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Improving Students' Critical Thinking Skills Trough Contextual Teaching and Learning Science Module

Siti Nur Hasanah [1], Widha Sunarno [2], Baskoro Adi Prayitno [3]
Universitas Sebelas Maret, Indonesia[1,2,3]
snhasanah@student.uns.ac.id[1], widhasunarno@gmail.com[2], baskoro_ap@uns.ac.id[3]

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ABSTRACT
This study aims to determine the effectiveness of the science module based on the contextual learning approach (CTL) in improving the critical thinking skills of junior high school students. The research method used was a quasi-experimental study involving 30 students in the experimental class and 30 students in the control class from a junior high school in Surakarta. The data collection technique was done by measuring students' critical thinking skills before (pretest) and after learning using the Science module (posttest). The instrument used was a critical thinking skill test based on Facione's critical thinking skills indicator. The improvement of students 'critical thinking skills was analyzed using a pretest-posttest gain score and followed by an independent sample t-test to determine the significance of the difference in the average increase in students' critical thinking skills. The results showed that the use of a science module based on a contextual learning approach could improve students' critical thinking skills, with a score of 0.46, or in the category of moderate improvement compared to control class students, with a score of 0.29, or in the low improvement category. Meanwhile, based on the results of the t-test the average gain score of the two classes shows a significant difference in the improvement of critical thinking skills between students who are taught using the Science module and students who are taught using conventional modules.

INTRODUCTION

Critical thinking skills are one of the skills needed to face globalization and internationalization in the 21st century [1]. Critical thinking skills are also considered as one of the foundations of learning in the 21st century [2]. Critical thinking skills are needed to analyze things that are needed in the decision-making process or determine better actions and careful consideration. Facione defined several skills, including critical thinking skills: interpretation, analysis, inference, evaluation, explanation, and self-regulation skills [3]. In an academic context, students need critical thinking skills to explore deeper knowledge and find the relationship between the theory studied and the arguments students have [4]. It

means that students can find strong evidence or arguments about the material being studied so that their knowledge is theoretical and practical. Based on these definitions, critical thinking skills can be interpreted as skills in interpreting, analyzing, explaining, drawing conclusions, and evaluating information/events in ways that are believed to be used to solve problems related to subjects and problems in everyday life. In this regard, the Government of the Republic of Indonesia through *Permendikbud* (Regulation of the Minister of Education and Culture) Number 20 of 2016 concerning competency standards for primary and secondary education graduates emphasizes that primary and secondary education graduates are expected to have skills to think and act critically [5].

Based on the results of observations in the field study location, it was found that students' critical thinking skills were still low. This can be seen from the students' ability to interpret, analyze, explain, conclude, evaluate, and regulate themselves which tends to be low, so it needs to be improved through the learning process and the habit of using critical thinking skills in daily activities [6]. For this reason, classroom learning must also be designed to improve students' critical thinking skills, particularly science learning. Based on the results of the study, science learning assisted with the Contextual Teaching and Learning (CTL) approach is one of the learning innovations that has been shown to improve students' critical thinking skills [6] [7] [8].

CTL is a way to help students connect the knowledge that students already know with new knowledge that will be formed through active learning techniques [9]. CTL is based on constructivist learning theory which calls on students to test ideas based on critical thinking and problem solving in an effort to build their own knowledge [10]. In addition, Contextual Teaching and Learning (CTL) also integrates inquiry, problem-based and project learning, cooperative learning, and authentic assessment [11]. Muslich added that CTL consists of seven main components, namely constructivism, question and answer, inquiry, learning community, modeling, reflection, and authentic assessment [12].

Based on the description above, the application of CTL in learning can make learning more meaningful, as the theory of meaningful learning according to Ausubel which explains that the most important thing in learning is the retention of student knowledge [13]. Learning material that is associated with contexts / events in everyday life and involves the active role of students in problem solving and critical thinking, makes student knowledge more meaningful, not easily forgotten / lost, and can be applied in everyday life.

