THE EFFECT OF SOCIO SCIENTIFIC ISSUES BASED LEARNING ON ELEMENTARY SCHOOL STUDENT' SCIENTIFIC LITERACY ABILITIES

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ABSTRACT

Scientific literacy is very important since by learning scientific literacy, one can solve all the challenges that occur in life. Students have difficulty in scientific literacy because of uninteresting learning. Therefore, efforts are needed to make learning more meaningful. This study aimed was to determine whether there was an effect of Socio Scientific Issues (SSI) based learning on elementary school students' scientific literacy abilities. The research method used was one group of pre-test and post-test design. The sampling technique used simple random sampling with a sample size of 14 students. The paired sample t-test and n-gain were used to analyze the data further. The research results revealed that there were differences before and after implementing SSI learning with the n-gain test in the practical category.

Keywords: learning; science literacy; socio scientific issues

INTRODUCTION

Various scientific and technical advancements and developments contribute significantly to humanity's well-being and prosperity. The OECD (Organization for Economic Co-operation and Development) stated that the impact of technological progress created complex problems in human life, making it necessary for human resources with scientific insight to solve those (Muyassaroh et al., 2022). However, with the positive role that society plays, ethical and moral challenges related to the energy crisis and global warming, pollution, and various frequent disasters also emerge and threaten the safety of human life (Rohmaya, 2022). This problem is not individual but has become a global problem. Thus, it is expected that society will be scientifically literate to become an effective, responsible, and alert society in dealing with various problems.

Education is the essential foundation that provides the necessary skills and knowledge for all fields. The central pillar of education today are 21st century skills, especially in science teaching, which currently needs to be taught better in schools (Fuadi et al., 2020). Scientific competency is defined as students' ability to recognize concepts, understand, explain, communicate, and apply knowledge to everyday life to solve everyday hardware-related problems they have studied (Widyastika et al., 2022). It is crucial to master scientific literacy because it involves understanding various aspects of science and having the skills to apply what students know about science and how science works in real situations faced by students and being able to solve various kinds of problems that arise over time.

According to the National Centre for Education Statistics (NCES), scientific competency is described as the knowledge and understanding of scientific concepts and methods required to make independent decisions, participate in cultural and social activities, and improve economic production (Winata et al., 2018). In accordance with the National Science Standards, scientific literacy, and scientific processes are involved in decision-making in cultural and economic matters (Dwisetiarezi & Fitria, 2021). Meanwhile, the National Academy of Science stated that the emphasis on scientific literacy does not only occur in base knowledge and understanding of scientific concepts, but also how a person makes decisions and participates in social, cultural, and economic life (Narut & Supradi, 2019). In the national education system in Indonesia, the concepts and mindset that exist in science education have been fulfilled and use a scientific and inquiry approach (Nugraha, 2022). However, it is a fact that this has yet to be applied to learning in schools.

Scientific literacy, as stated by PISA, is described as an individual's scientific knowledge used in identifying questions, acquiring new knowledge, explaining natural phenomena, and drawing conclusions about scientific problems based on factual evidence; determining the characteristics of science in solving scientific problems; understanding that science and technology are types of material, intellectual, and cultural environments; and being willing to engage in science-related issues (Hanifah, 2017). According to the findings of an international study conducted by PISA in 2018, Indonesia placed 74th out of 79 countries that were covered by PISA, with a score of 396, while the average PISA score in the international realm is 500. Since PISA released research results regarding students' scientific literacy abilities worldwide, Indonesia remains at the bottom of the ranking, indicating that the quality of science education in Indonesia is significantly below that of the OECD countries (McComas, 2014).

The importance of scientific literacy is claimed as an intellectual asset that must be included in the education system, especially at the primary school level. First, increasing scientific literacy is considered an important strategy to defend the country in technological and economic development. Second, with issues such as climate change, pollution, and available energy resources, science and technology have developed and been integrated into people's daily lives. Third, the global economy is growing and is becoming increasingly integrated to develop scientific literacy (Safrizal, 2021). There are four aspects used by PISA in assessing students' scientific literacy abilities as evaluation material for measuring students' level of knowledge, skills, and abilities related to scientific concepts: 1) content or knowledge; 2) competency or process; 3) context; and 4) attitude (Rohmah & Hidayati, 2021). Moreover, PISA assesses the content or knowledge aspect using three indicators: a) identifying scientific issues, b) explaining natural phenomena, and c) using scientific evidence (Mathias, 2022). Students' scientific literacy abilities should be aligned with the advancement and development of science and technology in order to respond to real-world consequences and outcomes. However, students still have difficulty connecting scientific concepts and phenomena in real life.

