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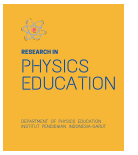

ARTICLE

Application of the Socio-Scientific Issues (SSI) learning approach to the Solar System learning to improve written argumentation skills

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Abstract

The purpose of this study was to find out that the application of the Socio-Scientific Issues (SSI) learning approach to the Solar System learning in junior high schools could affect the improvement of students' written argumentation skills. To find out differences in junior high school students' written argumentation abilities, the results of the treatment between learning using the Socio-Scientific Issues (SSI) approach and the conventional approach in learning the Solar System were compared. This research is a quantitative research with the type of quasi experimental research. This research was conducted in one of the junior high schools with the research sample chosen non-randomly. The instrument used is in the form of argumentative ability test questions which consist of six essay questions with argumentation indicators namely Claim, Evidence, and Reasoning. Based on the results of the analysis, it shows that the application of the Socio-Scientific Issues (SSI) learning approach to the Solar System learning in junior high schools can affect the improvement of students' written argumentation skills. In addition, there were also differences in the ability to write arguments after being given treatment between students who applied the SSI and students who applied the conventional approach. Thus, the application of the SSI approach is quite effective in training junior high school students' written argumentation skills.

Keywords: Socio-Scientific Issues (SSI), argumentation skills, Solar system

1. Introduction

Based on sociological and philosophical studies of science, science education views argumentation as a central scientific practice that students must learn (Songsil et al. 2019). This is due to the lack of training in students' written argumentation skills which can be caused by several factors, one of the influencing factors is the teacher's lack of mastery of techniques or ways of teaching so that it affects the arguments they have (Dawson and Carson 2020). There are three reasons why argumentation is very important in the learning process: to develop and improve knowledge

scientifically; to strengthen scientific debate in society; and to strengthen students' understanding in learning (Osborne et al. 2019).

Moreover, at the level of junior high school, there is still low service in the learning process (Dwipayana, Redhana, and Juniartina 2020). Not only that, students also experience obstacles in their learning process (Zalat, Hamed, and Bolbol 2021). One of which is in the Solar System material where the learning process students only do simple practices and use more textbooks (Inaltekin and Goksu 2019), which seems far from social issues which is currently happening. The Socio-Scientific Issues (SSI) learning approach is learning that involves students to strengthen their arguments with solutions that are not simple because they involve complex social issues (Zeidler, Herman, and Sadler 2019). So that the application of the Socio-Scientific Issues (SSI) learning approach can be used as an alternative to solving problems in learning the Solar System at the junior high school level, whether it is carried out offline or online.

Applying the Socio-Scientific Issues (SSI) learning approach can certainly help students generate arguments, seek the truth, be open-minded, analytical, systematic, wise, and more confident with their reasons (Kaur et al. 2020). In addition, Socio-Scientific Issues (SSI) are very effectively used in learning science, one of which is physics, because it can increase students' arguments (Bossér and Lindahl 2019). Therefore, researchers are interested in conducting research with the aim of applying the Socio-Scientific Issues (SSI) Learning Approach to Solar System learning in junior high Schools to improve Students' Written Argumentation Skills.

2. Literature Framework

2.1 Socio-Scientific Issues (SSI) learning approach

The Socio-Scientific Issues (SSI) learning approach is an approach that takes social issues contained in scientific contexts that are usually related to science in the learning process. The purpose of Socio-Scientific Issues (SSI) Learning is to stimulate intellectual, moral and ethical development as well as to understand awareness of the relationship between social life and science (Rostikawati and Permanasari 2016). In the learning process using the SSI learning approach there are steps that must be considered. The steps that must be considered appropriately (Zeidler et al. 2005). Here are the steps as seen in Table 1. Based on these steps, we developed all activities that are suitable to solar system concepts.