In practice, implementing CTL in learning requires careful planning and learning media so that the components of the CTL approach can be applied systematically and strategically so that it is more directed and easier for students to achieve the expected goals. The type of learning media that can be used as a special learning guide with the CTL approach is a module. Modules are one type of teaching material that is systematically arranged in language that is easy to understand, adjusted to the level of ability and age of students, and allows students to learn independently or with teacher guidance [14]. The module is an integral part of learning components that are process-oriented and the quality of learning. The modules used in learning are also adjusted to student needs, goals, learning outcomes, resources, learning and teaching strategies, assessment and evaluation criteria [15]. In addition, the selection of modules is also based on the results of the student needs analysis of the learning module.

In this study, the science module was compiled based on the components of the CTL approach with the aim of improving students' critical thinking skills. The selection of modules as teaching materials is based on the part of the module in the form of students’ worksheet which involve hands-on activities and thinking activities that can improve students' critical thinking skills. The selection of the CTL approach to improve students 'critical thinking skills is based on the results of research by Sadia and Kosassy, et.al., which show that the application of the contextual teaching and learning approach in science learning can improve students' critical thinking skills [16] [17] . For this reason, this study aims to determine the effectiveness of using the Natural Science module which is arranged explicitly with the Contextual Teaching and Learning (CTL) approach to improve students' critical thinking skills.

METHOD

The research method used to determine the effectiveness of the science module with the CTL approach in improving students' critical thinking skills was a quasi-experimental research design with a non-equivalent control group design [18]. The data population came from 280 students of class VIII in a junior high school in Surakarta. Field test samples were taken randomly based on the class/learning group (cluster random sampling), which consisted of one experimental class (learning using the science module with the CTL approach) and one control class (learning using conventional modules). Field test samples were obtained from students who had the same initial ability based on the homogeneity test.

Before being given the treatment, both classes (the experimental class and the control class) were given a pretest to verify the students' initial ability to use their critical thinking skills. Furthermore, after the experimental class was given treatment, the two classes were again given a posttest to determine students' critical thinking skills after learning.

Table 1. Experimental Design

Pretest	Treatment	Posttest
O_1	X	O_2
O_3	-	O_4

Explanation:
O_1 = Experimental class pretest results
O_2 = Experimental class posttest results
O_3 = Control class pretest results
O_4 = Control class post-test results
X = module use Science with the CTL approach in the experimental class.

Data collection was carried out using the written test method. The type of instrument used to measure students' critical thinking skills is a critical thinking test in the form of a description. The test questions were arranged based on Facione's critical thinking skills indicator. Before being used for field trials, test questions were validated in the construct (content) by expert lecturers, empirical validation for non-experimental class students, and tested for reliability to be valid and reliable. Testing the validity and reliability of the test items was carried out with the help of SPSS 18 for Windows software.

The effectiveness of the science module with the CTL approach in improving students 'critical thinking skills was seen from the n-gain average pretest and posttest of students' critical thinking skills. The n-gain value of students' critical thinking abilities in the experimental class and the control class was further analyzed using the one-way t-test (independent t-test) [19]. This test was conducted to show the significance of the difference in the average n-gain value of students' critical thinking skills who were taught using the Science module with the CTL approach and groups of students who were taught using conventional modules, with the following hypothesis:

H_0 : there is no significant difference between the average n-gain of students 'critical thinking skills in the experimental class and the control class. The students' critical thinking skills in experimental class.

H_1 : there is a significant difference between the mean n-gain of the experimental class and the control class.

RESULTS AND DISCUSSIONS

The results showed that the science module with the CTL approach could improve students' critical thinking skills with an n-gain value of 0.46 or included in the moderate improvement category. Conversely, the increase in critical thinking skills of control class students whose learning uses conventional modules is included in the low improvement category with an n-gain value of 0.29, as

shown in Table 2.

