Universal Journal of Educational Research 10(5): 311-317, 2022 http://www.hrpub.org
DOI: 10.13189/ujer.2022.100501

7E Learning Cycle Model Implementation: Students' Activities and Critical Thinking Skills towards Online Learning

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Received March 2, 2021; Revised June 12, 2021; Accepted April 15, 2022

Cite This Paper in the following Citation Styles

(a): *[1] Raohul Ilhami, Endang Widjajanti Laksono , "7E Learning Cycle Model Implementation: Students' Activities and Critical Thinking Skills towards Online Learning," Universal Journal of Educational Research, Vol. 10, No. 5, pp. 311 - 317, 2022. DOI: 10.13189/ujer.2022.100501.*

(b): *Raohul Ilhami, Endang Widjajanti Laksono (2022). 7E Learning Cycle Model Implementation: Students' Activities and Critical Thinking Skills towards Online Learning. Universal Journal of Educational Research, 10(5), 311 - 317. DOI: 10.13189/ujer.2022.100501.*

Abstract The spread of the COVID-19 epidemic has changed the education system. Teachers are encouraged to continue the online teaching process through certain platforms including Skype, Zoom, and Google Meet. Therefore, this study used Zoom application to look at the 7E learning cycle model's (7E LC) effect on student activities and critical thinking skills in chemistry teaching. This study is a quasi-experiment and only has a post-test design. The sample for this study is 11th-grade students from Yogyakarta 4 High School in Indonesia selected by random sampling technique. Two classes were selected as the samples, one as an experimental class where the 7E LC was implemented and another one as the control class where the learning used direct instruction model. The student's learning activity data were collected through questionnaire and the student's critical thinking skills data were obtained through an open-ended hydrolysis problem test. According to the MANOVA model, the difference between students' learning activities and students' critical thinking ability is analyzed. The result of this study is that there are significant differences in student activities and critical thinking skills between the experimental class and the control class.

Keywords Chemistry Learning, Critical Thinking Skills, Online Learning, Students' Activities, 7E Learning Cycle Model

1. Introduction

Since the beginning of this year, the spread of COVID-19 in Indonesia has turned the education system into online learning. Online learning and teaching are carried out on digital platforms. This is related to the 2020 Circular Letter No. 15 issued by the Minister of Education and Culture of Indonesia, regarding the guidelines for organizing family study during the emergency period of COVID-19 transmission. The announcement was issued to reduce the physical distance to reduce the spread of coronavirus disease and the burden on the health system. Online learning requires a variety of facilities, such as the Internet, and electronic products such as laptops or phones. Students and teachers will live in different places. This is a supplement to normal classroom learning [1], [2]. This online learning is carried out by using various platforms (such as Skype, Zoom, Google Meets, Webex, and Microsoft Team) [3].

The teaching and learning process must still be carried out, even though it has to go through online learning, so that students can still gain knowledge in this pandemic COVID-19. One of the educational goals is to enable students to have independent, effective and creative knowledge and skill systems [4]. According to Temel [5], teachers can help students think, research, and develop solutions to problems. In the teaching process, students actively participate in searching and processing information about the current topic understanding. The 2013 curriculum not only requires emphasis and attention on the final results obtained by students but also requires them to take part in the educational process. During the teaching activities, the student-centered learning process is monitored by inquiring, answering the teacher's questions, laboratory activities, discussion, and problem-solving.

Learning activities are activities of students in the course of learning. Every learning activity performed by students is to enhance knowledge, skills, and abilities [6], [7]. In addition, Manual [8] defines a learning activity as any activity for a person to improve knowledge, skills, and abilities. Learning activities are actual behaviors that occur when individuals perform tasks [9]. In other words, students' participation in the learning process is to build their own knowledge. Observe the activities of learners from many aspects: group oral activities, listening activities, visual activities, writing activities, and collaborative activities [6], [7]. Students involving in learning activities can obtain more effective and meaningful learning [10], [11]. According to the research of Chebii et al. [12], educational goals can be achieved in active student participation, demonstrations, classroom discussions, and other related learning experiences. Indeed, students are less engaged in their studies that are conducted under the teachers' command.

Involvement of students in the learning process will affect critical thinking skills that focus on 21st-century skills [13]. A good learning process not only prepares students for further studies but also solves the daily problems encountered in the work environment in view of the need for critical thinking skills to solve problems [14–16]. According to Mapeala and Siew [17], critical thinking skills must be created and developed at all levels of the school. According to interviews and observations, the fact is that teachers rarely train students to think critically. Therefore, students are accustomed to critical thinking and can practice it in the later stages of life and work. The training of critical thinking skills can be achieved through the 7E LC model. One of the models is the 7E LC model, which covers seduction, participation, exploration, interpretation, elaboration, evaluation, and expansion [18].

