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Implementation of Science Environment Technology and Society Approach on Learning Critical Thinking Skills

Denny Rachmadi*

Universitas Negeri Semarang, Indonesia

*Corresponding Author: dennyrachmadi1976@gmail.com

Abstract. Research on the implementation of the science environment technology ad society approach to learning critical thinking skills is qualitative research using a non-equivalent control group design which is included in the quasi-experimental design group. This study aims to determine the effect of the implementation of science environment technology and society on critical thinking skills in students. This research was conducted at SMAN 1 Purwodadi. The participants in this study are students of science class 2 (IPA 2) as an experimental class that implements science environment technology and society in learning while science class 3 (IPA 3) as a control class whose learning does not use the implementation of science environment technology and society. The results of the study obtained the percentage of achievement of critical thinking skills of experimental class students was better than the critical thinking skills of control class students. Thus, it can be concluded that there is an influence of the implementation of the science, environment, technology and society approach on learning on students' critical thinking skills.

Keywords: SETS approach; Critical thinking skills

INTRODUCTION

The Indonesian Education System is currently required to empower citizens to develop into quality human beings who are able to compete and proactively respond to the challenges of the times. Quality and competent human resources can be the main force for a country to overcome the problems. Therefore, in facing the modernization era as it is today, the education system in Indonesia is expected to be able to equip students with learning skills and life skills (Permendiknas Number 41 of 2007).

Teachers are expected to design an innovation in physics learning that can train and improve students' critical thinking skills through their learning experience. One of the efforts that can be done is to apply the Science, Environment, Technology and Socisty (SETS) approach (Umami: 2013).

In addition, teachers also equip students with creativity, critical thinking skills, care for the environment so that they are willing to take concrete actions if there are problems faced outside of the the classroom (Poedjiadi: 2010).

Anwar (2010) suggests that the SETS approach in the concept of Education has implementation so that students have higher order thinking skills, including critical thinking skills. In the physics learning process that applies the inquiry model with this SETS approach, in addition to students being invited to make discoveries and investigations, students are also invited to examine the technology or application of the material that has been studied into four elements at once, namely science, environment, technology, and society. Thus, students are able to explain and solve issues or problems related to technology, as well as its effects on the environment and society.

Based on the description above, the title of the research taken is "The Influence of Science, Environment, Technology and Society (SETS) Approach on Students' Critical Thinking Skills".

Literature Review

Aikenhead (1988) states that SETS refers to curriculum and teaching that links science, technology, society and the environment. In other words, students are invited to understand that science will be useful for their lives later when they grow up in seeing problems related to science, technology and the environment.

SETS in the view of social sciences and humanities basically provides an understanding of the relationship between science, technology and society, training the sensitivity of learners' assessment of environmental impacts as a result of the development of science and technology (Poedjiadi: 2010).

Form a correlation of interrelationships between the elements of SETS. The interrelationship between SETS elements shows positive and negative interactions so that SETS education must be able to provide understanding for students that not only pay attention to science, technology, society but also the impacts that may be caused.

Critical thinking is an intellectual process that actively and skillfully conceptualizes, applies, analyzes, synthesizes, and evaluates information gathered or generated from observation, experience, reflection, reasoning, or communication, to guide beliefs and actions (Scriven, 1997). Dewey (1909:9). Critical thinking is defined as "reflective thinking" which is an active, persistent and rigorous consideration of a belief or form of knowledge that is taken for granted in terms of the reasons that support it and the conclusions that become tendencies.

Carlgren (2013) suggests that to better understand critical thinking skills according to reality, 'Skill-sets' are made which contain output results to find out critical thinking skills. Skill sets are divided into three aspects, namely knowledge (cognitive), skills (psychomotor) and attitude (affective). The critical thinking skills assessment tools are as follows:

a. Aspects of knowledge, learners can:

1) Define the difference between facts and conclusions.
2) Deriving criteria for judging a problem or difficult circumstance.
3) Make a list of elements of thinking related to critical thinking according to the critical thinking model.
4) Identify inherent and hidden biases in an argument.
5) Identify errors in thinking due to oversimplifying or overcoming problems or generalization problems.
6) Identify and state thinking goals

b. Skill aspects, learners can:

1) Utilize background knowledge to solve difficult problems or circumstances.
2) Apply evidence to solve problems or difficult circumstances.
3) Uncover logical, clear, and concise arguments
4) Derive and model a process for analyzing, thinking, and solving problems or situations involving rational, logical, and critically relevant thinking strategies.
5) Explore alternative options and methods before drawing conclusions.
6) Illustrate and explore the consequences and implications following troubleshooting or problem solving.
7) Modeling displays thinking skills through oral, written, and physical means.

c. Attitude aspect, learners can:

1) Believe that it is possible for themselves to solve problems with a reasonable level of confidence.
2) Trust that they can ascertain the information needed to help themselves think about the problem or problem critically.
3) Respect diverse thinking and problem-solving that allows opinions and is taken into account without discrimination of other people's arguments