Table 2. Research Results

No	Class	Average Scorescore		Maximum	n-gain	Improvement Category
		Pretest	Posttest			
1	Experiment (using the "Simple Machine" Science module)	1.83	2.83	4	0.46	Medium
2	Control (using conventional modules)	1.70	2, 36	4	0.29	Low

Besides showing that there is a difference in the n-gain of critical thinking skills in the experimental class and the control class, Table 2 also shows that the initial critical thinking skills of the two classes are equivalent or almost equivalent. This proves that the increase in high critical thinking skills in the experimental class is indeed due to the effect of using the Science module with the CTL approach, not because of different inputs.

Whereas in terms of every aspect of critical thinking skills, in the experimental class, students 'analysis skills experienced the highest increase compared to the increase in students' critical thinking skills in other aspects. Meanwhile, the aspect of critical thinking skills that has increased the lowest is in the evaluation aspect, as shown in Figure 1 below.

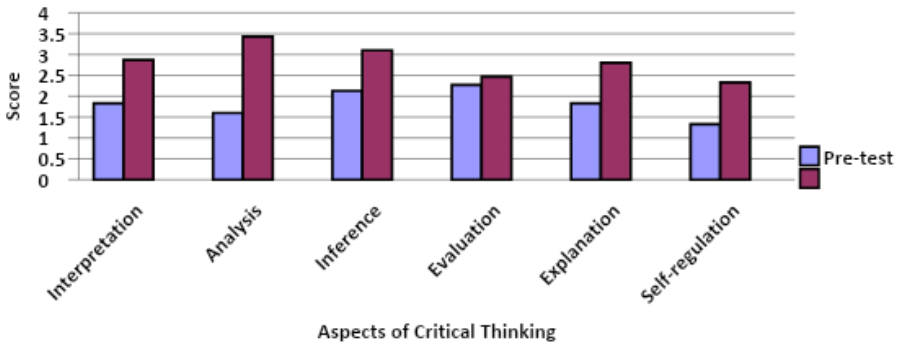

Fig 1. *Increasing the Critical Thinking Ability of the Experiment Class*

Figure 1 shows that the increase in students' critical thinking skills scores varies in every aspect. Students 'critical thinking skills in the analytical aspect experienced the highest increase because the activities in the science module based on the CTL approach which required students' analytical thinking skills appeared five times at most. These incidents were found in modeling activities, question and answer, inquiry, group discussions (learning communities), and authentic assessment. Meanwhile, students' critical thinking skills in the evaluation aspect experienced the least improvement. This is also related to the emergence of components in the module which also require a little skill in evaluating students, which only appears once in the component of self-reflection (reflection). This result is in line with Fisher's opinion which states that improving critical thinking skills requires active and continuous consideration, meaning that the more often used, these skills will increase [20].

Unlike the experimental class, the aspect of critical thinking skills in the control class that experienced the highest increase was the explanatory aspect, while the lowest increase was the inference aspect, as shown in Figure 2 below.

