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The Effect of the Socio-Scientific Inquiry (SSI) Learning Model on the Comprehension of Ecosystem Concepts by High School Students

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Abstract

Understanding biological concepts is the main target of learning because it relates to the Sustainable Development Goals (SDGs) objectives. However, understanding biological concepts still needs to be solved in Indonesia, one of which is the low understanding of biological concepts in ecosystem material. The purpose of this study is to ascertain how students' comprehension of concepts in ecosystem material is impacted by the Socio Scientific Inquiry (SSI) learning approach. A quasi-experiment with a two-group pre-test-post-test design was used in the research methodology. The sampling technique used was cluster random sampling. The research instrument was an essay with ten concept understanding questions in it. To find the standard deviation, mean, median, and mode of the data, descriptive analysis was employed as the data analysis approach. The independent t-test was used to assess the study's hypothesis, and the normality and homogeneity tests were run for the precondition analysis. The findings of the descriptive analysis show that the average post-test score in the experimental class is 80.50, whereas it is 67.83 in the control class. This discrepancy suggests that the experimental class's average post-test score is higher than that of the control group. T-test result found that the Sig (2-tailed) value was 0.000 < 0.05, which resulted in the acceptance of Ha and the rejection of H0. This suggests that students' conceptual comprehension is impacted by the Socio Scientific Inquiry (SSI) learning model. This study concludes that the Socio Scientific Inquiry (SSI) learning paradigm improves students' conceptual comprehension when compared to standard learning paradigms.

Keywords: *Ecosystem, Socio Scientific Inquiry (SSI), Understanding concepts*

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INTRODUCTION

Learning aims to achieve satisfactory learning outcomes through reciprocal interaction between a teacher and students (Gaol et al., 2022). Radiusman (2020) and Rahmadhani et al., (2021) believes that in the learning process understanding concepts is a crucial factor that has great significance in learning. Concept understanding is the ability to comprehend the logic underpinning the consequences and application of an idea to a novel context (Abebe et al., 2023). In addition, Aritia and Suyanto (2019) Declared that a student's capacity for definition, interpretation, and re-communication of what has been described both orally and in writing is known as conceptual comprehension.

Their comprehension of biological concepts will influence students' comprehension of biological phenomena in daily life (Shen & Lee, 2018). Furthermore, students can apply various biological concepts in real-world scenarios and connect them to contemporary environmental challenges due to a clear comprehension of the concepts (Rinjani et al., 2022). One of the biology learning materials that demands a thorough comprehension of concepts is ecosystem material. Students must study about ecosystems in order to understand the importance of preserving both terrestrial and marine ecosystems (Arief, 2023). It is consistent with the objectives of Sustainable Development Goals (SDGs) 14 and 15, which address the terrestrial and marine ecosystems, respectively (Filho et al., 2018). The objectives of these SDGs are to safeguard biodiversity ecosystems and sustainable forest management, which will contribute to the reduction of deforestation and have a beneficial effect on environmental sustainability (Filho et al., 2019). Consequently, to accomplish the SDGs, students must comprehend the concepts contained in ecosystem material.

Consequently, the learning process in schools must prioritize efforts to enhance comprehension of ecosystem concepts. Nevertheless, empirical research has indicated that Indonesian students' comprehension of the ecosystem concept needs to be revised. Wahyuni et al., (2023) state that in learning students are still unable to interpret, give examples, classify and summarize ecosystem material. In line with Azizah & Alberida (2021), the mismatch between students' comprehension of concepts is one of the challenges associated with biology education. The results of direct tests conducted at one of the private schools in Medan indicated that 54.16% of students had a low understanding of concepts in biology subjects, particularly ecosystem material, which also supports this.

Teachers' limited learning approaches, still dominated by teacher-centered learning approaches, can lead to a lack of comprehension of concepts (Lestari & Ristontowi, 2021). The lecture learning method is one of the limitations that hinders comprehension of concepts. Students are likely to be resistant and passive, acting as mere spectators (Tammu, 2018). It is consistent with the findings of observations conducted at a private school in Medan, which indicated that students' inadequate comprehension of concepts was attributable to the learning process's continued emphasis on the teacher, while students merely listened. Teachers' reaction to these issues is to innovate the way that they teach. Introducing pupils to pertinent socio-scientific issues (SSIs) is a useful way to improve their conceptual understanding. According to Kinslow et al. (2019), socio-scientific challenges are complex, dynamic problems that

incorporate scientific methods and knowledge into social difficulties that emerge. Complementary Given that education must include socially relevant content, it is imperative to take socioscientific issues into account as a backdrop (Hancock et al., 2019).

