



## The relationship between knowledge of socio scientific issue and nature of science in ecosystem material in high school students

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### ABSTRACT

The purpose of this study was to know the relationship between socio-scientific issues with nature of science students in ecosystem material of the XI Math and science class in one of the High Schools. This research was conducted from September- October 2020. The type of research was correlational with sample of 36 students taken using a purposive sampling technique as evidenced by the average value of daily tests. The technique on data collection was a non-test instrument socio-scientific issue questionnaire and essay test the nature of science. The research instruments used included a socio-scientific issue questionnaire which states 13 statements regarding controversial issues regarding ecosystems and the views nature of science form B (VNOS-B) description test to measure the nature of science dictated by Lederman et al. (1998) and have settled 14 questions. Data were analyzed using Pearson bivariate. The results of this study obtained a significance of  $0.00 < (0.05)$  which indicates the relationship between socio-scientific issues with the nature of science and 0.729 as the display value. This analysis concludes that there is a positive relationship between socio-scientific issues with the nature of science at a high level. Teachers are expected to be able to improve skills in indicators of socio-scientific issues, one of which is by training sensitivity and awareness of environmental problems that students encounter on a daily basis.

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## INTRODUCTION

Various environmental problems that occur in Indonesia are inevitable. Global warming, drought, floods, and forest fires are just a few examples of environmental damage that has occurred. Various factors such as increasing use of motorized vehicles, settlements along river banks, and land conversion are the trigger factors. However, the biggest factor causing environmental damage is the low level of education and awareness of the community and other stakeholders (Subiantoro, et al, 2013).

After the community and stakeholders find various factors that cause environmental problems, they try to find solutions to each existing problem. Various examples depend on each problem, including limiting the age of vehicles to limit the number of vehicles that are too many, moving residents to the flat for residents living along the river, monitoring regulations and policies that correlate with facilitation and incentives for farmers who apply LP2B (Lahan Pertanian Pangan Berkelanjutan) to conversion land that is made into rice fields, increases the state budget by 20% to improve the quality of education and implements a waste bank program to reduce and separate the types of waste generated by the community. Through various solutions that have been done, it can help overcome environmental damage, but the results are not optimal.

One of the things that can be addressed is through the science education system in schools. Science education should apply learning activities that direct students to recognize and instill a sense of concern for the environment. Not only through theory but also direct practice into the field, and students are directed to discuss and make decisions related to nature preservation.

The science education in question is through the application of learning with the context of socio-scientific issues. Because, according to some socio-scientific experts, it can make learning more interesting, improve competence in the form of learning outcomes, learning motivation, reflection, argumentation, communication, and the ability to make student decisions (Wang et al, 2018).

Socio scientific issues are dilemmas or problematic issues where science (biology) knowledge is conceptually, procedurally technology, and social awareness are related to one another and present mental conflicts that require the ability to make decisions to solve them related to science (Sadler, 2004). Students can improve their cognitive abilities and reasoning about environmental issues that they have learned in school so that in the long run they can form a sense of concern for nature preservation, with the ability of socio-scientific issues that they have.

## METHODS

### Research Design

This research was conducted in the XI Math and Science classes in one of the High Schools in Tasikmalaya, Indonesia. The research was conducted in September-October 2020. This research used a correlational method, which is research conducted by collecting data so that it can be seen whether there is a relationship between variables and how the level of relationship between variables is measured (Gay et al, 2012). In this study, two variables measured the level of relationship between these variables without any effort to influence each other.

### Population and Samples

The population in this study were all XI Math and Science class in one of the High Schools in Tasikmalaya City as many 261 students. In this study, the samples taken were carried out using a purposive sampling technique. The purposive sampling technique is used when selecting a sample that is believed to be representative of a population, or in other words, the

researcher selects the sample using his experience and knowledge of the group to be sampled (Gay et al, 2012).

