

Are scientific literacy and students' environmental attitudes on ecosystem materials and environmental change correlated?

Putri Rahma Dianti, Sueb *

Biology Education Study Program, Department of Biology, Faculty of Mathematic and Natural Science, Postgraduate, Universitas Negeri Malang, Malang, East Java, Indonesia

*Corresponding Author Email: sueb.fmipa@um.ac.id

Article Information	Abstract
Keywords: Scientific literacy; Environmental attitude; Correlation test Kata Kunci: Literasi sains; Sikap lingkungan; Uji korelasi History: Received : 30/07/2022 Accepted : 11/10/2022	This study aims to analyze the relationship between scientific literacy and students' environmental attitudes. Data were collected using a survey method with scientific literacy test instruments and environmental attitude questionnaires. The research samples are 123 students of MAN 1 Kuantan Singingi, Riau. Data were analyzed using Spearman's Correlational test. The results of research for student scientific literacy in three indicators get an average score 65.5 for indicators explaining scientific phenomena, 60 for indicators of scientific design and evaluation and 83.6 for indicators of data interpretation and scientific facts. The results of students' environmental attitudes on the four indicators get an average of 3.9 and 3.7. The results of the correlation test shown that the correlation coefficient of scientific literacy and environmental attitudes is $0.850 > 0.05$, which is not correlated. Based on this research, it can be explained that 1) the overall scientific literacy of students is in the moderate category 2) the overall environmental attitude of students is in the high category and 3) There is no correlation between students' scientific literacy and environmental attitudes. Pros and cons were found between the results of this study and previous studies. Further, broader research is needed to explore the causes of these differences, and to state their impact on education in the future. Abstrak Penelitian ini bertujuan untuk menganalisis hubungan antara literasi sains dan sikap lingkungan siswa. Pengumpulan data menggunakan metode survei dengan instrumen tes literasi sains dan angket sikap lingkungan. Sampel penelitian merupakan 123 siswa MAN 1 Kuantan Singingi, Riau. Data dianalisis menggunakan uji Korelasional Spearman. Hasil penelitian untuk literasi sains siswa pada tiga indikator mendapatkan rerata sebesar 65,5 untuk indikator menjelaskan fenomena saintifik, 60 untuk indikator desain dan evaluasi saintifik dan 83,6 untuk indikator interpretasi data dan fakta saintifik. Hasil sikap lingkungan siswa pada empat indikator mendapatkan rerata sebesar 3,9 dan 3,7. Hasil uji korelasi menunjukkan koefisien korelasi literasi sains dan sikap lingkungan sebesar $0,850 > 0,05$, yaitu tidak berkorelasi. Berdasarkan penelitian tersebut dapat dijelaskan bahwa 1) Literasi sains siswa secara keseluruhan berada pada kategori sedang 2) Sikap lingkungan siswa secara keseluruhan berada pada kategori tinggi dan 3) Hasil uji korelasi menunjukkan tidak ada hubungan antara literasi sains siswa dan sikap lingkungan. Ditemukannya pro dan kontra antara hasil penelitian ini dengan penelitian-penelitian sebelumnya. Diperlukan penelitian lanjutan lebih luas untuk menelisik penyebab perbedaan tersebut, dan menyatakan dampaknya bagi pendidikan di masa depan.

A. Introduction

Scientific literacy according to the Organization for Economic Co-operation and Development (OECD) is the ability to engage with science-related issues, and with scientific ideas, as reflective citizens (OECD, 2017). Based on the measurement of the 2018 Program for International Student Assessment (PISA) for measuring the competence of students in scientific literacy, based on three indicators, namely 1) explaining phenomena scientifically; 2) designing and evaluating scientific investigations and 3) interpreting data and facts scientifically. Scientific literacy can also be interpreted as the ability to apply scientific knowledge and practice in real phenomena in the environment or in everyday life (Forbes et al., 2020).

