The Effectiveness of guided inquiry model with starter experiment approach towards critical thinking skill in understanding fungi material: an experimental study on the first students of senior high school

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Abstract. Competency result is a major problem encountered in school level education. This research aims to investigate the effectiveness of the guided inquiry model with a starter experiment approach towards the students' critical thinking skills. Using a quasi-experimental design, this research took a sample of 64 students of X MIPA₁ and X MIPA₅. A technique in selecting the sample was cluster random sampling. To collect the data, the test was utilized. The data analysis was performed using the normality test, homogeneity test, and ANCOVA test with the significance level of 0.05. The mean of the posttest result was 84.14%. The improvement of critical thinking skills was 42.89%, compared to the result of the pretest. This research shows that the guided inquiry model with a starter experiment approach had a significant effect on the students' critical thinking skills in understanding Fungi material.

1. Introduction

The fact shows that the science learning implemented in Indonesia has yet to prove the students to learn with real life, especially Biology. Also, PISA administered a survey to measure the achievement in Literacy, Science, and Mathematics. Indonesia has an average score is 382. Again, it is far from Chinese students who get an average score of 580. Therefore, Indonesia is in the 53rd position of 54 countries participating in the survey [1].

Besides, teachers are currently the center of the learning process in the Biology lesson. Whereas, the students must be active in the Biology lesson. That is far from the development of the recent curriculum, that is, the curriculum of 2013 expecting the change in the learning process. The curriculum of 2013 aims to provide comprehensive and integrated knowledge to the students. It is to prepare humans to have life skills as individuals who are productive, creative, innovative, and effective. This way, teachers as the facilitator are expected to develop their innovations and creations. One of the way to gaining innovations and creations is use inquiry learning. Teachers stimulate the students to think, look for, and analyze information. The students are stimulated to find the answers themselves so that they can develop their confidence and systematic, logical, and critical thinking.

There are four levels of inquiry studies according to [2] namely structured inquiry, controlled inquiry, guided inquiry, and free inquiry. Guided inquiry is one of the models. How to obtain it through...
hypothesis, connecting, and doing the research [3]. Inquiry learning makes learning resources more diverse. It invites the students to actively take part in the classroom. Guided inquiry is an instruction to create a deep learning process. Therefore, giving guidance is a method of learning and it is a crucial part of the learning process [4]. According to Mulyana et al. [5], there are some kinds of Guided Inquiry; planning for teacher guidance to improve students' abilities. It can begin by answering my questions, and draws on what is already known, but going beyond it [6]. According to Kuhlthau and Caspari [7] the implementation of the Guided Inquiry consists of six steps namely: a. Open and Immere; b. Explore; c. Identify; d. Gather; e. Create and Share; f. Evaluation.

Guided inquiry need something interest to opening and immersing before applied to the theory of constructivism in learning activities, which serves to understand the concept [8]. Based on Subamia [9] Starter Experiment Approach (SEA) trains students to actively follow the learning steps to improve the quality of the learning process. In this context, assistance is mostly given through the starter experiment in the form of instruction, guidance, or stimulation leading students to arrive at the problems. SEA adopts an integrated approach in teaching Science (Physics, Biology, and Chemistry) which are usually broken down into parts and often unplanned [9]. What is meant by unplanned is that teachers still figure out the students' schemata which are used as the dominant learning topic in the classroom. The Starter Experiment Approach (SEA) is a learning approach that relates the learning materials to the students' daily experiences [10]. SEA activities largely focused on process skills and the liveliness of the students [11]. By developing process skills acquisition, students will be able to find and develop the facts and concepts as well as foster the attitudes and values required [12]. Therefore, the students are provided the chance to develop their abilities in gathering information using all their potentials. Besides, the students not only see or imagine but also experience the concrete learning process. This way, the students' internal abilities can be maximized so that the students can understand the concepts.

The implementation of guided inquiry with a starter experiment approach is expected to make the students able to develop their systematic, logical, and critical thinking. Thinking is a process that is created unconsciously in one's mind. It can be seen from daily activities, thought processes used as a way to solve the problems faced by people in their lives [13]. In other sense, the process of critical thinking is the process of problem-solving by decision making [14]. One that includes high-level skills i.e. critical thinking [15].

The learning process of Fungi using Guided Inquiry with Starter Experiment Approach is expected to improve the students' critical thinking skills and the students' abilities in the aspect of cognitive, affective, and psychomotor. Additionally, the researcher also wants to obtain empirical evidence of the effectiveness of the learning model.

2. Method
This research adopted the Quasi-Experimental method since not all the variables and the experimental conditions can be fully controlled. The design of this research was “Nonequivalent Control Group Design.”

Referring to this design, the first step done by the researcher was to select the sample from both experimental and control classes to control the experimental research condition. The second step was to give a pretest in both the experimental class and control class to figure out the condition of both classes. If the result of both classes was not significantly different, treatment was given. The experimental class was given the treatment using Guided Inquiry with Starter Experiment Approach, while the control class was given the treatment using the 5E learning model. Then, the researcher gave a test, that is, the posttest. The experimental class and control class were given a posttest to know the effect of the treatment. The success of the treatment was determined by comparing the score of pretest and posttest.