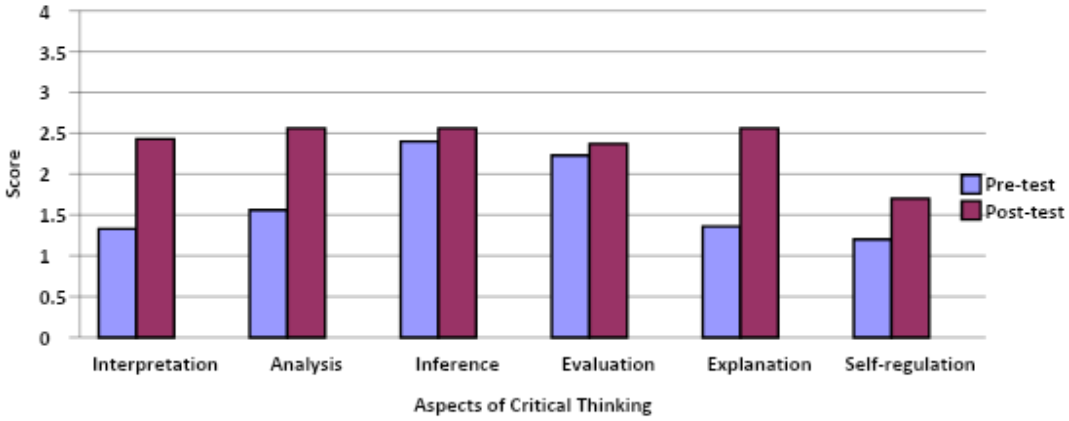

Fig 2. *Improved Critical Thinking Skills in Existing Classrooms*

Figure 2 shows that the critical thinking skills of control class students that improve the most are in the explanation aspect. This can happen because the conventional module used in the control class provides many practice questions that make it easier for students to answer questions by explaining. Whereas in the inference aspect, students 'skills did not improve much because the students' initial ability to conclude was good enough, so the increase was not significant.

Furthermore, to be more convincing, an independent sample t-test was carried out to see the significance of the difference in the n-gain mean of the experimental class and the control class' critical thinking ability. Prior to the t-test, the normality and homogeneity prerequisite tests were first carried out. The results of normality and homogeneity tests with the SPSS 18 for Windows software can be seen in Table 3.

Table 3. Results of Normality, Homogeneity, and t-Test

No	Type Test	Class	Asymp. Sig. (2-tailed)	Sig. (α)	Interpretation
1	Normality (Kolmogorov-Smirnov)	Experiment	0.812	0.05	Normal
		Control	0.549	0.05	Normal
2	Homogeneity (Levene's Test)	Experiment & Control	0.020	0.05	Inhomogeneous

The prerequisite test results, as shown in Table 3 above, indicate that the average acquisition of n critical thinking skills in the experimental class and normal control class. This indicates that the data has met the standard of data originating from populations that are normally distributed [21]. Meanwhile, the results of the Levene test showed that the mean n-gain variance of critical thinking ability of the two classes was not homogeneous. However, the t-test parametric test can still be performed, because homogeneity is not an absolute condition that must be met when testing the independent sample t-test hypothesis, so the basis for decision making is based on the value contained in the column "Equal variance is not assumed". Thus it can be continued with the t-test with the results as shown in Table 4 below.

Table 4. T-Test Results

Type of Test	Sig. (2-tailed)	Sig. (α)	Interpretation
Independent Sample t-test	0.003	0.05	H_0 is rejected (there is a significant difference between the n-gain average thinking skills of students in the experimental class and the control class)

The t-test results are as shown in the figure in Table 4, the more convincing that the use of the Science module with the CTL approach can improve students' critical thinking skills. This result is in line with previous research which also shows that students' critical thinking skills can be improved by applying the steps of the CTL approach presented in the Science module [7] [8] [20] [21]. In addition, the results of the research by Wulandari, et.al also show that the improvement of students' critical thinking skills is closely related to the learning approach chosen. In this case the CTL approach is able to invite students to be truly active in learning so that students' thinking skills are continuously honed and used to find/build new knowledge and/or solve problems through real and meaningful learning experiences [22].

The activities described in the science module refer to the components of the CTL approach: modeling, questioning, inquiry, learning community, constructivism, authentic assessment, and reflection [14]. The module consists of five learning activities, and each learning activity consists of seven core activities which represent the seven components. Learning objectives are described at the beginning of the learning activity after the activity title. This is intended so that students know the learning objectives and are expected to achieve them. Before carrying out the core of the lesson, pictures and illustrations of the suitability of the story are offered. This aims to arouse student motivation at the beginning of learning. Emda explained that motivation before the core learning activities started had a prominent position, namely preparing students to achieve maximum learning outcomes [23].

Main learning activities begin with modeling activities, which are activities that facilitate students to model how to use tools or observe the activities of someone who uses simple machines in everyday life. The presentation of the modeling components in the module varies, namely by presenting the tools so that the teacher or some students can directly practice using the tools and by presenting pictures of the use of these tools in everyday life. The presentation of the modeling components can arouse students' curiosity about the relationship between the use of these tools and the material being studied. In accordance with the main principle of the modeling component, namely presenting examples or models that can be observed and used by students as learning resources.

