The Influence of Contextual Learning Model and Critical Thinking to Science Literacy of High School First Year Students

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Abstract. This study aims to determine the influence of contextual learning model and the ability to think critically on science literacy of the High School first year students. This study was conducted to the first year students of SMAN 4 Kota Tangerang and SMAN 11 Kabupaten Tangerang. A Quasi-experimental method with two-way Anova (treatment by level 2x2) design was implemented in the study. 80 students were chosen as sample by using purposive sampling technique. Students on experiment class study using science, technology and society (STS) model. Meanwhile, students on control class study using contextual teaching and learning (CTL) model. The conclusion taken from the study, are as follow: student science literacy with STS model is higher than students with the CTL model; there is an interaction effect between learning model and critical thinking ability to student s science literacy; student science literacy with STS model is higher compared to the students with CTL model on the group of students that possess high critical thinking ability; and student science literacy with STS model is lower compared to the students with CTL model on the group of students that possess low critical thinking ability.

1. Introduction

In the 21st Century, the industrial world is growing rapidly due to the advances in science and technology to cater human needs. The rapid development of industry and technology in the 21st century also causes many problems; one of them is environmental aspect. This is due to a lack of awareness on science. Humans often utilize science and technology by exploiting nature without understanding the consequences for the environment and the future of the earth.

Science is a systematic effort to create, build and organize knowledge to understand universe [1]. The presence of science shapes human behaviour and character to care and responsible for itself, society and the universe which is literally defined as science literacy. Science literacy is considered a learning outcome; the key to science literacy education is at the age of 15 because at that age, someone should have chosen the career and participate in science and technological development [2].

To assess science literacy level, Indonesia has taken PISA (Programme for International Student Assessment) test, where it was initiated by OECD (Organization Economic Co-Operation and Development) that aims to evaluate education system of 72 countries around the world [9]. Every three years, students ranged 15 years old are randomly selected to have taken the PISA test [10]. PISA-focused subjects for tests are reading, math and science. This test is diagnostic which provides useful information in the improvement of the education system [11].

The facts of PISA 2015 result showed that the average science value of OECD Country is 493, while Indonesia only reached 403[3]. The data shows that science literacy within the education in
Indonesia is still less and adequate and there is a gap in treating science education. The use of appropriate learning model is expected to be able to increase the student interest and their science literacy. One of the learning models that support students’ literacy skills is contextual learning model. Contextual learning model includes technology and society model and contextual teaching and learning model.

Science learning with science, technology and society model is directed to science and technology literacy, meaning that students can understand science from the perspective of science and technology produced by them. This is in line with the fourth scientific literacy that is science, technology and community interaction intended to illustrate the impact of science on society, and to explain the implementation of science and how technology can help human [4]. The contextual teaching and learning model is a learning concept that links between the material taught by the teacher to the real-world situations of the students and encourages students to make connections between their knowledge and application in their live as family members and society [5].

In addition to positive impact of the science literacy of students, the use of science, technology and society model and contextual teaching and learning model, also requires the students to develop critical thinking ability because in both learning process the students are encouraged to dig many information analyzing the problem and answer it, and relate to the technology that exists in everyday life. John Dewey defines thinking as an active, orderly and meaningful process used to conquer the world. Meanwhile, being critical is to ask, understand and analyze. Thus, critical thinking is thinking well and organized, reflecting on the process that are part of the critical thinking [6].

The ability of critical thinking possessed by students may develop well if the implemented learning model within learning process is able to activate the students (student centre). The learning model used during learning process and critical thinking ability by each student may lead to science literacy. This is similar to the research that has been done by Ucu Cahyana et al., that there is an interaction effect between learning methods with the ability to think critically on the ability of science literacy [7]. Therefore, the writer conducted a study entitled “The Influence of Contextual Learning Model and Critical Thinking to Science Literacy of High School First Year Students”.

2. Methods
This study has several objectives, among others: address the difference of science literacy among students, technology and society model and students with contextual teaching and learning model, address the interaction between learning model and critical thinking ability towards students’ science literacy, address the difference in terms of students’ science literacy between science, technology and society learning model with high critical thinking ability and contextual teaching and learning model with high critical thinking ability, and address the difference in terms of science literacy between science, technology and society learning model with low critical thinking ability and contextual teaching and learning model with low critical thinking ability.