According to pre-research observations conducted at UPT SD Negeri 342 Gresik, it was found that students' scientific literacy abilities level was still relatively low, which is around 21%. These results found that students were still less able to relate scientific knowledge to phenomena that take place every day. Only theories and concepts are memorised by students without truly understanding them, and learning at school is still conventional. In addition, because problems in social life are conceptually closely related to scientific issues, the interaction between science and social life must be developed further. In order Teachers must design learning experiences in order to foster and advance students' scientific literacy in their studies situations that involve student activity, and the learning carried out is more student-centered (Irsan, 2021). On the other hand, some facts show that teachers can only master learning material well but are less able to teach effectively (Betari et al., 2016). Things like this happen because learning activities are not based on particular learning models or methods linked to learning material, so students' knowledge becomes low.

The appropriate and effective response to these difficulties is to implement learning based on social and scientific problems in everyday situations. Socio Scientific Issues (SSI) are taken from problems, issues, information, or news that occur in society and can awaken students' thinking to debate and resolve a problem that is currently occurring (Nazilah et al., 2019). Socio Scientific Issues (SSI) is a learning strategy that brings up problems in social life that have close ties to natural science, such as genetic engineering and natural phenomena such as global warming and climate change (Zairina & Hidayati,

2022). Sadler revealed that SSI learning aims to stimulate and build individual moral and ethical growth and an understanding of the connection between society and science (Hera, 2018). Scientific and Social Issues are critical in efforts to create a society that has scientific literacy skills because SSI is related to examining issues that occur and making decisions on problems that occur in real life, providing an opportunity to express students' understanding of learning so that it helps them how to make decisions and develop students' moral character (Nurmilawati et al., 2021).

Socio Scientific Issues as a learning context can be used for several things as follows: 1) making science learning more meaningful for students; 2) directing a deeper understanding of the characteristics of science; 3) improving argumentation and dialogue skills; 4) improving skills in assessing scientific information; and 5) increase scientific literacy knowledge (Nurhadi, 2022). The capacity for scientific literacy includes, among other things, argue and make decisions (Khasanah & Setiawan, 2022). SSI can train argumentative skills and make decisions for problem-solving (Pranomo et al., 2021). The existence of Socio Scientific Issues issues or problems in learning will trigger the emergence of pros and cons, which will make students use logic and interpretation to solve these problems. The lessons taught will help students develop their ability to form judgments about complex social topics and debatable as well as their scientific literacy. Although there is a similarity in the title, this research is superior to the previous studies in that this research uses different research materials and subjects. The hypotheses proposed in this study were:

Ha: There was an effect on students' scientific literacy abilities with Socio Scientific Issues (SSI) based learning.

Ho: There was no effect on students' scientific literacy abilities with Socio Scientific Issues (SSI) based learning.

The results from the previous study stated that SSI learning can improve students' scientific literacy skills, thus contributing to students' moral development. In addition, SSI trains students to consider and research social issues related to science and can improve scientific literacy and help students become responsive citizens (Lubis et al., 2022). Therefore, researcher decided to research The effect of socioscientific issue-based training on elementary school children's science knowledge and skills. The study's purpose is to determine whether teaching with an emphasis on socio-scientific concerns affects students' capacity for scientific literacy.

RESEARCH METHODS

This research is quantitative pre-experimental study with a one-group pre-test-post-test design. In this design, an experimental group is given pre-test questions, treatment using SSI learning, and post-test questions. This research is aimed at finding out whether there is an effect of an SSI-based learning treatment on elementary school students' scientific literacy abilities. According to Sugiyono, quantitative research is a scientific research method used to study a certain population or sample, gathering information via research tools and analysing statistical data to assess hypotheses related to a phenomenon (Pratama, 2019). The research design is as follows:

O1	X	O2

(Murdiasih & Wulandari, 2022)

Information :

O1 = pretest before treatment

X = class with Socio Scientific Issues learning

O2 = posttest after treatment

The research population was UPT students at SD Negeri 342 Gresik. According to Sugiyono, the population is the total area of individuals with specific quantities and characteristics determined by researchers to research and conclude (Tanzeh & Arikunto, 2020). The population was taken from all 5th-grade students at UPT SD Negeri 342 Gresik, totaling 15 students. The selection of research samples used the Simple Random Sampling technique based on certain objectives and considerations. Simple Random Sampling was chosen based on time and cost considerations as well as the limited number of students, so the sample used was 14 students in class 5. According to Sugiyono, the sample is part of the data source in research based on the number and characteristics of the population.

