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Implementation of Oriented Literated Science E-Module to Improve Critical Skills Thinking About in Hydrocarbon Material

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A B S T R A C T

The purpose of this study is to determine the increase in students critical thinking skills after using e-modules oriented towards scientific literacy. This research is a quasi-experimental study using the Design Randomized Control Group Pretest-Posttest. The research sample consisted of 2 classes, namely class XI MIA 8 and XI MIA 10. The analysis results using the independent sample t-test obtained that a significance value of 0.026 <0.05. The results of the analysis of critical thinking skills test data using the N-gain score test for the experimental class obtained a value of 77.2% including the very high category. While the average N-gain score for the control class obtained a value of 55.2% included in the medium category. It can be concluded that there are significant differences in students critical thinking skills in the experimental class with the control class.

1. Introduction

Chemistry is a branch of science that studies the composition, composition, structure of a substance, changes in the composition or properties of substances, energy changes that occur when a substance undergoes changes that form every element of the life (Mai et al., 2018). Students are declared to have understood chemistry learning if they have met the Graduate Competency Standards (SKL) that have been set in Permendikbud Number 20 of 2016, namely attitudes, knowledge and skills. In accordance with these predetermined standards, students must understand the concept of chemistry and its application in everyday life. Improving students' skills in linking chemical concepts and their roles is closely related to improving scientific literacy skills. Science literacy is an ability that must be possessed by every student. Therefore, students in their learning must contain science literacy oriented learning (OECD, 2016)

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The implementation of the 2013 curriculum aims to advance education in Indonesia. The 2013 curriculum directs students to think critically and actively learn (Citra et al., 2019). Critical thinking skills are based on the activities of linking and drawing conclusions on an idea and event and involve various cognitive processes such as solving problems, explaining phenomena, identifying a problem, examining, reflecting and criticizing (Serkan et al., 2009). Students critical thinking skills can be developed through science literacy-oriented learning Didit et al. (2016), because in the learning process is focused on building students' knowledge to use science concepts meaningfully, think critically in problem solving processes (Karenann et al., 2012). This is also in accordance with the cognitive processes involved in science literacy-oriented learning include inductive or deductive reasoning, critical thinking, and constructing explanations based on data. Therefore critical thinking ability is one of the high-level thinking skills needed in science literacy-oriented learning that can be implemented through ICT-based teaching materials, namely electronic modules.

The quality of education in Indonesia is still relatively low when compared to other countries, this is indicated by the results of PISA research in 2015 Indonesia was ranked 62 out of 70 countries in scientific literacy. The low ability of Indonesian children's science is due to the competency being tested is different from what is taught in schools. The competencies tested in PISA are more based on understanding, reasoning, problem solving, debating, critical thinking and being creative. Meanwhile, the competencies taught by schools in Indonesia do not yet refer to the competencies tested in PISA, so the lack of understanding of students' concepts will result in low critical thinking skills. The low critical thinking skills of students are shown by research Maulana (2014) conducted at Inderalaya 1 High School. From the results of the chemistry teacher interview class XI IPA 2 in SMA Negeri 1 Inderalaya that learning chemistry at school is still focused on writing a summary of the material in the notes and memorizing so that learning only emphasizes the cognitive achievements of students without having to understand the concept of chemical materials. According to Maulana (2014) in chemistry learning need not only be emphasized on the cognitive outcomes of students, but also activities that can build critical thinking skills. If the learning process of chemistry continues to rely on writing in books and memorizing, students' critical thinking skills will not develop due to lack of applying formulations and solving a problem, consequently it is difficult for students in Indonesia to compete with students from other countries. Because it is necessary to improve critical thinking skills.

The role of the teacher is needed in building students' critical thinking skills, where the teacher is required to make changes to the learning process in the classroom that directs students to practice critical thinking skills. One way that teachers can do as an effort to improve students' critical thinking skills is to use science-oriented e-modules. E-module (electronic module) oriented to scientific literacy is one of the teaching materials that is packaged in a digital format consisting of text, images, animations, videos that are presented systematically so that users can learn independently. the advantages of e-module oriented science literacy compared to ordinary e-modules is the existence of aspects of scientific

literacy which consists of the context of science, science processes and science knowledge so that it can train students' critical thinking skills.