The study is conducted at two schools of SMAN 4 Kota Tangerang and SMAN 11 Kabupaten Tangerang in February-May 2018. The study used quasi-experimental method with two-way Anova. There are two independent variables in this research design: they are the learning model (treatment variable) and critical thinking ability (attribute variable) and one dependent variable which are science literacy. Each independent variable is classified into two types: contextual learning model consisting science, technology and society and contextual teaching and learning model, while critical thinking ability consist of high critical thinking and low critical thinking. The following shows the design of study in Table 1:

| Critical Thinking Ability (B) | Learning Model (A) |
|-------------------------------|--------------------|
|                              | Science Technology and Society (STS) A₁ | Contextual Teaching and Learning (CTL) A₂ |
| High Critical Thinking (B₁)   | A₁ B₁              | A₂ B₁ |
| Low Critical Thinking (B₂)    | A₁ B₂              | A₂ B₂ |
The target population used in this study is all students of SMAN 4 Kota Tangerang and SMAN 11 Kabupaten Tangerang on their second semester of 2017/2018 period. The population used in this study are all first year students in Science Major of SMAN 4 Kota Tangerang and SMAN 11 Kabupaten Tangerang on their second semester of 2017/2018 period. The sampling was conducted using purposive sampling technique, where two out of six class of the first year Science major of SMAN 4 Kota Tangerang were taken and two out of seven class in SMAN 11 Kabupaten Tangerang to be implemented with different learning model, which is experiment class with science, technology and society model and control class with contextual teaching and learning model. A critical thinking ability test had given in each treatment class. The values obtained from the tests are then sorted by rank, from the highest to the lowest. Based on the result, about 27% top values are taken to form the upper group and 27% of the bottom values are the lower group [7]. Sample distribution can be seen in table 2:

| Critical Thinking Ability (B) | Learning Model (A) |
|------------------------------|--------------------|
|                              | Science Technology and Society (STS) A1 | Contextual Teaching and Learning (CTL) A2 |
| High Critical Thinking (B1)  | 20                 | 20                  | 40 |
| Low Critical Thinking (B2)   | 20                 | 20                  | 40 |

Data collection in this study is test. Test in this study include science literacy tests on business materials, energy, momentum and impulses as well as critical thinking ability test. The data analysis technique used in this study, including analysis techniques with descriptive statistics, prerequisite analysis test and data analysis with inferential statistics.

3. Result and Discussion
At the beginning of the study, both classes were tested for critical thinking ability which aims to classify students into two parts: high critical thinking and low critical thinking. Then, the students are given pre-test to determine whether the students' initial ability in both groups of the same class or not. Based on the result in the appendix, the mean pre-test score of the students in the experimental class before treated using science, technology and society model is 22.45 with standard deviation of 7.82, while mean pre-test score in the control class before using contextual teaching and learning model is 29.33 with standard deviation of 8.05.

| Table 3. Normality Test |
|-------------------------|
| Group   | Total Sample | L-score | L-table | Conclusion |
|---------|--------------|---------|---------|------------|
| Pretest |              |         |         |            |
| A1      | 40           | 0.072   | 0.140   | Normal     |
| A2      | 40           | 0.129   | 0.140   | Normal     |
| A1B1    | 20           | 0.112   | 0.190   | Normal     |
| A1B2    | 20           | 0.121   | 0.190   | Normal     |
| A2B1    | 20           | 0.170   | 0.190   | Normal     |
| A2B2    | 20           | 0.106   | 0.190   | Normal     |
| Posttest|              |         |         |            |
| A1      | 40           | 0.104   | 0.140   | Normal     |
| A2      | 40           | 0.094   | 0.140   | Normal     |
| A1B1    | 20           | 0.186   | 0.190   | Normal     |
| A1B2    | 20           | 0.131   | 0.190   | Normal     |
| A2B1    | 20           | 0.104   | 0.190   | Normal     |
| A2B2    | 20           | 0.135   | 0.190   | Normal     |
Based on table 3, the entire data group obtained is normal, because $L_{score}$ smaller than $L_{table}$. There are homogeneity test, the result is:

**Table 4. Homogeneity Test used.**

| Group      | Total Sample | $F_{score}$ | $F_{table}$ $(\alpha=0.05)$ | Conclusion |
|------------|--------------|-------------|-----------------------------|------------|
| **Pre-test** |              |             |                             |            |
| $A_1$      | 40           | 1.058       | 3.24                        | Homogeneous |
| $A_2$      | 40           |             |                             |            |
| **Post-test** |             |             |                             |            |
| $A_1$      | 40           | 2.09        | 3.24                        | Homogeneous |
| $A_2$      | 40           |             |                             |            |

Based on table 4, the entire data group obtained is homogeneous, because $F_{score}$ smaller than $F_{table}$. It is concluded that both pre-test data and post-test data of students in experiment and control class have the same population variance (homogeneous).

