Implementing contextual based learning: a study on science literacy improvement within topics of earthquake and flood

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Abstract. The goal of this research is gaining description on science literacy improvement of junior high school students regarding the topics of earthquake and flood as an effect of Contextual Based Learning (CBL) implementation during science instruction. Quasi-experiment serves as the method of this study with non-equivalent control group pre-test and post-test design. Jigsaw cooperative learning method functions as the control treatment. Research subjects involve 52 students of grade VII in a state junior high school in Bandung Regency, West Java. Those research subjects are divided into two classes namely experiment class and control class. The instrument used to collect relevant data is science literacy test covering aspects of science content, science competence, and attitude towards science. Two independent sample t-test is applied to analyze the comparison of science literacy improvement reached between experiment and control class. The result of statistical calculation for two independent sample t-test N-gain using version 23 SPSS software shows a significant value of 0.00 < α. 0.05 for all aspects. The findings indicate that CBL implementation during science instruction within topics of earthquake and flood is proven to be valid to improve students’ science literacy compared to jigsaw cooperative model.

1. Introduction

Natural science is a very potential school subject to build students’ high order thinking skills since natural science is not merely a collection of facts, concepts, or principles but it also is a result of finding answers accomplished scientifically [1]. Referring to the significant role of science in this 21st century life, it is necessary to apply a learning method which is capable of facilitating students at sharpening their abilities to solve problems, think critically, be creative, and be innovative to be able to make contribution in providing solutions towards problems existing in students’ learning environment. Those skills signify improvement on students’ literacy in terms of collecting and analyzing information coming from various sources. This is in line with the nature of science itself stating that science as a way of thinking becomes a basic substance of science instruction which makes use of scientific thinking skills in students’ thinking pattern [2].

The average scores on PISA science literacy assessment of Indonesian students in three times accordingly were 383 in 2009, 375 in 2012, and 403 in 2015. These average scores of Indonesian
students’ science literacy are below the standard of 500 determined by OECD [3, 4]. This fact leads to the idea that Indonesian students’ science literacy is far left behind other countries. However, it can be seen that the best score Indonesia can get is in PISA 2015. An assumption then appears stating that it is as an effect of the science-based 2013 curriculum implementation which improves students’ high order thinking skills so that the result of PISA assessment in 2015 was better than the previous years [5].

According to a research conducted by Yuliati [6] and Suroso [7], there are still many instructional contexts at schools which only focus on knowledge transfer and are not contextual to real life matters. Thus, it can be inferred that science instructional process at schools is not aligned with the nature of learning science itself. There is a model suggested in 2013 science curriculum namely problem-solving learning model which is strongly related to students’ daily problems such as Project Based Learning (PBL) and Contextual Based Learning (CBL). CBL or Contextual Based Learning in science instruction is a model highlighting on students’ skills in understanding and solving problems through social issues brought from real life so that science learning is considered to be more applicable and gives knowledge on modern science to students. Besides, CBL also supports the goal of “scientific literacy” development for all members of society namely participating in knowledge and technology advancement to solve existing social problems [8].

One of science topics where students’ science literacy is measurable is material on natural disaster like earthquake and flood in grade VII of junior high school. On the topics, students not only gain science conceptual understanding but also are able to apply their knowledge to solve a number of problems existing in the surrounding environment through scientific thinking process and execute the attitude of disaster responsive according to disaster emergency. The use of CBL as a learning method on this topic is considered to be necessary because Indonesia is located in an area prone to flood and earthquake.

Based on the description above, a problem formulation appears to obtain description on junior high school students’ science literacy improvement within the topics of earthquake and flood as an effect of Context Based Learning (CBL) implementation during science instructional process.

2. Methods
Quasi experiment method is applied in this research with “Non-equivalent Pre-test Post-test Group” design. Before treatment was given, students on both classes were given pre-test to measure their initial competence in science literacy. Post-test was given after treatment was accomplished to see the effect of the treatment on students’ science literacy skills. This research involves 52 junior high school students of grade VII in Bandung. 26 students were in experiment class and given Contextual Based Learning (CBL) using Socio-scientific issues approach while 26 other students were in control class using jigsaw model scientific approach. CBL learning with socio-scientific approach in experiment class was completed in two meetings. So was jigsaw model. The gathered data were going to be utilized to analyze students’ general science literacy improvement in terms of science knowledge, science competence, science process, and science attitude. The difference of students’ science literacy improvement between those who received Contextual Based Learning (CBL) using Socio-scientific issues approach and those who learn using Jigsaw model scientific approach was examined based on the results of pre-test and post-test scores.