The 7E LC model can improve students' activity and critical thinking skills. In addition, this model can improve the critical thinking of science students without destroying their cognitive learning achievements such as buffered learning topics in chemistry [19]. The 7E LC model includes elicitation (bring prior knowledge), participation (attractive), exploration (exploration, investigation), explanation, elaboration, evaluation and extension [20], [21]. The implementation of the 7E LC model can improve learners' activity ability and critical thinking ability in the learning process [18].

The process of implementation of the 7E learning cycle model will make students more active in the procedure of learning, especially in the chemistry learning process. It is expected that the chemistry study in the classroom will be qualified, which will make the study more meaningful. High-quality learning includes the value associated with the goal and the achievement of results that follow the standard guidelines effectively and efficiently. This is consistent with Kyriacou [10], who explained that involving students in learning activities will produce an effective learning process. The increase in student activities will affect their way of thinking and develop critical thinking skills in students. Therefore, it is expected that the 7E LC model will boost students' activities and critical thinking skills, which will make it easier for students to grasp the concepts being taught.

2. Methodology

General background

This was a quasi-experimental research design and used post-test only design conducted at Senior High School 4 Yogyakarta Indonesia in the academic year 2020/2021. There were two variables, namely the independent and the dependent variables. The independent variables were 7E learning cycle and direct instruction models. The dependent variables were students' activities and critical thinking skills.

Research samples

The population in this study is all Senior High Schools in Yogyakarta, Indonesia. The samples for this study were students from Senior High School 4 Yogyakarta, Indonesia. The experimental class is XI MIA 1 (32 students), and the control class is XI MIA 3 (32 students). The selection of samples is done by using random sampling techniques. The teaching process of the experimental class adopts the 7E LC model and the direct guidance model is used for the control class.

Research instruments and procedures

The research instrument consisted of tests, observation sheets and questionnaires. There are 5 open-ended questions and 28 questionnaire presentations. The tool was initially verified by two expert evaluations and empirical verification was performed on 200 students. Cronbach's estimated alpha values are 0.75 and 0.71, respectively, so both are acceptable. Validity categories and tool reliability are determined by using procedures suitable for PCM (Partial Credit Model).

Using the zoom app, we conducted 6 online meetings about hydrolysis in a week, and a post-test was conducted in the last meeting. Five descriptive questions were tested to assess students' critical thinking skills. Questionnaires were used to gather data on students' activity during the learning process.

Data analysis

MANOVA was used to analyze the data with the help of SPSS 25 to understand the impact of the 7E LC model on students' activities and critical thinking skills in the learning process. MANOVA was used because the number of dependent variables is more than one under the following assumptions:

H_0: By applying the 7E LC model and the direct guidance model to hydrolyzed materials, there are no significant differences in student activity and critical thinking skills.

H_I: By applying the 7E LC model and the direct guidance model to hydrolyzed materials, there are significant differences in student activity and critical thinking skills.

Decision Criteria: H_0: is rejected if the value (Sig) of Hostelling's Trace <0,05.

3. Results and Discussion

This study investigated application of the 7E LC model to student activity and critical thinking skills. The 7E LC model consists of 7 stages: elicit, engage, explore, explain, elaborate, evaluate, and extend. The application of the 7E LC model is expected to improve students' activity abilities during the learning process, thereby also improving learners' critical thinking skills.

In the elicit stage, teachers try to make students have a priori knowledge of the problems of daily life phenomena related to hydrolyzed materials. The disengagement stage is used to concentrate students' attention and attract students to learn. In the exploratory stage, students have the opportunity to develop their own knowledge by observing data, analyzing data, designing experiments, making graphs or tables, and developing hypotheses. In the explanatory stage, students are introduced to concepts or new theories, and then they are connected with the content of the previous stage. In the well-designed stage, students have the ability to put what they have learned into practice acquired in a new situation. In this step, students will generate new ideas and build their own knowledge. In the evaluation phase, the teacher will evaluate the students' activities in the previous phase in the form of test or non-test. In stage of extension, teachers guide students to apply the knowledge gained in the learning process to the next learning materials.

The data for this study were obtained through experiments through a zoom application used in online learning. Before using MANOVA for testing, the normality and homogeneity criteria for research data must first be met. The homogeneity is performed by Levene's Statistics, while the Kolmogorov-Smirnov test with Liliefors significance was used in this analysis as the normality test. According to the results of the Kolmogorov-Smirnov test and Levene's statistical data, the data in this study are normal and homogeneous, hence, MANOVA analysis was performed.

The summary of MANOVA test results in this study were answered with a multivariate test Hotelling's Trace because of two dependent variables students' activity and critical thinking skills, and the normal distribution of the data coming from populations with homogenous variance matrix. It can be seen in Table 1.