Table 1. Steps of SSI learning process

Steps of SSI learning approach	Activities
Subject Matter Knowledge	The teacher provides basic knowledge of the material being taught and students understand the basic concepts of the material studied
Informal Reasoning	Students must be able to reason and understand the material.
Decision Making	The teacher places more emphasis on group work
Character and Reflective Judgment	The teacher gives a character assessment to each student and makes decisions.
Argumentation	The teacher stimulates students to bring up arguments or opinions between groups.
Moral Reasoning	The teacher emphasizes morals.
Life experience	The teacher directs students to the community environment.

2.2 Argumentation skills

Scientific argumentation is a skill possessed by a person in expressing his ideas or ideas based on existing data or facts (Ginanjar, Utari, and Muslim 2015). Argumentation has several characteristics.

First, in argumentation, of course, it must be the result of critical and reasonable thinking. Second, starting from the existing evidence and facts. Third, it is to influence people or invite and can be tested for its truth. As for measuring argumentation skills according, there are 3 aspects, namely identifying claims or statements to answer problems; identify evidence or scientific data to support a statement; and Identifying Reasoning or reasons are justifications that link claims and evidence (McNeill et al. 2006).

In this study, argumentation training for students was based on the characteristics of the argumentation component itself. First, students are involved in responding to SSI first and then they are encouraged to propose hypotheses on the issue. Second, students are trained to construct aspects in argumentation by getting used to making claims, reasoning, and evidence. The three students are encouraged to work with context-rich types of questions that require in-depth analysis for students to solve. In this context students are required to submit complete arguments in each of its components, namely claims, reasoning, and evidence.

2.3 Relationship between SSI dan argumentation skills

The relationship between Socio-Scientific Issues (SSI) and argumentation is that argumentation can reveal scientific events based on scientific evidence and concepts significantly which can strengthen the application of Socio-Scientific Issues (SSI) learning in involving social issues that are currently happening. In other words, SSI and this argumentation are very important in a lesson, the reason is because the application of this SSI is seen as a strategy in the learning process so that students can express arguments against an ongoing problem in the form of ideas or ideas.

In this study, prospective science teachers in Indonesia participated in a professional learning session on argumentation by explicitly teaching argumentation skills to eighth graders studying the solar system. During the two lessons, the teacher used the whole-class discussion and writing outline of two social issues to teach students about argumentation. Analysis of class observation field notes, lesson transcripts recorded written data and student interviews showed that four factors drove student arguments. These factors are: the teacher's role in facilitating whole-class discussion; use of writing framework; context of socio-scientific issues; and student roles. It is suggested that professional learning to promote student argumentation may need to be tailored to individual teachers and that extensive classroom-based research is needed to determine the impact of classroom factors on student argumentation.

3. Research Method

3.1 Research design

The design used in this study is the Non-equivalent Control Group Design with non-random sampling, and there is the same comparison between the experimental group and the control group. Both the control and experimental groups were given the pretest beforehand and both were given the same posttest. In this context, the experimental class was given a learning treatment using a socio-scientific issues approach. Meanwhile, the control class was given physics lessons using a conventional approach, specifically the conventional approach.

3.2 Participants

The population in this study were all seventh grade students for the 2021-2022 academic year at a high school in the city of Garut—which consists of three classes. The samples in this study were students of class VII-C as the experimental group and students of class VII-B as the control group, where the number of students in each class was 26 people. With the sampling technique in the research conducted, namely the Purposive Sampling technique. This sampling technique was taken non-randomly because there were considerations of certain characteristics or characteristics, for example the number of students who were homogeneous in each class. The reason for using this

technique is because it is very suitable for use in studies that do not carry out generalizations or quantitative research (Etikan, Musa, Alkassim, et al. 2016).

3.3 Instruments

The test questions given are in the form of essay test questions for written argumentation skills totaling 6 questions by making the questions guided by aspects of argumentation which have been discussed in the previous chapter (McNeill et al. 2006). The calculation of the value of the argumentation ability test is to calculate the acquisition score, then compare it to the maximum score, and multiply it by each item weight provided. The material for this test is the solar system.

The empirical validity of the test was tested on students who had studied the Solar System material, namely eighth graders who had studied the material. Then the items to be analyzed next are reliability. This reliability test is an instrument test to see the validity or consistency of the instrument to be used. As for calculating this reliability using the Cronbach Alpha formula. The results of the calculations show that the reliability of this question is 0.786 (high category) (Etikan, Musa, Alkassim, et al. 2016).

