



## THE EFFECTIVENESS OF SOCIO-SCIENTIFIC ISSUES-BASED ELECTRONIC STUDENT WORKSHEET TO IMPROVE CRITICAL THINKING SKILLS FOR CLASS VII STUDENTS

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### Abstract

Technological developments have affected all aspects of life, including education. Advances in technology require people to be technologically literate. In addition, the occurrence of the COVID-19 pandemic also requires learning to be carried out online. This requires teachers to be able to develop teaching materials that can be accessed easily by students during the learning process. The learning process must also support the achievement of 21st-century skills, one of which is critical thinking. SSI-based learning can train critical thinking skills. The purpose of this study was to determine the effectiveness of the Electronic Student Worksheet based on socio-scientific issues (SSI) on environmental pollution materials to train the critical thinking skills of class VII students. The implementation was carried out on three class VII study groups using the One-Group Pretest-Posttest Design. Effectiveness in terms of increasing critical thinking skills during the learning. The improvement in critical thinking skills of students in grades VII-1, VII-3, and VII-4 is significant in the moderate category, with an N-Gain score of 0.48, 0.52, and 0.51. The student's response is positive, with a mode value of 4.

**Keywords:** Electronic student worksheet, socio-scientific issue (SSI), critical thinking

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**INTRODUCTION**

The rapid development of information technology and automation affects people's lives and the world of education (Wijaya, et al, 2016). Currently, the learning process does not only use manual methods in the classroom but also uses digital, online, and teleconferencing media (Astini, 2019). This requires mastery of technological competence or technology literacy for both teachers and students in the 21st century. The occurrence of COVID-19 pandemic also demands more mastery of technology in learning.

Online learning (on the network) can be used as a distance learning solution during a pandemic like this (Syarifudin, 2020). Fitriyani & Yuliani (2021) explain alternative teaching materials that can be developed to facilitate online learning, namely by developing learning media, one of which is the electronic student worksheet. Student worksheet emphasizes student activity, makes it easier for students to master the material, and contains assignments to practice and facilitate the learning process (Depdiknas, 2004).

The learning process must be able to support the achievement of the competencies required by education. 4C skills are a demand for education in the 21st century (Zahroh & Yuliani, 2021). These 4C skills include Creativity, Collaboration, Communication, and Critical thinking. Pieterse et al. (2016) explained that students need to be taught to have critical thinking skills in order to solve problems in everyday life, become reflective practitioners, and make decisions based on evidence. The results of research by Nuryanti et al. (2018) show that the critical thinking ability of junior high school students was still low.

Teachers can make several efforts to improve students' critical thinking skills, including implementing learning models that can improve critical thinking skills. One such learning model is socio-scientific issue-based learning (SSI). Understanding science issues in society or SSI is important for students because almost all aspects of life are related to science (Erman & Sari, 2019). With socio-scientific issue-based learning, students' critical thinking skills can be improved.

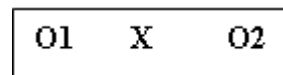
Learning about the environment has become an individual and social need because environmental problems have become the top topic on the world agenda (Arslan, 2012). Environmental problems that are currently often encountered are environmental pollution. Issues or phenomena related to environmental pollution have the potential to be studied by students in SSI-based learning so that students can apply their knowledge, analyze environmental problems, and make the right decisions according to their knowledge.

Based on this, a study was arranged to determine the effectiveness of E-LKPD based on socio-scientific issues (SSI) to improve the critical thinking skills of grade VII students. The effectiveness of E-LKPD in terms of increasing critical thinking skills and student responses to learning.

**METHODS**

**Research Design**

This type of research is quantitative research because it determines the effectiveness of electronic student worksheets in improving students' critical thinking skills. This study uses a trial design model One Group Pre-test – Post-test Design. The design formulation is as follows.



(Arikunto, 2012)

**Keterangan:**

O1 : Pre-test (before the learning)

X : The learning using socio-scientific issue-based electronic student worksheet.

O2 : Post-test (after the learning)

**Research Object**

The target or subject in this study is the SSI-based electronic student worksheet on environmental pollution material to train the critical thinking skills of class VII students, which was tested on three class VII students as a repetition at SMPN 1 Dawarblandong. The study was conducted in the even semester of the 2020/2021 academic year.

