



## **Students' Process Skills and Scientific Attitude: Implementation of Integrated Science Teaching Materials Based on Elementary Students' Science Literacy**

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### **Abstract**

The purpose of this study was to know students' process skills and scientific attitude ability through the implementation of integrated science teaching materials based on elementary students' science literacy. This research uses an experimental method with one group pre-test and post-test design. The research subject was fifth grade in SD 6 Cendono Kudus. Based on the research result, the average of students' scientific attitude ability was 84,41 with good criteria. The result of paired sample test in students' scientific attitude showed sig. (2-tailed)  $0,000 < \alpha = 0,05$ , which meant that there was a difference in scientific attitude ability before and after the lesson. However, the average of the ability of process skills was 83,83 with good criteria. The result of paired sample test in students' process skills showed sig. (2-tailed)  $0,000 < \alpha = 0,05$ , it meant that there was a difference in process skills ability before and after the lesson, so it was concluded that the integrated science teaching materials based on elementary students' literacy were able to develop students' scientific attitude and process skills ability. The implications of this research are related to improving students' scientific attitude and process skills aspects and teaching materials based on scientific literacy as a reference and consideration for learning on other subjects in science subjects.

**Keywords:** Scientific Attitude Ability, Process Skills Ability, Teaching Materials, Science Literacy, Integrated Science.

### Abstrak

Tujuan penelitian ini adalah untuk mengetahui keterampilan proses dan kemampuan sikap ilmiah siswa melalui penerapan bahan ajar IPA terpadu berbasis literasi sains siswa SD. Penelitian ini menggunakan metode eksperimen dengan desain one group pretest posttest design. Subyek penelitian adalah siswa kelas V SD 6 Cendono Kudus. Berdasarkan hasil penelitian rata-rata kemampuan sikap ilmiah siswa adalah 84,41 dengan kriteria baik. Hasil uji sampel berpasangan sikap ilmiah siswa menunjukkan sig. (2-tailed)  $0,000 < \alpha = 0,05$ , artinya ada perbedaan kemampuan sikap ilmiah sebelum dan sesudah pembelajaran. Namun rata-rata kemampuan keterampilan proses sebesar 83,83 dengan kriteria baik. Hasil uji sampel berpasangan pada keterampilan proses siswa menunjukkan sig. (2-tailed)  $0,000 < \alpha = 0,05$ , artinya ada perbedaan kemampuan keterampilan proses sebelum dan sesudah pembelajaran, sehingga disimpulkan bahwa bahan ajar IPA terpadu berbasis literasi siswa SD mampu mengembangkan sikap ilmiah dan kemampuan keterampilan proses siswa. Implikasi penelitian ini terkait dengan peningkatan sikap ilmiah siswa dan aspek keterampilan proses serta bahan ajar berbasis literasi sains sebagai acuan dan pertimbangan untuk pembelajaran pada mata pelajaran lain pada mata pelajaran IPA.

**Kata Kunci:** Kemampuan Sikap Ilmiah, Kemampuan Keterampilan Proses, Bahan Ajar, Literasi Sains, Sains Terpadu.

## INTRODUCTION

Science education has a significant role in preparing children to get into their living world. Science emphasizes the giving of direct experience to develop students' competence so that the students can explore and understand the environment around them naturally. Because of that, the teaching method which can prepare the students to have good competence and be aware of science and technology, able to think logically, critically, creatively, argumentative, communicative, and collaborative is needed. *National Research Council* state that the students' science literacy achievement is one of the major purposes of science education (Shwartz *et al.*, 2006).

The result of scientific achievement in TIMMS, shows that Indonesia is still low if compared to other countries. The achievement of Indonesia in TIMMS 2011 showed that Indonesia's rank decreased and Indonesia was in rank 40 from 42 countries with an average score of 407. The latest result from TIMMS in 2015 showed



that Indonesia's rank decreased drastically in rank 45 from 48 countries with an average score of 397 (Rahmawati, 2016). The information from the assessment of TIMSS showed that the achievement of the scientific ability of Indonesian students' decreased. Indonesia was still below average and generally, Indonesia was in a low phase (*Low International Benchmark*). The factor which affected that phase was the choice of teaching materials which did not explain the concept of science literacy to the students (Avikasari *et al.*, 2018). Science teaching materials essentially have to include the aspects of science literacy, such as science as the body of knowledge, science as the investigative nature, science as the way of thinking, and interaction of science, environment, technology, and society (Chiapetta, E.L., Filman. D.A., & Sethna, 1991). Based on the analysis result from the science teaching book, the category of science literacy was not proportional (Ahsani *et al.*, 2020).