Social science problems are often used in biology teaching, especially when it comes to ecosystems (Maryam & Suwono, 2023). Thus, in order to promote scientific literacy, the Socio-Scientific Issue provides a strong framework for immersing educators and students in scientific conversation (Macalalag et al., 2020).

Consequently, educators require a learning model that serves as a guide to assist them in applying this approach and context in the learning process (Maryam & Suwono, 2023). The Socio-Scientific Inquiry (SSI) learning model is a method that engages students in the context of social problems and science material. SSI is a learning strategy founded on inquiry involving students in scientific work that has a substantial cognitive impact by incorporating learning issues (Fahrurrizal et al., 2019). Additionally, SSI learning allows students to investigate the connection between science and life using the addressed subjects (Cook & Buck, 2013). The student's perspective, desires, and needs are the primary sources of SSI problems (Amos & Levinson, 2019).

Although numerous studies have been conducted on Socio-Scientific Inquiry (SSI), most of these studies concentrate on students' creative thinking abilities (Indriani & Jayanti, 2022). According to Azizah et al., (2021) Analyse the Socio-Science learning paradigm for problem-based learning-based literacy skills. Additionally, Lestari et al. (2021) investigate the effects of socioscientific problems on students' communication abilities in the inquiry-based learning paradigm. Meanwhile, Qamariyah et al., (2021) examine the study Socio-Scientific problems in the Model of Inquiry Learning for Higher Order Thinking skill. Research examining Socio Scientific Inquiry has been conducted by Maryam & Suwono, (2023) who focuses on decision-making skills.. This provides a chance to look at how students' comprehension of ecological concepts is affected by the Socio Scientific Inquiry (SSI) learning approach. The purpose of this study is to determine how the Socio Scientific Inquiry (SSI) learning approach affects students' conceptual understanding of ecosystem content, considering the issues above and the context. The results of this study should encourage teachers to incorporate relevant scientific concerns that have a big impact on social life into their lessons to help students better understand the material

METHOD

This study was characterised as a quasi-experimental investigation since it used a two-group pre-test-post-test design. In this study, students' conceptual knowledge served as the dependent variable (Y), and the independent variable (X) was the Socio Scientific Inquiry learning model. Two separate courses were used for the research: the experimental class learned using SSI, and the control class learned using traditional methods.

Population and Sample

Ninety students from three classes in class X Science at one of the private high schools in Medan City made up the population of this study. Class X IPA 1 (control class) with thirty students and class X IPA 2 (experimental class) with thirty students were the

classes chosen as samples. Cluster random sampling was the method of sampling that was applied.

Instrument

An essay with 10 questions that tested conceptual understanding was the research tool utilized in this study. The seven components of conceptual comprehension that were covered by the measure were classifying, summarizing, comparing, interpreting, explaining, and exemplifying. Evaluation specialists assessed the validity of the instrument to determine whether the content, Basic Competencies, question structures, and language usage were appropriate. Cronbach's Alpha and Pearson Product Moment were employed to evaluate the validity and reliability of the instrument. The validity results showed that this instrument was reliable and valid for usage, with a validity score of 0.903.

Table 1. Description of Socio Scientific Inquiry (SSI) learning activities by (Ariza et al., 2021)

Syntax	Teacher Activity	Implementation
ASK (Determining authentic questions related to socio-scientific issues)	1. The teacher presents SSI-based videos regarding phenomena related to environmental issues such as water or air pollution 2. The students identify, then ask questions and provide hypotheses about what has happened	Face-to-face meeting
Find out (Answering authentic SSI-based questions)	3. The teacher distributes the student Worksheets (LKPD) with Ecosystem material and the teacher forms groups 4. The students are asked to analyze and answer the questions that have been presented 5. The students hold study group discussions consisting of 5-6 people	Face-to-face meeting
ACT (determining solutions by taking action)	6. The students are given the opportunity to answer questions and hypotheses according to what they see on the LKPD 7. The students carry out a literature review from several agreed sources 8. The students present the results and create solutions from what they have concluded	Face-to-face meeting
Evaluation	9. The teacher guides and asks students to conclude the results of discussions and learning materials 10. The students conclude the results of the learning they have done	Face-to-face meeting

Procedure

The preparation, implementation, and completion phases of this research were separated into three phases. The steps of preparation included identifying the study population, developing a Learning Implementation Plan (RPP), establishing a worksheet (LKPD), and gathering validated multiple-choice test questions as research instruments. During this implementation stage, the following activities were done: 1) the teacher explained the learning objectives, 2) the students took a pre-test before beginning the learning process, and 3) the control class used a conventional learning model to learn the ecosystem material. 2) the teacher presented information using the lecture method, 3) the teacher checked students' understanding and provided feedback, 4) the teacher provided opportunities for further practice by giving assignments. Meanwhile, in the experimental class, Socio-Scientific Inquiry learning was implemented by providing LKPD, which contained learning activities according to SSI syntax. Table 1 presents the SSI syntax.

