The effect of reading assignments in guided inquiry learning on students' critical thinking skills

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Abstract. The purpose of this study was to determine the effect of reading assignment in guided inquiry learning on senior high school students’ critical thinking skills. The research method which was used in this research was quasi-experiment research method with reading task as the treatment. Topic of inquiry process was Kirchhoff law. The instrument was used for this research was 25 multiple choice interpretive exercises with justification. The multiple choice test was divided on 3 categories such as involve basic clarification, the bases for a decision and inference skills. The result of significance test proved the improvement of students’ critical thinking skills of experiment class was significantly higher when compared with the control class, so it could be concluded that reading assignment can improve students’ critical thinking skills.

1. Introduction
Training high-order thinking currently is one of the teacher’s focus in teaching. One type of high order thinking skill is critical thinking skills [1]. Critical thinking skill is one of the most important skill to be trained in this century [2]. The critical thinking skill becomes important because life choices are complex due to the proliferation of a variety of information that can be inaccurate and biased [3]. Without refined critical thinking skills, erroneous information can negatively impact life decisions.

Considering the importance of these abilities, many teachers are trying to prepare learners to face the requirements of this era by applying the lessons that train students to think and integrate actions that can foster critical thinking skills in the classroom. Learning that invites students to think this is expected to make students more motivated, more connected and prefer the learning and teachers who teach. One of the actions that can apply by teachers today is guided inquiry learning [4].

Inquiry learning can treat critical thinking skills because at each learning stage developed with the intention to teach students how to think [5]. In addition, the inquiry also can improve perceptions of inquiry learning skills, academic achievements, and retention of knowledge [6]. In this learning, the teacher will provide many questions that are guiding with the aim of students can be trained to think in answering every guidance question. This guidance question is intended to guide students to learn as scientists study nature because the true inquiry learning promotes the learning of scientific concepts and processes as well as “how scientists study the natural world” [7]. This kind of learning will be more inclined to student-centered learning and apply constructivist principles in learning [7-9].

In constructing knowledge by guided inquiry learning. Learning process can not only be done in the classroom but can also in the laboratory through experimental activities [10]. Where this learning can also thrill critical thinking skills [11]. The student in the laboratory will be trained for critical through exploration and explanation activities designed in a learning process to find a concept.
In applying inquiry learning in the laboratory on high school physics learning. One of the most important concepts to train is the concept of how electric current flows in a circuit and closed circuit (1st and 2nd Kirchhoff law). At Kirchhoff laws concept, some prior knowledge such as understanding about the nature of electric current, the concept of simple series and parallel circuit. Not only the knowledge, this topic also requires students already have the skills to use a multimetre and calculate the value of resistance either by using a measuring device or by reading directly on the resistor using colour or code written on the resistor. This knowledge and supporting skills have been taught to the students when they are in junior high school, so it is necessary to recall the process before doing the inquiry process about Kirchhoff law to remind students of that. It can be by employing a reading assignment.

The reading assignment like this provides supporting knowledge or prior knowledge that will make inquiry learning smoother and easier to teach. It is because inquiry process is based on constructivist theory where new knowledge is gained on the basis of previous knowledge (in the reach of previous knowledge) [12]. Reading assignment not only lead to the construction of knowledge activities easier but also the composition of text and graphics and images indirectly give students to have a more basic knowledge, deep, and directed to recall low-level cognitive abilities [13]. The cultivation of low-level cognitive abilities will make high-level cognitive skills better trained.

2. Methods
This research used quasi-experimental research method with pretest-posttest design on two classes which were homogeneous in critical thinking skills and cognitive ability and also homogeneous according to teacher's perception in skill and learning attitude. The experimental class on this learning was given guided inquiry study with the reading assignment. The reading assignment in this study was read a paper that had been provided by the researcher with components included (1) Concept of electric current, (2) Resistors (types of resistors, how to read resistor code), (3) Symbols related to electric circuits, (4) Concept of electrical circuit, (5) Concept of electric current source.

The reading assignment was followed by reflection when the lesson starts. These activities also able to strengthen engagement activities in inquiry learning. The activities of reflection in this research were question and answer about the reading topic, short discussion, and assisted lecture activity. These reflection activities were used to equate assumptions and generate perceptions of students if the reading assignment was a part of the learning activities and important to do. In another side control class was given guided inquiry instruction only.

In both classes of research, researcher controlled variables strictly. The controls included the similarity of inquiry processes, tools and materials used, place and duration of learning, and teaching teacher. The inquiry process used in this study was a guided inquiry process in the laboratory with same main guidance questions (variable selection questions, investigation method questions, and data analysis questions) in both classes. These main questions also trained in critical thinking skills (Socratic questions) [14]. Equipment provided in this research was all tools and materials which are available in the laboratory (students are given the freedom to choose which laboratory equipment they will use). The place of research was conducted in the laboratory of one high school in Indonesia with 150 minutes for each learning process.