Based on observations and interviews at MAN 2 Model Pekanbaru, 14 High School, Pekanbaru, and IT Al-Fityah High School it is known that in the sub-material identification of C and H atoms in carbon compounds, most teachers do not explain the material and students are only asked to read the material in the book text because the material is a concept so that it can be understood by reading. However, based on the results of the initial tests using the critical thinking ability questions many students could not answer because of the lack of students' ability to answer questions that needed a simple explanation. So to overcome these problems requires a media such as video animation through the development of e-modules that are able to explain the concepts in the sub-material identification of C and H atoms in carbon compounds clearly and can be observed, so that students' understanding will be deeper. In addition, from the results of initial observations using the test of students' critical thinking skills many find it difficult due to the lack of student analysis of the problems raised. One chemistry teacher mentioned that generally students find it difficult to react with hydrocarbon compounds, because they are abstract so they require a fairly high level of analysis. Therefore this research is important to do with the aim to improve students' critical thinking skills through the application of science literacy-oriented e-modules.

Based on the results of research conducted by Fatkhurrohman et al. (2017) at Pancasakti University, Tegal, it shows that the implementation of the basic physics module 1 based on scientific literacy is effective in increasing science literacy of students at the Tegal Science Education Study Program. Furthermore, the research results of Vina et al. (2018) showed that the N-gain test score of students 'pretest and posttest scores were 0.6 with a moderate category, which meant an increase in students' process skills before and after using the e-module. However, the purpose of this study is to determine the increase in students critical thinking skills after using e-modules oriented towards scientific literacy

2. Methodology

This type of research was a quasi-experimental research design with Randomized Control Group Pretest-Posttest. This research was conducted in July 2019. The research site was conducted at MAN 2 Model Pekanbaru. The population in this study were students of class XI MIA at MAN 2 Model Pekanbaru in the even semester of the 2019/2020 school year. The sample was determined through a homogeneity test using data on the results of the even semester semester 2018/2019 school year. The random selection of the experimental class and control class was carried out. Data collection techniques in research were interviews and tests of critical thinking skills. The data analysis technique was done by Shapiro Wilk normality test and hypothesis testing using independent sample t-test with research hypotheses are:

H0: There is no significant difference in the critical thinking skills of the experimental class and control class students

Ha: There are significant differences in the critical thinking skills of students in the experimental class and the control class

Decision making of independent sample t-test is that if the significance value <(α = 0.05) then the alternative hypothesis is accepted and the operational hypothesis is rejected. To find out the category of improvement in students' critical thinking skills after using e-module oriented science literacy is done through the N-gain score test with the help of the SPSS application. The category of obtaining an N-gain score refers to Table 1 (Hake., 1998).

Table 1. N-gain Score Category

N-Gain Value	Category
N-Gain > 7	High
0,3 < N-Gain > 0,7	Mid
N-Gain < 0,3	Low

3. Results and Discussion

E-module (electronic module) oriented to scientific literacy is one of the teaching materials in the form of modules that are packaged in a digital format consisting of text, images, animations and videos arranged systematically. The preparation of material in science literacy-oriented e-modules refers to aspects of scientific literacy that are aspects of the scientific context, science processes and science knowledge and indicators of critical thinking skills according to Robert H Ennis in Ika et al. (2016), focusing questions, analyzing arguments, answering questions which requires explanation, considers the truth of the source, deduces, induces, makes and determines the outcome of the consideration, defines the terms and considers definitions, identifies assumptions, and determines an action.

Students critical thinking skills can be enhanced by science literacy oriented learning which is implemented through e-modules, because science literacy oriented learning must be accompanied by an interactive, inspiring, fun, challenging learning process and can motivate students to actively participate in the learning process (Fitria et al., 2018). Therefore, the application of scientific literacy must be balanced with learning media to foster students' critical thinking skills in order to be able to solve all existing problems so that students will gain a deeper understanding. Examples of science literacy oriented hydrocarbon e-modules that have been tested for validity and practicality can be seen in Figure 1.