The sample was 64 students of X MIPA₁ and X MIPA₅ classes. The sampling technique adopted cluster random sampling by considering the population. Using the random sampling, X MIPA₁ was selected as the experimental class while X MIPA₅ as the control class.

To collect the data based on the variables, the test was utilized. The test of critical thinking was done twice: pretest and posttest. Pretest aimed to measure the students’ ability before the treatment was given.
Meanwhile, the posttest was conducted at the end of the learning process, aiming at measuring the students’ ability after the treatment was given. The single instrument to collect the data was a test to measure the students’ critical thinking skills. The indicators of critical thinking skills were adapted from [16]. The validity and reliability of the instrument were ensured. The validity of the instrument included logical validity and empirical validity (face validity, item validity), and test reliability. Logical validity was consulted with the expert, that is, the expert lecturer having expertise in material and evaluation. Empirical validity was obtained after the data was tested in the field. The analysis of empirical validity was done using SPSS program functioning to analyze the validity of test items, reliability, the level of difficulty of test items, and the criteria of success and fail of test items.

3. Results and Discussion
The data of the students’ critical thinking skills resulted from the pretest and posttest scores. Table 1 shows the mean score in the pretest and posttest of the students' critical thinking skills gained by the control class and experimental class. The number of students who followed the pretest and posttest of critical thinking in learning Fungi was 32 students in the control class and 32 students in the experimental class.

| Average Description | Control | Experimental |
|---------------------|---------|--------------|
|                     | Pretest | Posttest     | Pretest | Post test |
| The number of samples | 32      | 32           | 32      | 32         |
| Deviation standard  | 17.13   | 18.73        | 13.56   | 11.04      |
| Maximum score       | 68.00   | 100.00       | 68.00   | 100.00     |
| Minimum score       | 0.00    | 32.00        | 10.00   | 60.00      |
| Mean                | 32.37   | 69.12        | 41.25   | 84.14      |

The increased average: 36.75% 42.89%

Based on Table 1, the students’ mean score improved. Before the treatment was given, the control class gained 32.37. After the treatment, the class gained 69.12. In the experimental class, the students’ mean score improved from 41.25 in the pretest to 84.14 in the posttest. Also, the improvement of the control class was 36.75%, while the experimental class was 42.89% on average. Figure 1 depicts the average score of the students’ critical thinking of both the control group and experimental group in the pretest and posttest:

![Figure 1](image)

**Figure 1.** The mean score of the students’ critical thinking of the control group and the experimental group.

Based on Figure 1, it is evident that the students' scores improved. The experimental group got a higher score than in the pretest than the control group, and the difference between both groups was
8.88%. Meanwhile, in the posttest, the difference was 15.02%. Therefore, it is clear that the implementation of Guided Inquiry with Starter Experiment Approach in the experimental class was effective to improve the students' critical thinking in learning Fungi since there was an improvement in the mean score.

Table 2. The Result of Normality Test of Critical Thinking Skill

| Class       | Data               | Significance | Data distribution |
|-------------|--------------------|--------------|-------------------|
| Control     | Critical thinking skill | 0.200        | Normal            |
| Experimental| Critical thinking skill | 0.179        | Normal            |

The normality test was done by referring to the result of Kolmogorov-Smirnov in SPSS at the significance level of α 0.05. The data was normal if the probability result (sig) >α 0.05, referring to the Kolmogorov-Smirnov Test. The data shows that the normality test result of the students’ critical thinking skill in the control class had a significance value of 0.200, higher than the significance level of α 0.05. Therefore, it can be concluded that H₀ was accepted and H₁ was rejected, which means that the data was normal. Besides, the same test that was done to the experimental class shows the significant value of 0.179, higher than the significant level of α 0.05. This data was also normal.

Based on the result of the pretest of both the control class and experimental class, the result of the homogeneity test is as follows.

Table 3. The Result of Homogeneity Test of Critical Thinking Skill

| Data               | Significance | Data variance   |
|--------------------|--------------|-----------------|
| Critical thinking skill | 0.111        | Homogeneity     |

The homogeneity test was done using Levene statistics in SPSS at the significance level of α 0.05. The data was homogeneous if the probability (sig) >α 0.05, referring to the significance value. The data shows that the significance value of the homogeneity test was 0.111, higher than the significance value of α 0.05. Therefore, H₀ was accepted and H₁ was rejected, which means that the data was homogeneous.