3. Result and Discussion
3.1. Improvement on students’ science literacy in experiment and control class on competence aspect
Analysis on students’ science literacy on aspect of competence consists of three parts namely explaining a phenomenon in scientific manner, interpreting data and evidence in scientific manner, and evaluating and designing scientific investigation. Recapitulation on students’ science literacy skills is presented below on table 1 describing each part of science competence aspect between experiment and control class.
Table 1. Recapitulation on students’ science literacy skills on each competence aspect between experiment and control class

| Indicator | Experiment Class | Control Class |
|-----------|------------------|---------------|
|           | $\bar{x}_{pre}$ | $\bar{x}_{post}$ | N-gain | Criteria | $\bar{x}_{pre}$ | $\bar{x}_{post}$ | N-gain | Criteria |
| MFSI      | 47.37            | 68.81         | 0.41   | Medium   | 47.84          | 57.37         | 0.18   | Low      |
| MDBSI     | 44.45            | 73.35         | 0.52   | Medium   | 47.78          | 62.23         | 0.28   | Low      |
| MMPI      | 53.33            | 76.67         | 0.50   | Medium   | 26.67          | 36.67         | 0.14   | Low      |

Note:
MFSI : *Menjelaskan Fenomena Secara Ilmiah* (Explaining Phenomenon in Scientific Manner)
MDBSI : *Menginterpretasikan Data dan Bukti Secara Ilmiah* (Interpreting Data and Evidence in Scientific Manner)
MMPI : *Mengevaluasi dan Mendesain Penyelidikan Ilmiah* (Evaluating and Designing Scientific Investigation)

Table 1 shows that in the experiment class, improvement of science literacy on the whole competence aspect lies on medium category with N-gain is above 0.30. This is different from control class which is on low criteria in all aspects namely explaining phenomenon in scientific manner, interpreting data and evidence in scientific manner, and evaluating and designing scientific investigation. This finding signifies that activities in experiment class using Contextual Based Learning (CBL) method with Socio-scientific issues approach is more effective compared to control class which applies jigsaw model scientific approach.

Competence aspect of science literacy is exercised through problem solving activities in orientation phase related to context and reading articles during discussion to obtain answers and solution. This is different from control class which applies jigsaw model. Therefore, assessment result in experiment class generally lies on medium criteria while the whole assessment result of science competence in control class lies on low category.

3.2. Improvement on students’ science literacy in experiment and control class on knowledge aspect

Aspect of science knowledge in this research deals with science knowledge aspect stated in PISA 2015 and the context covers hazard, science, and technology which are strongly related to topics of earthquake and flood which involve personal aspect, local aspect and global aspect of human life. On table 2 below is the recapitulation result of students’ literacy skills on each aspect of science knowledge between experiment and control class.

Table 2. Recapitulation on students’ science literacy skills on each science knowledge aspect between experiment and control class

| Indicator | Experiment Class | Control Class |
|-----------|------------------|---------------|
|           | $\bar{x}_{pre}$ | $\bar{x}_{post}$ | N-gain | Criteria | $\bar{x}_{pre}$ | $\bar{x}_{post}$ | N-gain | Criteria |
| Content   | 56.11            | 77.8          | 0.48   | Medium   | 56.67          | 68.33         | 0.27   | Low      |
| Epistemic | 41.11            | 62.78         | 0.37   | Medium   | 47.79          | 54.45         | 0.13   | Low      |
| Procedural| 39.17            | 66.67         | 0.45   | Medium   | 24.17          | 37.50         | 0.18   | Low      |

Referring to table 2 above, it shows that aspect of science knowledge related to science context in experiment class on the whole lies on medium category with N-gain > 0.30. Control class is on low category with N-gain < 0.30. This achievement on science knowledge aspect can be said the same as achievement on science competence aspect both for experiment and control class. It indicates that there is correlation between competence aspect and science knowledge aspect within science context itself. Although the categories are different both in experiment and control class, the two obtain high scores on sub aspect of content where N-gain sub aspect of content in experiment class is 0.48 while N-gain of control class is 0.27.
3.3. *Improvement on students’ science literacy in experiment and control class on aspect of science competence, knowledge, and context*

Multiple choice test is utilized to measure aspect of science competence, knowledge, and context. The multiple-choice test consists of 18 questions. In this research, the science context aspect is more focused on hazard context, science, and technology according to the raised topics namely earthquake and flood. Science literacy test is given at the beginning of the instruction in the form of pre-test and at the end of the instruction in the form of post-test both in experiment and control class. Experiment class is using Contextual Based Learning (CBL) model with Socio-scientific issues while control class applies jigsaw model scientific approach. Data on scores of N-gain statistic recapitulation are presented on table 3 below.

| Table 3. Statistics analysis on students’ science literacy skills on aspect of science competence, knowledge, and context |
|--------------------------------------------------|
| Component | N-Gain |
|-----------|--------|
| Group     |        |
| N         | 26     | 26     |
| Mean      | 0.57   | 0.24   |
| Standard Deviation | 0.12 | 0.11 |