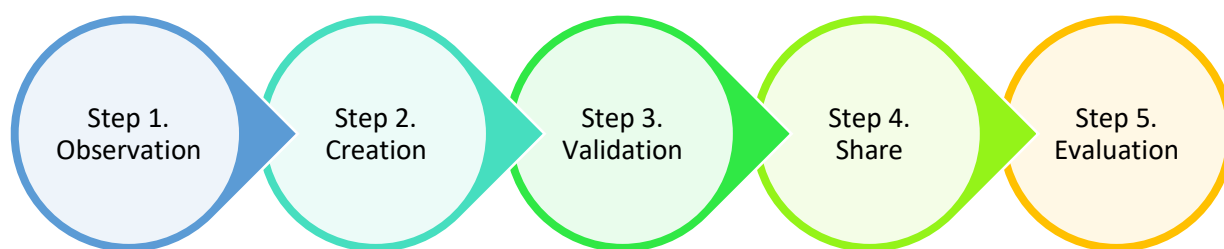
Based on this opinion, the determination of the sample taken is students from XI Math and Science 7 class with amount 36 students in one of the High Schools, who have a good understanding of the nature of science and can relate environmental problems encountered with theories that have been studied in school, which is indicated by the average score. The highest daily test among the 8 classes.

### Instrument

The instruments used in this study consisted of a non-test socio-scientific issue and a nature of science essay test. The instrument used to measure the ability of the socio-scientific issue in a questionnaire. The non-test instrument in the form of a questionnaire was used to measure the ability of socio-scientific issues totaling 13 statements based on the 1-4 Likert scale principle covering affection statements (+) and cognition statements (-) (Nemoto & Beglar, 2014). Furthermore, to measure the ability of the nature of science, researchers used a test instrument in the form of descriptive questions, totaling 14 questions. VNOS (Views of Nature of Science) form B represents instruments developed by Lederman et al. (1998) that are used to know the understanding of natural science. VNOS (Views of Nature of Science) form B is an instrument developed and perfected from VNOS (Views of Nature of Science) form A (Listiani & Arief, 2017).

### Procedure

The procedure in this study was carried out based on the following stages: 1). Observation (before the research was carried out, the researcher observed the behavior and abilities of students in biology subjects and conducted interviews with biology teachers), 2) Creation (after carrying out observations the researcher made a non-test instrument for the socio-scientific issue questionnaire and essay test about the nature of science through google form to be used when collecting data), 3) Validation (instruments in the form of a questionnaire and description questions validated by the lecturer or expert judgment) 4) Share. Share the instrument link that has been created via google form and oblige students to fill it in within 90 minutes), 5) Evaluation. Process and analyze data on students' answers from questionnaires and essay tests that students have filled via a google form.



**Figure 1**  
Research procedure

### Data Analysis Techniques

This research used ANOVA (Analysis of variance). Before the data were analyzed, the

samples were distributed normally and linearly as evidenced by the Kolmogorov-Smirnov normality test and linearity. The results of normality and linearity can be seen in Table 1.