3.4 Data analysis

The research data used in this data analysis is pretest and post-test value data from the two groups that have been pre-processed. The purpose of this research data analysis is to answer the research problem formulation. The type of data analysis used in this research is descriptive statistical analysis and inferential statistical analysis. The first step is to carry out a descriptive analysis, then test the data based on normality and homogeneity tests, after that, the data will prove to be normal and homogeneous, then the researcher will conduct a hypothesis test, and after that the researcher can perform a t-test on Normalized Gain (N-Gain) to determine the increase in each indicator of student argument. In analyzing the data researchers used the IBM SPSS application version 25.

4. Result of the research

Based on the results of observations that have been made using the Socio-Scientific Issues (SSI) approach, there are 3 aspects that are observed, namely the preliminary aspects, core activities, and closing. The three aspects are broken down into 15 points. Meanwhile, this observation activity was carried out in 2 meetings and the results showed that all of these 3 aspects could be carried out in accordance with the observation sheet that had been filled in by the observer.

4.1 Descriptive statistical and inferensial representation

From the results of the pretest post-test above, the next step is to carry out a descriptive analysis using SPSS calculations and the results of the descriptive analysis are obtained in the table below.

Table 2. Data of descriptive statistics

Group	N	Minimum	Maximum	Mean	Std. Deviation
Exsperiment (pretest)	26	12	43	23.46	7.783
Exsperiment (post-test)	26	56	95	78.85	11.27
Control (pretest)	26	3	35	22.23	7.421
Control (post-test)	26	30	73	54.15	10.961

After calculating using SPSS, the normality test results were obtained before and after learning was given to both the experimental group and the control group, while the normality test results are shown in Table 3. Based on the output above, it is known that the significance (sig) for all data

is good for the Kolmogorov-Smirnov test and the Shapiro-Wilk test results are greater than 0.05, therefore this normality test is normal, both for the normality test before (pretest) and after (post-test) learning is given, namely the experimental group and the control group.

Table 3. The result of normality test

Group	Kolmogorov-Smirnova			Shapiro-Wilk		
	Statistic	df	Sig.	Statistic	df	Sig.
Experiment (pretest)	0.137	26	.200*	0.949	26	0.217
Experiment (posttest)	0.137	26	.200*	0.938	26	0.121
Control (pretest)	0.094	26	.200*	0.973	26	0.704
Control (posttest)	0.15	26	0.135	0.947	26	0.2

Furthermore, the homogeneity test aims to determine if the variance of the experimental and control group data is homogeneous or not, using the SPSS version 25 calculation. The homogeneity test output is known to have a significance (sig) Based on Mean is 0.362. This shows that the sig results based on the mean are greater than 0.05. Thus it can be concluded that the data variants of the experimental group and the control group are the same or homogeneous, for the results of the homogeneity test can be seen in Table 4. Based on the output of the homogeneity test above, it is known that the significance (sig) based on mean is 0.362. This shows that the sig results based on the mean are greater than 0.05. Thus it can be concluded that the data variances of the experimental group and the control group are the same or are homogeneous.

Table 4. The result of homogenity test

Measurements	Levene Statistic	df1	df2	Sig.
Based on Mean	0.845	1	50	0.362
Based on Median	0.622	1	50	0.434
Based on Median and with adjusted	0.622	1	49	0.434
Based on trimmed mean	0.804	1	50	0.374

4.2 The effect of SSI learning approach on argumentation skills

The data used in testing the effect of the SSI learning approach on argumentation skills is the pretest and post-test data of the two groups. From the output of pair 1 above, the result is "sig < *alpha*" then H (o) does not apply or is rejected, so it can be concluded that the Socio-Scientific Issues (SSI) learning approach to learning the Solar System in junior high school can have an effect on improving skills students' written arguments.