The prerequisite test of data analysis towards critical thinking skill met the criteria, that is, the data was normal and the variance between the groups was homogeneous. Considering this result, the analysis was continued to the different test of pretest data using Independent Sample T-Test. The result of Independent Sample T-Test is as follows:

Table 4. Independent Sample T-Test of Critical Thinking Skill

| Data               | t-test for Equality of Means |
|--------------------|------------------------------|
|                    | Sig  | Df    | Sig. (2-tailed) |
| Critical thinking skills | Equal variances assumed | 0.111 | 62    | 0.025 |
|                    | Equal variances not assumed | -     | 58.8  | 0.025 |

Based on the calculation from SPSS 22, the data was significant if the probability (sig) >α 0.05, referring to the significance Sig (2-tailed). The significance value of critical thinking skill was 0.025, lower than the significance level of α 0.05; therefore, H₀ was rejected and H₁ was accepted, which means that the data was not significant or had a different variance.

The result of data analysis can be seen in the descriptive data of critical thinking skills. The descriptive data shows that there was an improvement in the students' mean score of their critical thinking skills. The mean score of the posttest from the experimental class was 84.14 while the mean score of the posttest from the control class was 69.12. It suggests that the students’ critical thinking skill in the experimental class is higher than that of the control class. The effect of Guided Inquiry with Starter Experiment Approach towards critical thinking skill was evident due to the giving of guidance to the students to think and find the solutions based on the faced problems. The students, therefore, can understand the way how to solve all the problems based on their abilities.

The students’ critical thinking skills can be trained and developed through the activity of asking and questioning any phenomena being learned, notably when the learning process is occurring. In the
observing stage, the students can directly get the result based on the theories they know. The learning process can be more active and effective because the students are directly involved; they ask questions each other and exchange information with other friends and the teacher. Besides, the students’ activity in finding the solutions can lead them to be more critical, logical, and systematic.

In the Guided Inquiry learning, the students actively work in their groups, do the discussion, and the teacher guides them during the lesson. This means that the teacher’s role is the facilitator, that is, to provide guidance. Meanwhile, the students in their groups try to find the answers and information related to the problems through a series of the investigation. This is consistent with [17] stating that guided inquiry is a learning model encouraging the students to find solutions towards the problems provided by the teacher with intensive guidance. In the process of guided inquiry learning, teachers can spend more time interacting with the students; however, the interaction is not to help the students find the answers.

A study was done by [18] revealed on the implementation of guided inquiry learning towards the students’ critical thinking skill, proved from the significance value of 0.00 < 0.05. Therefore, it can be concluded that guided inquiry learning significantly affected the students’ critical thinking skills. Additionally, [19] said that the treatment using guided inquiry is more effective in improving the students’ critical thinking comparing to conventional learning. The students respond positively and the teacher does the positive activities in the learning process of guided inquiry; however, the teacher is less optimal in managing the class.

In the implementation, the students are given the chances to infer what might happen, prove the inferences through the experiment in groups, communicating the result of each group, solving the problems by deciding the experiment result that is relevant to the problems; this series of activities can improve the students’ critical thinking skill.

4. Conclusion
The data of descriptive analysis shows was a difference in the mean score of the students’ critical thinking skills. Thus, Guided Inquiry with Starter Experiment Approach was effective towards the students’ critical thinking skills. The effectiveness was evident due to the guidance given to the students in thinking and finding the solutions based on the problems. Therefore, students can understand how to solve any problems based on the abilities they have.

References
[1] Gurria A 2012 PISA 2012 Results in Focus: What 15 Year Olds Know and What They Can Do with What They Know. (OEC)
[2] Sadeh I, Zion M 2012 Research in Science Education 42 831
[3] Pedaste M, Mäeets M, Siiman L A, De Jong T, Van Riesen S A, Kamp E T, Manoli C C, Zacharia Z C, Tsourlidaki E 2015 Educational research review 14 47
[4] Arslan A 2014 Procedia-Social and Behavioral Sciences 141 407
[5] Mulyana S, Rusdi R, Vivanti D 2018 Indonesian Journal of Science and Education 2 105
[6] Calder N, Brough C 2013 International Journal of Mathematics Teaching and Learning 1 64
[7] Maniotes L K, Kuhlthau C C 2014 Knowledge Quest 43 8
[8] Laksana D N 2017 Journal of Education Technology 15
[9] Wardani I, Dijkstra D 2019 JPBI 5 277
[10] Purwanto J, Hasanah D, Syafaat F Y 2017 Jurnal Penelitian Pembelajaran Fisika 21 8
[11] Indriarini N M, Bayu G W 2019 Mimbar Ilmu 24 124
[12] Jaya M C 2014 Jurnal Pendidikan Fisika 2 69
[13] Zulmawidha R, Dahlan J A 2018 Journal of Physics: Conference Series 1028 01209
[14] Edriati S 2018 Journal of Physics: Conference Series 948 012031
[15] Aktaş G S, Ünlü M 2013 Procedia-Social and Behavioral Science 93 831
[16] Ennis R H 1962 Harvard Educational Review 32 81
[17] Lee V S 2012 New directions for teaching and learning 129 5
[18] Sitindaon S F, Bukit N, Turnip B M 2017 *Jurnal of Education and Practice* 8 129
[19] Zaini M 2016 *IOSR Journal of Research & Method in Education (IOSR-JRME)* 6 50