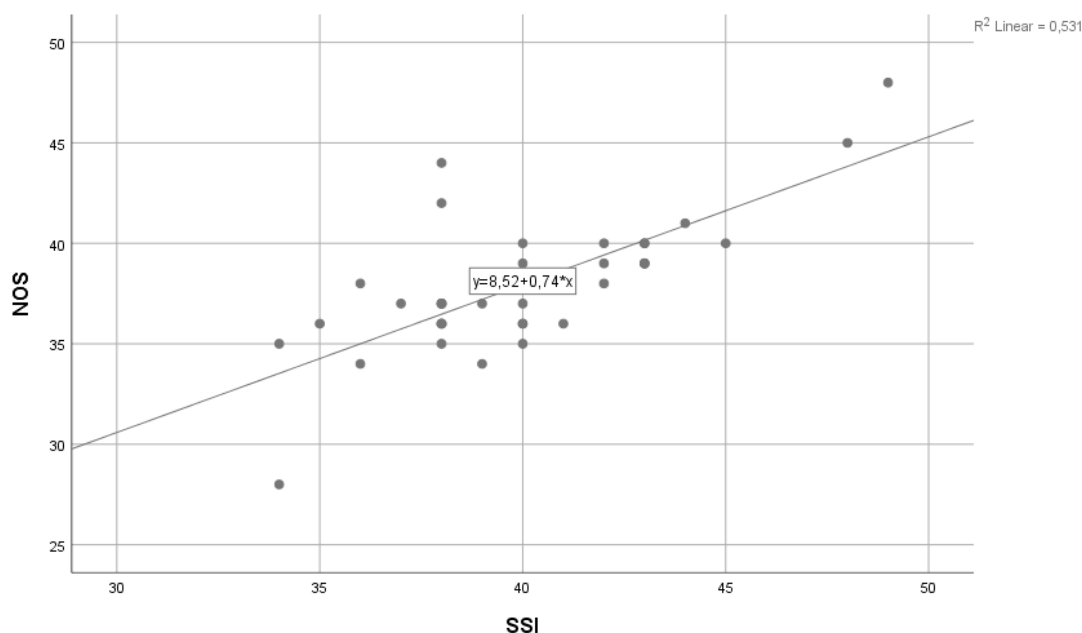
**Table 1**

The result of the normality and linearity test

No.	Test Name	$\alpha$ (0.05)	Significance	Analysis Result	Analysis Conclusion
1.	Socio scientific issue normality test	0.05	0.077	Significance >0.05	Ho accepted (Samples were taken from populations distributed normally)
2.	Nature of science normality test	0.05	0.074	Significance >0.05	Ho accepted (Samples were taken from populations distributed normally)
3.	Socio scientific issue with nature of science linearity test	0.05	0.562	Significance >0.05	Ho accepted (Both variables were linear)

Normality and linearity testing data used the SPSS version 25 for windows application with a significance level of 5%.

For a linear correlation, the most suitable procedure is known as linear regression and is guaranteed to produce the correct solution in a limited time that can be used scatterplot. The following is a scatterplot (bivariate) diagram of the nature of science to the nature of science (X with Y) can be seen in Figure 2.



**Figure 2**

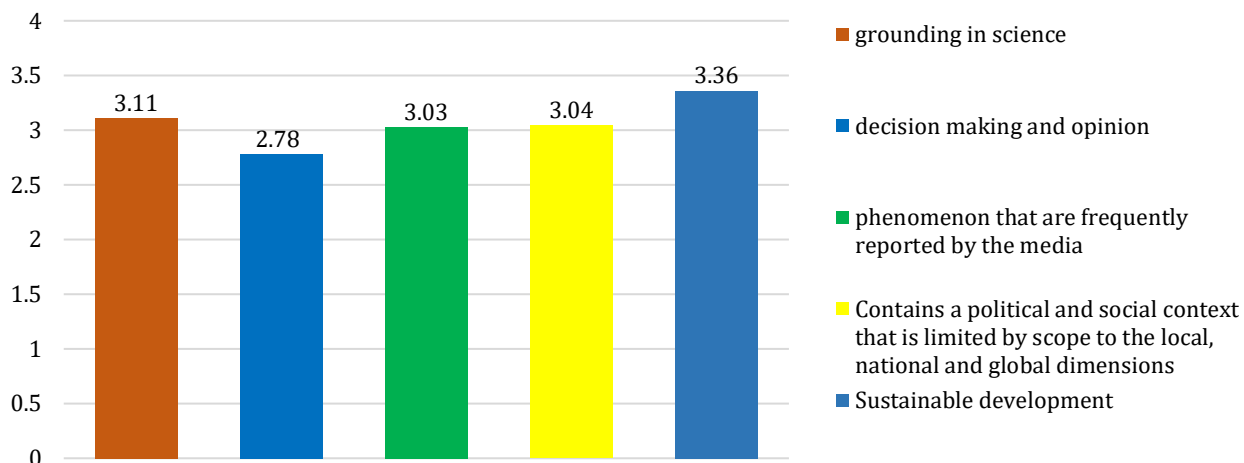
Scatterplot diagram between socio-scientific issue and nature of science

Based on Figure 2, it can be seen that the equation  $\hat{Y} = a + bx$ . The results of the regression analysis showed that the coefficient for the social scientific issue variable (a) was 8.52, while the coefficient for the nature of science variable (b) was 0.74 so that the regression equation obtained was  $\hat{Y} = 8.52 + 0.74x$ . The regression has a positive value, meaning that if the score of the socio scientific issue variable exists, the students' score of nature of science will increase. If the students' social scientific issue is increased by one time, the students' nature of science will increase by 0.74x. Meanwhile, the points on the plot indicate the amount of deviation (error)

from this relationship. This positive relationship means that if the socio scientific issue of students has increased, the nature of the science of students will also increase, and the category is large, because coefficient correlation was 8.52.