The components of the CTL approach presented in the module after the modeling component are the components of questioning skills that are packaged in the "Let's Ask" activity. Through this component, students are directed to make questions based on previous modeling activities. According to Prilanita & Sukirno, asking questions is an activity that supports the achievement of student understanding at a higher level of thinking, in this case critical thinking skills [24]. This is in line with Yafi's research results which show that the learning outcomes of students who actively ask questions are better than students who are less active in asking questions [25].

After students are directed to make questions, the inquiry component or inquiry activity is put forward. The purpose of presenting this activity in the module is to direct students to find answers to questions that have been formulated in the activity of asking questions and finding new concepts about simple machines through the stages of inquiry or experiment that are in accordance with the scientific method. Based on the results of the research, Rositawati stated that the inquiry step can be used as a foundation for students to improve their critical thinking skills through a systematic, logical, and in-depth reasoning process, accompanied by accurate data/evidence [26]. Furthermore, through inquiry activities, Sanjaya also stated that students can acquire new knowledge, solve problems based on logical and systematic steps from experimental or observation activities, and involve critical thinking skills [27].

After describing the investigative activities, this module provides a learning community component that is packaged in group discussion activities. Data from students' experiments/investigations are then analyzed in this section. Students analyze the results of the experiment by answering the questions given. Through group discussion activities, it is hoped that multi-directional communication will occur so that the information/knowledge obtained is broader. This activity also directs students to make accountable conclusions because it is accompanied by data and analysis of experimental results. In addition, through this activity students also have the opportunity to think, express opinions, attitudes, and aspirations, and are trained to develop tolerance, respect, communication, and cooperation [28]. Thus, student learning

outcomes in the aspect of attitude can also indirectly increase.

Furthermore, in this module, students are directed/guided to make conclusions in the "Let's Conclude" section. The process of making conclusions is a process of building knowledge (constructivism) carried out by individual students. The conclusions obtained by students through investigations and group discussions are strengthened by the material descriptions presented in the "Strengthening Concept" section. This section is a confirmation section that provides information on important concepts students discovered through experiments and group discussions. This is in accordance with the principle of constructivism which states that learning is process-oriented, and the new knowledge acquired is built by students based on previous knowledge.

Furthermore, this module presents the authentic assessment section. The type of authentic assessment used is a written test that describes five evaluation questions according to the learning indicators, and students are asked to solve these questions. Apart from going through the written test, the teacher also assesses student learning outcomes in the aspects of attitudes and skills through observation sheets. The authentic assessment component presented refers to the characteristics of authentic assessment. Martaningsih, et al. stated that assessment activities were integrated with learning, but students still knew and were aware of the things being assessed because they were explained in the instructions for using student modules [29].

The final component of the CTL approach offered in the module is reflection. This section displays a table containing self-assessment sheets. Students are asked to evaluate/reflect on their learning outcomes by placing a check mark (√) in the column according to the expected learning objectives. In addition, there is also an open question column that asks students to write down things that need to be corrected or perfected in further learning activities. Through this section, students are expected to know the advantages and disadvantages of completing learning activities and improve learning outcomes [30]. The characteristics of the modules previously described are the characteristics of the science module with the CTL approach which is proven to improve students' critical thinking skills. Increasing students' critical thinking skills is also influenced by other factors, such as student learning motivation, supporting facilities and infrastructure, teacher competence in facilitating/helping student learning, age, and student intelligence level [31].

CONCLUSION AND SUGGESTION

The results of this study concluded that the use of the science module with the contextual learning approach (CTL) was effective in improving students' critical thinking skills. The components of the CTL approach presented in the module can encourage students to use logical and systematic thinking skills to build new knowledge through strategic steps. Thus, the science module with the CTL approach can be considered as a solution to empower and improve students' critical thinking skills in 21st century learning. Increasing students' critical thinking skills is not only influenced by the modules and learning approaches used, but also by other factors such as age, gender, facilities and infrastructure, teacher competence, and student intelligence level. Therefore, these things can be used as material for consideration of learning innovations to improve students' critical thinking skills.

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