Global warming, environmental and climate change, genetic engineering issues, biodiversity loss and virus outbreaks (Herman et al., 2022; Karisan & Zeidler, 2016; Sadler, 2011). These problems are examples of phenomena that students can find in their daily lives today. Materials that discuss environmental problems are found in Biology subject class X, namely in Basic Competencies (KD) 3.10 and 4.10 and KD 3.11 and 4.11 with the topic of ecosystems and environmental change. Students' understanding of these materials and phenomena is useful for developing cognitive competencies or knowledge (Yuliskurniawati et al., 2019).

Cognitive competencies or knowledge is needed for students in the process of developing thinking and problem solving abilities (Feucht et al., 2017). The ability to solve problems based on understanding and mastery is the ability of scientific literacy (Yuliastini et al., 2016). This statement is also in line with that conveyed by Yaumi & Taufikurohmah (2019) that problem solving skills developed by students will improve their scientific literacy skills.

Measurement of scientific literacy in PISA is divided into several groups including mathematics, chemistry, physics and biology (OECD, 2019). Ecology and environmental pollution materials support students' environmental knowledge to answer categories of PISA questions. Understanding related to the material is also expected to develop students' caring attitude towards the environment.

The attitude of caring for the environment in students arises as a result of understanding and habituation (Safitri et al., 2020). Environmental attitudes are related to attitudes and actions of a person who seeks to avoid and also repair environmental damage (Gustria & Fauzi, 2019).

Gökmen, (2021) also stated that environmental attitudes are individual emotions towards the environment that can influence individual perspectives and preferences regarding environmental events. Knowledge, attitudes and behavior in environmental studies are interrelated with one another.

Knowledge can build attitude, attitude can build behavior, knowledge and traits can contribute to produce behaviour (Wulandari et al., 2021). The attitude of caring for the environment is one manifestation of environmental ethics. Environmental ethics is a form of ethics and moral values that function to consider human behavior regarding right and wrong actions (Mcdaniel et al., 2011; Pineda Pinto, 2020). Environmental ethics is related to a person's attitudes and behavior towards his environment. Humans as creatures who live side by side with nature should behave ethically and respect the interests of other species (Berque, 2005).

The results of interviews with Biology teachers at MAN 1 Kuantan Singing explained that in an effort to improve student scientific literacy, teachers applied a problem-based learning model by linking environmental issues in Kuantan Singingi district. The school also has several extracurricular programs that aim to encourage students to care about the environment, such as the Go Green movement, an environmental-based scientific work. The problems encountered by the teacher in the field explained that efforts to solve environmental problems were still low, while students' awareness of the environment was quite good.

The condition of students is inversely proportional to research conducted by Kawamoto et al. (2011) in Japan related to the study of scientific literacy. The results of Kawamoto's research explain that the scientific knowledge of society is positively correlated with scientific and environmental factors but has no correlation with social factors. In other words, Japanese people have high scientific knowledge, but these competencies have no effect on social attitudes related to science and technology. Other research conducted by Karakaya & Yilmaz, (2017) in Turkey showed that environmental knowledge acquired by a person through environmental education does not have a positive effect on the level of environmental awareness and ethics of that person. The research shows that environmental learning in Turkey is not sufficient to support the development of environmental skills and attitudes.

Razak et al. (2019) through his research on students in Malaysia also obtained results that were in line with two previous studies that the knowledge gained by students through environmental-based education in schools did not affect positive attitudes towards environmental awareness. The description of several of these studies showed that in terms of action there is no correlation between knowledge and environmental care attitudes in students. However, if viewed in terms of knowledge and understanding, the concept of environmental material will build student attitudes.

Based on this background, it is necessary to re-examine the correlation between students' scientific literacy and environmental attitudes. The results of previous studies explained that there was no correlation between scientific literacy and environmental attitudes, due to inadequate learning. This condition is different from MAN 1 Kuantan Singing which has been doing lessons to improve scientific literacy and student environmental attitudes. This research was specifically conducted on Biology material, as information for efforts to improve scientific literacy and student environmental attitudes. So the researchers formulated the title of this research, namely "Study of Correlation Between Science Literacy and Students' Environmental Attitudes on Ecosystem Materials and Environmental Change". This study aims to analyze the relationship between scientific literacy and students' environmental attitudes.