## RESULTS AND DISCUSSION

Based on the research results, there are differences in the ability of students to answer the questionnaire from each indicator on the socio-scientific issue variable. The achievement of the average score for each socio-scientific issue indicator can be seen in Figure 3.



**Figure 3**  
Socio-scientific issues indicator average score

Figure 3, explains the acquisition of the average score on each student's socio-scientific issue indicator. The highest score was on the indicator of sustainable development, whereas the lowest score was on the indicators of decision and opinion-making. The range of scores on each indicator is not significantly different. This is because data collection uses a sample of students who have the same abilities and levels of social skills as scientific issues and scientific characteristics. Based on the data in Figure 2, it can be seen that the average score of indicators is moderate to quite high, because from 4 scale score, students get 2,78 until 3,36. Students have understood the meaning of socio-scientific issue and can apply it in everyday life. Socio scientific can increase argumentative scientific skills, study moral issues, increase moral reasoning and the ability to reflect reflective judgment (Zeidler, 2009) so that students can make decisions on problems in the environment. social scientifically and of social value.

### Nature of science

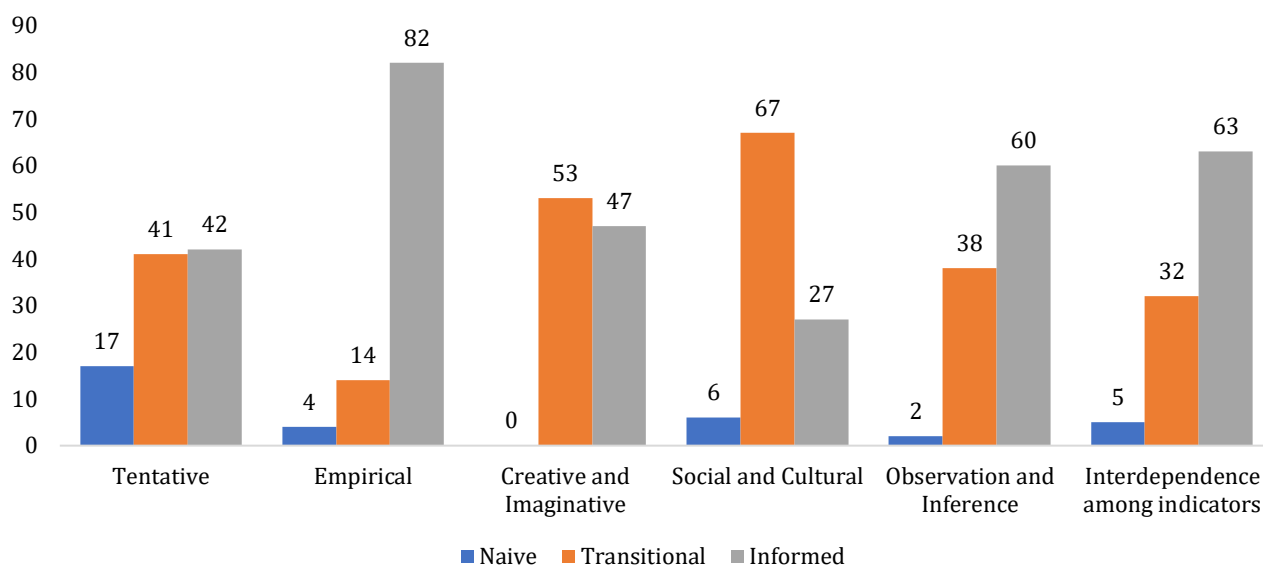
Students understanding of the nature of science is analyzed based on a combination of assessments that have been adapted from Liang's research (Liang, et al, 2008). The results are presented in Table 2.

**Table 2**

Percentage of understanding of nature of science

No	Nature of Science Indicator	Naive (%)	Transitional (%)	Informed (%)
1.	Tentative	17	41	42
2.	Empirical	4	14	82
3.	Creative and Imaginative	0	53	47
4.	Social and Cultural	6	67	27
5.	Observation and Inference	2	38	60
6.	Interdependence among indicators	5	32	63

From the table above, it can be described in the diagram of the level of understanding of the nature of science in each indicator which can be seen in Figure 4.



