Profile of students’ scientific literacy in application integrated science on the theme of air pollution

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Abstract. The function of this research was to describe the scientific literacy of junior high school students in integrated science on the theme of air pollution. The method used in this research is descriptive method. Population and sample are junior high school student in Bandung. The instruments are used scientific literacy test, attitude scale and student response questionnaire. The results showed that the average achievement of student’ scientific literacy as a whole was 72% (enough category). The achievement of scientific literacy in the domain of process science for indicators identifies scientific issues is 76%, explains scientific phenomena 74%, and uses scientific evidence 66%. The achievement of scientific literacy in the domain of content science for acid rain is 78%, environmental contamination 80%, change of matter 74%, global warming 68%, substance characteristics 72%, and acid base 70%. The scientific literacy in the domain of students’ attitude toward science as a whole achieves is 76.3% (good category). For indicators to support science inquiry and students’ interest in science achieve is a good category outcomes, while for indicators of responsibility for resources and environment achieve sufficient category achievement. Students respond positively to integrated science learning on the theme of air pollution.

1. Introduction
Scientific literacy is defined as the capacity to use scientific knowledge, identify questions and draw conclusions based on existing evidence and data in order to understand and help make decisions about the natural world and human interaction with nature. Literacy of science is a blend of concepts, history and philosophy that help a person in understanding scientific problems [1]. The current process of science learning is still conventional and based on conceptual mastery that has not led to the development of science literacy. Learning science is able to involve students in the learning process, so that will provide experience directly to students, will help improve the ability of science literacy students. This is in accordance with the research conducted by Guven, the results of research indicate that the science literacy of grade 2 elementary students can be improved by the use of project-based learning model [2].

According to the National Research Council (NRC) that the low contribution of science learning to the success of citizens is due to the release of science learning from the social context. Science learning is done only focuses on mastery of the material, so that students are only prepared to master knowledge [3]. In science learning students should know the relevance of science learning to everyday life and
social life. Science learning in schools should be directed at understanding the importance of science when linked with past, present or future societies [4].

In the process of science learning, students are not only required to develop their cognitive potential but also hopefully able to develop their skills holistically. Therefore, by applying science learning in an integrated manner is expected to facilitate students in applying the concepts of science in everyday life. This learning can provide immediate experience so that learners can find themselves a meaningful and authentic concept. According to Fogarty there are 10 types of alignment that are fragmented, connected, nested, networked, shared, threaded, integrated, webbed, sequenced and immersed [5].

The integrated science learning curriculum is being implemented in countries such as Nigeria and Barbados, and research is continuing to see the effectiveness of applying the integrated science curriculum [6,7]. Several studies have also been undertaken to look at the impact of integrated science learning on learners as practiced by Ameyaw; Endokpayi & Suleiman and Sarfo [8,9,10]. In the application of integrated learning should be supported by professional teachers who are able to apply integrated science learning in the classroom well [11].

In integrated science learning is needed one of the theme that aims to facilitate the teacher in organizing and combining the content of subjects. The theme used in this study is air pollution, where the content studied in this theme includes acid rain, environmental pollution, change of matter, global warming, the characteristics of substances and acid base. Through integrated science learning is expected to have a positive impact on the ability of students’ scientific literacy.

2. Experimental Method
The method used in this research is descriptive method, that is research directed to extract data from actual condition [12,13]. The data in question is the students' science literacy for the process domain, content and student attitudes on integrated science learning air pollution themes. The research was conducted in one of the junior high schools in Bandung with the research sample is the students of grade VII which amounted to 108 people. The instrument used in this research is about science literacy test, attitude scale and student response questionnaire.

3. Result and Discussion
The science learning used in this research is integrated science learning with integrated type on the theme of air pollution. The theme of air pollution in this study, will be reviewed from the disciplines of Physics, Chemistry and Biology. The design of integrated science learning on the theme of air pollution carried out in this study can be seen in figure 1. It shows that the content taught on the theme of air pollution includes acid rain, environmental pollution, change of matter, global warming, the characteristics of substances and acid base.

Figure 1. Design of integration science on the theme of air pollution
Learning on the theme of air pollution is done by using a scientific approach, where the learning process is centered on students (student center), so that students actively seek and construct the knowledge they learn. The study of integrated science on the theme of air pollution was conducted six times a meeting. At the end of the learning is given a test to know the literacy of science students. Results of students’ scientific literacy as a whole can be seen in table 1.

### Table 1. Results of achievement of students’ scientific literacy as a whole.

| Achievement                                      |       |
|--------------------------------------------------|-------|
| Max value                                        | 86    |
| Min value                                        | 48    |
| Average students’ scientific literacy (%)        | 72    |

Table 1 shows the results of the students' overall science literacy test on integrated science learning air pollution themes. The maximum value is 86 and the minimum value is 48. The average achievement of students' scientific literacy as a whole is 72%, according to Purwanto, the percentage of this achievement is sufficient category [14]. This is consistent with Toharudin's statement that the ability of students' scientific literacy can be trained through learning that provides hands-on experience to students through investigative activities like a scientist [15].

The results of students' scientific literacy, besides being viewed as a whole, there are three domains of scientific literacy which are viewed as process science, content science and students’ attitudes toward science. The results of students' science literacy achievement in the domain of science process which consists of identifying scientific issues, explaining scientific phenomena and using scientific evidence can be seen in figure 2.