B. Materials and Methods

This research is a descriptive correlational research with a survey method. The research was conducted online at MAN 1 Teluk Kuantan, Kuantan Singingi Regency, Riau, from October-November 2021. The population of this study were high school student's class X, XI and XII at MAN 1 Kuantan Singingi with a total of 225 students. The sampling technique used in this study was purposive sampling and proportional stratified random sampling. The purposive sampling technique is based on the provisions that class X students have not studied the material on ecosystems and environmental changes, while students in class XI and XII have studied the material. Furthermore, proportional stratified random sampling was done by dividing the number of students in one class by the total number of students and then multiplied by the total number of sample members. From a total of nine classes X, XI and XII, 13-15 samples were taken each so that a total sample of 123 students was obtained.

Data was collected using test instruments and questionnaires which were converted into Google Form. The test instrument uses 15 multiple choice questions with scientific literacy indicators adapted and modified based on the 2015 and 2009 PISA questions from the OECD document (OECD, 2009 & OECD, 2017). The scientific literacy indicators include 1) explaining phenomena scientifically; 2) designing and evaluating scientific investigations and 3) interpreting data and facts scientifically. Environmental attitude questionnaire using 20 questions adapted from research Lucena et al. (2019). The indicators measured by environmental attitudes are 1) responses to chemical pollution, 2) attitudes about pollution, 3) handling of waste and waste in cities and 4) responses to noise pollution. The questions and questionnaires have been checked by the evaluator lecturer and can be used. Questionnaires use a Likert scale with five categories.

The research procedure was carried out online where the researcher sent a Google Form link to the classroom teacher to be distributed to 123 students. It is carried out in stages in each class for a week. The statement in the questionnaire will be answered by students by choosing one of the answer choices from the five available categories.

Table 1 Category of Student Science Literacy

Score	Category
86-100	Very high
76-85	High
60-75	Medium
55-59	Low
54	Very low

(Source: Purwanto, 2009)

Table 2 Categories of Students' Environmental Attitudes

No	Average	Category
1	1.00-1.80	Very low
2	1.81-2.60	Low
3	2.61-3.40	Medium
4	3.41-4.20	High
5	4.21-5.00	Very high

(Source: Riduwan & Kuncoro, 2007)

The research data were then analyzed using descriptive statistics consisting of demographic analysis by means of grade level and gender, analysis of students' scientific literacy results using the average score compared to the scientific literacy category from Purwanto (2009). Analysis of the results of students' environmental attitudes using the average score compared to the five scale rating category according to Riduwan & Kuncoro (2007). The categories of scientific literacy and

students' environmental attitudes can be seen in Table 1 and 2. The analysis of the relationship between environmental literacy and student attitudes was carried out using the Spearman correlation test, with the prerequisite test for One-Sample Kolmogorov-Smirnov normality and linearity tests first.

C. Results and Discussion

The results of the analysis of the data obtained are then described as follows: 1) Analysis of the description of scientific literacy; 2) Analysis of the description of environmental attitudes and 3) analysis of the relationship between scientific literacy and students' environmental attitudes.

1. Student Science Literacy

The results of students' scientific literacy data were analyzed based on the average for each indicator. The description of students' scientific literacy results can be seen in Figure 1.