Table 1. The result of MANOVA on students' activities and critical thinking skills

Effect	F	Sig.	*Partial Eta Square*
Pillai's Trace	6.308^b	.003	.806
Wilks' Lambda	6.308^b	.003	.806
Hostelling's Trace	6.308^b	.003	.806
Roy's Largest	6.308^b	.003	.806

Students' learning activity data were obtained from questionnaires while data of the student's critical thinking skills were obtained using a five-question test in the hydrolysis topic. After obtaining activity data and critical thinking skills, test the application of the 7E LC model. Since the two dependent variables, activity and critical thinking skills, the normal distribution of the data comes from the population with a mean square error matrix, the MANOVA test results in this study were answered with the multivariate test Hotelling's Trace (Sig 0.003 <0.05). According to the results of the multivariate analysis (Table 1), we can conclude that H_0 is rejected, which means that under the application of the 7E LC model and the direct guidance model, there are significant students' activities and critical thinking skills or the control class and experimental class have significant differences in the level of 95% in terms of learning activities and critical thinking skills of learners between the experimental class and the control class.

Further analysis was solved by using the test of knowing the difference between subjects for each variable in the second grade. Based on the results of the Test Between Subject to each dependent variable (Sig < 0.05) as shown in Table 2 it can be inferred that the experimental class and control class in this study had significant differences in the level of 95% in terms of students' activity and critical thinking skills.

Table 2. Test results between subjects

	Dependent Variables	df	F	Sig.
7E learning cycle models	Activity	1	41.765	.000
	Critical Thinking Skills	1	4785.765	.000

Table 2 shows the results of the Test Between Subjects to each dependent variable (Sig < 0.05); it can be concluded that the experimental class and the control class in this study have significant differences in the level of 95% in terms of students' activity and critical thinking skills.

Activities here refer to students' activities in the learning process. The habits of students during the learning process can be used as an indicator of students' activities in the learning process. A questionnaire containing many statements (28 statements) was used to measure student activities. These statements included evaluation indicators of student learning activities during the learning process of hydrolyzed materials. Table 3 lists the observation results of students' learning activities in the learning process.

Table 3. Description of observation results on students' activities in the experimental and control classroom

Description	Score	
	Experimental Class	Control Class
N	32	32
Minimum	64.19	51.20
Maximum	95.79	90.55
Average	84.00	74.19
Standard Deviation	13.34	9.26

Based on Table 3, it can be seen that all the observation grades of experimental students show higher scores than the control students.

There are six aspects of student activity observed in this study, the visual, verbal, listening, writing, motor, cooperation aspects. Category of every aspect can be found in Table 4.

Table 4. Category of every aspect of students' activity in control class and experimental class

Aspects Rating	Experiment	Control
Visual	Very Good	Good
Oral	Good	Enough
Listen	Good	Good
Write	Good	Good
Motor	Very Good	Very Good

Table 4 shows that the overall activity of the experimental class students is included in the good category and very good category while control class students are in enough, good, and very good. Motor is the most dominant aspect of second-grade students, which means that the activities of the students in the control class and the experimental class are similar in the motor aspect. Most aspects of the experimental class are dominated by visual aspects and motor aspects. This happens because the 7E LC model can increase students' activities to find information and activities during laboratory experiments, and oral, listening, writing, and collaboration are all included in these two categories. The highest aspect of the control category is the motor aspect and the visible aspect, and the speaking and cooperation aspects are included insufficient categories. This is caused by a learning process that is only teacher-centered.

The learning process using the 7E LC model can improve students' learning activities. The model is still a relatively new learning model that can be used in research samples, thereby increasing students' learning enthusiasm and increasing their activities in the learning process. It is consistent with the theoretical framework of Mapeala and Siew [17], who pointed out that the 7E LC model is students-centered, which makes them more active than teacher-centered learning implementation. In addition, as students learn in an environment that will train the exploratory investigation process, the 7E LC model makes students more active. It can train active students in the learning process. The model also pre-emphasizes students' knowledge and experience so that students will actively associate new knowledge with their previous experience and knowledge. This is what will make the learning process more meaningful because students are able to develop their knowledge [8].

In the process of online learning, teachers observe the activities of students as they are studying. The observation results show that the students in the experimental class are more active than the students in the control group. According to observations from the first to the fourth meeting, the number of students who continuously asked questions and expressed opinions in the experimental class were 8 students, 10 students, 6 students and 16 students. In the control classes of the first to fourth meetings, there were 4 students, 6 students, 3 students and 7 students respectively.