This research measured critical thinking skills with the definition of critical thinking skills by Ennis [15]. The instrument used in this study was 25 multiple choice interpretative exercise test items with justification [3,16]. With critical thinking skills measured include involve basic clarification, the bases for a decision and inference skills on Kirchhoff law concept.

This research uses a partial hypothesis. The hypothesis used is the reading assignment can improve the critical thinking skills of high school students significantly. Test of significance which is used for this study is the T test for normalized data and Mann Whitney test for un-normalized data.

3. Results and Discussion
Before starting the learning the students were given pre-test to know the starting point of their critical thinking skills. After the pre-test was done, quasi-experimental research will be held for 3 weeks. With
the first week about simple circuits, law 1 Kirchhoff at 2nd week, and law 2 Kirchhoff for the 3rd week. In the final students will take a post-test. The test results are shown in figure 1 and table 1.

![Score of critical thinking skills](image)

**Figure 1. Score of critical thinking skills**

**Table 1. The Improvement of Critical Thinking**

| Class     | N  | Min | Max | Mean | SD  |
|-----------|----|-----|-----|------|-----|
| Experiment| 34 | 0   | 9   | 6.47 | 1.957 |
| Control   | 31 | 0   | 6   | 2.58 | 1.708 |

After having improvement score for each class. The research continues to test the hypothesis. The results of normality test using Kolmogorov-smirnov test obtained sig. 0.000 (<0.05) for the experimental class and sig. 0.011 (<0.05) for the control class so it can be concluded that the data is not normalized. Then the process continued with homogeneity test that obtained sig. 0.838 (> 0.05) so that it can be concluded that the data obtained homogeneous. Due to un-normalized and homogeneous data, the research data analysis will use Mann-whitneys test as an alternative. The results Mann-whitney test is obtained sig. of 0.00 (<0.05) so that it can be interpreted that the reading assignment significantly improve students’ critical thinking skills.

In this study, researchers investigated the benefits of reading assignment in inquiry learning as an effort to improve critical thinking skills. Researchers found that the provision of significant reading assignment can improve students’ critical thinking skills. This can be interpreted into several things. First, the task of reading can improve the ability of inquiry learning in improving students' critical thinking skills. This is in line with the results of research Guthrie, Van Meter [17] and Guthrie, Wigfield [18] which states that reading activities as concept orientation have a positive influence on the learning strategy used. In addition, reading activities can also control the initial knowledge and initial understanding so as to give a positive influence on conceptual knowledge built through the learning process. On the other hand, these results are also confirmed by the results of the study of Romance [19] which states that the provision of science-based reading strategies can provide a positive influence on attitude toward and confident in science.

When prior knowledge and early understanding was controlled. It will accelerate the students in developing the concept in a science learning activity [20], in addition, it will also facilitate the teacher in guiding students in investigation activities due to attitude and confidence in the students' high so that the learning process becomes smoother and more responsive. Less learning obstacle will make many learning objectives will be achieved better.

In this study, the focus of research was to improve critical thinking skills, so on the learning, students will be guided to answer a question clearly and logically. With the reading activity then the students
have got the basic knowledge that can be their reference in conveying the explanation of the answer of a problem. In this study, students were not given procedures, experimental tools, and how to analyze experimental results but through a guidance activity involving a series of guiding questions. In the process of guidance, students choose the tools and materials, as well as the selection of procedures and how to analyze, students need a critical nature in the right choice judge in the process of inquiry. With the existence of controlled early knowledge then students have a basis in considering a choice well. Finally, in the inquiring entrapment, the student will be given the opportunity to conclude through the use of logical reasoning processes this will indirectly train the critical thinking skills to make an inference.

Second, reading assignment can be as reflective activities that can build critical thinking skills. By the reading assignment, students will remember the prior knowledge which they have learned before. This process will build a low-level cognitive ability better, better low-level cognitive skills will be able to support the build of higher-level cognitive abilities better. While on the other hand high order thinking is the abilities that are awakened by high-level cognitive ability. In conclusion, it is clear that the class who gets the reading assignment will get a higher level of thinking skills, in this case high order thinking was the critical thinking skills.

4. Conclusion
Providing reading assignments give a controlled prior knowledge and initial understanding. That will facilitate the process of building knowledge in inquiry learning, in another hand reading assignments also provide a much better lower-level cognitive foundation that can support the building process of better critical thinking skills.

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