This research data was taken from 5th-grader students at UPT SD Negeri 342 Gresik. Research data was taken from scores before SSI learning was implemented (pre-test) and scores after SSI learning was implemented (post-test) using scientific literacy indicators on environmental pollution material.

The research instrument used was a test sheet. This test sheet was used to determine the level of students' scientific literacy abilities. The test questions use scientific literacy indicators: understanding natural occurrences, identifying scientific difficulties, and employing scientific

evidence. Before using the instrument, its validity and reliability will first be tested using SPSS version 26 software.

Table 1. Question Validity Test

Question	1	2	3	4	5	6	7	8	9	10	11
Rxy count	0,839	0,525	0,526	0,839	0,525	0,526	0,411	0,743	0,478	0,526	0,411
R table	0,329	0,329	0,329	0,329	0,329	0,329	0,329	0,329	0,329	0,329	0,329
Conclusion	Valid	Valid	Valid	Valid	Valid	Valid	Valid	Valid	Valid	Valid	Valid

According to validity test results, all questions number 1 to number 11 were declared valid because the calculated r value was more significant than the table r value. In conclusion, the test sheet meets the eligibility criteria or is declared valid. Therefore, test questions for scientific literacy skills can be used for research purposes. The test results can be continued by conducting data reliability tests.

Table 2. Data Reliability Test

Cronbach's Alpha	N of Item
.855	11

The test was then continued with a reliability test to determine the consistency of the instrument items in data collection. Cronbach's Alpha reliability test findings showed that the Cronbach's Alpha value was greater than the r table value.

The data collection technique is by using the test method. The test questions use scientific literacy indicators: understanding natural occurrences, identifying scientific difficulties, and employing scientific evidence. This test method is carried out to obtain results of scientific literacy skills of pupils before and after instruction. Students will be given conventional learning and then given test questions. Afterward, students will be given learning based on Socio Scientific Issues and then given test questions. Before SSI-based learning implementation is preceded by a test known as a pretest; following SSI-based learning implementation called a posttest.

The method of data analysis employed is by taking scores from the students' pre-test and post-test results. The pre-test score is before SSI based learning is implemented, while the post-test score is after SSI-based learning is implemented. The results of the pre-test and post-test scores will be analyzed using the N-gain formula:

$$\text{N-gain} = \frac{Posttest\ score - Pretest\ score}{Ideal\ score - Pretest\ score}$$

N-Gain Criteria:

N-Gain Value	Category
N gain $> 0,7$	High
$0,3 \leq$ N gain $\leq 0,7$	Average
N gain $< 0,3$	Low

(Fatikasari et al., 2020)

RESULTS AND DISCUSSION

The observations of learning implementation were carried out by two observers for three meetings. Learning implementation assessment is used to evaluate the way students are taught in a classroom during the research process. The implementation of learning is assessed based on several phases of the Discovery Learning learning model. Applying the Discovery Learning learning model to Socio Scientific Issues learning about

environmental pollution material, it aims to discover the ability to argue and make decisions to respond to a problem that might trigger the emergence of pros and cons. This learning requires students to use logic and interpretation in solving the problem. In this way, students can develop the ability to form judgments about complex and controversial social topics.

The pre-test measures students' initial scientific literacy abilities before the learning process begins, after which the learning process is carried out. Meanwhile, the post-test measures students' level of scientific literacy after conducting SSI learning on environmental pollution material. Data from observations of learning implementation for each item has an assessment range of 1 to 4 (Hajrah et al., 2021). Assessment of learning implementation results is used to evaluate the learning process in class during the research process. The results of the learning implementation were obtained through 3 meetings, with the results shown in Table 3.