Science has more interrelated topics emanating from all the natural sciences (i.e., Physics, Chemistry, Biology). This implies that Integrated Science has elements of the other Science concepts subsumed in it. This unique property of Integrated Science makes it typical and hence, a student is good at Integrated Science (Asano *et al.*, 2021). It is the responsibility of teachers to give pupils high-quality integrated science instruction and learning so that the students will understand basic scientific ideas and behave appropriately in their surroundings. The curriculum developers should plan a course on scientific literacy or merge scientific literacy concepts and activities in science textbooks (Shahzadi & Nasreen, 2020).

Science literacy is the ability to understand the scientific process and be involved meaningfully with available scientific information in daily life (Fives *et al.*, 2014). Science literacy is related to the goals of science education (Liu, 2009). Scientific literacy is very important to be mastered by students in the way how they see the environment, health, economy, and the problem of modern society which depend on technology and the advance and development of science (Rusilowati *et al.*, 2016). Scientific literacy not only considers knowledge and understanding of science but also attitudes, values, and reasoning related to science and technology and their impact on society (Araújo *et al.*, 2020).

Therefore, its development for every individual is extremely important. Every individual is demanded to have scientific literacy covering its scientific knowledge, scientific process skill, and scientific attitude (Dewi *et al.*, 2021). To improve scientific



literacy, scientific attitudes also need to be developed positively. Individuals with a scientific perspective are eager to identify problems and seek solutions (GENÇ & ACAR, 2021). In addition, the development of the scientific attitude dimension of science learning is as important as the development of the cognitive dimension. Therefore, students' attitude toward science is an important factor in increasing their success (Tekin & Muştu, 2021).

Science process skills are skills that are acquired through basic mental, physical, and social skills training. Science process skills are included in the scientific method which is very important for students to improve students process skills (Ernawati *et al.*, 2021). Science process skills involve cognitive skills or intellectual, manual, and social. Cognitive and intellectual skills are involved because by involving process skills, students use their minds. Manual skills are clearly involved in the process skills because they involve students' skills in using the equipment and materials, measurement, preparation, or equipment assembly (Duda & Susilo, 2019). Students' capacity to comprehend, discover, and advance science through the scientific method as scientists identify concepts is based on their scientific process skills and attitudes (Padhi & Dash, 2015). Science process skills and scientific attitudes are needed in the learning process so that students are active and understand subjects, especially science subjects.

Based on observations in class V SD 6 Cendono has not fully developed process skills and science attitudes. Because of that, the purpose of this study was to know the students' process skills and scientific attitude ability through the implementation of integrated science teaching materials based on science literacy with the theme "*Benda-benda di Lingkungan Sekitar*".

## METHODS

This research uses an experimental method with one group pre-test and post-test design. The research subject was fifth grade in SD 6 Cendono Kudus. The data collection was taken before and after the lesson to know the students' scientific attitude and process skills ability. The used instrument was the paper on scientific attitude observation, the paper on process skills observation, the student's response questionnaire, and the paper on implementation of learning observation. The



technique of the data analysis used a prerequisite test, normality test, and paired sample t-test. The students' scientific attitude included spiritual aspect, curiosity aspect, cooperation aspect, and responsibility aspect. The students' process skills and aspects were assessed with an observation paper. There were five assessments criteria which were used in process skills aspects, they were (1) tools preparation, (2) how to use the tools, (3) doing the experiment procedure, (4) observing the experiment results, (5) presenting the report of experiment result.

## **RESULTS AND DISCUSSION**

The result of this study was taken from the analysis of the student's behavior using the students' paper on scientific attitude observation and the paper on process skills observation.

### **a. The Scientific Attitude of Students' Science Literacy**

The assessment of the result of the students' science literacy in scientific attitude skill was taken in every learning activity using the paper of behavior observation. The students' scientific attitude aspects included the spiritual aspect, curiosity aspect, cooperation aspect, and responsibility aspect. The average result of the observation of the students' scientific attitude skill could be seen in Table 1.

