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The Effect of Learning Cycle 5E on Critical Thinking Skills for Junior High School Students

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abstract

This study aimed to find out the influence of the 5E Learning Cycle on the critical thinking skills of SMPN 1 Talangpadang VII graders. This study also aimed to determine the significance level of the two methods in improving critical thinking skills. One of the efforts is implementing the 5E learning cycle (Engagement, Exploration, Explanation, Elaboration, Evaluation). This study used a quasi-experimental with the matching-only pretest-posttest control group design. The population was all VII graders, while the samples were VII3 and VII4 students, where VII3 was the experimental class, and VII4 was the control class. The instrument used in this study was an essay test on critical thinking skills. The data underwent normality test using Kolmogorov Smirnov and homogeneity test using homogeneity of variances. Based on the t-test using the Independent Sample Test with SPSS statistics 21.0, the significance was 0.00 or less than 0.05, showing the influence of the 5E Learning Cycle on students' critical thinking skills.

1. Introduction

Based on the global context and the diversity of Indonesian citizens, the mission and direction of The 2013 Curriculum have been transformed into a learning application with a specific purpose to provide the skills needed by current and future students. Implementation of the 2013 Curriculum is a reference for an educational process expecting students to achieve various skills through applying HOTS or critical thinking skills as one of the 21st-century skills (Ariyana et al., 2018; Malik et al., 2020; Malik, & Ubaidillah, 2020).

One of the learning models supporting critical thinking skills is the 5E Learning Cycle. This model provides opportunities for students to optimize their reasoning or thinking skills through activity stages consisting of engagement to generate interest in the subject, exploration offers opportunities to interact in groups. It provides opportunities for students to convey ideas through discussion, elaboration, or class participation to apply problem-solving concepts. Moreover, the models evaluate knowledge, conceptual understanding, or competence. Therefore, the 5E Learning Cycle is a model requiring students to play an active role in the learning process, especially in measuring students' critical thinking skills.

Aryulina (2009) stated the 5E Learning Cycle consists of engagement, exploration, explanation, elaboration, and evaluation, and this cycle can improve inquiry skills and conceptual understanding. Critical thinking skills are mental processes for analyzing or evaluating information to understand deeply in forming a belief in the truth of information and making the best decisions. According to Ennis (Fisher, 2011), critical thinking is reasonable, and reflective thinking is focused on deciding something to believe or do. Critical thinking skills consist of providing simple explanations, building basic skills, concluding, making further explanations, and strategies and tactics consisting of several sub-aspects and indicators.

The critical thinking skills of Indonesian students are still relatively low. They have been tested based on experience in the scientific field, especially the application of PISA survey results (Program for International Student Assessment). Compared to students in other countries, Indonesian students are still low in problem detection and conclusions. Indonesia is proven to be ranked 61 out of 70 countries (OECD, 2016). According to TIMSS 2015, Indonesian students are also ranked 45th out of 48 countries in science (TIMSS, 2016). PISA and TIMSS questions are designed for practicing skills to optimize critical thinking (Syutharidho & Rakhmawati, 2015).

However, based on interviews with SMP Negeri 1 Talangpadang Tanggamus science teachers, critical thinking was still low. This is indicated by the average score of 70 students who have not met the passing grade of 75 due to teacher-oriented education. Teachers do not practice an active learning model, meaning, on the contrary, a functional learning model is needed by using reading procedures to improve critical thinking skills.

After observing schools, teachers have not maximally developed learning based on learning needs. For example, teachers still use the old or lecture method to deliver material to students. Of course, this is not following the demands of the curriculum and the needs of self-development. This method also causes inadequate response and feedback from students to questions and explanations from teachers. In addition, the concentration of attention is also limited, and students tend not to improve and develop thinking and personality skills actively. If this pattern continues to be applied, students' critical thinking skills will not be achieved and designed correctly.

2. Method

The study was carried out at SMP N 1 Talangpadang, Talangpadang Sub-District, Tanggamus Regency. The study was carried out using a quasi-experimental with the matching-only pretest-posttest control group design. (Fraenkel, 2006).

Table 1. Pretest-posttest design

Class	Pretest	Treatment	Posttest
Experiment	O_1	X	O_2
Control	O_3		O_4

Description: O_1 = Pretest on experiment class; O_2 = Posttest on experiment class; O_3 = Pretest on control class; O_4 = Posttest on control class; X= Learning used 5E Learning Cycle; C = Learning used conventional method

This study had two variables, namely the independent and dependent variables. The independent variable was 5E Learning Cycle, and the dependent variable was critical thinking skills. The population of this study was 110 VII graders, while the sample was 41 students from VII3 and VII4. Data were collected through essay tests. Data underwent t-test using SPSS Statistics 21.0.