Table 5. The experimental class and control class in each indicator of critical thinking skills

Indicators	Score	
	Experiment	Control
Identifying the Problem	72.75	50.35
Evaluating Arguments	43.55	30.05
Determining Solution	72.65	50.00
Draw a Conclusion	68.75	53.25

In addition to improving students' learning activities, 7E learning cycle model can also improve students' critical thinking skills [13], [14], [18]. Critical thinking skills data of students in this study were obtained from the results of the posttest with five questions about the description obtained from four indicators of critical thinking, identify problems, evaluate an argument, define solutions, and draw conclusions [22]–[24]. For example, when the teacher asked students "What is meant by partial hydrolysis?". Students with higher critical thinking skills answer partial hydrolysis is the reaction of one ion of the salt with water (H_2O), where negative ions will form clusters with H_2O while positive ions are around H_2O. Meanwhile, students with lower critical thinking just answer the definition of partial hydrolysis without explaining if negative ions are represented by water or not. The value obtained by each class for each indicator is given in Table 5.

Based on Table 5, it can be seen that the values of indicators of identify problems and determine solutions obtained are almost the same in both classes. This corresponds to the work of Almulla [25] stating that critical thinking is generally perceived as a highly important cognitive skill directly related to information processing. The experimental class values were 72.75 and 72.65, while the control class values were 50.35 and 50.00. This is because students seek their knowledge in experimental class using a variety of sources. A nother case with the control class only received the knowledge from the teachers so that students in the control class tend to memorize and not to understand. The learning process requires students to seek their knowledge will make the learning process more fun and worthwhile for students or teachers [26]. Evaluating an argument indicator is an indicator with the lowest value among other indicators. The low value is due to subtracting the student's ability to make sense of his argument in the discussion process and many students are afraid to speak. The last indicator is to draw conclusions, the experimental class and the control class have a value that is not too significantly different. This is caused by the end of the learning process both in the experimental class and the control class. The teacher always concluded the learning outcomes so that it can be said that habituation during the learning process influences this indicator.

After analyzing the indicators of critical thinking skills, perform an overall analysis of the performance of the students in the experimental class and the control class. The post-test results are shown in Figure 1. The average value of the experimental class and the control class shows that the critical thinking ability of the experimental class students is better than the critical thinking ability of the control class students. This is consistent with research reported by Hartono [19] which states that the 7E learning cycle model has an influence on the life skills of learners in terms of critical thinking skills. Critical thinking skills of students can be seen from how their activity during the learning process, activities such as answering questions asked by teachers and active in the laboratory. Students are able to establish a certain way, which they can use to solve the problem.

Based on Figure 1, it can be seen that the highest value of the experimental class is 95.55 and the control class is 85.37, while the lowest value of the experimental class is 50.05 and the control class is 42.26. The average value of the experimental class and the control class, respectively, are 82.72 and 64.09.

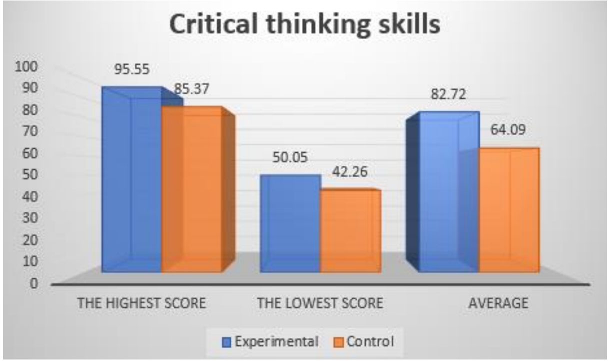

Figure 1. Posttest Results of Control Class and the Experimental Class

Figure 1 shows that the post-test results of the experimental class are better than the control class as seen from the highest value, lowest value and the average value.

The learning process was applied in the experimental class to represent a process to train critical thinking skills, but it would not develop by itself if it is not practiced by the teacher. Critical thinking skills take practice, practice again, and patience [27]. Critical thinking skills need to be trained as early as possible, because critical thinking skills are important not only in school but also in daily life and work environment [28]. Each stage of the learning cycle model is a more accurate and effective way to improve activity and critical thinking skills. Therefore, it is possible to assume that the application of the 7E LC model can improve learners' activity and critical thinking skills. Instead of using the direct teaching model.

4. Conclusions

Based on the result of this study and discussion, it can be concluded that there is a significant difference in the student's activity and criticality between the 7E LC model and direct instruction model to the hydrolyzed materials. Students' activity can be seen in six aspects observed in this study as the visual aspect, verbal aspect, the aspect of listening, writing aspect, and the motor aspects, while critical thinking skills are seen from four indicators, identify problems, evaluate arguments, define solutions, and draw conclusions.

Based on the findings of this study, there are some suggestions that will be presented for further researchers. Research related to the application of the 7E LC model should be done in schools that are accustomed to conducting the learning process with an inquiry approach so that the learning process is more effective, because the 7E LC model was developed from the inquiry approach. It is necessary to do similar research in a longer time and other topics so that students are familiar with the application of the 7E LC model.

Acknowledgements

The authors would like to thank the Indonesian Ministry of Research Technology and Higher Education for funding this research through the 2020 "Penelitian Tesis Magister" Research fund.

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