

# Artikel Bram

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**Submission date:** 12-Dec-2018 03:16PM (UTC+0700)

**Submission ID:** 918526849

**File name:** Proofreading\_by\_Arnita.docx (118.79K)

**Word count:** 4181

**Character count:** 24206

# THE EFFECTIVENESS OF GUIDED INQUIRY AND INSTAD TOWARDS STUDENTS' CRITICAL THINKING SKILLS ON CIRCULATORY SYSTEM STUDY MATERIAL

## ABSTRACT

Critical Thinking Skills (CTSs) are fundamental skills possessed by students to adaptive with the external challenges of 21st-century. To empower students' CTSs, Guided Inquiry and INSTAD may work effectively. This research aims to see the effectiveness of guided inquiry and INSTAD against students' critical thinking skills. This research was a quasi-experimental. The Instrument o get data on CTSs using a valid essay test according to Facione. The sampling technique using the intact group sampling method. The number of participants involved 188 students of XI grade science class at SMAN 7 Surakarta as a middle-quality school. The total number of research sample was 32 students as Guided Inquiry class and 32 students as INSTAD class. Hypothetical test using ANCOVA 5% significance level. The result obtained there are significant differences of CTSs on circulatory system study material through INSTAD and Guided Inquiry. Students' CTSs which applied INSTAD learning model has a higher than Guided-Inquiry.

**Keywords:** Critical Thinking Skill, Guided Inquiry, INSTAD

## INTRODUCTION

The 21st-century is an era of science and technology has developments very rapidly. The necessary skills to face the 21st-century challenges was not only about teaching reading, writing, and arithmetic but also about how to use and develop thinking skills became high-order thinking skills (HOTS) (Borstner & Gartner, 2014; Collins, 2014). Critical thinking skills are one of the HOTS needed for making purposeful, reflective and fair-minded judgments about what to believe or practical issues in the future. Therefore, the skills to think critically about the students becomes very important, because in general, the real problem in today's world is not simple (Mutakinati & Anwari, 2018). Students' CTSS and some HOTS should also be optimally empowered in learning at school.

Critical thinking skills have a long-term benefit in the field of education as it can assist students in solving problems encountered in the learning process and its application in everyday life (Kaddoura, 2011). Meanwhile, the short-term goal of students trained CTSS in the learning process in order to strengthen conceptual understanding (Khasanah, *et al.*, 2017), especially in natural sciences (IPA). Therefore, The students' CTSS is needed to overcome problems in everyday life.

Facione (2011) classifies critical thinking skills into several aspects: (1) Interpretation; (2) inference; (3) evaluation; (4) explanation; (5) analysis; (6) self-regulation. The interpretation aspect requires students to be able to categorize, explaining the meaning of a term. The analysis aspect is related to researching ideas, identifying and analyzing arguments. The evaluation aspect relates to the skills to assess opinions. The inference aspect consists of the skills to look for evidence and alternatives. The explanation aspect is the skills to express results, justify procedures, and present. The self-regulation aspect relates to the skills to monitor students' self-learning. Fong, *et al.* (2017) states that students who have critical thinking skills tend to be more competent than students who are less critical.

According to the observation results at XI MIPA of SMAN 7 Surakarta using critical thinking skills test compiled based Facione indicator showed that the aspect of interpretation was 45,81%. The Skills of analysis was 33,59%. The aspect of Evaluation was 30.01%, the aspect of Explanation was 24.84%, the aspect of Inference was 27.01%, and the aspect of self-regulation was 62.50%. Critical thinking skills with percentage 25-43,75% included in a low category, 43,76-63,15% included in a medium category, and 63,16-80,00% included in high category (Saputri, Sajidan, & Rinanto, 2018). critical thinking includes a list of skills is performed by critical thinkers (Paul & Elder, 2011). So, Based on the results of focused observations found that the critical thinking skills of students of class XI MIPA SMAN 7 Surakarta were still relatively low.

Students' critical thinking skills could be optimized with applying of inquiry-based learning model (Asyari, *et al.*, 2016; Boleng, *et al.*, 2017; Zubaidah, *et al.*, 2017). Inquiry-based learning demands that students actively build their knowledge, search for meaning from the learned, make reasoning by searching for meaning, and compare new

concepts with an early concept. That activity was potential to students using critical thinking skills during the learning process (Putra, *et al.*, 2016). Inquiry-based learning also concerns to provides a process of learning not the product. There is compatible with the essence of Integrated natural sciences (IPA) learning. The essence of IPA is process oriented, so it could train the thinking ability, solve problems, and deliver students into self-regulated learner or students play an active role during the learning process to build knowledge independently through a series of activities so that learning becomes meaningful (Lederman, Lederman, & Nature, 2013).