Data analysis

Both descriptive and inferential analyses were performed on the research's data. The application of learning and concept understanding scores average, standard deviation, minimum score, and maximum score obtained from each group is described using descriptive data analysis. Prior to doing the inferential analysis, two preparatory tests are performed: the Levene statistical test for homogeneity and the Kolmogorov-Smirnov test for normality. The goal of inferential analysis employing the independent sample t-test is to determine the impact of SSI learning model implementation on students' conceptual comprehension of ecological content. According to the research results criteria, if the t-test significant value is less than 0.05, then Ha is accepted and H0 is rejected, indicating that the independent and dependent variables have an influence on each other.

RESULTS AND DISCUSSION

This research has produced quantitative data. The data was obtained using a test of students' concept understanding, measured or seen using student-completed pre- and post-tests. After processing the data from the pre-test and post-test results for the experimental and control classes, the descriptive statistical data was acquired. The descriptive analysis's findings demonstrate that students' conceptual comprehension scores improved during the pre- and post-test periods. In the experimental class, there is a minimum pre-test score of 15 and a maximum score of 60. There is also a minimum post-test score of 70 and a maximum score of 95. In the control class, the minimum score on the pre-test is 15, the maximum is 60, the minimum score on the post-test is 50, and the maximum is 85. The average (mean) value in the experimental class has increased by 24. In contrast, the control class's average (mean) pre-test value was 35.83 with a standard deviation of 14,389 and its average (mean) post-test value was 67.83 with a standard deviation of 8.375, indicating a 32-fold increase in the control class's average (mean) value. The experimental class's average (mean) pre-test value was 38.50 with a standard deviation of 14,922 and the average (mean) post-test value was 80.50 with a standard deviation of 7,114. The

average pre-test and post-test scores for the control and experimental courses are contrasted in Figure 1.

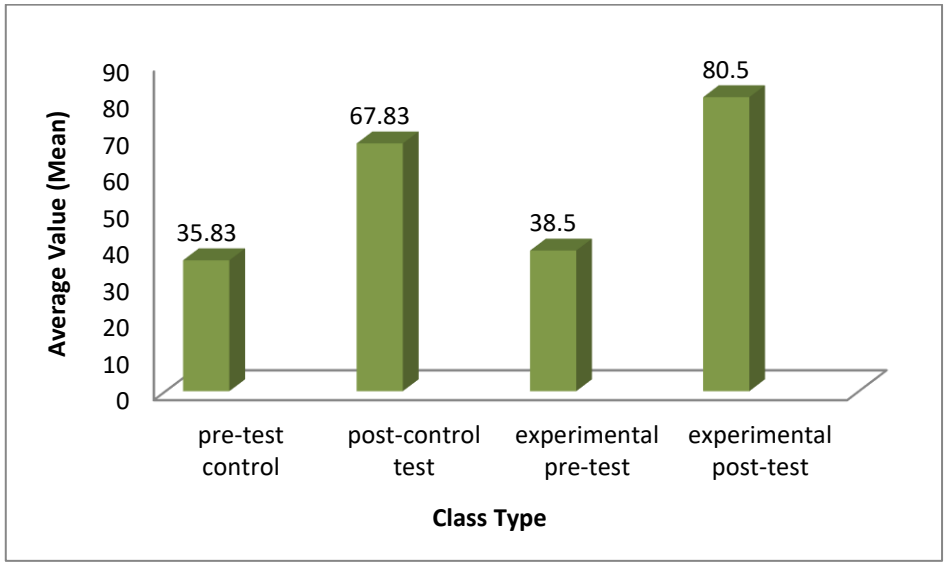

Figure 1. Comparison graph of the average pre-test and post-test scores of control and experimental classes

The above chart shows that the experimental class taught using Socio Scientific Inquiry (SSI) had an average value (Mean) of grasping concepts in ecosystem content that was greater than the control class taught using the traditional learning methodology. In order to determine the results of the t-test hypothesis test, the pre- and post-test data from the control and experimental classes are subsequently subjected to data analysis. This includes a homogeneity test using Levene statistics and a normality test using Kolmogorof-Smirnov. The results of the normality test for the pre- and post-test data in the experimental and control groups are shown in Table 1.

