Implementation of the use of textbooks with the context of socio scientific issues on climate change materials and its impact on life to improve students' scientific literacy

Asep Saefullah[1*], Yudi Guntara[1], Diana Ayu Rostikawati[2]

[1]*Department of Physics Education, Universitas Sultan Ageng Tirtayasa, Indonesia*

[2]*Department Industrial Engineering, Universitas Bina Bangsa, Indonesia*

*E-mail: asaefullah@untirta.ac.id

ABSTRACT

The purpose of this study was to determine the effect of implementing the use of teaching materials in the context of Socio-Scientific Issues (SSI) on students' scientific literacy on climate change material and its impact on life. The research method used is a weak experiment with a one-group pretest-posttest design. The number of samples used is 60 students who are contracting Earth and Space Sciences (IPBA) courses. The research instrument used is a multiple-choice scientific literacy test instrument. The results showed that the use of teaching materials with the SSI context affected students' scientific literacy. This can be seen from the effects of statistical tests, which showed the arithmetic significance value $(0.002) < 0.05$. The use of teaching materials in the SSI context can also improve students' scientific literacy, which can be seen in the n-gain value of 0.54, which is in the medium category.

Keywords: climate change, socio scientific issues, students' scientific literacy.

INTRODUCTION

Scientific literacy is the ability to understand, communicate, and apply science to solve problems (Yuliati, 2017). Students need to have scientific literacy skills in facing challenges in the global era. Based on *Program for International Student Assessment* (PISA) data conducted by the *Organization for Economic Cooperation and Development* (OECD) in 2015, Indonesian students' scientific literacy results were ranked 64th out of 72 participating countries with 403. These results show that the scientific literacy ability of students is still below the average and is in a low category (Pertiwi, 2018).

Based on this fact, various innovation efforts are needed to improve students' scientific literacy skills. Some innovations that can be done to improve scientific literacy include the use of learning models such as *guided inquiry* learning models (Saefullah, 2017), the use of learning media such as *Sparkol Vidoescribe's*

media (Nulhakim, 2019), or the use of teaching materials with SSI context on the theme of using food addictive substances (Rostikawati, 2016).

Several researchers have made various innovations in compiling teaching materials. Suitable teaching materials should not focus on content alone but should pay attention to the context in real life (Nazilah, 2019). One of the science content materials that are very close to the context in real life is climate change and its effects on life (Dawson, 2020). Today, climate change has been in the spotlight by both experts and the general public and has emerged as a social issue related to science.

SSI is one of the learning strategies that present teaching materials in the context of social issues. It aims to make students aware of the relationship between science and social life (Saefullah A., 2020). For example, science content regarding climate change and its social effects on people's lives, such as floods droughts, etc. SSI as a learning strategy has the potential to be used in the learning process in lectures. Through the application of SSI in the learning process, it is expected to be able to provide a more meaningful learning experience (Subiantoro, 2012).

Based on a literature study, the use of SSI related to science is still limited. For example, SSI is related to environmental themes, biotechnology, the use of addictive substances in food, energy sources, and global warming (Levinson, 2012). SSI content in teaching materials can develop argumentation skills in science learning (Zo'bi, 2014). SSI in teaching materials can also be used for materials on climate change and its impact on life. Science content and its context can be combined. For example, the actual social context of climate change is connected with science content that causes climate change.

The results of the analysis of the available IPBA textbooks obtained minimal data regarding the discussion of climate change. In addition, the existing teaching materials still do not include the social context related to science on the theme of climate change. This is the basis for researchers to reconstruct IPBA steel mate-

rials on climate change materials and their impact on life in SSI to increase students' scientific literacy. The problem in this research is the effect of using SSI-based teaching materials on students' scientific literacy is? And how is the increase in students' scientific literacy after being given treatment in the form of learning using SSI-based teaching materials?.