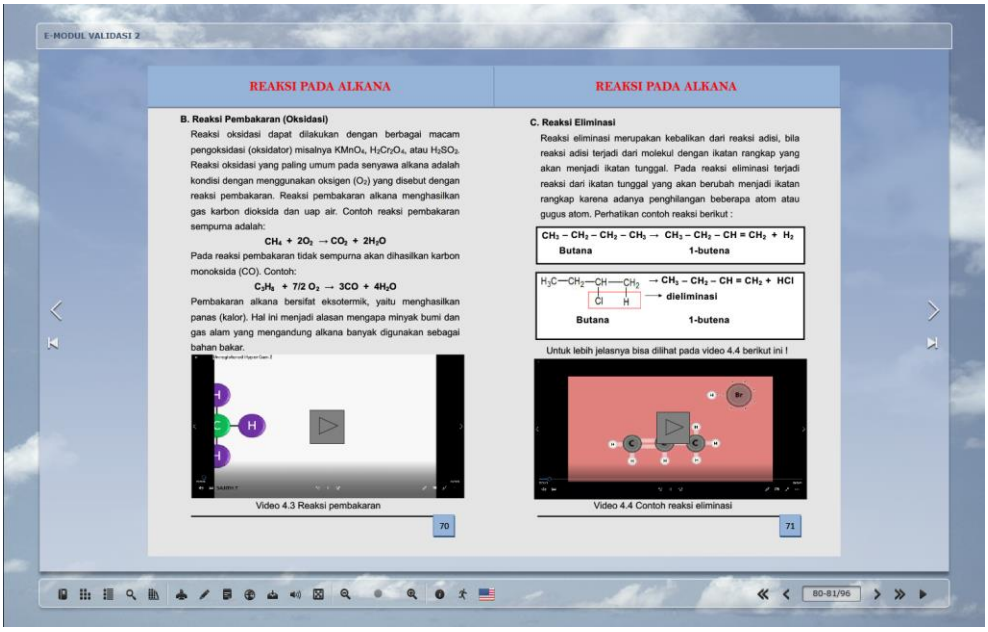

Figure 1. Science Literacy Oriented Hydrocarbon e-module

The matrix of the relationship between indicators of scientific literacy with indicators of critical thinking can be seen in Table 2.

Table 2. Relationship Indicators of Scientific Literacy with Indicators of Critical Thinking

Learning Activities	Indicator of Scientific Literacy	Indicator of Critical Thinking
The impact of charcoal or carbon from burning organic compounds such as fat (satay meat) on health.	The context of science in the fields of health and disease	-
Learners watch the video identification of C and H atoms in a hydrocarbon compound then explain why lime water becomes turbid when a sample of a hydrocarbon compound is heated.	Science process and science knowledge	Analyze arguments
Students observe the structure of hydrocarbon compounds which are one component of objects that exist in everyday life and do identify differences or characteristics of each structure of the hydrocarbon compounds	Science process and science knowledge	Identifying assumptions
Learners see a video about the benefits of hydrocarbon compounds in everyday life. For example bensi and LPG gas whose main components are hydrocarbon compounds.	The context of science (natural resources)	-
Students identify homologous data on hydrocarbon compounds (alkanes, alkenes and alkenes) to find a general formula.	Science process and science knowledge	Induce and consider the results of induction
Students understand the explanation of cis unsaturated fats, oleate which is good for health and trans unsaturated fats, namely eleidics which can cause cholesterol.	Science context (health and disease)	-

Students conduct experiments by assembling a number of hydrocarbon structures with the molecular formula C6H14, then identifying the similarities and differences of the structures found to find out the meaning of isomerism.	Science process and science knowledge	Make and determine the results of consideration
Learners understand the explanation of the reaction of the formation of acetylene gas from the reaction between carbide and water used for fruit maturation quickly.	Science context (food sector)	
Students look for information through e-modules about differences in substitution, elimination, oxidation and addition reactions based on observations on examples of some reactions of alkane, alkene and alkyne compounds and then find out what reactions that alkanes, alkenes and alkuna compounds might have.	Science process and science knowledge	Define terms and consider definitions

The data used to find out the increase in students' critical thinking skills after using a scientific literacy-oriented hydrocarbon e-module are the results of a critical thinking ability test. The results of the analysis of the normality of the posttest data of the experimental and control classes using the Shapiro Wilk test can be seen in Table 3.

Table 3. Shapiro Wilk Test

Class	Shapiro wilk		
	Statistic	df	Sig
Experiment	0,930	24	0.095
Control	0,945	23	0,229

Based on Table 2 it can be seen that the posttest data values of the experimental class and the control class have sig values of 0.095 and 0.229, respectively, with the meanings that both data have sig> 0.05 so that it can be concluded that the data are normally distributed. After the data is declared normally distributed then to see whether there is a significant difference in the average posttest value of the experimental class and the control class is done through the independent sample t-test which can be seen in Table 4.

Table 4. Test Results for Independent Sample t-test

		t-test for Equality-sample t-test						
		T	df	*Sig. (2-tailed)*	*Mean Difference*	*Std. Error Difference*	*95% Confidence Interval of the Difference*	
							Lower	*Upper*
Value	*Equal Variances assumed*	2,295	45	0,026	6,208	2,705	0,761	11,656

Based on Table 3, it is known that the average difference in the posttest value of critical thinking skills of the experimental class and control class students is 6.208

with a significance value of 0.026 <0.05, meaning that Ha is accepted. Then it can be concluded that, there is a significant difference in students' critical thinking skills in the experimental class with the control class. Increased students' critical thinking skills in the experimental class due to the use of science literacy-oriented e-modules has several advantages, namely: the use of e-modules makes learning more fun, because in e-modules are equipped with multimedia facilities such as images, animation, audio and video. This can be seen when the learning process of students is very active in asking questions and enthusiastic in learning the material in the e-module. The results of this observation are consistent with the findings of Fengky et al. (2017) who found that e-module based on process skills is effective in increasing the motivation of experimental class students compared to the control class. The results of Hartini et al. (2017) research, they also found that the use of instructional media integrated with text, images, animation, audio and video was effective in increasing motivation so as to facilitate students in understanding the concept of the material. This is also in accordance with the statement of Tuyuzsuz (2010) who explains that the learning process that uses media such as attractive video animations will facilitate students in the learning process. The same statement was explained by Miftahul et al. (2019), Muhammad et al. (2018), Yenita et al. (2017) who found that ICT-based media was effective and feasible to be used in the learning process.