3. Result and Discussion

This study aimed to find out the influence of the 5E Learning Cycle on the critical thinking skills of SMP Negeri 1 Talangpadang VII graders regarding environmental pollution. The results of data processing in pretest and posttests on critical thinking skills in both classes can be seen in Table 2.

Table 2. Pretest and posttest data

Description	Experiment		Control	
	Pretest	Posttest	Pretest	Posttest
Max	65.00	85.00	60.00	70.00
Min	45.00	65.00	45.00	47.00
Mean	60.71	75.00	54.05	59.00
Total students	21.00	21.00	20.00	20.00

The mean pretest scores on the experimental and control classes were 60.71 and 54.05, respectively. This showed no significant differences between the two. After treatment, there was a significant difference in the mean posttest score. In the experimental and control classes, the mean posttest scores were 75 and 59, respectively. This shows that the 5E Learning Cycle in the experimental class influenced students' critical thinking skills.

Based on t-rest results, the pretest scores in the experimental and control classes showed no significant differences. Therefore, students' critical thinking skills in the control and experimental classes before the learning process showed no significant differences. However, after treatment, the pretest scores showed significant differences on the posttest scores of the experimental class and control class, where t-count > t-table. Thus, the critical thinking skills of the experimental class with the 5E Learning Cycle and the control class with the conventional learning model showed significant differences, where the 5E Learning Cycle was better than the control class.

Students' critical thinking skills had significant differences between the experimental class with the 5E Learning Cycle and the control class with the conventional method. Critical thinking skills were measured by N-gain on each indicator of critical thinking skills. Each critical thinking indicator can be seen in (Table 3).

Table 3. N-gain of critical thinking skills per indicator

Critical thinking indicator	Experiment		Control		Sig (2-tailed)
	N-gain	Criteria	N-gain	Criteria	
Making simple explanation	0.70	High	0.42	Medium	0.00
Developing Basic Skills	0.45	Medium	0.14	Low	0.00
Concluding	0.64	Medium	0.03	Low	0.00
Making further explanation	0.79	High	0.49	Medium	0.00
Strategy and Tactics	0.85	High	0.42	Medium	0.00

Table 3 presents that the "making simple explanation" indicator had an N-gain of 0.70 on the experimental class and 0.42 on the control class. There were no significant differences in N-gain because, during learning activities, students were able to make a simple answer to a given problem. For example, students can explain the definition of environmental pollution. According to (Surya 2013), critical thinking allows a person to analyze, assess, explain, and restructure thinking. Furthermore, students asked the teachers and other groups questions about the material they had not yet understood. In the "developing basic skills" indicator, the N-gain on the

experiment class was 0.45, and the control class was 0.14. Meanwhile, the "concluding" indicator N-gain of the experiment class was 0.64, and the control class was 0.03 due to learning in the control class being more dominant using the lecture method. This is different in the experimental class, where the "concluding" aspect was quite good after actively implementing the 5E Learning Cycle in learning to work together with friends.

Susanto (2012) stated one of the stages to teach or train students to think critically is to conclude. Readers are required to describe and understand various aspects gradually to arrive at a new formula, namely a conclusion. The last indicator (making further expansion) had *N-gain* on the experimental class was 0.79, and the control class was 0.49, where students were able to identify terms and definitions of environmental pollution and identify assumptions. The *N-gain* of the experimental class was higher than the control class because the learning process using the 5E Learning Cycle worksheet had a significant influence on students' critical thinking skills. Students in the experimental class carry out meaningful learning by doing practical activities.

Florea and Hurjui (2015) stated critical thinking skills can be developed through continuous practice where teachers encourage students to think independently, be confident in expressing ideas, and accept differences to collaborate to find problem-solving. The way that teachers can hone students' critical thinking skills is through finding information from various sources both through experience, communication, and observation so that an active intellectual process occurs (Vieira et al., 2016). Through observing real objects, students are trained to be able to think critically so that they can find the principles and concepts of an object. Teachers can lead students to have critical thinking through triggering questions at this stage. Following the 5E Learning Cycle, students explore and analyze questions on the explanation stage. Students discuss with group members to discuss the observed results. Questions can generate curiosity and a willingness to analyze (Nisak and Suwono, 2017).

The prerequisite test was carried out before testing the hypothesis using homogeneity and normality tests. Based on the homogeneity test, the significance value of 0.153 was greater than 0.05, meaning the data were homogeneous. Furthermore, based on the normality test, A Symp. Sig. (2-tailed) of 0.173 was greater than the alpha value of 0.05, meaning the data were normally distributed. Furthermore, hypothesis testing aims to see the influence of the 5E Learning Cycle on students' critical thinking skills.