RESEARCH METHOD

Research design

To determine how the influence of using teaching materials with the SSI context on increasing student scientific literacy, the implementation stages of using textbooks in the learning process with scientific strategies was carried out. The research method used is a weak experiment with a one-group pretest-posttest design, with a structure as shown in table 1 (Arikunto, 2010).

Table 1. Schematic of *One-Group Pretest-Posttest Design*

Pretest	Treatment	Postest
O_1	X	O_2

Description :
O_1 = *Pretest* was carried out before being given treatment
X = treatment in the form of using teaching materials with SSI context on climate change material and its effects on life
O_2 = *Posttest* is done after being given treatment

Research subject

The subjects in this study were Physics Education students who were contracting a course in Earth and Space Sciences (IPBA). Research subjects as many as 60 people were selected using the *purposive sampling* method.

Research instrument

The research instrument used in this study is a test instrument for scientific literacy on climate change and its impact on life. The number of questions used is ten multiple-choice questions. Before being used in the study, the test instrument had gone through expert validation tests, and the results were

declared valid and reliable for use.

Data and Data Processing

The data obtained in this study were the pretest and posttest scores of students' scientific literacy abilities. The Pretest is given before the learning process, and it aims to determine the students' initial scientific literacy ability. Meanwhile, a posttest is given after students receive treatment in the form of learning using SSI-based teaching materials. To determine the increase in students' scientific literacy skills after being given treatment, the pretest and posttest scores were processed through the normalized gain value equation (n-gain) using the following (Sugiyono, 2010).

$$\langle g \rangle = \frac{S_{post} - S_{pre}}{S_{max} - S_{pre}}$$

$\langle g \rangle$ = normalized gain value

S_{post} = posttest score

S_{pre} = pretest score

S_{max} = maximum score

Table 2. Category of n-gain value
Value of n-gain

Meanwhile, the inferential statistical test was conducted to determine the effect of using teaching materials in the SSI context on students' scientific literacy. This test was carried

Value of n-gain	Category
$\langle g \rangle \geq 0,7$	High
$0,3 \leq \langle g \rangle < 0,7$	Medium
$\langle g \rangle < 0,3$	Low

RESULTS AND DISCUSSION

Before discussing the study results, it will be explained beforehand about the SSI-based teaching materials used in the learning process. The teaching materials used in the research have been validated first. The valida-

tion results show that the *Content Validity Ratio* (CVR) calculation results in each aspect (minimum value of $CVR_{count} = 0,7$) is greater than the table CVR value (0.62). This indicates that each sub-indicator in the book is valid. While the value of the *Content Validity Index* (CVI) calculation results is 0.94, which suggests that the book has been declared suitable for use in the learning process (Ayre, 2014). The cover page for the book can be seen in Figure 1 below.
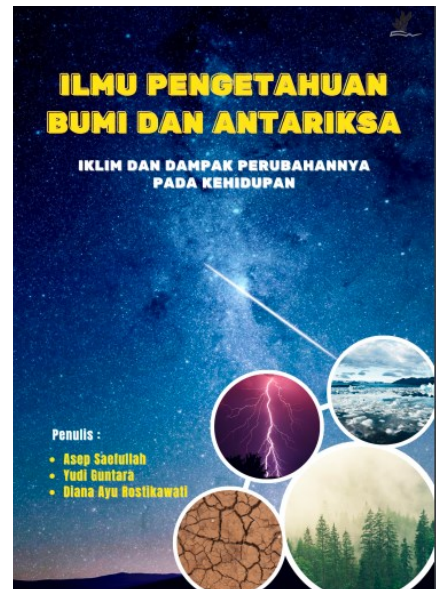

Figure 1. Book cover of climate and the impact of its changes on life

A hypothesis test was conducted to find out how the influence of teaching materials in the SSI context on students' scientific literacy. The first stage of hypothesis testing is to test the normality of the data obtained. Table 3 shows the results of the normality test of the pretest and posttest data.

