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THE EFFECT OF 5E CYCLE LEARNING MODEL ON CRITICAL THINKING SKILLS IN NATURAL SCIENCE LEARNING

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ABSTRACT

This study aims to determine the effect of the 5E learning cycle model on critical thinking skills in the theme of my environment being polluted at SMP Negeri 1 Candimulyo. The form of the research design used is the nonequivalent control group design. The population in this study was all seventh-grade students at SMP Negeri 1 Candimulyo while the samples used were class VII C as the experimental class and class VII D as the control class obtained through cluster sampling technique. The results showed that the indicator that had the highest increase was the explanation indicator with an average difference of 30,38 while the indicator that had the lowest increase was the inference indicator with an average difference of 11,53. In addition, from the data analysis conducted using the effect size test, the effect size (d) value was 1,762 with very high effect criteria. The effectiveness of the 5E Learning Cycle application in improving critical thinking skills can be further developed by implementing the model in the face-to-face learning process with appropriate time allocation in maximizing each learning stage.

Keywords: *Critical Thinking Skill, Sciene Learning, 5E Learning Cycle*

INTRODUCTION

This era is a century where the world is experiencing rapid changes in all aspects of life. These changes must be balanced with skilled human resources in mastering 21st century skills. The results of the identification of skills that need to be mastered in the current era are critical thinking (Zubaidah, 2018). These skills can be developed through the learning process in an educational unit.

Critical thinking skill is one of the essential skills to be mastered by students. This skill is self-skill using deep and structured thinking as the basis for making decisions (Facione, 2015). The mastery of critical thinking skills for students could increase students' awareness of the conditions that arise in their surrounding environment (Alsaleh, 2020).

Students' critical thinking can be developed through the educational process, one of which can be implemented through science learning. This is due to the IPA learning that contains knowledge of ideas and concepts that are related to nature (Hamdani, 2011). Through these characteristics, students are trained to familiarize themselves in applying science concepts meaningfully and thinking critically to encounter problems emerged in their life.

The results of an interview conducted on January 6, 2021, with teachers of IPA subject for Grade VII at SMP Negeri 1 Candimulyo produce data that shows the low mastery of critical thinking skills. This was suggested by the relatively low interpretation and analysis levels of the students in the learning process. Therefore, it is necessary to come up with solutions to overcome the problem. The result indicates factors that influence the low critical thinking skills of the students, among others, learning process that is less optimum in supporting the mastery of the skills; therefore, this requires a solution.

One of the veracious solutions to overcome students' low critical thinking skills is the application of a learning model that is

capable of improving the skills. The 5E learning cycle is a learning model that is able to handle the issue since it is developed to enhance students' critical thinking skills through five-stage activities, namely engagement, exploration, explanation, elaboration, and evaluation (Swintari, *et al*, 2014). The research result suggests that the model could enhance critical thinking skills since it is constructivism through a learning approach that involves students' activity in the learning process (Zakiyah & Lisdiana, 2022). The elaboration stage is an essential stage that involves students developing critical thinking as it directs students to develop content studied in a new situation (Mustofa, 2019). This learning process will not require students to memorize concepts of the content studied since the concepts will imprint on the students' minds through a series of process that has been passed (Muliyati et al., 2019).

Based on this, the research aims to prove the effect of the 5E-learning cycle learning media on increasing students' criticality on the theme of my environment being polluted at SMP Negeri 1 Candimulyo.

METHOD

This quantitative research was carried out using quasi-experimental method and a nonequivalent control group design. The class used in this study consisted of an experimental class with special treatment in the form of applying a learning model in research and a control class with a conventional model treatment (lectures and questions and answers).

The population includes students of SMP Negeri 1 Candimulyo. Sampling with the Cluster technique resulted in two classes as control and experimental classes. The technique utilization was based on class groups that had been formed without researcher intervention and had met the homogeneity and normality of the sample data.

The data collection technique employed a written test technique in the form of pretest-posttest before and after the treatment. The test instruments consisted of 6 question items according to Facione's critical thinking skill indicators. The determination of the validity and reliability level of the test instrument was conducted with a trial on 30 students of Grade VIII. Based on the data, the validity test results indicated that 8 questions were in the valid category, which was question number 2,4,5,6,7,8,9,10,11 and 4 questions were invalid namely question number 1,3,4,8,12. The valid questions had met the criteria of the 6 Facione's critical thinking indicators thus the reliability test was followed. The reliability test results suggested that 8 questions had a reliability level of 0.613. The results implied that the 8 question items of the critical thinking skills were valid and reliable.

The data analysis technique used a parametric test with prerequisite tests that consisted of normality and homogeneity tests. The normality test results indicated that the pretest-posttest data of the control and experimental class had a significance value > 0.05; thus, the data were normal. The homogeneity test was then conducted to identify the equality of both classes involved in the research. The homogeneity test results with the one-way ANOVA method implied that each data had a significance value > 0.05; hence, both classes were homogeneous. The results of the normality and homogeneity data suggested that the data were normal and homogeneous; hence, the statistic parametric test can be done.