Table 4. T-test results on critical thinking skills of students

Mean	t	df	Sig. (2-tailed)
.23633	10.308	62	0.000

The mean difference test can be seen on the t-test for Equality of Means. At equal variances assumed, the t-test value was 10.308, and the significant level was p= 0.000 or less than 0.05, showing the use of the 5E Learning Cycle on students' critical thinking skills. Based on previous results, there were critical thinking skills in the experimental class, and this is because the 5E Learning Cycle applied to the experimental class can improve critical thinking skills. The 5E Learning Cycle demands optimal involvement to improve critical thinking skills in the learning process.

This is in line with a study by (Verawati et al., 2017), stating that the 5E Learning Cycle is a model developed to create effective and efficient learning activities in improving critical thinking skills by "generating interest" (engagement) to interact with each other in answering questions. This interaction makes students more active in finding information to answer each question. According to (Wena, 2017) this was performed by asking questions about factual processes in everyday life related to the topic.

In the exploration stage, students are enthusiastic about working on questions in groups to test new hypotheses where the teachers are only facilitators. However, due to a lack of understanding, they cannot be separated from the obstacles faced when the learning process is less than optimal. Supposedly, students were asked to investigate a case in the discussion process, but the teacher's worksheet was not following the second step procedure. However, this does not become an obstacle to the score or activity of students in the learning process because other syntaxes are executed according to the available steps.

In the Explanation stage, students explain the results of group discussions in front of the class. Other students respond to and criticize the presenters, answer other students' questions, and explain the concepts studied. This will trigger the ability to search for information and feel responsible for the questions given by the teachers so that in the learning process, the teachers only act as facilitators in this stage because, in this learning model, students play an active role.

Students can make further explanations in the elaboration stage, and skills are acquired in new situations (Bybee, 2011). At this stage, students explore critical thinking skills by making further explanations shown in asking questions about the subject, proposing problem-solving, making decisions, conducting experiments, and further observations. After going through the previous stages, students can experience equilibration, where they can be said to have built their knowledge. The indicator for making further explanations is expected to be shown by students with the emergence of activities asking questions about the subject, proposing problem-solving, making decisions, conducting experiments, and further observations.

The evaluation was designed by filling out a worksheet where the activity stimulates students to ask questions about the subject but has not been able to stimulate students to propose solutions and make decisions, conduct experiments, or further observations. For the second meeting, the elaboration stage was designed to fill out a worksheet. In other words, the activities developed in the elaboration stage on the first and second meetings were not sufficient to facilitate students to propose solutions and make decisions, conduct experiments, and follow-up observations.

Based on Piaget's cognitive development, junior high school students are categorized on the concrete operational stage. At the concrete active stage, students can think logically more easily than in the previous stage of cognitive development. Furthermore, students can also do deductive reasoning or draw logical conclusions based on the information provided (Ormrod, 2010). However, even though students show concrete operational thinking by displaying many characteristics of logical thinking, cognitive development is not yet perfect. They have difficulty understanding abstract ideas and have problems dealing with many hypotheses or variables. Although there were low scores, overall, the experimental class taught with the 5E Learning Cycle showed an average percentage of critical thinking achievement was better than the control class taught with conventional learning models. This is in line with a study by (Budprom et al., 2010) showing students' critical thinking skills as a whole and in terms of being taught with the 5E Learning Cycle was better than students being taught by the instruction manual of teachers. Armiza (2007) stated that Learning Cycle with empirical abductive can also improve the critical thinking skills of junior high school students.

4. Conclusion

Based on the problem formulation, the 5E Learning Cycle had a significant influence on the critical thinking skills of SMP Negeri 1 Talangpadang VII graders. Learning models can stimulate students in critical thinking, namely the 5E Learning Cycle consisting of the Engagement stage, Exploration stage, Explanation stage, Elaboration stage, and Evaluation stage.

References

Ariyana, Y., Pudjiastuti, A., Bestary, R., et al., (2018). *A handbook oriented to high-level skills*. Ministry of Education and Culture.

Armiza. (2007). Empirical abductive learning cycle model to improve conceptual understanding and critical thinking skills of junior high school students on light reflection material. *Journal of Science Education Research* 1(1).

Aryulina, D. (2009). Implementation of 5E learning cycle to increase students' inquiry skills and biology understanding. *Jurnal Kependidikan Triadik, 12*(1). 45-55.

Asthira P, I Wy., Mrs. Kusmariyatni, I Gd. Margunayasa. (2016). The effect of the "5e" learning cycle model on science learning outcomes for fifth-grade students in cluster III. e-*Journal of PGSD Ganesha University of Education Department of PGSD* 4 (1).