**Figure 4**  
Categorization diagram of nature of science

The research data were analyzed by grouping the answers to description questions into 3 categories (Ağlarıcı, Sarıçayır, & Şahin, 2016), there are : naïve, transitional, and informed. The score is included in the naïve category if the student's answer deviates from the actual concept of nature of science. Transitional category if their view is in accordance with the actual concept of nature of science but is unable to explain or mention an example. Next, the informed category is included informed if the view is in accordance with the actual concept of nature of science and is able to explain it accurately.

Based on the table above, it can be seen that the profile of students' understanding of the nature of science, obtained varying results in each aspect. The tentative indicators show that most students believe that science can change based on the times and the formation of discoveries resulting from pre-existing interpretations. Furthermore, the empirical indicators show that almost all students believe that the information or data obtained is based on observations of nature-based on facts so that evidence is found.

Then, the creative and imaginative indicators prove that students have understood when collecting and analyzing the data obtained using their creativity and imagination. This finding is following the statement of Lederman (2002), the development of science involves the investigation of nature, but the discovery of science also involves human creativity and imagination. Next, on the socio-cultural indicators, data is obtained that most students have responded consistently to the statements submitted but not as a whole, where students believe that the development of science depends on the influence of the social and cultural conditions that are preserved in an area.

Then, the observation and inference indicators obtained data that some students consistently and understood the meaning of the observation and inference indicators. Students have understood that the knowledge gained is based on direct observation using sensory tools (observation) and is also supported by indirect observation using sensory organs but using an interpretation of observations that other people have done (inference). Finally, the indicators of interdependence between indicators indicate that the majority of students judge that one indicator is related to another, that science is not only composed of one indicator, for example, science is tentative or can change, it is also influenced by social and culture in a dynamically developing society.

In line with the data obtained that the learning given by the teacher influences the understanding of students, according to Sumranwanich and Yuenyong (2014) students have a positive attitude towards learning that is tentatively indicated and the dependence between various kinds of scientific knowledge. Meanwhile, on the empirical indicator (scientific method) their ability decreases. It can be interpreted that the tentative indicator is an indicator that is easy to understand and teach, while the Scientific Method indicator is the opposite. The statement agrees with the score for the categorization of the nature of science indicator on the tentative aspect of 2.39 while on the empirical aspect of 1.49.

Students can appreciate the understanding of tentative and empirical indicators if they can use higher-order thinking skills. In particular, understanding empirical indicators requires experience in carrying out scientific investigations. Other factors from the background of students are also related to students' views of the nature of science, learning, and motivation factors such as learning approaches, motivation goals, and self-efficacy involved in this study (Hacieminoğlu et al, 2015). Empirical is the indicator that gets the lowest score because teachers rarely conduct direct observation activities in the form of practicum on ecosystem material, considering that the school is located in an urban area so that teaching and learning activities are not optimal.

Teacher's understanding of the nature of science also has an involvement in the percentage of understanding the nature of science in students. This is in line with the results of research (Hacieminoglu, 2014) . The limited time that provide for learning and teaching make teacher can't apply all of nature of science indicator, no matter these teacher capable and proficient. Even though teacher have learn about how to teach effective for nature of science. This is as stated by (Hacieminoglu, 2014) that Teachers have to high competence because they have responsibility for build discussion environment, make base learn with project, and guide students with introspectif questions. Based on the results of observations and interviews with Biology teachers who teach the sample classes, it can be seen that having a sufficient understanding of the nature of science, carrying out learning according to the curriculum with the learning methods commonly used. However, with an increase in science, students' understanding of the nature of science will increase. Also, the material load in the curriculum is burdensome for teachers because they are required to complete material according to the curriculum which makes learning not optimal and in-depth. Then, various backgrounds possessed by students make the ability of students to absorb information and understand each indicator of the nature of science differently.