Table 1. Critical Thinking Skill Categories

Percentage of Achievement (%)	Category
80 < PK ≤ 100	Very High
60 < PK ≤ 80	High
40 < PK ≤ 60	Moderate
20 < PK ≤ 40	Low
0 < PK ≤ 20	Very low

(Source: Arini, 2018)

The parametric tests employed in the research consisted of analysis of the improvement in critical thinking skills, using t-test, and effect size test. Categories for the analysis of the improvement in critical thinking skills are presented in Table 1. While the t-test criteria used in the study refer to Table 2.

Table 2. Guidance for T-test Criteria

If Sign (2-tailed)<0,05, then H_0 is rejected and H_a is accepted
If Sign (2-tailed)>0,05, then H_0 is accepted and H_a is rejected

The effect size category in the study is determined in Table 3.

Table 3. Effect Size Criteria

Effect Size (d)	Criteria
$0 < d \leq 0,2$	Low Effect
$0,2 < d \leq 0,5$	Moderate Effect
$0,5 < d \leq 0,8$	High Effect
$d > 0,8$	Very High Effect

(Source: Cohen, 1988)

RESULTS AND DISCUSSION

The research aimed to identify the effect of the 5E-learning cycle model on the students' critical thinking skills in the theme of my environment being polluted. Research conducted using a trial design of quasi-experimental design resulted in critical thinking analysis results based on the pretest-posttest scores obtained as shown in Table 4.

Table 4. Analysis of Critical Thinking Results

Indicators of Critical Thinking Skills	Experimental Class		Control Class	
	Average		Average	
	Pretest	Posttest	Pretest	Posttest
Interpretation	35.22	53.22	33.06	35. 19
Analysis	9.28	30.06	10.34	11.38
Inference	20.66	32.19	23.75	16.50
Evaluation	52.19	71.03	41.63	42.81
Explanation	25.81	56.19	26.84	25.84
Self-regulation	26.97	42.69	14.47	12.38
Total Average	28.35	47.56	25.02	24.02

Based on the data, the interpretation indicator received an average difference of 18 in the experimental class and 2.13 in the control class. The significant difference between the two classes is because there is an engagement stage that directs students to interpret events so as to support the mastery of interpretation indicators.

In the analysis indicator, the average difference in the experimental class was 20.78, whereas in the control class was 1.05. The difference between both classes was due to the experimental class that applied the explanation stage in the 5E-learning cycle model. The stage directed students to be able to analyze opinions expressed through the process of identifying reasons for a certain concept.

The inference indicator obtained the lowest increase in the test class of 11.53 and the control class of -7.25. The improvement in the experimental class can be linked to the exploration stage in the 5E-learning cycle model where students were guided to test estimation and record results and ideas through literature study activities. The exploration stage demands students to be actively involved in exploring knowledge independently through identification skill that brings up hypotheses of the encountered problems (Rusydi & Kosim, 2018). The stage is related to the critical thinking skill indicators since good inference skill is influenced by skills in analyzing and identifying problems correctly (Ismail & Bempah, 2018). The lowest improvement, however, was due to the limited communication and guidance between teacher and students; therefore, students found it difficult in carrying out the exploration activity.

In the evaluation indicator, the average difference in the experimental class was 18.84 and 1.18 in the control class. This is because the evaluation stage contained in the experimental class learning model. The stage guided the students to evaluate outcome of the learning conducted in terms of the concepts studied.

The fifth indicator, which is explanation, had the highest improvement in the experimental class with an average difference of 30.38. On the contrary, the control class

experienced a decrease of 1. The improvement in the experimental class was related to the influence of elaboration stage that supported the students to expand their knowledge by providing them with a problem and the students could estimate its solutions.

The last indicator was self-regulation that received an improvement of 15.72 for the experimental class but a decrease in the control class 2.09. In the experimental class, the improvement in the indicator was supported by every stage in the learning model.

The data in Table 4 shows that there is no significant difference in the pretest results of the subjects studied. These results are in line with the results of the t test, where the learning model applied has a significant effect on student criticality. The comparison of the results of the t test is presented in Tables 5 and 6.

Table 5. Average Difference Test of Pre-Test

Results of Critical Thinking Skills	Sig. (2-tailed)
Equal variances assumed	0,241
Equal variances not assumed	0,241

The above data clarifies that there was no significant difference. This indicated that the critical thinking skills of both classes were equal. The result was in contrast to the average results of the posttest presented in Table 6.

Table 6. Average Difference Test of Post-Test

Results of Critical Thinking Skills	Sig (2-tailed)
Equal variances assumed	0,000
Equal variances not assumed	0,000

The above data implies that the significance (2-tailed) obtained was 0.000 < 0.05; hence, the posttest was significant. The comparison of the results of the T test on the two data concludes that there is a significant effect of student criticality due to the application of the learning model.