**Table 1. The Average of the Students' Scientific Attitude**

Aspect	Meeting						Average
	I	II	III	IV	V	VI	
Spiritual	81,94	84,03	86,11	87,5	88,89	90,28	86,46
Curiosity	77,08	79,86	81,94	84,72	85,42	88,89	82,99
Cooperation	76,39	79,17	80,56	85,42	86,81	88,89	82,87
Responsibility	79,86	80,56	85,42	87,5	88,19	90,28	85,30
<b>Average</b>	<b>84,41</b>						
<b>Criteria</b>	<b>Good</b>						



Based on Table 1, it was noticed that the average of the scientific attitude skills of every aspect increased from the first meeting until the last meeting. The average of the student's scientific attitude in the spiritual aspect was 86,46, the curiosity aspect 82,99, the cooperative aspect 82,87, and the responsibility aspect 85,30, so the total average was 84,41 with good criteria.

The Scientific Attitude of students' science literacy ability increased. The data from the normality test showed  $p > \alpha = 0,05$ , so the data were distributed normally. The statistical analysis could be used as a paired sample test.

**Table 2. Paired Samples T-Test Scientific Attitude Skill**

Domain	Mean	N	Sig. (2-tailed)
Scientific Attitude	-4.218	36	0.000

Based on Table 2, it was noticed that the result of paired sample test in students' scientific attitude skills showed sig. (2-tailed)  $0.000 < \alpha = 0,05$ , which meant that there was a difference before and after the lesson, so it could be concluded that the integrated science teaching materials based on students' science literacy could increase students' scientific attitude skills.

The learning process with integrated science teaching materials based on students' science literacy could make the students participate actively and enjoy the learning process. The student's behavior during the learning process increased from the first meeting until the last meeting. In every lesson, the students were divided into some groups heterogeneously. The group encouraged the students to be more passionate in study and enjoyed the learning process. Furthermore, the group also could develop cooperative behavior among students in discussion and when doing the experiment. This was related to (Harsanto, 2007) which stated that studying together in a group will increase academic skills and a positive attitude towards the school. Science literacy skills predicted the attitudes



toward scientific literacy in a meaningful way (Karademir & Ulucinar, 2016). Scientific literacy was a way of thinking and acting that regulate the attitudes, skills, and knowledge of students (Yuenyong & Narjaikaew, 2009).

Based on the results of the observation of scientific attitude skills, it was noticed that the student's behavior in the learning process achieved 84,40 with good criteria. Scientific literacy educated students to have a scientific attitude from an early age (Arlis *et al.*, 2020). Children answered the empirical their scientific attitudes through interviews, experimenting with real things, allowing children to learn from direct experiences suitable for their development, which was consistent with the concept of learning by doing (Prachagool, 2021). Learning through scientific investigations encouraged students to develop skills through an exchange of views to improve science literacy and attitudes toward science (Jufrida *et al.*, 2019). When a scientific literacy attitude was developed, the development of problem-solving skills and academic success will follow (Gençi, 2015).

#### **b. The Process Skill of Students' Science Literacy**

The observation of students' process skills was conducted in the experiment activity and the observation with performance assessment which emphasized in the process of experiment activities. The experiment activities were the experiment to know the characteristic of solids, liquids, and gas, to observe the changing states of things, to know how water caused erosion and the plant's role in decreasing erosion, and to identify clean water and contaminated water. The students were divided into six groups and conducted a simple experiment based on the integrated science teaching materials based on students' science literacy and Students' worksheets (LKPD).

The students' process skills aspects were assessed with observation paper. There were five assessments criteria which were used in process skills aspects, they were (1) tools preparation, (2) how to use the tools, (3) doing the experiment procedure, (4) observing the experiment results, (5) presenting the report of experiment result. The average of the students' process skills could be shown in Table 3.



