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Effectiveness of E-Module Circulation System Based on 8E Learning Cycle on High School Student's Critical Thinking Ability

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A B S T R A C T

Critical thinking skills are skills students must have in the 21st century. These skills can improve analytical skills and make students think more carefully This study aims to determine the effect of circulation system e-module based on learning cycle 8e on high school students' critical thinking skills. This type of research is quasi-experimental, which consists of 2 classes, namely XI IPA 1 as the experimental class with treatment using e-module circulation system based on learning cycle 8e and XI IPA 2 as the control class, which uses conventional learning. Based on the results of the study, it was found that there was a significant effect of the circulation system e-module based on learning cycle 8e on students' critical thinking skills, where in the control class the average posttest score was far below the experimental class, which was 55.5 and the experimental class average posttest score was 69.5. Based on the results of hypothesis testing, a significant value (2 tailed) was obtained of 0.003 ($p<0.05$). The use of circulation system e-module based on learning cycle 8e has a positive effect on students' critical thinking skills.

1. Introduction

The 21st century is known as the era of science and communication. To face the challenges of the 21st century, quality human resources are needed, namely through the field of education. Where in the field of education the 2013 curriculum was formed to improve human resources. The 2013 curriculum demands learning activities that are able to help students improve the competence of attitudes, skills and knowledge of students reported by Kemendikbud, (2013). Based on the results of the 2018 PISA organized by the OECD as a study to evaluate students' 21st century competencies in the field of education in various countries in the world, Indonesia is ranked 71st among 79 representative countries

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in the field of science. Indonesia's low ranking in PISA 2018 indicates that students' 21st century competencies are very low, especially in critical thinking skills, because the PISA evaluation not only assesses students' knowledge abilities, but also assesses students' ability to analyze a problem based on real experience reported by PISA, (2018).

According to Purwati et al., (2016), Critical thinking skills are students' ability to analyze and evaluate information or data obtained from observation, experience, reasoning and can provide correct conclusions based on this data.Then, based on results from observations were conducted in several schools and the results of the open questionnaire analysis of Biology teachers at MGMP Kuantan Singingi, information was obtained that students also have low critical thinking skills, which was characterized by low students' abilities in the problem solving process. The students were unable to analyze and synthesize a problem and were unable to provide conclusions in the form of solutions or opinions about the problems presented. Many students have not been able to achieve KKM scores in biology lessons, especially the subject of circulation systems. The teacher revealed that on average students did not play an active role during learning activities on the subject of the circulation system.

This was in line with research that was conducted by Jumiati (2017), which stated that students' critical thinking skills at SMAN 11 Pekanbaru were very low in circulation system material, characterized by low students' ability to solve problems and unable to provide solutions to the problems presented, then based on the critical thinking questions given to students the average overall student score was 30% with a very low critical thinking ability category. Students' critical thinking skills were low in circulation system material because it was abstract or could not be observed directly, and has high complexity, involves many organs, molecules and processes that were mutually continuous. The low critical thinking skills of students make teachers have to be able to present innovative learning activities and provide innovative digital teaching materials that can provide real experiences for students through the learning stages presented in teaching materials.

One of them is e-modules, e-modules are digital-based interactive teaching materials and can help teachers facilitate students in learning independently, especially during a pandemic repoterd by Asrial et al., (2020). The development of e-modules can be integrated with learning models so that they can direct student activities in learning independently, one of which is the learning cycle 8e model. Therefore, this study aims to conduct research on the development of circulation system e-modules based on learning cycle 8e.

2. Methodology

According to Sugiyono, (2018), The type of research was quasi-experimental with a pretest-posttest non-equivalent group design, which used 2 groups of class XI IPA. Then a pretest was carried out to find out the initial state of the students and

see if there were differences between the control class and the experimental class. The population in this study were students of class XI in senior high school. The sample used was class XI students of SMA Negeri 1 Sentajo Raya, which consisted of 2 classes, the control class and experimental class were determined by random sampling. The critical thinking assessment instrument was in the form of 30 reasoned multiple choice questions consisting of 5 aspects and several indicators. The following aspects and indicators of critical thinking are shown in Table 1.

