
5	Open-minded and cooperation attitude (SI_5)	10,11	0,82	High
6	Diligent/perseverance attitude (SI_6)	12,13	0,67	Medium
7	Sensitive to the surrounding environment Attitude (SI_7)	14,15	0,71	High

Table 1 and 2 above show that the indicator of scientific attitudes of the students in the experimental class is higher than in the control class. It is known that in the control class, 4 scientific attitude indicators are in high value while the three other indicators have medium value. For the experimental class, 5 scientific attitude indicators have high value while the rest have medium value.



ISSN: 2502-4124

Figure 1. The comparison of the average scores of students' scientific attitude in both classes

Note:
SI_1 : Curiousity attitude
SI_2 : Respect towards the facts/data attitude
SI_3 : Critical thinking attitude
SI_4 : Discovery and creativity attitude
SI_5 : Open-minded and cooperation attitude
SI_6 : Diligent/perseverance attitude
SI_7 : Sensitive to the surrounding environment attitude

Figure 1 shows that the highest average value in the experimental class is SI_5 indicator of 0.82 and the lowest at SI_6 indicator of 0.67. Whilst, in the control class the highest average value is SI_5 indicator of 0.81 and the lowest is SI_2 of 0.67. Based on these data, it can be concluded that the overall scientific attitude of students at SMAN 6 Banda Aceh is categorized as high. It can be proved from the tests performed for both classes which obtained the average value for all indicators for 0.72. The acquisition of the high average number of scientific attitude has a positive effect on the application of CIL model.

After obtaining the data of the level of scientific attitude of the students in the topic of heat and temperature, the t-test was then performed. The t-test was intended to see the differences between the two average scores of the increased in the scientific attitude of learners between the experimental and the control classes. The results can be seen in Table 3.

Table 3. Difference test of the average of students' scientifical attitude in both classes

Class	Average	t_{count}	t_{table}	Conclusion
Experiment	46,00	2,09	2,01	Siginificant
Control	43,00			

Based on the data in Table 4, the scientific attitude of the students in both classes have t_{count} of 2.09 which is greater than t_{table} of 2.01. Because the significance <0.05, it can be said that there is a significant difference after learning with CIL model. This results is in accordance with the statement of Dewi et al. (2013) and Gusriana et al. (2014) that the scientific attitude of the learners has positive and significant impacts on the mastery of physics concepts with the used of *guided inquiry* model. Thus, CIL model can improve learners' scientific attitude. The topic of heat and temperature taught by CIL model is more favourable during the instructional process that involves learners to be directly active in showing their attitudes of curiosity, respect towards the data/facts, critical thinking, discovery and creativity, open-minded and collaboration, perseverance, and sensitive to the surrounding environment. It is also consistent with the research results of Bilgin (2009) that learners, taught by inquiry model, indicated scientific attitude performance better than the students who were in the control class.

In the scientific attitude, it is seen that after the implementation of CIL learning model, there is an iimprovement in 5 indicators in high category. The improvement happened in the experiment class was due to the implementation of CIL learning model. This is probably because the students had followed the steps for this model, namely, collecting and analyzing data, critical thinking skills that was in analyzing the arguments and deciding an action. This was in accordance with the statement of Sudarmini et al. (2015) that the students who had high scientific attitude will be easier and quicker to understand and solve the problems related to critical thinking skills as they may use their knowledge to find the answers either by reading and or asking anyone who knows the solution. While, the students who had low scientific attitude will require more guidance and time to solve them.

CIL model learning activities emphasize the process that promote students' scientific attitude and encourage them to be more active and find their own answers to the problems faced by doing an experiment. During the practical activities, not all learners demonstrated their scientific attitudes. This was because the learners were already accustomed with the learning model of verification lab taught by their teacher. In this model, the teacher only gave a definition of a word as well as provided the principles and concepts of learning. Moreover, teachers seldom provided an opportunity to the students to do observations or experiments. This resulted in being passive and less able to increase their scientific attitude when studying physics. These results are in line with the conclusion of research done by Maretasari (2012) that laboratory-based guided inquiry had a significant effect on the students' learning outcomes and scientific attitudes in physics.

4. CONCLUSIONS

The analysis result of the questionnaire data showed that in the control class there were 4 scientific attitude indicators which had relatively high category, and the three other indicators were in medium category, whereas in the experimental class there were 5 indicators with high category and the rest were in medium category. Based on the data analysis of t-test, it showed that the students' scientific attitude in both classes had t_{count} of 2.09 which was bigger than t_{table} of 2.01, and because of

ISSN: 2502-4124

the significance of <0.05, it can be said that there was significant differences after the instruction of heat and temperature topic with CIL model.

5. ACKNOWLEDGMENTS

Researchers are grateful to the Rector of Syiah Kuala University for his financial support at this research through the Grant Incentive Postgraduate Program (IHPS) of the fiscal year of 2015. Thanks also given to all those who have supported the smooth implementation of this study.

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