**Table 3. The Average of The Students' Process Skills**

Aspect	The Experiment					Average
	1	2	3	4	5	
Tools preparation	75,00	84,03	88,89	91,67	93,06	86,53
How to use the tools	77,78	79,86	84,03	90,28	93,75	85,14
Doing the experiment procedure	72,22	84,03	84,03	89,58	90,97	84,17
Observe the experiment results	66,67	76,39	80,56	88,89	89,58	80,42
Present the report of experiment results	72,92	78,47	82,64	88,19	92,36	82,92
<b>The Total Average</b>						<b>83,83</b>
<b>Criteria</b>						<b>Good</b>

Based on Table 3 it was noticed that the average results of the students' process skills in every aspect increased from the first meeting until the last meeting. In the tools preparation aspect 86,50, how to use the tools aspect 85,16, doing the experiment procedure aspect 84,17, observe the experiment results in aspects 80,42, and present the report of experiment results 82,92, so the total average was 83,83 with good criteria.

The increase of the students' science literacy in process skills aspects was assessed during the learning process. The results of the normality data showed  $p > \alpha = 0,05$ , so the data distribution was normal. The statistical analysis used was paired sample test.

**Table 4. Paired Sample t Test in Process skills**

Domain	Mean	N	Sig. (2-tailed)
Process skills	-4.291	36	0.000

Based on Table 4, it was noticed that the result of paired sample test in students' process skills showed sig (2-tailed)  $0,0001 < \alpha = 0,05$ , which





means that there was a difference between before and after the lesson, so it could be concluded that the integrated science teaching materials based on the students' science literacy could increase students' process skills.

The integrated science teaching materials which were developed encouraged the students to investigate in the experiment and observation activities. Those activities encouraged the students to do the experiment, answer the questions after doing the experiment and concluded the experiment result during the investigation. The skills: of observation, research, testing, exploration, discussion, and deduction were very important in the process of teaching science to elementary students and were part of scientific thoughts (Sentürk & Sari, 2018). The purpose of the investigation process by doing a simple experiment was to strengthen the concept which was understood by the students from the previous phase. It was related with (Samatowa, 2016), that observation, experience, and organizing the idea through an experiment and encouragement the students to think through the learning experience. Science was not only a subject matter, but it was a process of knowledge construction (El Islami & Nuangchalerm, 2020). Someone could ask, find, or decide the answer to the questions which was achieved from the curiosity of daily life (Ceccucci *et al.*, 2015). Science literacy was the skill to understand the scientific process with scientific information in daily life (Fives *et al.*, 2014). This made the students to be more active in a learning activity in the class as well as in the practical activity. Participatory learning and learning by doing (Ross *et al.*, 2013). In the experiment activity, it showed that every aspect increased from the first meeting until the last meeting.

The observation result in the process skills aspect in students' experiment activity showed good criteria. The experiment showed that students could understand the lesson easily and acquire improved motivation to seek new concepts (Winarni & Purwandari, 2019). It was related to (Marks & Eilks, 2009) who stated that the learning situation which was conducted by the students and the teacher interestingly would be successful in increasing the students' science literacy. The integrated science teaching materials based on students' science literacy encouraged



the students to be more aware of science, not only replacing the memorizing concept, but also to understand the concept, and apply in the daily life (Ahsani *et al.*, 2020).

The science processes skills were best taught hands-on science such as creating more activities, experiments, and projects (Mustafa *et al.*, 2021). One of the factors that affect students' science process skills was doing a practicum. Practicum was expected to support the development of certain skill activities, such as process skills, motor skills, and the formation of scientific attitudes, especially the development of interest in the investigation, research, and interest (Duda & Susilo, 2019). In this process, students who used scientific process skills could create knowledge in a more effective way. Students made observations and measurements related to a case or an event, they collected data, they interpreted the data they collect and they made a generalization based on the data collected (Gültekin & Altun, 2022).

## CONCLUSION

The integrated science teaching materials based on science literacy with the theme "*Benda-benda di Lingkungan Sekitar*" included spiritual aspects, curiosity aspect, cooperative aspect, and responsibility aspects were able to increase students' scientific attitude with a total average was 84,41 with good criteria. Whereas the integrated science teaching materials based on science literacy through the experiment to know the characteristic of solids, liquids, and gas, to observe the changing states of things, to know how water caused erosion and the plant's role in decreasing the erosion, and to identify clean water and contaminated water can increase students' process skills the total average was 83,83 with good criteria. Concluded that the integrated science teaching materials based on students' science literacy could increase students' scientific attitude skills. Concluded that the integrated science teaching materials based on the students' science literacy can increase students' scientific attitude and process skills.



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