The frame of mind chart in the study is outlined in figure 2.2

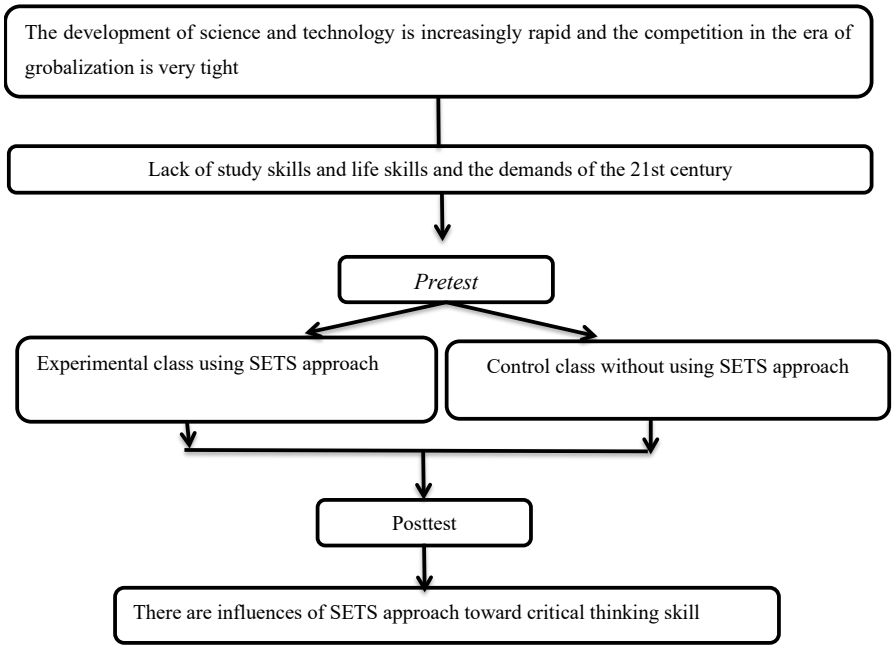

Figure 2.2 Thinking framework chart in research

In connection with the formulation of the research problem that has been described, the hypothesis of this research is as follows:

Ha: There is an influence of the SETS approach on learners' critical thinking skills.

From the hypothesis above, the initial hypothesis is:

Ho: There is no influence of the SETS approach on learners' critical thinking skills.

METHOD

This research was conducted at SMA Negeri 1 Purwodadi which is located at Jalan

R. Suprapto No. 82 Purwodadi Grobogan Regency, Central Java 56813 on odd semester of the 2022/2023 academic year, which is in August 2023. The population in the study is all students of grade XI science at SMA Negeri 1 Purwodadi while the sample in this study is class XI students of IPA 2 as an experimental class and class XI IPA 3 as a control class.

The use of the design is done with the consideration that the existing class has

preformed so that random grouping is no longer done which can mess up the lesson schedule that has been arranged. In this design there are two groups that are given a pretest to determine whether the initial state is the difference between the experimental group and the control group. Schema Non-equivalent control group design can be seen in Figure 3.1.

O1XO2

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O3 O4

Figure 3.1 Schematic of non-equivalent control group design

Information:

O1 and O3: Pretests given before treatment.

X: The treatment given to the experimental class that apply learning with the SETS approach.

O2 and O4: Final tests (posttest) given after treatment.

The sampling technique used in this study is a purposive technique Sampling is a sampling technique based on certain considerations (Sugiyono, 2015). Sampling is carried out with the consideration that students in each class are taught by the teacher, materials, curriculum, and same learning facilities. Class division is not based on rank thus allowing each class to be a representative sample.

In this study there are two variables, namely the SETS approach as a variable free (X) and critical thinking skills as dependent variables (Y). Data Retrieval Techniques in this study are Documentation Techniques and Test Techniques.

RESULTS AND DISCUSSION

The study was conducted three times. The following is presented data from research on students' critical thinking skills on the concept of static fluids.

1.Critical Thinking Skills Test Results

Data on students' critical thinking skills test results are data taken before and after learning using the SETS approach in experimental classes and control classes without the SETS approach. The average initial score of critical thinking skills of the experimental class was 24.22 and the control class was 19.41. After learning, the average score achieved by the experimental class was 75.99 while the control class was 57.83.

2. Critical Thinking Skills Improvement Test Results (Gain Test)

The gain test is used to determine the increase in the average score of the pretest and posstest. Classically, the gain test result in the experimental class of 0.68 is included in the medium category, while in the control class, the gain value of 0.48 is also included in the medium category. Aspects of critical thinking skills after learning in the control class and experimental class were also analyzed.

There are five aspects of critical thinking used, namely basic clarification, basis in decision or support, inference, further clarification, and strategy and tactics. The average gain test results of each aspect of critical thinking can be seen in table 1.