Normality test (Sapiro-Wilk), normally distributed if sig.>α in which α= 0.05

| sig. value | 0.330 | 0.096 |
| Conclusion | Normal | Normal |

Homogeneity test (Levegne), homogeneous if sig.>α in which α= 0.05

| sig. value | 0.402 |
| Conclusion | Homogeneous |

Difference test (Two independent sample t-test), significantly different if sig.< α in which α = 0.05

| sig. value | 0.000 |
| Conclusion | Significantly different |

According to table 3, the data normality test through Sapiro-Wilk, it is obtained that N-gain lies on normal category both for experiment and control class. The result of homogeneity test is yielded by checking Levegne test table on the result test of SPSS 23. N-gain homogeneity test is homogeneous. As the data gathered are normal and homogeneous, two independent sample t-test is carried out. The result of two independent sample t-test between N-gain of experiment and control class shows significant difference with sig. value 0.00 < α=0.05. The data above in general indicate that there is a significant difference between N-gain of experiment class and control class. This fact signifies significant difference on science literacy improvement between experiment and control class on aspect of science knowledge, competence, and context. The difference of N-gain above is in line with analysis of each aspect which has been accomplished in which competence and knowledge aspect in experiment class falls in different category with control class.

3.4. *Improvement on students’ science literacy in experiment and control class on aspect of science attitude*

Aspect of attitude in science literacy is assessed using Likert-scale questionnaire. The number of science attitude given to students is 15 statements with 4 options of answers namely strongly agree or (ss), agree (s), disagree (ts), and strongly disagree (sts). Questionnaire on science attitude is distributed to students at the beginning (pre-) and after (post-) learning both for experiment and control class. Statistic data analysis of science attitude is presented on the following table 4.
Table 4. Statistics analysis on students’ science attitude

| Component          | Experiment | Control |
|--------------------|------------|---------|
| N                  | 26         | 26      |
| Mean               | 0.51       | 0.22    |
| Standard Deviation | 0.22       | 0.14    |

- Normality test (*Saphiro-Wilk*), normally distributed if sig.>α in which α= 0.05
  - sig. value          | 0.736   | 0.058   |
  - Conclusion          | Normal  | Normal  |

- Homogeneity test (*Levene*), homogeneous if sig.>α in which α= 0.05
  - sig. value          | 0.042   |
  - Conclusion          | Not homogeneous |

- Difference test (*Two independent sample t-test*), significantly different if sig.< α in which α = 0.05
  - sig. value          | 0.000   |
  - Conclusion          | Significantly different |

Table 4 showed that experiment class has N-gain mean of 0.51 in medium category while control class has N-gain mean of 0.22 in low category. Next, statistic test is carried out by testing data normality and homogeneity both for N-gain value of experiment and control class. From data normality test using Kolmogorov Sminovr table, N-gain falls on normal category for experiment and control class. The result of homogeneity test is obtained by looking at the Levene test table on the result of SPSS 23 test. It is obtained that N-gain of the two classes belongs to not homogeneous category. As the obtained data are generally normally distributed, two independent sample t-test is carried out. The result of two independent sample t-test shows that there is significantly different N-gain between experiment and control class with sig. value < α=0.05.

The result of science literacy data analysis on science attitude aspect identifies significant difference on mean score of N-gain between experiment and control class. Difference on mean of N-gain shows improvement on science literacy skills through different treatment between experiment class which is taught using Contextual Based Learning and control class which applies jigsaw model scientific approach. This finding supports a CBL-related research conducted by King and Anderson [9] which states that real-life context learning can affect learning outcomes which is shown through students’ understanding related to context and knowledge represented by the students’ high science literacy level.

Similar research accomplished in chemistry field also reveals that CBL influences students’ interest in learning chemistry and refines their perceptions regarding the relevance of chemistry at school with chemistry in the society so that it results in better conceptual understanding [10-13, 8]. Other research figure out that students’ science understanding in real life can affect their learning outcome which shows students’ understanding on science concepts [9]. Besides, CBL-related research also increases students’ interest on the next level of education. This fact means that students prefer contextual learning to chalk and talk learning [14].

In general, based on analysis on each aspect of science literacy in terms of science competence, context, knowledge, and attitude, the finding shows that CBL model plays significant role in students’ science literacy change. This fact is aligned with junior high school students’ competence achievement expected by the ministry of education and culture 2017 in learning science. In line with the goal of using CBL model in instructional process according to Parchmann [8] states that the use of CBL model can build students’ scientific literacy skills as a form of fulfilling the needs of modern society. Students are given opportunities to explore their existing knowledge and develop that knowledge through social problems in real life so that the existing knowledge is functioning in a more relevant and applicative manner. Furthermore, CBL serves as a bridge which connects students’ science...
concepts and real-life context learning. It makes students more convinced that learning materials given by teachers at school are in harmony with the nature of science discovery itself. Science is a discipline obtained through problem solving processes in the society life [12].

4. Conclusion
Research on the use of CBL model especially within the topics of earthquake and flood in junior high school level shows that Contextual Based Learning (CBL) is one of suggested models in 2013 curriculum and is relevant to be implemented as a learning model at school to improve students’ scientific literacy skills although achievement on each sub aspect of science competence and knowledge between experiment and control class is not greatly different and has not yet reached high category. However, there is a significant difference on score improvement between experiment class which is taught using CBL model with Socio-scientific issues and control class which implements jigsaw model scientific approach.

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