Budprom, W., Paitool, S., & Adisak, S. (2010). Effects of learning environmental education using the 5E - learning cycle with multiple intelligences and teacher's handbook approach on learning achievement, Basic science process skills, and critical thinking of grade 9 students. *Pakistan Journal of Social Sciences* 7 (3), 200-204.

Bybee, R. W. (2011). Scientific and engineering practices in K-12 classrooms. *Science Teacher*, 78(9), 34-40.

Ennis R. H. (2011). The nature of critical thinking: An outline of critical thinking dispositions and abilities. The University of Illinois.

Facione, P. A. (2011). Critical Thinking: What it is and why it counts. Millbrae, CA Measured reasons and the California academic press. 1- 23.

Fajaroh, F. & Dasna, I. W. (2007). Innovative model-learning models. Malang: State University of Malang.

Fisher, A. (2011). Critical Thinking: An introduction. Cambridge: Cambridge University Press.

Florea, N. M., & Hurjui, E. (2015). Critical thinking in elementary school children. *Procedia - Social and Behavioral Sciences,* 180, 565–572.

Fraenkel, J. R., Wallen, N. E., & Hyun, H. H. (2006). *How to design and evaluate research in education* 7. McGraw-Hill.New York.

Gunawan, G., & Liliasari, L. (2012). Modern physics virtual laboratory model to improve the critical thinking disposition of prospective teachers. *Journal of Educational Horizons*, 5(2), 185-199.

Hikmawati. (2015). Physics learning with the 5E learning cycle model (Engage, Explore, Explain, Elaborate, Evaluate) as an effort to improve students' life skills. Journal of Physics and Technology Education, 1(1), 24-37.

Malik, A., & Ubaidillah, M. (2020). Students Critical-Creative Thinking Skill: A Multivariate Analysis of Experiments and Gender. *International Journal of Cognitive Research in Science, Engineering and Education:(IJCRSEE), 8*, 49-58.

Malik, A., Yuliani, Y., Rochman, C., Zakwandi, R., Ismail, A., & Ubaidillah, M. (2020, April). Optimizing students critical thinking skills related to heat topics through the model of content, context, connection, researching, reasoning, reflecting (3C3R). In *Journal of Physics: Conference Series* (Vol. 1521, No. 2, p. 022001). IOP Publishing.

Ministry of Education and Culture. (2013). Regulation of the Minister of Education and Culture No. 59 of 2014 concerning the 2013 Curriculum for SMA/MA. Jakarta: Ministry of Education and Culture.

Latifa, B. R. A., Verawati, N. N. S. P., & Harjono, A. (2017). Pengaruh model learning cycle 5E (Engage, Explore, Explain, Elaboration, & Evaluate) terhadap kemampuan berpikir kritis peserta didik kelas X man 1 mataram. *Jurnal Pendidikan Fisika dan Teknologi, 3*(1), 61-67.

Muhfahroyin. (2009). Empowering students' critical thinking skills through constructivist learning. *Journal of Education and Learning, 16*(1), 88–93.

Nisak, M. K., Wartono., & Suwono, H. (2017). The effect of guided inquiry learning is based on the mutual discussion on the critical thinking skills of junior high school students based on academic ability. *Journal of Education: Theory, Research, and Development, 2*(1), 113–120.

Novianti, A., Noor, M. F., & Susanti, B. H. (2014). The effect of the learning cycle model on students' critical thinking skills. *Science Edu, 6*(1), 110 – 116.

OECD. (2016). PISA 2015 Results in Focus. Accessed at https://www.oecd.org/pisa/pisa-2015-results-in-focus.pdf. accessed 15 August 2021 at 08.30 AM.

Rusnilawarni. (2017). Pengaruh model pembelajaran dan gaya belajar terhadap kemampuan berpikir kritis peserta didik kelas X SMK Negeri 2 Watampone. *Chemistry Education Review (CER)*, 45-53.

Syutharidho & Rakhmawati, M. R. (2015). Development of critical thinking questions for junior high school students in grade VIII. *Al-Jabar: Journal of Mathematics Education* 6(2), 219 – 227.

TIMSS. 2016. TIMSS 2015 and TIMSS advances 2015 international results. Diakses on page http://timss2015.org/ accessed on 15 August 2021 at 08.17 AM.

Verawati, N. N. S. P., Wahyudi, W., & Taufik, M. (2017). The effect and contribution of the use of inquiry model-based cognitive conflict strategies on increasing students' critical thinking abilities. *Journal of Physics and Technology Education*, 4(2), 232-239.

Vieira, R. M., Tenreiro-Vieira, C., & Martins, I. P. (2016). Critical Thinking: Conceptual clarification and its importance in science education. *Science Education International,* 22(1), 43-54.

Wena, M. (2012). Contemporary innovative learning strategies: An operational conceptual review. PT. Earth Literature.