Table 3. The Results of Learning Implementation Analysis

Meeting	Average
1	3.35
2	3.57
3	3.85
Overall Average	**3.59**
Category	**Very good**

Based on the table above, implementing learning for three meetings obtained an overall average of SSI-based science learning in the very good category. At the first meeting, learning implementation achieved an average result of 3.35. At the second meeting, learning implementation achieved an average result of 3.57. At the third meeting, the average value of learning implementation reached

an average result of 3.85. These results show that every implementation of SSI-based science learning experiences an increase in scores. The average results obtained are adjusted to the range of 3.5 – 4.00, which is considered very good. Apart from that, the percentage agreement for learning implementation is >75%, which is 87.71% (Febriyanti et al., 2021). This shows that the learning preparation has been prepared consistently in measuring the implementation of learning during the learning process.

Socio Scientific Issues (SSI) is a strategy applied in the learning process that brings students closer to scientific problems in a contextually appropriate way through social problems found in social life (Ika Kartika, Surti Kurniasih, 2017). The advantages of bringing up challenges or issues at the start of the learning process can provide both positive and bad aspects that force pupils to consider and evaluate the subject (Rahmayanti & Andayani, 2022). During the learning process, the teacher serves as a learning facilitator. Teachers often help students fill in student activity sheets at the first meeting but less frequently at subsequent meetings. In learning activities, teachers adjust the amount of teaching to the level of student achievement.

In the environmental pollution material, some problems are often encountered around students, such as water pollution. Water is a daily need for living creatures on earth, but humans often carry out activities that can pollute it with chemicals that are not good for consumption. Rivers are often used as rubbish dumps, industrial activities throw waste or oil into the sea, and fishermen fish with inappropriate materials. According to the local community, this activity is usually

carried out, and there are no impacts. However, if this problem is left for a very long time, it can cause risks and impacts. Given this problem, students need to complete it with activities that are more positive, healthy, and do not damage the ecosystem in the water. Through these pros and cons, the use the utilization of Socio Scientific Issues solve environmental pollution problems with scientific knowledge.

Students' scientific literacy ability tests are carried out before and after learning. The test before the learning activities take place (pretest) aims to determine students' initial scientific literacy abilities, and the test after the learning activities are carried out (posttest) aims to determine the level of improvement in students' scientific literacy abilities after receiving the learning. Table 4 displays the outcomes of the students' scientific literacy tests.

Table 4. The Results of Students'
Scientific Literacy Ability

Sample	Pre-test	Post-test	N-Gain	Category
Average	67.21	86	0.7	Currently

The table above shows that during the pre-test, there were only two students who completed it, while the other students still did not. After implementing Socio Scientific Issues (SSI) based learning, all students completed it. Students are considered complete if they get a score equal to or above the KKM of 75. The average score for students' scientific literacy abilities on the pre-test was 67.21, while on the post-test was 86.

Gain scores test how well students' scientific literacy skills have improved. Based on the data obtained, it shows that

SSI-based learning can lead to an improvement in kids' knowledge of science, as seen by increasing scientific literacy scores in the process of learning. The typical level of scientific literacy among students' abilities obtained in the pre-test was 67.21, while the average value obtained in the post-test was 86. In addition, the resulting N-Gain score was 0.7, which is in the medium category.

To ascertain whether the data is regularly distributed, the normality test is run. Because in this research, normal data distribution is an absolute requirement that must be met. The students' normality test data before and after the test were normal. The significant values obtained were more than 0.05, which are 0.166 and 0.579, which could be interpreted as normal reading data.

Table 5. Data Normality Test

| Sample	Pre-test	Post-test
Normality test	0.166	0.579

The Paired Sample t Test was carried out to compare the average values studied. The t-test results show a significant value of 0.000, which explains the striking difference between the average pretest and posttest scores. A significant value of <0.05 indicates that there are differences in students' scientific literacy abilities after being given treatment. The treatment in question uses SSI based science learning, proven to improve knowledge, conclusion, and decision-making abilities.

