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Implementation of Double Critical Technology Society Learning Model for Middle School Students

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ABSTRACT

This study aims to determine the implementation of Double Critical Technology Society (DCTS) learning model on the critical thinking skills of 7thgrade students of SMP Negeri 1 Suhaid. This type of research is a quasi-experimental with posttest only design. Samples were taken from 7thgrade students of SMP Negeri 1 Suhaid in the first semester of the 2019/2020 Academic Year which consisted of two classes, namely the experimental class and the control class. The research instruments used were a test to measure students' critical thinking skills after DCTS learning model was applied and a questionnaire to measure student responses after being given a DCTS learning model. The data obtained were then analyzed using descriptive statistics and independent sample t test. The results of data analysis with the independent sample t test showed that the significance value of students 'critical thinking skills was 0.00 less than 0.05 so there was an influence on the implementation of the DCTS learning model on students' critical thinking skills. The critical thinking skills of the experimental class students with an average value of 71.30 were better than the control class which had an average value of 50.23. The results of the assessment of the response questionnaire with an average of 83.25 showed an excellent response from students to the DCTS learning model.

Keywords: *Implementation, Double Critical Technology Society, Critical Thinking Skill.*

INTRODUCTION

The implementation of science learning must be in line with the nature of science learning. Carin and Evans (in Sudarisman, 2015: 31) stated "The nature of science learning includes 4 things namely products, processes, attitudes and technology". Carin and Evans's statement meant that the achievement of the nature of science can’t be separated from problem solving by applying an appropriate model so that students' understanding of the concepts was not limited to memorization and comprehension but could also conduct analysis, study, discovery and application.

But in reality the learning process is still dominated by lecture methods and is teacher-centered in explaining science to achieve product so it puts less emphasis on the process. Learning is still textual and has not used issues in the surrounding environment as a learning reference.

Some teacher lacks an understanding of the relationship between science and technology and does not utilize the availability of technology. Existing technology should be used by students in solving science problems. This conventional learning ultimately impedes the development of students' potential. Students are not accustomed to being involved in the problem solving process related to the material they are learning.

In ideal learning, students should be the center of mobilization, while the teacher acts as a facilitator in enriching student learning experiences. Through learning experiences students are expected to be able to construct their own concepts through problem solving.

According to Sukiman (2008: 60) constructivists view learning as an active process of constructing meaning in the form of text, dialogue, physical experience, or other forms. Glasersfeld (in Sukiman, 2008: 60) states that in a constructivist perspective, learning is not an embodiment of the stimulus-response relationship. Learning requires self-regulation and the formation of conceptual structures through reflection and abstraction. Fosnot (in Sukiman, 2008: 61) added, learning objectives are more focused on developing concepts and in-depth understanding rather than merely forming behavior or skills. Learning like this will empower students' high-level thinking skills, one of which is critical thinking skills.

According to Cabera (Fachrurazi, 2011), mastery of critical thinking skills is not enough to be used as an educational goal only, but also as a fundamental process that allows students to overcome future problems in their environment. Glazer (Sabandar, 2008) states that critical thinking is the ability to involve prior knowledge, cognitive strategies to generalize, prove, and evaluate situations. Thus it is necessary to have a learning model that is able to build students' knowledge and critical thinking skills.

The learning model that is in line with the description is a problem-based and constructivist learning model. Trianto (2009) states that in problem-based learning students work on authentic problems with a view to compiling their own knowledge, developing inquiry and critical thinking skills, developing independence, and self-confidence.

A constructivist-based learning model Piaget developed saw learning as an organic process for constructing knowledge, not a mechanical process for gathering or memorizing knowledge. Students are required to be able to formulate hypotheses, testing hypotheses, manipulate objects, solve problems, dialogue, research, look for answers, express ideas, express questions, hold reflections, and others. These steps have the potential to be able to empower students' critical thinking skills (Prayitno, *et al.*, 2013).

One of the learning model developed based on the integration between problem-based and constructivist models is the Double Critical Technology Society (DCTS) model. This model has a characteristic that the problem solving is done through double critical thinking and the use of technology as a tool for problem solving. The advantage of this model is to develop higher order thinking skills that are carried out collaboratively through the mechanism of team work, as well as utilizing data literacy, technology literacy, and human literacy in the learning stages. With the emphasis on empowering critical thinking in concept construction and problem solving, it is expected to improve student learning outcomes.

The DCTS model has 4 stages. First, the preliminary stage, which consists of initiating problems. At this stage students are guided in developing original initiatives to solve problems they find in everyday life, which are related to the concepts of the subject being taught. How to build it is to raise current issues that are developing in the community or through effective questions and explore students' basic understanding of the subject. Then through team work, students conduct relevant analyzes of the problems found towards the problem solving process.