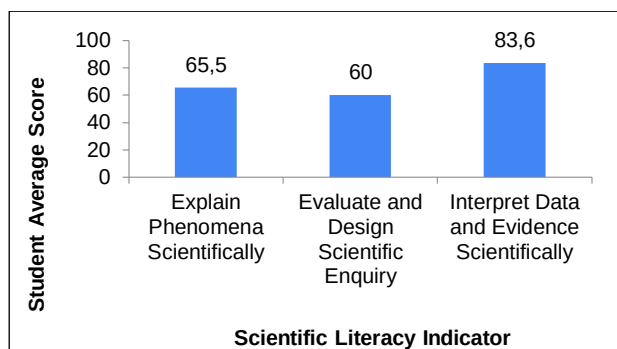


Figure 1
Student Scientific Literacy Results Based on Indicators

Figure 1 shows that there are differences in students' scientific literacy results for each indicator. The highest results were obtained on the third indicator, namely the interpretation of data and facts scientifically with an average score of 83.6. The indicator explaining scientific phenomena gets an average score of 65.5 and the lowest result on the scientific design and evaluation indicator is with an average score of 60.

These results indicate that students' ability to interpret data and facts scientifically is in the high category. Furthermore, the students' ability to explain scientific phenomena and the ability to present the design and evaluation of scientific investigations were in the medium category. Overall, based on this research, students are stated to have scientific literacy competence in the medium category. According to Wilsa et al. (2017); Asrizal et al. (2018) someone with good scientific literacy competence will have the ability of

scientific knowledge, the ability to evaluate problems, design research and interpret data. These results indicate that problem-based learning applied by teachers can support students' scientific literacy skills at MAN 1 Kuantan Singingi.

Providing problem-based learning by authentically linking environmental issues can develop students' scientific literacy skills (Flores, 2018; Rubini et al., 2019). However, based on the overall average results, teachers still need to improve students' scientific literacy. Improving students' scientific literacy, started from the development of epistemic knowledge, as a basis for scientific literacy (Lin, 2021). Teachers can also apply problem-based project-based learning to improve students' investigative abilities (Mustikasari et al., 2020).

2. Student Environmental Attitude

The results of the student's environmental attitude data are discussed based on the measurement categories and indicators of environmental attitudes. The following is a breakdown of the percentage of students' environmental attitudes based on the measurement category in Figure 2.

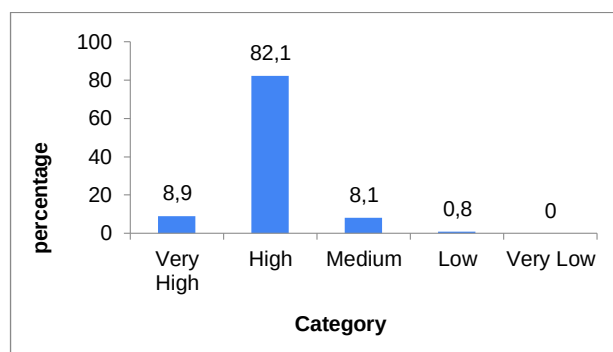


Figure 2
Environmental Attitude Questionnaire Results

Based on Figure 2, it is known that students' environmental attitudes generally show good results. The highest percentage is in the high category, which is 82.1% with a total of 101 students. The lowest percentage is in the low category of 0.8% with one student. These results indicate that the development of students' environmental attitudes at MAN 1 Kuantan Singingi based on the measurement category is good. . Based on the environmental attitude indicators in Table 3, for the four indicator points, the average was 3.9 and 3.7, which according to the measurement category were at a high level.

Table 3 Environmental Attitude Analysis Based on Indicator

Indicator	Average Score
Chemical pollution response	3.7
Attitude about pollution	3.7
Handling garbage and waste in the city	3.7
Noise pollution response	3.9

These results provide an illustration that students have been able to provide responses related to pollution, namely chemical and noise pollution, and provide attitudes regarding actions or activities that cause pollution. Students already have a commitment to express their attitude towards environmental issues. This fact is in line with research Otsuka et al. (2018) related to environmental attitudes, where students who have high environmental attitudes are students who are committed to responding to environmental issues. Student commitment can be seen from the ability to respond to environmental issues such as pollution and waste management. Keskin et al. (2013) through his research also states the same result that the commitment of social attitudes to environmental preservation is the embodiment of environmental attitudes.