![Figure 2. Percentage of students’ scientific literacy achievement in the domain of science process](image)

Figure 2 shows that overall, the percentage of scientific literacy achievement in the domain of science process for indicators identifies the scientific issue is 76% (good category), the indicator explains the scientific phenomenon is 72% (enough category) and the indicator uses scientific evidence is 66% category enough). The results of this study are in accordance with the analysis of scientific literacy conducted by Word, which states that the science literacy for the domains of science process that are more controlled by the students is in the indicator explain scientific phenomenon and identify scientific issue, while for process indicator use scientific proof become indicator with lowest achievement process science domain [16].

The results of students' scientific literacy achievement in the domain of science content consisting of acid rain content, environmental pollution, change of matter, global warming, the characteristics of substances and acid base can be seen in figure 3.
Figure 3. Percentage of students’ scientific literacy achievement in the domain of science content

Figure 3 shows that the achievement of scientific literacy for acid rain content is 78% (good category), environmental pollution content is 80% (good category), change of matter content is 74% (enough category), global warming content is 68% (category enough), characteristics of substances content is 72% (sufficient category), and acid base content is 70% (enough category). From these data shows that the achievement of students' scientific literacy in the highest science content domain contained in environmental pollution content. In the discussion of environmental pollution content, students are first given the task of making an article about environmental pollution followed by group discussion. With the method of discussion conducted while learning allows students to learn from friends. As the discussion progresses, students' learning atmosphere seems more alive, students are more active and interaction occurs among students. This happens because before the discussion process takes place, students have mastered the material they can when creating the article task. Students who are actively involved in the learning process, have a positive impact on the quality of interaction and communication among students. This quality of interaction and communication can improve student achievement [17].

In order to encompass the scientific literacy of students science attitudes, an attitude scale instrument of 15 items of attitude statements is used, where each statement consists of 4 choices of answers: strongly agree, agree, disagree and strongly disagree. The scientific attitudes revealed in this study include three indicators that support science inquiry, responsibility for resources and environment, and students' interest in science related to integrated science learning. The results of students’ attitudes toward science can be seen in Table 2.

| Many students | Attitude score | Interpretation |
|---------------|----------------|----------------|
| 36            | 86 ≤ X         | Very good      |
| 49            | 76 ≤ X ≤ 85    | Good           |
| 23            | 60 ≤ X ≤ 75    | Enough         |

Average students’ attitude = 76.3, Good

Table 2 shows the results of scientific literacy in the domain of students' attitudes toward science as a whole obtaining a mean of 76.28 (good category). In detail, as many as 36 students get attitudes achievement with very good category, 49 students get attitudes with good category and as many as 23 students get attitudinal achievement with enough category. Overall, students' attitudes toward science are good. This means that students have an attitude that supports science inquiry, has responsibility for
natural resources and the environment, and has a high interest in science. The attainment of attitudes on each indicator can be seen in Table 3.

| Indicator                                               | Average score attitude | Interpretation |
|---------------------------------------------------------|------------------------|----------------|
| Supports science inquiry                                | 77.1%                  | Good           |
| Responsibility to resources and environment             | 70.6%                  | Enough         |
| Students’ interest in science                          | 81.2%                  | Good           |

Table 3 shows the achievement of students' scientific literacy on students' attitude toward science for indicators supporting science inquiry is 77.1% (good category), environmental and resource responsibility indicators is 70.6% (sufficient category), and indicators of student interest in science is 81.2% (good category). Based on the data can be said that the study of integrated science on the theme of air pollution has a positive effect on students' attitudes toward science. The attitude of each student in this science has a psychological role for interest and responsibility for science and technology in general. The results of this research are in line with one of the objectives of science education: developing responsive attitudes toward scientific issues and applying scientific and technological knowledge to benefit both personal, social and global [18].

Students also positively respond to integrated science learning. To find out the students' responses on integrated science learning on the theme of air pollution, data were collected using questionnaires. Questionnaires are made in the form of Likert scale, consisting of 20 statements that include positive statements and negative statements. There are three aspects that are asked in this include student opinion aspect (8 statements), student interest aspect to integrated science learning (6 statements) and aspects of integrated learning science benefit (6 statements). The result of questionnaire of student response can be seen in Table 4.

| Aspect                                               | Positive respond | Negative respond |
|------------------------------------------------------|------------------|------------------|
| Students' opinions                                   | 89.8%            | 10.2%            |
| Student interest                                     | 93.5%            | 6.5%             |
| The benefits of integrated science learning          | 94.4%            | 5.6%             |
| Average students’ response                           | 92.6%            | 7.4%             |

Table 4 shows that students responded positively to integrated science learning on the theme of air pollution is 92.6% (very good category), while negative response is 7.4%. This shows that students love the integrated science learning on the theme of air pollution.

4. Conclusion

Based on the result of the research, it is concluded that integrated science learning on the theme of air pollution has a positive impact on the scientific literacy of junior high school students. Average achievement of students’ scientific literacy as a whole is 72% (enough category). The achievement of scientific literacy in the domain of science process for indicators to identify scientific issues is 76%, indicator explain scientific phenomenon is 74% and indicators using scientific evidence is 66%. The achievement of scientific literacy in the domain of science content for acid rain content is 78%, environmental pollution content is 80%, change of matter content is 74%, global warming content is 68%, characteristics of substances content is 72% and acid base content is 70%. The scientific literacy in the domain of students' attitude toward science as a whole achieves 76.3% (good category). For indicators to support science inquiry and students' interest in science achieve good category outcomes, while for indicators of responsibility for resources and environment achieve sufficient category achievement. Students also give positive responses to integrated science learning on the theme of air pollution with questionnaire percentage of student opinion aspect 89.8%, student interest 93.5% and integrated science learning benefit equal to 94.4%.
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