If the initiation process does not occur properly, which is marked by the inability of students to explore, differentiate, and relate concepts, then the teacher needs to intervene. Interventions can be done directly or indirectly, but must still be based on the right didactic and pedagogical concepts. Furthermore, after the initiation and analysis of the problem is done, students are expected to be able to formulate initial problems related to the things they encountered at the time of initiation to detect the direct cause of the problem and then design a temporary solution.

Second, the concept development stage.At this stage, teachers can use various approaches and methods. Here it is preferred to use demonstration or experimental methods. At this stage students are expected to have understood through logical reasoning that the analysis carried out in the first stage has used relevant concepts in problem solving. To ascertain whether problem solving has gone through relevant concepts, students are encouraged to interpret data or other information as a medium of communication with team members. Cognitive conflict that might occur at this stage will really ensure that the concept found is a solution that can be used in problem solving.

Third, the second problem detection stage. This stage prefers higher critical thinking power to do another problem solving at a higher level, which is obtained from team work through interpretation of data or information. The teacher introduces more complex issues which are a continuation of the first problem.Team members try to find, design and predict the implementation of the solution that will be done to solve the second problem.

Fourth, the strengthening and application of concepts.This stage is focused on the application or modeling of the design of a simple technology or the use of existing technology to solve problems. This process can involve students both mentally and physically. This process of strengthening and application of concept is very important to make student understanding of subject more meaningful (learning with understanding).

Learning by using the DCTS model will place students as subjects in learning. In the DCTS model, teachers no longer function as givers of knowledge, but rather as facilitators. The teacher prepares a variety of learning tools and encourages students to be able to study more focused and optimal, directing student discussion through effective questions that stimulate students to think critically.

In the DCTS model, students do not passively receive information, but students actively construct knowledge. The DCTS model is designed to encourage students to think critically in finding and solving problems, thus providing opportunities for students to do activities in small groups cooperatively. When conducting activities or problem solving in small groups cooperatively, students interact with each other, help each other, and complement each other. This will allow students to be able to understand for themselves a concept or scientific principles in improving problem solving skills.

Implementation of learning with the DCTS model is expected to change teaching and learning patterns from teacher-centered to student-centered. In addition, this model is expected to encourage the development of students' critical thinking skills, which in turn will have an impact on improving learning outcomes.

RESEARCH METHODS

The method used in this study is a quasi-experimental with posttest only design. The subject of the research was 7th grade students of SMP Negeri 1 Suhaid consisting of 3 classes. The sample used was 2 classes that randomly selected from the population after the prerequisite tests in the form of homogeneity, normality, and balance tests. These two sample classes are then each given learning with DCTS as experimental class and conventional model as control class. The research design is shown in Table 1 below.

Table 1. Research Design.

Kelas	Perlakuan	Posttest
Experiment	X_{DCTS}	T
Control	X_{konv}	T

(Modified from Sugiyono, 2008)

Legend:

X_{DCTS} : natural science learning with DCTS model.

X_{konv} : natural science learning with conventional model.

T : students' critical thinking skills

Data collection tools in this study are tests of critical thinking skills and questionnaire of students' responses. The research instrument used was validated by 3 validators to see its validity. The critical thinking ability test is used to measure students' critical thinking skills after being given treatment. This test is arranged based on indicators that can be seen in the following Table 2.

Table 2. Indicators of critical thinking skills test

Group of Critical Thinking	Indicator
Build basic skills	Observe and consider the results of observations
Provide a simple explanation	Analyzing arguments
Conclude	Perform deductions and consider the results of deduction
Set strategy and tactics	Choose criteria to consider possible solutions

The analysis technique uses descriptive statistics and the Mann-Whitney U test (t test for non-parametric statistics of independent samples). Student responses to the DCTS learning model were assessed using the following assessment criteria.

Table 3. Criteria of students' responses to the DCTS learning model

Percentage (%)	Category
81,25 < x < 100	Very good
62,5 < x < 81,25	Good
43,75 < x < 62,5	Not Good

RESULTS AND DISCUSSION

There are two research data obtained. The first were students' critical thinking skills after learning with the DCTS model for the experimental class and conventional models for the control class. The second data were the students' response after being given the DCTS learning model.

Students' Critical Thinking Skills

This critical thinking skills data consists of posttest data from the experimental class and the control class. The data is presented in Table 4 below.

Table 4. Students' Critical Thinking Skills

Data	Expt. Class	Control Class
Mean	71,30	50,23
Varians	63,88	85,58
Standard deviation	7,99	9,25
Maximum Value	62,50	37,50
Minimum Value	87,50	75,00

Data

Based on the data in Table 4, it is known that the average value of critical thinking skills of the experimental class students is higher than the control class, which is 71.30 in the experimental class and 50.23 in the control class. This shows that the DCTS model implemented in the experimental class has a positive impact on students' critical thinking skills in natural science subjects.

