Promoting Science Literacy with Discovery Learning

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Abstract. This study aims to promote science literacy through discovery learning on matter characteristics theme. This study used one group pretest and posttest design. Participants were seventh-grade students of SMP Negeri 13 Bogor. Data were collected by science literacy test, observation sheets, and questionnaires. Data analysis was performed by descriptive and inferential. The results showed that there were increasing science literacy abilities of students with high category and it was significant. The ability of science literacy is highest in identifying aspects of science issues. Therefore, the discovery learning was able to promote science literacy of students.

Keywords: Promoting; Science literacy; Discovery learning.

1. Introduction

The development of science and technology occur very rapidly. This needs to be supported by human resources quality and character. One effort to produce quality human resources is through learning. Learning science is a vehicle for students to develop themselves and learn about the natural surroundings, as well as development prospects to apply it in daily life.

The national curriculum requires science teaching at junior high school level should be integrated by providing hands-on experience for students to develop their knowledge, attitudes, and skills. But in reality, observation result showed the implementation of science teaching was still conceptual and less provide opportunities to students to conduct investigations in the laboratory and their surrounding environment. Learning science was still fragmented. The results from Forum Group Discussion of science teachers in Bogor City concluded that the problem of science teaching is teachers have difficulty to teach science holistically and contextually, and also teachers need teaching aids and instructional materials [1].

Students also were not able to apply their knowledge in everyday life, they were not accustomed to thinking critically about the issues in the learning process, and their achievement of science literacy was still low. Research results showed the achievements of junior high school students’ science literacy in Bogor City have an average of 30% for all three aspects: content (29%), process (30%), and context (31%) [2]. Most of the students could not relate the science knowledge with natural phenomena which occur in the environment. Literacy achievements of students in Indonesia were still low. The Program for International Student Assessment (PISA) assesses science literacy periodically every three years to students aged 15 years (junior high school level) in the advanced industrial countries and developing countries such as Indonesia. Based on PISA assessment, the scores achievement of Indonesian students’ science literacy in 2012 and 2015 are 382 [3] and 408 [4]. This result demonstrated that the achievements
of Indonesian students’ science literacy still below the average score of 500 from all of the participant countries.

The achievement of science literacy which is not satisfactory yet because the learning process is not in accordance with the nature of science. Learning science does not provide direct experience for students through the presentation of the context of science. The context of science is a vehicle for students to understand and apply knowledge of science and science attitude correctly.

The effort to improve students’ achievement of science literacy has been done using guided discovery and problem-based learning model [5]. The results showed an increase in students’ science literacy ability, although the improvement is in the medium category (41%). Other studies mentioned that science literacy can be built through ICT-based learning with constructive learning strategies through a context, so it will be able to build a desire to find knowledge and improve the level of science literacy [6].

The importance of science literacy in science learning requires teachers to constantly attempt learning innovation. One of learning that can be used for junior high school students is discovery learning. Discovery learning requires students to seek and find the contents of science through active involvement in the learning process by applying science attitude. The use of discovery learning on the theme of matter characteristics is expected to engage students in science activities, have a scientific attitude, and find the knowledge of science so that the achievements of students’ science literacy will be better.

The rest of this paper is organized as follow: Section 2 describes the proposed research method. Section 3 presents the obtained results and following by discussion. Finally Section 4 concludes this work.

2. Research Method

The study was involved 31 students of class VII SMP in Bogor and used one group pretest and posttest design. Students conducted science learning on matter characteristics theme by science approaches and discovery method. Students administered pretest and posttest which composed of 26 item multiple choice with a reliability coefficient of 0.83. Teacher and students activities during the lesson were observed by two observers. In addition, the questionnaire distributed to students at the end of the lesson to gather students’ opinion about discovery learning. The collected data was calculated for N-gain, then it analyzed descriptively and inferentially.