Table 1. Test the average gain of each aspect of critical thinking

Aspect of critical thinking skill	Control Class			Experimental Class		
	Pretest (%)	Posttest (%)	Gain	Pretest (%)	Posttest (%)	Gain
Basic Clarification	56	78	0.5	55	81	0.58
Basic Decision or Inference Support	11	42	0.35	21	73	0.66
Further Clarification	11	50	0.44	16	73	0.68
Strategic and Tactic	15	51	0.42	22	84	0.79
	5	68	0.66	7	69	0.67
Average	20	58	0.48	24	76	0.68

Based on Table 1 it can be seen that all aspects of learners' critical thinking skills after learning had a higher average percentage in the experimental class than the control class. However, in the aspect of strategy and tactics has an average percentage of critical thinking skills and almost the same gain value.

1. Categories of Learners' Critical Thinking Skills

The category of critical thinking skills is also analyzed by each student. The results of the analysis of the critical thinking category can be seen in table 2 while the complete data in appendices 19a and 19b.

Table 2. Analysis of critical thinking skills categories

Category	Control Class		Experimental Class	
	Pretest (%)	Posttest (%)	Pretest (%)	Posttest (%)
Very Low	30 (96.8)	0 (0)	30 (96.8)	0 (0)
Low	1 (3.2)	9 (30)	2 (6.2)	0 (0)
Average	0 (0)	17 (56.7)	0 (0)	8 (25)
High	0 (0)	4 (13.3)	0 (0)	20 (62.5)
Very High	0 (0)	0 (0)	0 (0)	4 (12.5)
Total	31	30	32	32

Based on the analysis of research data, the discussion to be studied includes the influence of the SETS approach on critical thinking skills and the improvement of critical thinking skills after learning with the SETS approach. Aspects of critical thinking skills studied in this study include basic clarification, basis for making decisions or support, inference, further clarification, and strategies and tactics.

The improvement of students' critical thinking skills is assessed based on pretest and posttest results. The results of the pretest data averaged the experimental class of 24.22 and the average score of the control class was 19.41. The results of this pretest illustrate that the two classes have skills that are not much different. After that, a posttest was held where the average score of the experimental class was 75.99 and the average score of the control class was 57.83. The posttest results of the experimental class are better than those of the control class. This is in accordance with research conducted by Umami (2013) that there is an influence of the SETS approach on students' critical thinking skills.

In the control class, critical thinking skills students are less awakened because they are not given an approach that requires them to solve problems in the environment and society based on science and technology. According to Widyatiningtyas (in Anwar, 2010) the SETS approach can connect children's real-world lives as members of society with the classroom as a science learning space. This approach process can provide a learning experience for children in identifying potential problems, collecting data related to problems, considering alternative solutions, and considering consequences based on certain decisions.

In learning in experimental classes, students are given problems related to the material to be taught. Through the discussion method, teachers help students develop and form concepts, namely by providing group discussion sheets containing questions about issues or problems. Students search and analyze data from various sources such as books and the internet to get conclusions

and solutions to the problems given It then presents the results of the discussion and the other group responds. Furthermore, the teacher provides solidification of the concept so that misconceptions do not occur. Teachers conduct assessments by giving tests to determine the success or failure of learning. This is in accordance with the learning steps with the SETS approach proposed by Poedjiadi (2010).

Based on the calculation of the t test, the calculation was obtained at 7.815970051 and lu for the level of significance of 5% was 1.667. Because tcount > ttable. H0 is rejected. This shows that there are differences in students' critical thinking skills between the experimental class and the control class. Because the average posttest score of the experimental class is greater than the control class, it can be concluded that the SETS approach affects the critical thinking skills of students. The SETS approach can shape individuals to have science and technology literacy and have concern for community and environmental problems, Poedjiadi (2010).

The improvement of students' critical thinking skills can also be known from the results of the gain test. The gain value in the fourth aspect is higher in the experimental class because in the experimental class there are discussion activities that encourage students to master further clarification aspects. Based on the discussion, learners are asked to define the material taught. In addition, through discussion students can also identify assumptions and state whether or not there is a relationship between these assumptions. Through these activities, students build their own understanding and are active in discussions so as not only to gain knowledge from teachers but also from various sources.

In the control class, students were only asked to look for definitions through books. Students are not required to identify whether there is a relationship between variables so that the skill to identify assumptions and state whether or not there is a relationship from these assumptions is less awakened.

The strategy and tactics aspects have almost the same gain value in the control and experimental classes, this is because in this aspect, students both interact with the teacher at the time of solidification of the concept and during confirmation.

CONCLUSION

Based on the results of the analysis and discussion, it can be concluded that the approach SETS affect students' critical thinking skills. Skills critical thinking of experimental classroom learners using the SETS approach better than control classes that don't use the SETS approach. The SETS approach is best used in critical thinking skills That is on the aspect of further clarification.

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