**Data Collection Technique**

The data obtained from this study were quantitative data consisting of increasing students' critical thinking skills and student responses. The improvement of critical thinking skills was obtained from the results of the pre-test and post-test, which were carried out using a written test. The critical thinking ability assessment sheet is in the form of critical thinking questions along with their answers and scores. The form of critical thinking questions is in the form of multiple-choice questions and essay. The number of questions that will be used is ten multiple choice questions and four essay items. The results of students' critical thinking skills were analyzed using the N-gain score to determine the increase. N-gain is calculated using the Hake formula as follows (Savinainen & Scott in Tukan, 2016).

$$g = \frac{S_{post} - S_{pre}}{100 - S_{pre}}$$

Description :

g = gain score

S<sub>post</sub> = *post-test* score

S<sub>pre</sub> = *pretest* score

Student responses were obtained through a questionnaire. The student response questionnaire is a questionnaire that must be filled out by students after participating in learning using an electronic student worksheet based on socio-scientific issues to determine the interest of students in learning and the effectiveness of the developed electronic student worksheet. The results of the student response questionnaire were analyzed using descriptive statistics, namely the mode, to find out the response scores that appeared the most.

**RESULT AND DISCUSSION**

Electronic Student Worksheet is a study guide for students that can be accessed via a browser, either on a smartphone or a computer, using the live worksheets platform. There are three electronic student worksheets developed, each consisting of a cover, student identity, learning objectives, step guides for learning activities, learning activities, and a bibliography.

The developed electronic student worksheet is based on *SSI* issues so that the learning activities consist of parts of the *SSI*-based learning syntax. In the issue orientation section, socio-scientific issues were presented in the form of news about pollution that occurred in several areas near the students' residences. In the section reviewing the material, learning materials were presented that must be studied by students. The material was presented in the form of Google Drive and Youtube, which students could learn directly in the electronic student worksheet by clicking on the link provided. In the exploration of personal ethical values, critical thinking skills were trained to evaluate, and students assess the actions in the issue according to their personal ethics. In the statement construction section, critical thinking skills were trained, such as making simple explanations, making estimates, and inferences. In the ethical/moral study section, students were asked to conduct a literature study to ensure that their opinions on the exploration of personal ethical values were in accordance with relevant and credible sources. In the decision-

making section, the ability to make decisions is trained, and students determine the appropriate efforts to overcome problems related to the issues presented.

The first electronic student worksheet was used at the first meeting to study water pollution. In the electronic student worksheet on water pollution, before the issue orientation section, students were asked to do a simple experiment to find out the difference between polluted and unpolluted environments. In the simple practicum section, an experimental guide video was presented, which can be seen by students directly on the electronic student worksheet. In the simple practicum section, critical thinking skills were also trained, observing and considering the results of observations, and making simple explanations. The second electronic student worksheet was used in the study of the second meeting to study soil pollution. The third electronic student worksheet was used in the learning of the third meeting to study air pollution.

There were several advantages of the developed electronic student worksheet. Electronic student worksheet could be accessed easily by students through a browser and does not require an e-mail login. Students could access the electronic student worksheet easily via smartphones so that the developed electronic student worksheet could be used in online learning. Electronic student worksheets contained several features, such as Google Drive and Youtube links. Learning videos presented through YouTube could be viewed directly in the electronic student worksheet without having to leave the browser. In addition, electronic student worksheet also contains socio-scientific issues and critical thinking skills so that they could train students' critical thinking skills.

The critical thinking skill of students was measured before and after learning using electronic student worksheet based on socio-scientific issues. This measurement was in the form of pre-test and post-test, which was done online via a Google form. The average critical thinking skill test results for students in grades VII-1, VII-3, and VII-4 can be shown in Table 1.

**Table 1.** The Results of Students' Critical Thinking Skill Tests Before and After Learning using Electronic Student Worksheet Based on Socio-Scientific Issues on Environmental Pollution Materials

Class	Results		N-gain	Category
	Pre-test	Post-test		
VII-1	73,25	85,75	0,48	Medium
VII-3	59,50	81,33	0,52	Medium
VII-4	60,58	81,67	0,51	Medium

The increase in students' critical thinking skills is in the medium category. This is because not all students' critical thinking skills have increased

significantly. There were some students who even did not complete the post-test results. There are students who have not finished classes VII-1 and

VII-3 due to the lack of active students in online learning. There are a number of six students who tend to be passive in learning and do not respond to learning directions in the Whatsapp Group. According to Nurhayati (2020), the form of student activity in the learning process can be seen from the involvement of students in the learning process, such as discussions, listening to explanations, solving problems, actively working on the task of making reports, and being able to present report results. This low-learning activity affected student learning outcomes (Gunawan, 2018).