Inquiry-based learning is a very suitable learning model for IPA learning, also on Circulatory System Study Materials (Retnawati *et al.*, 2017). The circulatory system study material has many abstract concepts, so it cannot be understood simply by memorizing it. Scientific work contained in both models allows students to observe directly, conceptualize, and deduce new knowledge that has been obtained from the experimental activities — for example, the question of the principles of blood classification. Through the scientific approach, students can immediately observe how the clumping process occurs or not, what is agglutinin and antigen, so that students can then conclude the principles of blood classification. In addition, through these activities students can train aspects of critical thinking skills i.e., interpreting, analyzing, concluding, evaluating, self-regulation, and explaining (Weaver *et al.*, 2016).

Scott, Tomasek, and Matthews (2010) stated that guided-inquiry teaching has six stages: observation, formulating problems, hypothesizing, designing and executing experiments, analyzing data, communicating. The observation stage aims to reveal the student's early conception, thus helping the teacher to recognize the students' initial understanding and ideas. The next stage is to formulate problems, make hypotheses, design and carry out experiments. These three phases give students the opportunity to do scientific work so that students are actively involved in learning. The next stage of analyzing the data, this stage requires students to develop their thinking skills to get the conclusions from the experiments conducted so that students are expected to use high-order thinking skills. The last stage is to communicate; students are given the opportunity to present the results of experiments that have been done, to be able to train the explanation skills.

There was a weakness of the Guided-Inquiry model conducted in the Classroom, which was the limited time to do scientific work in IPA learning. Students with lower academic level have minimally guided, then required a longer time than students with a higher academic level (Damavandi & Shekari, 2010). The Guided-inquiry learning which focused only on the application of the learning model would be difficult to accommodate the training of CTSS of the lower academic students. To solve this problem, was important to conduct scaffolding between Higher Academic (HA) to Lower Academic (LA) students. Scaffolding from HA to LA students in IPA learning

could be effective if the scientific work conducted in cooperative group (Boleng et al., 2017).

In addition, the empowerment CTSSs between students with different academic skills need to be a concern. A potential learning model also able to improve HA and LA students' critical thinking skills is Inquiry-Student Team Achievement Development (INSTAD). INSTAD is new learning model in which integrated the investigate aspect from the guided-inquiry model and collaborative aspect from STAD model (Prayitno & Suciati, 2017). Existing research result about INSTAD has shown great improvement Students' Science Process and Scientific Outcomes. So, INSTAD is assumed it could be improved Students' CTSSs students more effectively than Guided-Inquiry.

According to Prayitno (2017), INSTAD has five phase. The First phase is problem orientation. This phase not only requires students to find problems of the phenomena presented but also organize learning where students are formed into teams with members of approximately five people with heterogeneous academic skills. The next phase is inquiry work in a collaborative group. This part requires students to conducting IPA concepts by scientific work in a different way. The heterogeneous academic skills of students in the collaborative group are intended to make scaffolding process through peer tutorials well facilitated, so the aspect of self-regulation and explanation could be optimized more than scientific work in guided-inquiry. The third phase is the presentation of the class, after the collaborative concept-forming activity then the students are required to present their group work in front of the class in this phase. The next phase is the individual test phase and team recognition. This phase also not in the guided-inquiry. The individual test were trained students to evaluate the received IPA concepts during the learning process through practice questions, then calculate individual progress scores, team scores, and reward teams, such as the characteristic of IPA, the last stage trains students to monitor their learning process by writing value enhancement after learning activities, writing materials that are still difficult to understand (Sulistijo, et al, 2017).

Based on the explanation above, it was necessary to do research aimed to the test the effectiveness of Guided-inquiry and INSTAD on the students' critical thinking skills.

## METHOD

This research was quasi-experiment with factorial design 2x1 (Creswell, 2012). The research sample was treated for five meeting, and the CTSSs were measured at the end of the treatment. The fixed factor of this research was guided guided-inquiry and INSTAD teaching models, while the dependent variable was the students' critical thinking skills. The analysis of this research uses descriptive statistical analysis and inferential statistics. Data of critical thinking skills was taken with a sort of essay test. The test instrument for retrieving the data of critical thinking skills was conducted based on the Facione indicator.

The participants of this research involved 188 students of XI grade science class at SMAN 7

Surakarta as a middle-quality school. The researcher decides to choose a middle-quality school with assuming in that school has more various academic skills than low or high-quality schools — sampling technique using an intact group sampling which has previously been done equality test (Creswell, 2012). The equality test in this study was conducted by students' examining score using the test of Komolgorov-Smirnov Normality and Levene's homogeneity test. The conclusions of the normality and homogeneity test indicate that the population has equality. After the equality test obtained, we do matching class test using ANOVA. ANOVA result indicates there were no significant differences between each class, so we can directly choosing two sample groups that class XI-Science 2 as experiment group 1 using INSTAD treatment and class XI-Science 3 as experiment group 2 using Guided Inquiry treatment.