This result was further strengthened by the Mann-Whitney U test conducted. In this study, the Mann-Whitney U test was used because the data came from two independent sample groups. The analysis of the prerequisites tests for the critical thinking skills of control and experimental classes showed that the data were not normally distributed so that the hypothesis testing used was non-parametric tests. The test results show a significance value of 0.00 which is less than the significance level of 0.05. It can be concluded that H_0 is rejected and H_a is accepted. This means that there is a significant difference between the value of students' critical thinking skills given the DCTS learning model and students who are given conventional learning models.

This result was obtained because the DCTS learning model provides opportunities for students to empower their thinking abilities. Through the questions posed by the teacher, students are required to initiate problem finding independently with their respective groups. This problem finding process forces students to analyze the issues that exist in their daily lives and sort out which ones relate to the concepts to be learned and which are not. This activity encourages students to explore the basic concepts they have previously obtained and then relate them to the problems found and find appropriate solutions to solve those problems. Students will use their critical thinking skills to the maximum so that self-concepts will be formed about the subject being studied. In contrast to conventional learning, students tend to depend on information / concepts obtained from teachers so they are not trained in critical thinking.

The DCTS learning model in its stages encourages students to empower their critical thinking skills at a higher level. In this model students are required to find and solve problems twice. This process is carried out in two stages. The initial problem initiation stage requires students' critical thinking skills in finding problems from the issues around them and determining the right initial concepts in their solution. The solution they propose at the end of this initiation stage will be proven by demonstrations and simple experiments. Furthermore, students are faced with more complex problems and require critical thinking skills at a higher level. Students can then utilize existing technology in an effort to solve these problems.

This result is in line with the research concluded by Wulandari (2012), that the learning model that emphasizes the thought process to find and find answers to a problem in question will be able to improve students' thinking abilities. In addition, this learning model will involve students to carry out activities directly in finding concepts, facts, theories, principles, and laws in the field of Natural Sciences (Puspaningtyas & Suparno, 2017).

Furthermore, the DCTS model emphasizes the use of appropriate technology in problem solving efforts. This technology can be either simple technology or technology that has been developed before. This will help in increasing students' motivation and interest in learning. Learning activities become not boring because students actively carry out learning activities.

Students' Responses to the Double Critical Technology Society Learning Model

In addition to critical thinking skills data, other data obtained in this study are students' responses to the implementation of the Double Critical Technology Society (DCTS) learning model. This data was obtained from the questionnaire assessment of responses that were filled in by 27 students who received learning with the DCTS model. The data is presented in Table 5 below.

Table 5. Students' responses to the implementation of DCTS learning model.

Response Aspect	Percentage (%)
Attractiveness of DCTS model	85,75
Clarity of DCTS model	81,50
Usability of DCTS model	82,50
Response average	83,25

From Table 5 above it appears that student responses to the attractiveness aspects of the DCTS learning model amounted to 85.75% with a very good category. In the aspect of clarity of the DCTS learning model obtained 81.50% response which is in the very good category. The usability aspect of the DCTS learning model gained a response of 82.50% which was included in the very good category. Overall, the average response of students to the DCTS learning model is 83.25% which is in the very good category. This shows that the implementation of the DCTS learning model received positive responses from students.

The learning process with DCTS provides opportunities for students to actively search for information and issues that are around them to find existing problems. This problem is then sought to be solved by proposing appropriate solution ideas. Furthermore, with demonstrations and experiments students are asked to prove the accuracy of the solutions they propose in answering problems. In this process students will become more interested and motivated in learning. The experience they gain will further strengthen their understanding of the concepts of the subject being studied. In addition, the use of technology in problem solving efforts also provides a new learning experience for students.

This kind of learning process is in line with what Ariyawati, et al (2017) applied the Pairs, Investigation, and Communication learning model that contains the concept of investigative learning, namely discovery and proof. In this study it was concluded that learning by discovery and proof can increase student activity. This is reinforced by the opinion of Rusman (2011) which states that learning should not be focused on theoretical knowledge, but must also provide opportunities for students to do, try, and experience themselves (learning to do) so that the learning experience students have always related to the actual problems that occur in the environment.

CONCLUSION

The Double Critical Technology Society (DCTS) learning model has a significant influence on the critical thinking skills of 7th grade students at SMP Negeri 1 Suhaid. This is evident from the results of the experimental class test with an average value of 71.30 which is better than the control class with an average result of 50.23. The average response of 83.25 shows that students also gave a very good response to the implementation of this learning model.

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