Meanwhile, there are also many students who achieve completeness, and the N-gain score is in the high category. There are several factors that support the high increase in students' critical thinking skills. One of the factors is that they participate in learning using electronic student worksheets based on socio-scientific issues to the fullest. Rahayuni (2016) stated that critical thinking skills could be trained through learner-centered learning because students were active in constructing their knowledge. By learning to use electronic student worksheets based on socio-scientific issues, students are trained in analyzing issues based on the concepts of the lessons learned.

SSI involves the use of scientific topics that require students to engage in dialogue, discussion, and debate (Zeidler & Nichols, 2009). Issues that are controversial have added value in the form of moral and ethical levels in the decision-making process. The purpose of the integration of SSI in learning is to increase the meaning and interest of students in learning, and to demand the use of knowledge concepts based on reasoning evidence to understand scientific information.

The presentment of SSI in the E-LKPD used during learning required students to be able to think holistically in order to find the right solution to the issue. Study of news that contains SSI, analysis of SSI which is guided by several questions, and formulation of solutions to problems in news train students to think critically. So that students' critical thinking skills can increase after learning.

Critical thinking skills are also influenced by the teacher's role in motivating and providing direction to students regarding the steps of learning based on socio-scientific issues. This learning motivation affects student learning outcomes, especially in the context of critical thinking.

Students who have high learning motivation allow for high learning outcomes as well because the higher the motivation, the greater the effort and effort made, the higher the critical thinking skill (Nugraha, et al, 2017).

There were five critical thinking indicators that were trained and tested for students, namely (1) asking and answering questions from an explanation, (2) observing and considering the results of observations, (3) deduction, (4) evaluation, and (5) making estimates. When viewed from the N-Gain score for each critical thinking indicator, the indicator asking and answering questions from an explanation and observing and considering the results of observations in class VII-1, obtaining the highest score of 0.50. While in class VII-3, the indicator of deduction obtained the highest score of 0.67. And in class VII-4, the indicator of observing and considering the results of observations obtained the highest score of 0.78. So it can be concluded that the indicator of critical thinking ability with the highest increase is in observing and considering the results of observations. In these indicators, students are asked to compare experimental data so that the right conclusions are obtained. At the first meeting, students were asked to do a simple experiment to differentiate between polluted and unpolluted environments. Then, students were asked to observe and write down the data from the observations. The data is used to formulate the concept of environmental pollution. Learning hands-on activities has an effect on increasing critical thinking skills. Through hands-on activities, students can also benefit, including (1) increasing interest, (2) motivation, (3) strengthening memory, (4) being able to overcome learning difficulties, (5) avoiding misunderstandings, (6) getting feedback from students, and (7) connecting the concrete and the abstract so that students' critical thinking skills (Erti, 2017). Based on this explanation, it can be seen that the use of electronic student worksheets based on socio-scientific issues (SSI) on environmental pollution materials can train students' critical thinking skills.

To find out or test the significance of increasing critical thinking skills, the t-test is used (Arikunto, 2012). The results of the t-test can be shown in Table 2.

**Table 2.** The Result of T-test Improving Students' Critical Thinking Skill Class VII-1, VII-3, and VII-4

Class	t <sub>calculate</sub>	t <sub>table (0,05)</sub>	Description
VII-1	8,1932	1,6991	Significant
VII-3	10,2477	1,6991	Significant
VII-4	10,791	1,6991	Significant

Based on the calculations, it is known that in grades VII-1, VII-3, and VII-4, the increase in students' critical thinking skills occurs significantly. So, it can also be stated that the use of electronic student worksheets based on socio-scientific issues (SSI) on environmental pollution materials is effective in training students' critical thinking skills.

In addition to being seen from the improvement of critical thinking skills, the effectiveness of using E-LKPD based on socio-scientific issues is also seen from the response of

students to learning. After learning to use the electronic student worksheet based on socio-scientific issues, students were asked to fill out a questionnaire containing student interest in the learning components, student responses to the novelty of the E-LKPD component, student responses in understanding the components, student opinions about the novelty components of critical thinking, and the interest of students in participating in learning in other competitions. The results of student responses are shown in Table 3.