Table 1. Normality Test Results

Data type	**Class**	**Sig. Kolmogorov-Smirnov**	Information
Pre-test	Experiment	0.200	Normal
	Control	0.199	Normal
Post-test	Experiment	0.146	Normal
	Control	0.169	Normal

The data indicates a significant level (Sig.)> 0.05 for both the experimental and control groups, according to the findings of the normality test performed using SPSS on the pre-test and post-test scores. The experimental class has a pre-test value of sig.0.200>0.05 and a control class of sig.0.199>0.05; the experimental class has a post-test value of sig.0.146>0.05 and a control class value of sig.0.169>0.05. These findings suggest that the data is typically dispersed. The Levene statistical test is used in the homogeneity test within the SPSS software. If the probability (Sig.) is greater than 0.05,

the data is homogeneous. The findings of the homogeneity analysis are shown in Table 2.

Table 2. Homogeneity Test Results

Data Type	Sig value	Information
Post-test scores of control and experimental classes	0.372	Homogeneous

The data is homogeneous and has the same variance, according to the Levene statistical test results for homogeneity, since its significance (Sig.) >0.05, or 0.372, is present. The learning outcomes are homogeneous and normally distributed based on the findings of the prerequisite test, and a hypothesis test analysis is performed to determine whether or not H0 is accepted using the t-test. The purpose of this hypothesis test is to ascertain whether the Socio Scientific Inquiry (SSI) learning model, particularly with regard to ecosystem content, enhances students' conceptual grasp of biology. The post-test results that student received provide the information required for the subsequent t-test. The findings of the student post-test t-test analysis are shown in Table 3.

Table 3. Hypothesis Test (T-test)

		Independent Sample Test t-test for Equality of Means		
		Df	**Sig.(2-tailed)**	**Mean Difference**
Learning outcomes	Equal Variences assumed	58.00	0.000	12.667
	Equal Variances not assumed	56.52	0.000	12.667

The results of the t test are shown in the above table, with the Sig value (2-tailed) 0.000<0.05 indicating that H0 is rejected and Ha is accepted. This indicates that there is a relationship between the Socio Scientific Inquiry (SSI) learning model and students' conceptual knowledge. Additionally, there is a distinction between students taught using the conventional learning model and those taught using the Socio Scientific Inquiry (SSI) approach in terms of their average conceptual comprehension scores. These findings show that students' conceptual knowledge while utilizing the Socio Scientific Inquiry (SSI) approach is better than when they utilize the traditional model that was used in the control group. According to research by Hera (2018), students' conceptual understanding of environmental pollution content is influenced when they use the SSI learning paradigm. Apart from that, the research results conducted by Karahan & Roehrig (2017) also stated that integrating Socio-Scientific Inquiry (SSI) into learning can increase students' understanding of concepts.

Because the Socio-Scientific Inquiry (SSI) approach necessitates students to

independently acquire knowledge by investigating contemporary issues, a stimulus for interest and comprehension of scientific concepts related to phenomena that occur in life, particularly in ecosystem materials, the Socio Scientific Inquiry (SSI) approach has a substantial cognitive influence by incorporating issues in problem formulation activities (Fahrurrizal et al., 2019). In addition, SSI can be employed to state students' conceptual comprehension to generate enduring comprehension explicitly (Arini et al., 2021).

The learning syntax of the Socio-Scientific Inquiry (SSI) learning model is comprised of four stages: ASK (Determining authentic questions related to socio-scientific issues), Find out (Answering authentic questions based on SSI), ACT (determining solutions by taking action), and evaluation based on indicators of conceptual understanding in the form of interpreting, exemplifying, classifying, concluding, summarizing, comparing, and explaining. As a result, teaching with the Socio Scientific Inquiry (SSI) approach can improve students' conceptual comprehension, particularly when it comes to learning about ecosystems. The Socio Scientific Inquiry (SSI) learning model has the benefit of assisting students in practicing their conceptual understanding.

CONCLUSION

The preceding discussion's findings demonstrate how using the Socio Scientific Inquiry (SSI) learning model affects students' comprehension of ecosystem-related concepts. The study's findings suggest that the SSI model has a favorable effect on students' comprehension, so it is essential to strive for its widespread implementation in schools. Thus, follow-up efforts are needed to study the application of the SSI learning model in different material contexts. Through SSI, students can understand social phenomena in society through the science content studied at school.

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