Table 1. Critical Thinking Aspect and Indicator

No	Indicator	Sub Indicators
1	Analyze	• Look for similarities and differences. • Looking for the structure of a statement • Identify and classify • Identify information from drawings, charts, graphs, diagrams and maps.
2	Synthesize	• Seek and relate information to develop new ideas • Develop relevant facts, concepts and theories • Develop plans or steps by finding relationships between certain units. Examples of pictures, symbols, schematics, and writing
3	Identity and solve problem	• Identify the elements of the problem • Applying concepts in solving problems • Able to provide responses or solutions according to relevant facts and theories
4	Summarize	• Seek to understand • Inductive or deductive reasoning • Providing varied ideas and choices
5	Evaluate and Asses	• Express and defend opinions • Assessing with certain criteria • Able to work on evaluation questions

(Source : Angelo, 1995)

For an analysis of the percentage increase per critical thinking indicator, the data that has been obtained from the results of the critical thinking ability test according to Rizki (2020) is analyzed using the formula 1.

$$Critical\ thinking = \frac{JB}{JS}\ x\ 100\ (1)$$

Where, the JB is Number of correct answers and the JS is Number of students. Critical thinking criteria shown on Table 2. Pretest and posttest data will be tested using SPSS Statistics 21, with the Shapiro-Wilk method to find out whether the data is normal or not. Then proceed with the homogeneity test with the Leneve test method. The pretest and posttest values will be compared so that the n-gain value of students' thinking abilities can be known and continued with the T test to determine the effect of circulation system e-module based on learning cycle 8e on students' critical thinking skills.

Table 2. Critical thinking criteria

Competency Mastery Level	Criteria
90 – 100	Very critical
80 – 89	Critical
65 – 79	Quite critical
55 – 64	Not enough critical
<55	Very Not enough critical

(Source: Evandewi, 2016)

3. Results and Discussion

The following shows the circulation system e-module based on learning cycle 8e in Figure 1.

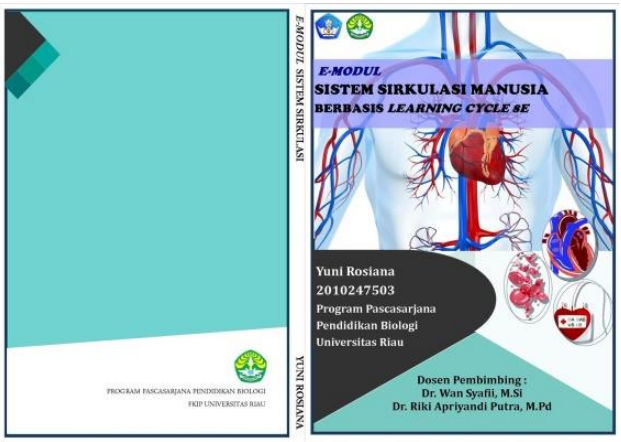

Figure 1. Appareance e-Module

E-module circulation system based on learning cycle 8e, is able to make students follow a series of learning independently even though there is no teacher, so students can build concepts independently through a series of learning on e-modules and are able to improve critical thinking skills. Learning materials in e-modules are prepared using various print and non-print references (available online). The material presented in the e-module is integrated with the 8e learning cycle model and critical thinking indicators.

A. Students Critical Thinking Results

The following is a comparison of the average critical thinking scores of control class and experimental class students, which can be seen in Table 3. The average critical thinking skills of the control and experimental class students in the pretest scores were not much different, but significant differences were seen in the students' critical thinking abilities in the posttest scores. In the posttest scores, the students' critical thinking skills in the experimental class were relatively high compared to the control class. This is due to the experimental class, in the learning activities using teaching materials e-module circulation system based on learning

cycle 8e, so that students are able to explore their knowledge and practice their critical thinking skills through the questions presented in the e-module.

Table 3. Comparison of the Critical Thinking Ability Values of the Control and Experiment Classes

Class	Pretest		Postest		N-Gain	
	Average value	Criteria	Average value	Criteria	Indeks n-gain	Category
Experimental	34	Very not enough critical	69,5	Quite critical	0,54	Currently
Control	29,3	Very not enough critical	55,5	Not enough critical	0,36	Currently

While in the control class, only using printed books as the main teaching material. The following comparison of students' critical thinking in the control class and the experimental class per aspect can be seen in Table 4.