**Table 5. Homogeneity Test used.**

| Group  | Total Sample | $F_{score}$ | $F_{table}$ $(\alpha=0.05)$ | Conclusion |
|--------|--------------|-------------|-----------------------------|------------|
| **Pre-test** |              |             |                             |            |
| $A_1B_1$ | 20           | 0.44        | 7.815                       | Homogen     |
| $A_1B_2$ | 20           |             |                             |            |
| $A_2B_1$ | 20           |             |                             |            |
| $A_2B_2$ | 20           |             |                             |            |
| **Post-test** |             |             |                             |            |
| $A_1B_1$ | 20           | 3.94        | 7.815                       | Homogen     |
| $A_1B_2$ | 20           |             |                             |            |
| $A_2B_1$ | 20           |             |                             |            |
| $A_2B_2$ | 20           |             |                             |            |

Based on table 5, the entire data group obtained is homogeneous, because $F_{score}$ smaller than $F_{table}$. It is concluded that both pre-test data and post-test data of students in experiment and control class have the same population variance (homogeneous).

The pre-test and post-test data in the experimental class and control class have been tested to be normal and homogeneously distributed, then the next stage is hypothesis test. Hypothesis test used two ways Anova, the data in hypothesis test only post-test data, with result as follows:

**Table 6. Two-Way Anova Test Result**

|          | Variance Source | Db | JK  | RJK | $F_{score}$ | $F_{table}$ $(\alpha = 0.05)$ | Conclusion |
|----------|-----------------|----|-----|-----|-------------|--------------------------------|------------|
| **Pretest** |                 |    |     |     |             |                                |            |
| Between $A_1$ dan $A_2$ | 1              | 171.1125 | 171.1125 | 2.743 | 3.12        | $H_0$ accepted                 |            |
| Interaction $A \times B$ | 1              | 2.8125 | 2.8125 | 0.045 | 3.12        | $H_0$ accepted                 |            |
| In Group (D) | 76              | 4740.75 | 62.378 | -    | -           |                                |            |
| Total (T) | 80              | 59473 | -    | -    | -           |                                |            |
| **Posttest** |                 |    |     |     |             |                                |            |
| Between $A_1$ dan $A_2$ | 1              | 117.6125 | 117.6125 | 6.671 | 3.12        | $H_0$ rejected                 |            |
| Interaction $A \times B$ | 1              | 2702.8125 | 2702.8125 | 153.299 | 3.12        | $H_0$ rejected                 |            |
| In Group (D) | 76              | 1339.95 | 17.631 | -    | -           |                                |            |
| Total (T) | 80              | 464667 | -    | -    | -           |                                |            |

Based on table 6 (pretest), $F_{score}$ is 2.743 while $F_{table}$ is 3.12 because of $F_{score}$ is smaller than $F_{table}$, it is then $H_0$ is accepted. It can be concluded that there are no a differences in students' science literacy
on the treatment of science, technology and society model and contextual teaching and learning. Based on table 6 (post-test), $F_{\text{score}}$ is 6.671 meanwhile $F_{\text{table}}$ is 3.12 because of $F_{\text{score}}$ is bigger than $F_{\text{table}}$, it is then $H_0$ is rejected where it can be concluded that there are differences in students' science literacy on the treatment of science, technology and society model and contextual teaching and learning.

Based on analysis pre-test data, $F_{\text{score}}$ is 0.045 while $F_{\text{table}}$ is 3.12 Because of $F_{\text{score}}$ is smaller than $F_{\text{table}}$ so $H_0$ is accepted and it can be concluded that there is no an interaction between the contextual learning model and the ability to think critically of the students science literacy. Based on analysis post-test data, $F_{\text{score}}$ is 153.229 while $F_{\text{table}}$ is 3.12 Because of $F_{\text{score}}$ is bigger than $F_{\text{table}}$ so $H_0$ is rejected and it can be concluded that there is an interaction between the contextual learning model and the ability to think critically of the students science literacy. Graph of interaction between the contextual learning model and the ability to think critically of the students science literacy, could be seen below:

![Graph of Interaction between The Contextual Learning Model and The Ability to Think Critically of The Students Science Literacy](image)