Table 3. Pretest and Posttest data normality test results

Data source	Shapiro-will			
	Statistic	N	Sig.	Distribution
Pre-	0.943	60	0.291	Normal
Post-	0.952	60	0.131	Normal

The normality test results using SPSS software found that the pretest and posttest data had a significance level > 0.05. This indicates that the two data are typically distributed.

The next step is hypothesis testing to test whether there is an effect of implementing SSI-based teaching materials on students' scientific literacy. Because the two data are normally distributed, the hypothesis test uses a parametric statistical test, namely the paired sample t-test. The results of the paired sample t-test can be seen in table 4.

Table 5. Pretest, posttest, and n-gain value data

Pretest	Posttest	n-gain
4.80	7.60	0.54

Based on the data in table 5, the average posttest score is 7.80, indicating that students have good scientific literacy after being given treatment in the form of using teaching materials in the SSI context. This result is reinforced by the n-gain value of 0.54 (54%), which indicates an increase in scientific literacy in the medium category. This is in line with the research results conducted by Kartika (2019), which stated that SSI teaching materials effectively increased students' scientific literacy by 0,60 (60%).

To see the n-gain of student scientific literacy in each category, we can look at Figure 2 below.
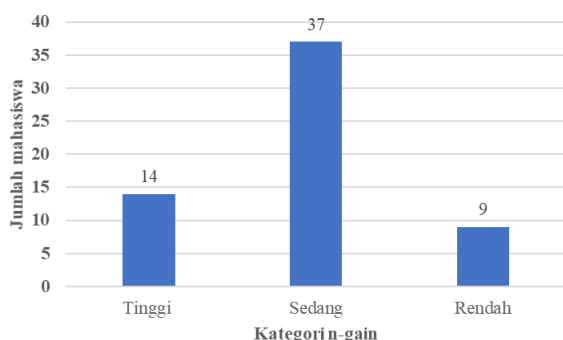

Figure 2. The number of students for each category of n-gain.

Based on Figure 2, there are 14 (23.33%) students who experienced an increase in scientific literacy in the high category, 37 (61.67%) students experienced an increase in

scientific literacy in the medium type. There were 9 (15.00%)) students who experienced an increase in scientific literacy in the low sort. Students still share an increase in scientific literacy in the low category because initially, students already have good scientific literacy, so the rise is not very visible.

The assessment of students' scientific literacy skills focuses on the content aspect and the attitude aspect. Figure 3 shows that the graph of student science literacy data on the part of attitude.
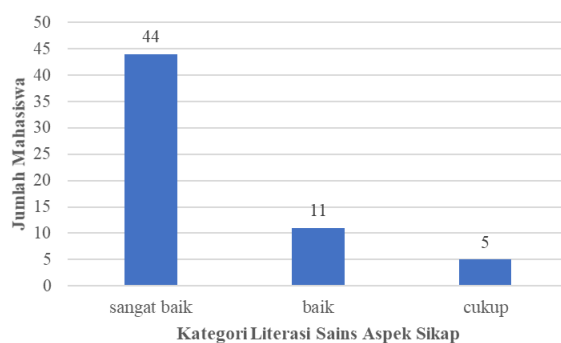

Figure 3. Student science literacy on attitude aspect

The results of scientific literacy on the attitude aspect shown in Figure 3 show that as many as 44 (73.33%) students have an outstanding attitude towards the phenomenon of climate change that impacts life, as many as 11 (18.33%) students have a good mood. And only 5 (8.33%) students had attitudes in the reasonably good category towards climate change issues. These data show that overall, students have a positive attitude towards climate change issues that have a real impact on life, for example, drought phenomena, rain that results in flooding, air pollution in urban and industrial areas, etc.