Table 4. Comparison of Indicators and Students' Critical Thinking Values

No	Critical thinking indicator	Control class			Eksperimental class		
		Pretest	*Postest*	N-Gain	*Pretest*	*Postes*t	N-Gain
1	Analyze	30 (Very not enough critical)	65 (Quite critical)	0,47 (Currently)	40 (sangat tidak kritis)	80 (kritis)	0,63 (Currently)
2	Synthesize	29 (Very not enough critical)	58 (not enough critical)	0,36 (Currently)	33,2 (Very not enough critical)	70 (Quite critical)	0,53 (Currently)
3	Identity and solve problem	27 (Very not enough critical)	50 (Very not enough critical)	0,28 (low)	30 (Very not enough critical)	66,5 (Quite critical)	0,49 (Currently)
4	Summarize	32 (Very not enough critical)	55,7 (not enough critical)	0,31 (Currently)	30,6 (Very not enough critical)	66,5 (Quite critical)	0,46 (Currently)
5	Evaluate and Asses	27 (Very not enough critical)	48 (Very not enough critical)	0,22 (low)	36,2 (Very not enough critical)	65 (Quite critical	0,44 (Currently)

Based on these data (Table 4) it can be seen that the indicators for analyzing in the experimental class are higher and effective in increasing students' analytical skills compared to the control class. This is related because learning uses an e-module

circulation system based on learning cycle 8e. According to Hannum et al., (2019) the ability to analyze students is obtained through innovative and constructive learning and this is where the advantages of the e-module and learning cycle 8e model are.

The second indicator is synthesizing, the ability to synthesize students in the experimental class compared to the control class because the experimental class students are better able to plan and find relationships between the concepts of the circulation system compared to the control class. According to Sugiharti et al., (2019) e-modules based on learning cycle 8e are effective in increasing students' critical thinking skills because students are required to collect data such as in the e-search stage and link material concepts through the material presented in the e-module. Then, the ability to recognize and solve problems in the experimental class is higher than the control class. This is because the circulation system material presented in the e-module requires students to be able to find and solve a problem. The presentation of the learning cycle stages in the e-module, especially the explore stage, students are required to observe and record data so that students are able to recognize and find ways that can be done in the process of solving problems.

The fourth indicator concludes, it is known that the experimental class is more effective in improving students' inferring abilities than the experimental class, this is because through practical learning cycle 8e-based e-module teaching materials and presenting learning videos can make it easier for students to understand and conclude learning material, then according to Mahardika et al., (2018) learning based on the learning cycle 8e model requires students to be able to provide clarification regarding learning experiences and concepts that students understand, so that students have an important role in learning activities as contained in the explain stage (conclude) .

The last indicator is evaluating and assessing, the experimental class is effective in improving students' evaluation abilities compared to the control class. This is in line with the opinion of Br Tarigan et al., (2022) which states that through learning using the e-module learning cycle, students are actively involved in learning so that they are able to develop their individual potential, especially at the evaluate stage.

B. Hypotesis Test

Prerequisite test is done first before testing the hypothesis. The prerequisite test consists of the normality test and homogeneity test. The normality test aims to determine whether or not the distribution of the data used in the study is normal reported by Arikunto, (2011).

Normality test results in the control class, pretest 0.180, posttest 0.984 and in the experimental class pretest 0.072, posttest 0.320. Based on Shapiro Wilk with a significance level (α) of 0.05, it indicates that if the significance value (2 tailed) >

0.05 then the data is normally distributed. Based on the Levene statistical test, it is known that if the sign value is> 0.05, then Ho is accepted, which means that the variance between the control and experimental classes is homogeneous. So it can be stated that the data is homogeneously distributed.

The hypothesis test aims to determine differences in students' critical thinking skills who were treated with the learning cycle 8e-based circulation system module and those who did not use the learning cycle 8e-based circulation system module. The hypothesis test that was carried out was the independent t test with a significance of $\alpha = 0.05$. The following table tests the hypothesis of students' critical thinking skills which can be seen in table 5.

Table 5. Independent Test T test Critical Thinking Class Control and Class Experiment

T	df	Sig (2 tailed)	Mean Difference
3.130	42	.003	4.09545

Based on table 5 it can be seen the results of the t test in the control class and the experimental class. The results of the t test on students' critical thinking skills are known to have a significant value of 0.003 <0.05, so H0 is rejected and H1 is accepted. So it can be concluded that the learning cycle 8e-based circulation system module has an effect on students' critical thinking skills. According to Sugiharti et al., (2019); Mahardika (2018) learning cycle-based e-module teaching materials train students to find and understand new material and relate it to the material they already have so as to improve students' critical thinking skills.

4. Conclusion

E-module circulation system based on learning cycle 8e has a significant influence on students' critical thinking skills senior high school. The experimental class got an average score of critical thinking which was much higher than the control class. The experimental class succeeded in obtaining sufficiently critical criteria while the control class was classified as not enough critical. So we can conclude, The use of circulation system e-module based on learning cycle 8e has a positive effect on students' critical thinking skills.

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