3. Results and Discussion

Learning science on matter characteristics theme involved 31 students of class VII by using a scientific approach and discovery method. The learning activities begin with a stimulus for students to conduct investigations. Descriptive research results were showed in Table 1.

| Description        | Pretest | Posttest | N-gain (%) |
|--------------------|---------|----------|------------|
| Highest Value      | 85      | 96       | 95.5       |
| Lowest Value       | 12      | 46       | 26.3       |
| Average value      | 33.9    | 86.1     | 78.3       |
| Standard deviation | 16.5    | 10.4     | 18.6       |

The results showed an increase of science literacy with the high category with N-gain average of 78.3%. Discovery learning encourages students to construct and create a relationship between the knowledge possessed by an application in daily life. The students’ science literacy skills can be trained in the learning process of science which gives opportunity to the students to involve in the process of investigation and discovery [7, 8, 9]. Statistical tests to determine the average of significant difference of science literacy before and after implementation of discovery learning were shown in Table 2.
Table 2. Results of Inferential Statistical Test

|                  | Normality test (Kolmogorov-Smirnov) | Homogeneity Test (Test Levene’s) | t-test (two-tailed) | Description               |
|------------------|-------------------------------------|----------------------------------|-------------------|---------------------------|
| Pretest          | \( P = 0.015 \)                     | \( p = 0.397 \)                  | Wilcoxon test with Asymp. Sig. (2-tailed) =0.000 | Significant              |
| Posttest         | \( p = 0.009 \)                     |                                   |                   |                           |

Table 2 showed that there was a significant difference between the students’ science literacy achievement before and after discovery learning. This is due to the discovery learning provide students to obtain the contents of science and students directly involved in the process of science. Discovery learning methods engage students in problem-solving activities, independent learning, and critical thinking [10].

The results of this study were also in accordance with [11] which states that discovery learning can improve students’ academic achievement and inquiry skills significantly compared to traditional methods because in the discovery learning students were active in findings knowledge. Swakk et al. (2004) also states that learning using empirical cycle (process approach) such as collecting and classifying of information, formulating a hypothesis, make predictions, interpretation of experimental results and make conclusions can improve inquiry skills and students’ cognitive processes; students are given the opportunity to think analytically and solve the problems [11]. This is a positive impact on student thinking and understanding competency that ultimately make a positive contribution as well as to their science literacy.

Science literacy achievement according to content/ science materials was shown in Figure 1. Based on Figure 1, the achievements of science literacy on pretest was lower in all the materials and the highest achievement of science literacy was a physical change. After completing learning process, science literacy achievement increased significantly with the highest value was the physical changes by 92 in the posttest and the lowest was chemical changes by 69. The low of students’ achievement in chemical changes due to chemistry materials was still unfamiliar to junior high school students.

![Figure 1. The Achievement of Science Literacy in Science Materials](image)

Science literacy achievement according to the aspects of science such as identification of scientific issues, explaining scientific phenomena, and using scientific evidence was showed in Figure 2.
Figure 2 showed an increase in science literacy achievement for every aspect with the highest scores on identifying scientific issues and the lowest on explaining scientific phenomena. It could be indicated that students did not have a habit to think critically and expose their opinion based on their knowledge. Reasoning and argumentation can be improved and practiced through the debate of socioscientific issues [12].

The questionnaire results showed that students interested to participate in science learning with discovery method because they were an active participant. Discovery learning is a learning model that facilitates students and teachers to be active in the learning process [11,13]. The pleasant atmosphere enables students to enjoy learning and become self regulated learning [14]. The learning model should be able to change students learning activities from passive to active, promote responsibility, and independence to construct a concept which supports the balance of knowledge, skills, and attitudes [13].

4. Conclusion

This study has promoted science literacy through discovery learning on matter characteristics theme. Discovery learning was able to promote scientific literacy of students. The achievement of students science literacy was a high category and significant. The ability of science literacy was highest in the aspect identifying scientific issues and the lowest in explaining scientific phenomena.

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