The instrument of the test in this study is a written test compiled using rubric critical thinking skills according to Facione (Facione, 2011). Before beginning the assessment, the validity and reliability index of the essay test were tested. The validity test was conducted through expert analysis and empirical test. Three experts lecturer from Post-Graduate Programme of Teaching and Education Knowledge Faculty of the Sebelas Maret University of Surakarta were selected in analyzing whether the test was appropriate for measuring the critical thinking skills indicators and whether it was consistent with the learning material. The judgment from experts was the test is valid with a validity index of 3.80

The implementation of learning model during the research was controlled by six observers based on observational instruments to check the consistency of the model's implementation. INSTAD teaching model was applied by considering the criteria of the grouping method. Groups in each treatment class were divided into six, each with five members. Two or three students with high academic skills were put together with lower academic skills students, in order to guarantee peer scaffolding in this model. While, in the guided-inquiry learning model, randomly grouping system was applied.

This study lasted four times in class with groups that did not change. Each meeting has 90 minutes. The first meeting was blood components learning. The second meeting was the blood type learning. The third meeting was the organs and mechanisms of the circulation system. The fourth meeting was the disorders and abnormalities in the circulation system learning. The last meeting was an examination to carried out data retrieval of critical thinking skills using validated questions.

Data analysis using ANCOVA test which had previously tested the prerequisite that is normality test and homogeneity test. In order to eliminate the variation of critical thinking skills among research samples, the pre-test scores or the baseline of Students CTSSs were used as covariates. Kolmogorov-Smirnov parametric statistical analysis was used for testing data normality, the pre-test score was 0.070 and posttest score 0.052, i.e., within the normal category, whereas the Levene homogeneity test concluded that homogeneous variants were at 0.54.



## RESULT AND DISCUSSION

The result of the test of critical thinking skills on learning model data source is presented in Table 1.

**Table 1** Anacova Test Results in Students' Critical Thinking skill

Source	Type III Sum of Squares	df	Mean Square	p.
Corrected Model	1157.156 <sup>a</sup>	2	385.719	.000
Intercept	9354.534	1	9354.534	.000
Model	165.554	1	165.554	.039
Pretest	285.968	1	285.968	.008
Error	2219.898	60	36.998	
Total	376939.438	64		
Corrected Total	3377.054	63		

ANCOVA assumes that there is no group difference at pretest, so the first step is looking at the p.values of pretest as a covariate. Table 1 showed the p.values of pretest data source obtained 0.008 (<0.050), that is indicated the sample has significant different for the baseline. That is mean Most of the research participants in this research experienced critical thinking skills improvements. Then, Model data source obtained p. values 0,039 (<0,050), there was indicated a significant differents of the influence of learning model on critical thinking skills. The results of the students critical thinking skills applied with Guided-Inquiry and INSTAD were visualized in Table 2.

**Table 2** Critical Thinking Skills in different learning models.

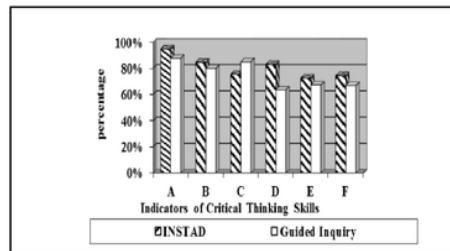
Model	XCTS	YCTS	Gain	CTScor
Guided Inquiry	30.636	71.721	43.68	73.205
INSTAD	31.719	79.752	50.45	79.924

Note: Note: XCTS: The average result of critical thinking skills pre-test, YCTS: the average result of critical thinking skills post-test, CTScor: The average corrected critical thinking skills

Based on the results of Ancova test which showed in Table 1 indicates there is a significant difference in improving students' critical thinking skills on guided inquiry learning model and INSTAD. Table 2 indicates the students' critical thinking skills in INSTAD class has a corrected average value of 81.093 higher than guided inquiry which is only 75.205. Table 2 also shows an increase in critical thinking skills in the guided-inquiry class by 143%, while the INSTAD class has a higher increase of 159%. These results indicate that the INSTAD model has a higher potential to improve critical thinking skills than the guided inquiry model.

Differences in students' critical thinking skills in guided inquiry models and INSTAD are also analyzed in every aspect of critical thinking skills. Figure 2 visualizes

the difference in scores of each aspect of critical thinking skills in the inquiry learning model and INSTAD.