**Figure 1.** Graph of Interaction between The Contextual Learning Model and The Ability to Think Critically of The Students Science Literacy

| Table 7. Tukey Test Result |
|-----------------------------|-----------------|-----------------|-----------------|
| Group | N | $Q_{\text{score}}$ | $Q_{\text{table}}$ | Conclusion |
| Pre-test | | | | |
| $A_1B_1$ | 20 | 1.83 | 3.96 | $H_0$ accepted |
| $A_1B_1$ | 20 | 1.42 | 3.96 | $H_0$ accepted |
| $A_1B_2$ | 20 | 14.963 | 3.96 | $H_0$ rejected |
| $A_2B_1$ | 20 | 9.798 | 3.96 | $H_0$ rejected |
| Post-test | | | | |
| $A_1B_2$ | 20 | | | |
| $A_2B_1$ | 20 | | | |

Based on table 7, hypothesis test between group $A_1B_1$ with $A_2B_1$ is explained here. Analyzed pre-test data, $Q_{\text{score}}$ is 1.83 while $Q_{\text{table}}$ is 3.96. Because of $Q_{\text{score}}$ is smaller than $Q_{\text{table}}$ so $H_0$ is accepted and it can be concluded that there are no a differences in students science literacy between science, technology and society learning model with high critical thinking ability and contextual teaching and learning model with high critical thinking ability. Analyzed post-test data, $Q_{\text{score}}$ is 14.963 while $Q_{\text{table}}$ is 3.96. Because of $Q_{\text{score}}$ is bigger than $Q_{\text{table}}$ so $H_0$ is rejected and it can be concluded there are differences in students science literacy between science, technology and society learning model with
high critical thinking ability and contextual teaching and learning model with high critical thinking ability.

Based on table 7, hypothesis test between groups $A_1B_2$ with $A_2B_1$ is explained here. Analyzed pre-test data, $Q_{score}$ is 1.42 while $Q_{table}$ is 3.96. Because of $Q_{score}$ is smaller than $Q_{table}$ so $H_0$ is accepted and it can be concluded there are no differences in students science literacy between science, technology and society learning model with low critical thinking ability and contextual teaching and learning model with low critical thinking ability. Analyzed post-test data, $Q_{score}$ is 9.798 while $Q_{table}$ is 3.96. Because of $Q_{score}$ is bigger than $Q_{table}$ so $H_0$ is rejected and it can be concluded there are differences in students’ science literacy between science, technology and society learning model with low critical thinking ability and contextual teaching and learning model with low critical thinking ability.

The results showed that there are four hypotheses that have been tested such as: (1) there is difference in terms of science literacy between students given the science, technology and society model with the students given the contextual teaching and learning model. The result data showed the average post-test in the experimental class is 78.08 while the mean post-test in the control class is 73.60. This means that the students’ science literacy with science, technology and society model is higher than the students with contextual teaching and learning model.

This is because learning with science, technology and society model in the experimental class gives the students several advantages with steps included in the model that makes them become active, responsible, and able to use their knowledge to create a simple technology that makes them learning thoughtfully [8]. (2) There is an interaction between the contextual learning model and the critical thinking ability of students' science literacy. This is because the contextual learning model emphasizes the process of student involvement in finding the relationship between knowledge and its application in daily life, thus encouraging students to develop critical thinking ability. This has a positive impact on the increased literacy results of student science [12]. (3) There is difference of student science literacy between science learning model, technology and society with high critical thinking ability and learning model of contextual teaching and learning with high critical thinking ability.

The data showed that the average post-test of students who are given the science, technology and society model with low critical thinking ability is 85.10, higher than the average post-test of students with contextual teaching and learning model with high critical thinking ability is 69. This is because the science, technology and society model is a short, clear and solid learning process and may invite the students to create simple projects as the application of the subjects, while in contextual teaching and learning model, there are lots of learning model resulting to lack of focus and takes a lot of time [13]. (4) There is a difference in science literacy between science, technology and society learning model with low critical thinking and learning contextual teaching and learning model with low critical thinking ability.

The data showed that the average post-test of students who are given the model of science, technology and society with low critical thinking ability is 71.05 lower than the average post-test of students given contextual teaching and learning model with critical thinking ability low is 78. This is because in the contextual teaching and learning model, the teacher still guides the students to work on the worksheets that have been given and provides an initial explanation first [14]. This is preferable for students with low critical thinking skills.

4. Conclusion
Based on the result of the study obtained from data analysis and hypothesis testing, it can be concluded that: there is a difference in terms of science literacy between students that is given the science, technology and society model with the students that is given contextual teaching and learning model, there is an interaction between contextual learning model and critical thinking ability towards students’ science literacy, there is a difference in terms of students’ science literacy between science, technology and society learning model with high critical thinking ability and contextual teaching and learning model with high critical thinking ability, and there is a difference in terms of science literacy between science, technology and society learning model with low critical thinking ability and contextual teaching and learning model with low critical thinking ability.
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