The e-module helps students understand abstract hydrocarbon material through video animation, for example the concept of identification materials C and H atoms in carbon compounds, which explains the concept more effectively when assisted with video animation so that the combustion reaction process that results in carbon dioxide and water vapor can be clearly observed by students. Thus the material is not only accepted by reading and memorizing, but also increasing the understanding of concepts and practicing students' critical thinking skills through video animations contained in the e-module. This is in accordance with the findings of Made et al. (2013) who found that e-modules can improve students' critical thinking skills and get positive responses from students. The same research has been conducted by Fengky et al. (2017) who found that e-modules based on process skills effectively improve students' critical thinking skills. Zulfahrin et al. (2019) also found that students' understanding of concepts taught using problem-based chemistry e-modules from students taught using LKS had significant differences.

In the e-module oriented science literacy is presented the concept discovery activities through aspects of scientific literacy that is interpreting data, identifying data and explaining phenomena. From the observations of this activity encourage students to think critically in answering the problems raised in the e-module. In addition, the scientific context presented in the e-module also broadens insights and encourages students to look for deeper information, this is evident when students are enthusiastic in asking questions because there is a connection between the material being studied with daily life.

To find out the category of improvement in students' critical thinking skills after using an e-module oriented to scientific literacy can be done through N-gain score

statistical tests. The results of the analysis of the N-gain score data on the results of tests of critical thinking skills of experimental and control class students can be seen in Figure 2.

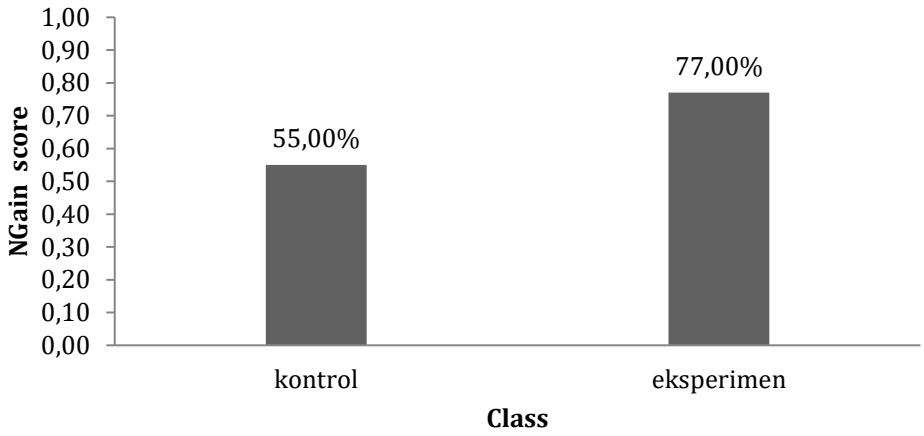

Figure 2. Analysis of Ngain Score on Critical Thinking Skills Test

Figure 2 shows that the results of the analysis of the N-gain score of the average experimental class (using science-oriented e-modules) amounted to 0.77 included in the high category. While the average N-gain score for the control class (without using an e-module) is 0.55 included in the medium category. Then it can be concluded that the use of e-module oriented to scientific literacy can improve students' critical thinking skills with a large increase of 0.77 including the high category. This finding is in accordance with the results of research conducted by Vina et al. (2018) who also found that the results of N-gain test scores of students' pretest and posttest scores were 0.6 with a moderate category, which means an increase in the process skills of students before and after using the e-module. In addition, research by Maria et al. (2019) showed that the value of students 'critical thinking skills based on tests obtained an average value of 84.21 with a very high category, this shows that teachers succeeded in increasing students' critical thinking skills because of the problems raised in the module is very challenging with connecting problems in life.

4. Conclusion

The application of science literacy-oriented e-modules on hydrocarbon material gives the result that there is an increase in students' critical thinking skills in the experimental class with very high improvement categories. The increase in students 'critical thinking skills is caused because in the learning process students are trained to think critically through scientific literacy oriented concept discovery activities contained in science literacy oriented e-modules, so that through these activities it is able to improve students' critical thinking skills such as analyzing argument, identifying data and explaining scientific phenomena related in daily life.

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