Note: A: Interpretation, B: Analyze, C: Explanatory, D: Evaluation, E: Concluding, F: Self-regulation

**Figure 1** differences between learning models through critical thinking skills in each aspect

Figure 1 indicated that students ability to interpretation within INSTAD teaching model has the highest score than other, whereas student' ability to evaluation within Guided-inquiry teaching model has the lowest percentage. Students' ability to interpret, analyze, evaluation, concluding, and self-regulation that applied by INSTAD teaching model has a higher percentage than Guided-inquiry implementation. However, also, the explanatory indicators within guided-inquiry has a higher percentage than INSTAD teaching model.

The Collaborative group formation phase for inquiry work makes the INSTAD model different from guided inquiry models and other inquiry-based models (Prayitno & Suciati, 2017). Collaborative teams with members of approximately five people are grouped by heterogeneous academic skills. Also, in this phase, the teacher also provides the circulation system material phenomena that will be a problem to be investigated, such as cases of anemia, cases of accidents and needed blood transfusions. The case can stimulate students' curiosity at before the learning began. The scaffolding process works so well that each group member who has a higher academic ability can guide lower ability group members to achieve ZPD (Azizah, Masykuri, & Prayitno, 2018). Peer tutors among group members in the INSTAD model were more active than the guided-inquiry class. The scaffolding process between peers that appears in the group makes students' critical thinking skills, especially the self-regulation of INSTAD learning model is higher than the guided-inquiry model (Garrison & Akyol, 2015).

- LA1: No determining part of heart ( the experiment using Cow Heart ), then ask to HA1
- HA1: Prompting and probing (ask to LA1), then Observe and verbalizing the cow heart, the right and left heart can be distinguished by observing the valve
- LA1: No determining the location of Aorta, ask to HA2
- HA2 : Prompting and probing (ask to LA1), then LA2 explaining the location of Aorta (on his answer), then Making concep map (between the part of Heart)

**Figure 2** examples of peer tutoring between HA and LA students in the collaborative group INSTAD

The increasing aspect of explanation indicates that the student has started to be trained to describe the information that illustrates the content of the information clearly (Facione, 2011). After treatment using both models, students were able to explain the procedure for measuring a person's blood pressure, identifying between normal and abnormal blood pressure, and experimental results have been made, such as explaining the structure and function of circulatory organs. A good explanation cap skills will be seen when the student expresses her opinion with confidence (Zhou, Huang, & Tian, 2013). Their activity in constructing the concepts, conclude, then presents to others has been proven to improve students' critical thinking skills, especially aspect of explanation (Sampson & Clark, 2008; Forawi, 2016).

The class presentation stage requires students to act as the presenter in charge of explaining the results of the experiment in the previous stage. Students present about the various components of blood, the principle of blood type, and other concepts that have been obtained during scientific work. Both learning models have stages that enable students to communicate the results of experiments that have been done in the next stage. However, the collaborative group organizing on heterogeneous INSTAD learning based on students' academic skills makes the group members of lower academic skills less confident when explaining something so that students are more likely to have the higher academic skills in the group explaining the results of the lab. The lack of confidence makes the skills to explain students to be less than optimal (Damavandi & Shekari, 2010; Ramli et al, 2017).

In addition to the teaching models differences also contributed to the differences in students' critical thinking skills. The results of this research indicate that there is a difference in critical thinking skills between INSTAD and Guided-Inquiry models. Thus, the results of this research match with the previous research that stated that there was INSTAD has a higher potential to enhance learning process than Guided-inquiry (Prayitno et al., 2017; Prayitno & Suciati, 2017; Sulistijo et al., 2017). However, these results are specific to study the effect of different teaching models in students critical thinking skills.

The differences between INSTAD and Guided-inquiry can be seen from the differences in their activity when doing inquiry work. The differences in the collaborative team when doing inquiry-work affect students with low academic skills in determining their scaffolding process. Scaffolding through peer tutoring provides more study time for low academic students (Yusnaeni, et al, 2017). Adequate time to study can improve the critical thinking skills of low academic students as students with high academic skills.

Based on the results of this research, the researcher recommends implementing INSTAD, especially to guarantee the scaffolding process by peer tutoring, to nurturing students' critical thinking skills. Critical thinking skills need to be trained on each indicator because it is one of the fundamental skills to mastering IPA and implement it in everyday life.

## CONCLUSION

The results of this research support the theory and the previous research that state that there is a difference in critical thinking skills between teaching models. The students who applied INSTAD teaching

model had the highest critical thinking skills. The Indicators of Critical thinking skills within INSTAD are higher than Guided-Inquiry, expect the ability to explain. This research was limited to the subject of science in SMAN 7 Surakarta. The research may be continued on the subject of science or other subjects at the primary school or middle school level. Future research can also focus on other thinking skills, such as creative thinking skills, problem-solving, science literacy, and among others.

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