Table 6. Paired Sample t Test

Sample	Pretest – Posttest
Paired t Test	0,000

The data obtained is processed to analyze the scientific literacy competency

indicators that have been developed, which are identifying scientific issues, explaining natural phenomena, and using scientific evidence. The results of the calculation of the analysis of scientific literacy indicators can be seen in Figure 1.
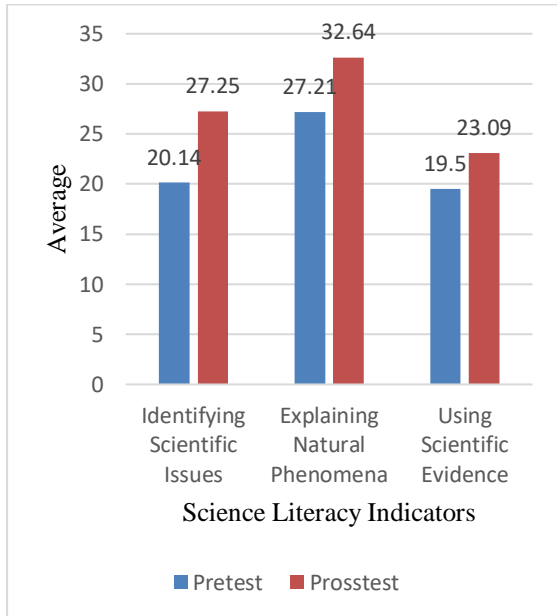
Figure 1. The Analysis of Scientific Literacy Indicators

Based on the graph above, it can be seen that before Socio Scientific Issues-based learning was implemented in the learning process, the average score for each indicator ranged from 19.5 to 27.21. In contrast, after Socio Scientific Issues-based learning was implemented in the learning process, the average score for each indicator was from 23.09 to 32.64. The results of the data analysis show that socio-ecological issues influence students' scientific literacy abilities. SSI learning can train students' scientific understanding capacity in terms of scientific understanding capacity indicators:

Identify scientific problems, explain natural phenomena, and use scientific evidence.

The research results showed that students responded positively to interest in applying learning, novelty of learning, ease of learning, continuity of learning, the role of the teacher in teaching, and ease of learning when answering evaluation questions. Through this, students understand the importance of a healthy and pollution-free environment. Increase students' interest in studying science further because by implementing SSI learning, students play an active role in learning the instructor just serves as a facilitator (Rohmaya, 2022). Students have the opportunity to explain problems in life, analyze the causes of problems, estimate the impact of problems on living things and ecosystems, and make efforts to reduce environmental pollution.

This shows that Socio Scientific Issues based learning can develop scientific literacy capacity and help students acquire scientific understanding skills (Sudibyo et al., 2018). Students are motivated to interpret the subject matter they are studying because the difficulties or problems raised in the learning process affect them directly and are closely related to real life. Scientific literacy involves making decisions based on one's reasoning based on their prior knowledge or concepts (Hasasiyah et al., 2020). In simple terms, reasoning can be interpreted as the process of drawing conclusions based on knowledge obtained at school. Findings from student science literacy tests abilities show good results.

This research shows that by learning Socio Scientific Issues, students have good scientific literacy skills. This ability functions to identify scientific issues, explain natural phenomena, and use scientific evidence (Melya & Irhasyuarna, 2022). This is demonstrated by the

implementation of learning, which shows excellent results and students' ability to complete evaluation questions, where the questions have been adapted to the context of scientific literacy. Socio Scientific Issues can help students discover concepts they will learn independently. The teacher's task is limited to being a facilitator who helps students' learning (Putri et al., 2014). Students will form knowledge through real-life experiences by combining old knowledge with new information obtained to create more meaningful learning and knowledge that students will remember. SSI enables students are expected utilise ethical reasoning to convey ethical dilemmas critically, analyse, synthesise, and evaluate many sources of evidence and information, and comprehend the complexity of relationships inherent in contextual science learning. (Selamat, 2021).

CONCLUSION

The researcher concluded that science learning based on Socio Scientific Issues (SSI) succeeded in increasing students' scientific literacy skills by 74.75% in the quite effective category. The implementation of SSI based science learning achieved very good results, with the assessments at the first, second, and third meetings, respectively, being 3.35, 3.57, and 3.85. The average value of students' scientific literacy abilities on the pre-test was 67.21, and on the post-test was 86. The average value of scientific literacy abilities for each indicator in the pre-test ranged from 19.05 to 27.21, while in the post-test, it ranged from 23.09 to 32.64.

For further research, it is expected that SSI-based science learning that connects students' scientific literacy skills

is not only taught a few times but must be taught continuously to produce optimal results. This research needs to be developed further to analyze the difficulties faced by students in solving scientific literacy questions and familiarizing themselves with questions related to scientific literacy indicators. As a result, students are acquainted with, trained in, and accustomed to answering these types of questions.

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