Based on the results of the independent sample t test that has been carried out, it is known that the significance result is Sig. (2-tailed) 0.000 < 0.05, it can be concluded that H(o) is rejected and H(a) is accepted, which means that there is a difference in the average results of students' written arguments after being given treatment between learning that applies the Socio-Scientific Issues (SSI) approach with learning that applies a lecture approach.

From the output of the N-gain score test calculation, it shows that the average N-gain score for the experimental group that applies the Socio-Scientific Issues (SSI) approach is 0.7 in the medium category and for the N-gain percent in the experimental group it has a value of 73%. included in the quite effective category. Meanwhile, based on the output of the N-gain score test calculation, it shows that the average N-gain score for the control group that applies the lecture approach is 0.4 which has the moderate category and for the N-gain percent in the control group it has a value of 41% which is included in the less effective category.

Based on the two outputs, it shows that the two methods have differences in improving students' written argumentation skills on the Solar System material. Thus learning by applying the Socio-Scientific Issues (SSI) approach is quite effective in improving students' written argumentation skills in learning the Solar System in junior high school. Whereas learning by applying the lecture approach is less effective in improving students' written argumentation skills in learning the Solar System in junior high school.

Table 5. The result of t-test

Groups	Paired Differences					T	df	Sig.
	Mean	Std. Deviation	Std. Error Mean	95%				
				Lower	Upper			
Experiment (pretest to posttest)	-55.385	9.663	1.895	-59.287	-51.482	-29.227	25	0
Control (pretest to posttest)	-31.923	11.93	2.34	-36.742	-27.105	-13.645	25	0

5. Discussion

In this study, the assessment was students' written arguments with racing indicators (McNeill et al. 2006). There are 3 aspects to measure the ability to write arguments, namely claims (statements), evidence (scientific data) and reasoning (reasons). Based on the results of the analysis of students' argumentation abilities, the average value was obtained which indicated that the students' initial test abilities on written arguments were still relatively low, both in the experimental group and the control group. This can be seen from the students' answers when given pretest questions, most students cannot write down scientific data about the material and cannot express statements (claims) and provide inappropriate reasons. So that on the ability of the initial test obtained a score of evidence (scientific data) < claim (statement) < reasoning (reason).

For the average score of students' final test abilities on written arguments, it has a fairly high value when compared to the score before being given treatment. This can be seen from the students' answers when given the final test questions (post-test), students have been able to answer questions based on argumentation indicators so that scores of claim arguments (statements) > evidence (scientific data) > reasoning (reasons) are obtained. However, even though there was an increase in scores in both groups after being given treatment between the experimental and control groups, the results remained that there were differences in students' argumentation abilities between learning that applied the Socio-Scientific Issues (SSI) approach and the lecture approach based on the Independent Sample t Test. The difference in argumentation ability can be caused by learning that applies SSI involving social issues that are currently happening related to science, while lecture learning does not involve social issues.

Not only that, the written argumentation skills of students who apply the Socio-Scientific Issues (SSI) learning approach to learning the Solar System at junior high School have an influence on improving students' written argumentation skills based on the results of the Paired Sample t Test. This is in accordance with one of the goals of Socio-Scientific Issues (SSI) that students are able to think critically, explain and analyze (Zeidler, Herman, and Sadler 2019). Thus this SSI learning approach can improve written argumentation skills because students are required to think critically. The results of this study can be used as input for teachers and prospective teachers to improve themselves related to the teaching that has been done by paying attention to appropriate learning methods in improving students' written argumentation skills.

6. Conclusions

The data and analysis of data obtained from this present study shows that the use of SSI learning approach in have positive impact to students' argumentation skills. This can be seen from the enhancement of pretest to post-test scores and the significance of result of t-test. We have obtained data that SSI learning approach provides some activities that are beneficial to students to promote written argumentation skills. They have trained to propose claim, reasoning, and evidence, from what they have learnt.

There are two practical implications from this present study. First, this approach can be used by whole physics or science teachers in any concepts of science. Secondly, the use of SSI should be designed creatively so that the teachers can motivate their students to think creatively in proposing scientific argumentation.

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