The data showing the level of effectiveness of the applied model is shown in Table 7.

Table 7. Effect Size Test

Data Source	Value				
	$\bar{X}$	n	S	S_{pooled}	D
Experimental Class	47,66	32	15,539	13,34	1,762
Control Class	24,16	32	11,225		

Based on the above calculation of the effect size, it can be stated that the effect size value (d) was 1.762 and was in the criteria of a very high effect based on the estimation of the effect size effectiveness since the value was greater than 0.8. The test results with high category suggested that the implementation of the 5E learning cycle in the experimental class was effective in enhancing critical thinking skills compared to those in the control class with the conventional learning model. The results also elaborated that stages in the 5E learning cycle model are suitable for training interpretation, analysis, inference, explanation, evaluation, and self-regulation skills in students in experimental class in SMP Negeri 1 Candimulyo (Ramdani et al., 2021).

Improvement of critical thinking skills that only occurs in the test class was due to differences in the treatment of the applied learning model. The advantages of the learning model applied in research are based on constructivism so that it can affect students' critical thinking skills (Novianti, 2014). The large increase in student criticality is also due to the learning model that guides students to take an active role in the process of seeking and discovering new knowledge for themselves (Pratiwi, 2016).

Another advantage of the learning model applied in the experimental class is that it is effective in achieving learning outcomes. This is consistent with Suci (2020) stating that effective learning is learning that can improve understanding of students' learning achievement that affects the success of learning objectives.

Successful learning achievement in the research was proven by an improvement in critical thinking skills in the experimental class in each indicator. The highest improvement was in the explanation indicator of 30.38, whereas the lowest improvement was in the inference indicator of 11.53. The level of improvement in the explanation indicator was due to the learning process that emphasizes elaboration by students which affects student skills in explaining problems. The low level of the inference indicator was influenced by the poor communication process between teachers and students. The results is consistent with the research results of (Latifa et al., 2017) that indicated a significant difference in the improvement between critical thinking indicators that are affected by the success in the learning process in each stage performed.

The use of this learning model can increase students' criticality when compared to conventional learning models (lectures and questions and answers). This was due to the learning stages in the learning model that accommodate students' active roles in exploring, analyzing, and evaluating comprehension obtained on the studied concepts (Putra et al., 2018). In addition, indicators of critical thinking skills which are the learning objectives are widely applied in this learning model which makes students' criticality increase optimally.

Critical thinking as a crucial basic skill in the 21st century serves to equip students in overcoming existing problems. Students with good critical thinking skills could solve problems appropriately so that they have competitiveness to compete globally in the 21st-century era. Critical thinking skills create an individual that is skillful in self-management to achieve his/her goals and is capable of handling difficulties by relying on awareness of their skills (Hunaepi et al., 2020).

Critical thinking skills also affect the level of students' maturity of thought thus it becomes a foundation for the individual in making a decision wisely and responsibly. Herayanti & Habibi, (2015) express that critical thinking skills have characteristics of student activities that consist of asking questions according to the core of the problem discussion, answering questions in the problems based on reasoning ability, and self-confidence activities from the reasoning results. Based on the opinion, it can be inferred that the utilization of themes that are related to my environment being polluted has closeness for students; thus, it supports students' reasoning in developing critical thinking skills. The selection of the themes also had conformity to the students in terms of environmental awareness. Through their critical thinking, students can foster awareness of problems related to environmental pollution and efforts in overcoming the issues.

Another finding is that the use of this learning model in the online learning process can affect student learning independence. Students are demanded to follow the direction given by the teacher in finding information. Students learn independently to solve assignments by going through the sequence of stages in acquiring science or concepts.

The results of this study are relevant to the results of previous research, namely the research of Oktavia Nurma Sari, et al (2014) which states that students' critical thinking skills can be raised through each step of the learning model. The results of the study are also in accordance with research by Baiq Rizkia Ayu Latifa, et al. (2017) that the learning series applied in the 5E learning cycle model contains a process to train critical thinking skills. In addition, it is also relevant to the research of Irhamna, et al. (2017) where each stage in the 5E learning cycle learning model is able to improve students' critical thinking skills in the medium category.

CONCLUSION

Based on the research results, it can be concluded that there was an effect of the 5E-learning cycle model on critical thinking skills in

the theme of my environment being polluted at SMP Negeri 1 Candimulyo. The learning model applied in the learning was effective in improving students' critical thinking skills in the theme of my environment being polluted at SMP Negeri 1 Candimulyo.

Suggestions offered for future research include 1) it is expected that researchers could apply the 5E-learning cycle model in the face-to-face learning process, and 2) researchers who want to apply the 5E-learning cycle model should pay attention to time allocation in their learning process, especially online learning process so that the learning process takes place optimally and smoothly according to the time allocation.

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