The MAN 1 Kuantan Singingi school program by implementing Go Green activities and environmental-based scientific works shows a positive impact on students' environmental attitudes. The sensitivity of students to this environment according to Yassin et al. (2016) is the

result of observing their daily lives, which often encounter environmental pollution such as garbage and vehicle noise. Jahan et al. (2016) state the factors experienced by these students both at home, at school and in their environment produce responses to show commitment to the attitude of handling issues. Addition, according to Tamara (2016), character education by habituating students to love the environment will support students' attitudes towards the environment.

3. Correlation of Science Literacy and Students' Environmental Attitudes

The correlation between scientific literacy and students' environmental attitudes was analyzed through the Spearman test using SPSS. Data analysis started with normality test using Kolmogorov-Smirnov test and linearity test. This prerequisite test was conducted to see the normality and linearity of the scientific literacy scores and students' environmental attitudes. Based on the results of the normality prerequisite test, data were declared to be abnormally distributed with a significance of 0.008 and 0.045, both of which were < 0.05 . The data are not normally distributed due to the unequal distribution of the scores on the two variables. The normality test was used as a prerequisite for the correlational parametric test. However, because the data were not normally distributed, the hypothesis test was continued using Spearman's non-parametric test.

Table 4 Results of the Correlation Test of Science Literacy and Students' Environmental Attitudes

Correlations				
Spearman's rho	Science Literacy	Correlation Coefficient	Science Literacy	Environmental Attitude
		Sig. (2-tailed)	.	,017
		N	123	123
	Environmental Attitude	Correlation Coefficient	-,017	1,000
		Sig. (2-tailed)	,850	.
		N	123	123

The results of the correlation test show that the correlation coefficient of scientific literacy and environmental attitudes is $0.850 > 0.05$, which means that scientific literacy competence is not correlated with students' environmental attitudes. Based on the description analysis, it is known that students' scientific literacy is in the medium category while students' environmental attitudes are in the high category.

These results are in line with research by Razak et al. (2019); Aminrad et al. (2013) which explains that scientific literacy and knowledge competence of students are uncorrelated with the competence of their environmental attitudes.

Addition, Razak et al. (2019) explained that students' environmental care attitudes can grow from the influence of the application of environmental care ethics. Students can have a high caring attitude even though their analytical knowledge is still in the low category. Direct involvement of students in the environmental care movement will have a positive impact on student attitudes, compared to cognitive competence (Bybee & McCrae, 2011). The scientific literacy of students at MAN 1 Kuantan Singingi with a moderate category does not make students low in attitude towards environmental conditions.

However, these results contradict the research conducted by Liu & Zeng, (2017), where the results of this study indicate a positive correlation between students' knowledge of environmental issues supporting a more optimistic environmental attitude, because someone with broad knowledge competence will support their attitudes and behavior towards the environment. Chen et al. (2011) in his research also states that literacy and environmental knowledge are related to students' environmental attitudes, where when students' knowledge increases about environmental issues, environmental attitudes will also increase.

The results of this study can be used as a reference and comparison for further research to analyze the correlation between students' scientific literacy and environmental attitudes. Due to the findings of the pros and cons between the results of this study and previous studies, further research is needed to answer what distinguishes the results of this study, so that the implications for education in the future can be explained.

D. Conclusion

The conclusions of the research based on the research objectives are described as follows: 1) The scientific literacy of MAN 1 Kuantan Singingi students as a whole is in the medium category 2) The overall environmental attitude of students has reached the high category with the average of each environmental attitude indicator also reaching the high category; 3) The results of the correlation test show that there is no relationship between students' scientific literacy and environmental attitudes. Overall, it can be concluded that students' scientific literacy in the medium category does not affect students' environmental attitudes. These results are supported by several studies, but are also challenged because there should be a relationship between knowledge competence and student attitudes. Based on this research, it can be seen that the positive improvement of students' environmental attitudes can be done with activities that involve students directly. Students' knowledge and scientific literacy can be improved in learning, but for environmental attitudes, real action is needed from schools. The researcher's recommendation for further research is to compare the correlation of scientific literacy and scientific attitude in several schools with different learning and programs.

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