**Table 3.** The Results of Student Responses to Learning Using Socio-scientific-Based Electronic Student Worksheet on Environmental Pollution

No	Statement Description	Mode		
		VII-1	VII-3	VII-4
I	Student Interest in Components			
1	This learning material makes me interested in learning science	3	3	3
2	Electronic student worksheet which is used as a learning media can help me understand science lessons	4	3	4
3	I think the learning atmosphere with the socio-scientific issue-based learning model is fun	4	4	3
4	I am very happy because the electronic student worksheet used can be accessed easily via the internet	3	4	4
II	Student responses to the Component's update			
1	I am happy because electronic student worksheet contains problems that we can encounter in everyday life and we are given directions to find solutions	4	4	3
2	I am happy with the critical thinking skills training provided and I can work on my arguments	4	4	4
III	Student responses in understanding Component			
1	I feel more understanding by using the electronic student worksheet which is used to help study online	4	3	3
2	In this learning activity, I am happy with the way teachers teach using a socio-scientific issue-based learning model	4	4	4
IV	Students' opinions about the up-to-date component of critical thinking skills			
1	If I am asked a question or rebuttal I can provide an argument accompanied by data from relevant and credible sources	3	3	3
2	I like being guided by the teacher to learn to deal with problems from various points of view	4	4	3
3	I like to be able to make decisions based on the problems and learning materials at the time.	4	3	3
4	I am happy to be able to estimate the sustainability of a problem	4	3	4
5	I am more satisfied if I can conclude the learning together with the teacher	4	4	4
V	Interests of students taking lessons in other competencies			
1	I would be happy if other materials could be taught using a socio-scientific issue-based learning model	4	3	4
2	I will be happy if other materials can be taught with electronic student worksheet	4	3	4
	<b>Mode</b>	4	3	4
	<b>Reliability</b>	85,17 %	84,61 %	85,17 %

Based on Table 3, it can be seen that the value of the student's response tendency is 4. This

shows that students respond positively to learning activities using electronic student worksheets based

on socio-scientific issues. Interest and interest in learning students have an influence on learning outcomes. The high learning interest of students in learning using electronic student worksheets based on socio-scientific issues has an influence on increasing critical thinking skills. Prihatini (2017) mentions that the presentation of material and the selection of discussion methods in the science learning process were very important in attracting students' interest and attention. If someone has a great interest in the lesson, then the value of learning outcomes tends to change in a better direction.

The reliability of the responses of students in grades VII-1, VII-3, and VII-4 to learning using electronic student worksheets based on socio-scientific issues (SSI) on environmental pollution material is more than 75% and can be categorized as reliable so that the response given by 90 students are consistent. Thus, students give a positive response to learning using electronic student worksheets based on socio-scientific issues (SSI) on environmental pollution material, so the learning tools developed are effective and feasible to be applied in learning to practice critical thinking skills.

## CONCLUSION AND SUGGESTION

### Conclusions

Based on the results of research data analysis and discussion, it can be concluded that electronic student worksheet based on socio-scientific issues of environmental pollution material is effective in improving students' critical thinking skills. The improvement of students' critical thinking skills in class VII-1 is in the medium category, with an N-Gain score of 0.48. The improvement of students' critical thinking skills in class VII-3 is included in the medium category, with an N-Gain score of 0.52. The improvement of students' critical thinking skills in class VII-4 is included in the medium category, with an N-Gain score of 0.51. Student responses to learning are positive, with a trend value of 4 and reliability >75%, so it can be categorized as reliable.

### Suggestion

Based on the research that has been done on the effectiveness of electronic student worksheets based on socio-scientific issues on environmental pollution material, the suggestions that can be given by researchers include: (1) Teachers can use electronic student worksheets based on socio-scientific issues to improve students' critical thinking skills on the material of environmental pollution. (2) If learning is carried out online, the teacher should ensure in advance that students have an adequate internet quota so that learning using electronic student worksheets can progress

optimally. (3) Researchers should always innovate to create learning models that are in accordance with the characteristics of students and learning materials so that learning objectives can be achieved optimally.

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