Based on the descriptions of the data above, teaching material on climate change and its influence on life in the context of SSI influences on improving students' scientific literacy skills, both in terms of content and attitudes. One of the influencing factors is the use of social issues as a context in teaching materials. The problems used are those around students and are closely related to real life, thus motivating students to interpret the subject matter they are studying. This is in

line with the findings of Subiantoro A. W (2013), who argues that learning using teaching charts in the SSI context can improve students' ability to make decisions related to controversial social issues. This is because students are involved in making decisions, showing students how important their choices are, and train them to comprehensively study a problem, including issues related to their attitudes.

The research results above are reinforced by the results of the study conducted by Zo'bi Science (2014) which states that using teaching materials with the SSI context in learning can increase students' moral sensitivity, thereby contributing to the overall moral development of students.

CONCLUSION

The implementation of teaching materials with the SSI context in learning indicates that teaching materials have a significant influence on students' scientific literacy. The use of teaching materials in the SSI context can also improve students' scientific literacy in terms of competence and attitude. They have increased students' scientific literacy with an n-gain value of 0.54 (54%) in the medium category.

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REFERENCES

Arikunto, S. (2010). *Metode peneltian.* Jakarta: Rineka Cipta.

Ayre, C. (2014). Critical values for Lawshe's content validity ratio: revisiting the original methods of calculation. *Measurement and evaluation in counseling and development*, 79-86.

Dawson, V. (2020). Introducing argumentation about climate change socio-scientific issues in a disadvantaged school. *Research in Science Education*, 863-883.

Kartika, I. (2019). Pengembangan Bahan Ajar Berbasis Socio-Scientific Issues Pada Materi Bioteknologi Untuk Meningkatkan Literasi Sains Siswa. *Journal of Science Education and Practice*, 1-12.

Levinson, R. (2012). A perspective on knowing about global warming and critical comment about schools and curriculum with socio-scientific issues. *Cultural Studies of Science Education*, 693-701.

Nazilah, N. (2019). Pengaruh Bahan Ajar Berbasis Socio-Scientific Issues Pada Materi Pemanasan Global untuk Melatih Kemampuan Literasi Sains Siswa. *Natural Science Education Research*, 8-16.

Nulhakim, L. (2019). The influence of using Sparkol video scribe's learning media to increase science literacy on pressure concept. *AIP Conference Proceedings*, 2169.

Pertiwi, U. D. (2018). Pentingnya Literasi Sains pada Pembelajaran IPA SMP Abad 21. *Indonesian Journal of Natural Science Education (IJNSE)*, 24-29.

Rostikawati, D. A. (2016). Rekonstruksi bahan ajar dengan konteks socio-scientific issues pada materi zat aditif makanan untuk meningkatkan literasi sains siswa. *Jurnal Inovasi Pendidikan IPA*, 156-164.

Saefullah, A. (2017). Efforts to improve students' scientific literacy through guided inquiry learning based on local wisdom of Baduy's society. *Jurnal Penelitian dan Pembelajaran IPA*, 84-91.

Saefullah, A. (2020). Reconstruction of Teaching Materials with Socio-Scientific Issues Context on Source of Energy Content. *Journal of Physics: Conference Series*.

Subiantoro, A. W. (2012). Lesson Study Dalam Perkuliahan Biologi Umum Dengan Socioscientific Issues-Based Instruction Untuk Character Building. *Prosiding Seminar Biologi*, 90-96.

Subiantoro, A. W. (2013). Pembelajaran Materi Ekosistem Dengan Socio-scientific Issues Dan Pengaruhnya Terhadap Reflective Judgment Siswa. *Jurnal Pendidikan IPA Indonesia*.

Sugiyono, S. (2010). *Metode penelitian kuantitatif dan kualitatif.* Bandung: Alfabeta.

Yuliati, Y. (2017). Literasi sains dalam pembelajaran IPA. *Jurnal cakrawala pendas*.

Zo'bi, A. S. (2014). The Effect of Using Socio-Scientific Issues Approach in Teaching Environmental Issues on Improving the Students' Ability to Make Appropriate Decisions towards These Issues. *International Education Studies*, 113-123.