The differences between schools can be explained by the relationship between other aspects, such as the learning environment in the classroom, factors related to parents, school and student characteristics, learning factors, and motivation. Concerning the relationship between student background variables, the positive relationship between income levels and tentative indicators of the nature of science revealed that students from high-income families had a more complete understanding of tentative indicators of the nature of science than students from low-income families. Higher incomes can help parents provide their children with better educational opportunities, such as extracurricular courses, personal computers and internet connections at home, more books, and other materials. This significant difference encourages the idea that having additional learning opportunities might be one of the reasons for having a better understanding of the nature of science (Hacieminoğlu et. al, 2015). Based on the results of observations of the class used as the research sample, most students come from families with middle and upper economic levels, this is evident from the admission of students that almost all students in the class take tutoring programs outside of school to optimize understanding. towards subjects in school, and they are also facilitated by having books and gadgets.

**Table 3**

Hypothesis Testing on socio-scientific issue relationship with nature of science

Model	R	R Square	Adjusted R Square	Std. The error of the Estimate	Change Statistics				
					R Square Change	F Change	df1	df2	Sig. F Change
1	.729 <sup>a</sup>	.531	0.518	2.429	.531	38.540	1	34	.000

a. Predictors: (Constant), *socio scientific issue*

Based on Table 3, there is a relationship between the socio-scientific issue and the nature of the science of students with a correlation coefficient of 0.729 which means it is included in the high correlation category. Also, the coefficient of determination was 0.531 which means that the socio-scientific issue variable contributed 53.1% to the nature of science. The results of the hypothesis testing using the bivariate correlation test showed that there was a relationship between students' socio-scientific issues in ecosystem material. The relationship between variables in this study is included in a positive relationship. Because, the socio-scientific issue is able to develop an understanding of the nature of science for students and teachers through an ideal context (Karisan & Zeidler, 2017). So, a lesson that combines these two variables will be very suitable to support each other and can improve students' abilities towards scientific literacy.

There are factors that cause the high correlation value between socio scientific issues with the nature of science, such as: indicators contained in the nature of science are able to increase the ability of students' socio scientific issues. For example: observation and interpretation indicators which are the basis of science on socio scientific issues because the knowledge gained by students is the result of direct observation by the five senses and is the result of the interpretation of these observations. Another example, is an indicator of events that are often reported by the media related to indicators of nature of science, such as tentative, changing climate situations are often reported in the national media so that students know the current climate conditions. The conclusion is that through understanding on socio scientific issues, an understanding of the nature of science can be developed at the same time.

The learning context that applies the socio-scientific issue-based nature of science is canis increase students' critical sense of scientific evidence of the conflict being discussed, foster diverse views on solutions to various problems, and interpret data differently from each student (Khishfe, 2012; Khishfe, and Lederman, 2006; Sadler et al., 2004; Walker & Zeidler, 2007; Zeidler, et al., 2002). Thus, the ecosystem material studied by students will be easier to understand and imply problems in real life (Harahap, Ristanto, & Komala, 2020; Fajar, et al., 2020). Through a critical attitude, students are taught to distinguish facts and opinions on conflict, open insights from various viewpoints, and be able to interpret data through their thinking, so that their thinking power develops and make better decisions or actions.

When ones learned that utilizes the context of socio-scientific issues was relevant to the life of students, they can create interesting discussion forums to explored indicators of the nature of science along with certain scientific content disciplines, thereby improved their decision-making skills (Walker & Zeidler, 2007). In line with this statement, the assessment of the understanding of the socio-scientific issues in this study was to see whether students have been able to made decisions well through the questionnaire that has been provided, and it was proven that the result was that when students' understanding of the socio-scientific issues was high enough, the ability to made decisions was also good, and understanding of the nature of science was also quite good with the socio-scientific issues variable.

## CONCLUSION

Based on the results of data analysis and discussion, it is concluded that there is a positive relationship between socio-scientific issues and the nature of science. The correlation



coefficient of 0.729 shows a high correlation category, which means that the higher the students' socio-scientific issues ability, the students' natural science ability will also increase. Then, the coefficient of determination is 0.531, from the coefficient of determination it is known that the contribution of the socio-scientific issues variable to the nature of science is 53.1%, while the remaining 46.9% is determined by other factors not examined in this study.

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