



The Development of E-Student Worksheet on Environmental Pollution to Improve Critical Thinking Skills of Junior High School Students

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Abstract: This study purposed to develop an E-student worksheet on environmental pollution material to improve the critical thinking skills of junior high school students. E-student worksheet is an electronic-based student worksheet that utilizes the internet in its application. E-student worksheets can create various kinds of visual and audiovisual content to train and assist students in finding concepts through the learning process. The development research method used a 4-D model, but only three stages were carried out: defining, designing, and developing. This research was conducted on seventh-grade students at SMPIT Al Ghazali Jember. The instruments used in this study were validation sheets, learning implementation sheets, critical thinking skills tests, and student response questionnaires. The results of this study indicated that the E-student worksheet had very valid criteria with a value of 94%. The implementation of learning showed very high criteria with a value of 92%. The effectiveness of learning had effective criteria with an average N-gain value of 0.70, and student responses had a good criterion, with a value of 77.3%. It can be concluded that the E-student worksheet on environmental pollution material could improve students' critical thinking skills in science learning in junior high school.

Keywords: E-Student Worksheet; Critical Thinking skills; Environmental Pollution

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Introduction

Sciences study natural phenomena that include living and non-living things in life (Rahayu et al., 2012). Science learning has very complex characteristics because it requires critical thinking skills in analyzing a problem (Rahayuni, 2016). In the application, many students still have difficulty understanding abstract material due to the lack of students' critical thinking ability (Awalsyah et al. 1., 2018; Mulyadi et al. 1., 2016).

Critical thinking skills are a process of thinking deeply about information to obtain accurate

conclusions through investigation, exploration, experimentation, and others in which it can build students' knowledge significantly (Wahyuni et al., 2019). Critical thinking skills can occur because students face complex problems, where the problem will be a challenge for students to use their various abilities, such as analyzing and conveying arguments, giving classifications, providing evidence, reasoning, analyzing the meaning of an opinion, and the ability to draw conclusions. (Afifah & Nurfalah, 2019).

Students' critical thinking skills are important to develop in the learning process because they are the

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basic in understanding science learning concepts (Dewi et al., 2016). The ability to think critically is very important for students because it can help students to think rationally in overcoming problems in everyday life (Hidayat et al., 2019). In addition, critical thinking skills can also be used to solve problems. It can be taken into consideration in making the right decisions (Wahyuni, 2015).

Based on the results of observations at school, students' critical thinking skills were not as expected, or it could be said that critical thinking skills were still relatively low. According to Utomo et al. (2020) stated that the decline in student achievement in science learning in Indonesia was based on the results of the TIMSS (Trends in International Mathematics and Science Study) assessment program in 2011, which reported that science learning achievement from 42 participating countries, Indonesia was ranked 40 or number 2 from below. This statement is supported by the statement of Utomo et al. (2018), which states that the achievement score is included in the cognitive domain, which includes knowledge, application, and reasoning with 406 points from the center of the TIMSS 500 scale. This Result shows that students' abilities in the realm of reasoning are still in the low category, which is 45.7 % of students experienced reading errors so that they were wrong in giving answers.

The low critical thinking ability could be caused by several things, including media and learning resources that have not been used optimally in the application of learning in the classroom (Triono & Santoso, 2018). According to Nuryanti et al. (2018), students' low critical thinking ability was also caused because students were less familiar with active learning and could not maximize their thinking potential. In addition, teachers could still optimally integrate critical thinking into the learning process (Choy & Oo, 2012).

One of the problems in the learning process that is often faced by students related to critical thinking is the topic of environmental pollution. Teachers in environmental pollution have not trained the learning process and evaluation questions to develop critical thinking skills (Supriatna, 2019). Meanwhile, the learning process carried out is generally still teacher-centered, so it cannot teach students concretely material about the complexity of problems in environmental pollution. It could be caused that students do not understand the concept (Assa et al., 2018).

According to Sari & Bharata (2017), the process of understanding the concept will be better if it is guided by the activity steps contained in the Student Worksheet (student worksheet). A student worksheet is one media that students can use as a guide in conducting investigation activities or solving problems (Fitriani et al., 2017). Through this student worksheet,

the learning process could improve the knowledge and critical thinking skills. Students will remember not only facts and events but also the results of self-discovery, a science concept. Additionally, critical thinking skills can increase (Firdaus & Wilujeng, 2018).

Several research efforts have been carried out, such as the research conducted by Firdaus & Wilujeng (2018), which developed the student worksheet with the theme "*Gunung Meletus*." The results of the study stated that there was an increase in students' critical thinking skills who were in the medium category with a score of 0.43 and received a score of 0.43 for positive student response. Then the research was conducted by Sari & Bharata (2017) by developing a student worksheet on circle material, with the results of his research stating that students' critical thinking skills increased after using student worksheets in learning with all critical thinking indicators increasing. This Result shows that student worksheets can improve students' critical thinking skills.

However, those efforts have only used conventional student worksheets. It has never used E-student worksheets or electronic student worksheets as media used in learning. Where in online learning (On the Network) during the current Covid 19 pandemic, the E- student worksheet is necessary to use. Using the E- student worksheet as a learning medium connects time and space limitations (Ferdiana, 2020). Based on that analysis, this study developing E- student worksheet to improve the critical thinking skills of junior high school students. According to Asma et al. I. (2020), the use of the E- student worksheet was an interactive media addressed to help teachers more easily in the classroom. Students can also learn happily without feeling bored. Chinedu et al. (2015) stated that E- student worksheet was an innovative learning tool to support learning objectives. Thus E- student worksheets can be an alternative teaching material that can help students be more active in learning activities to improve critical thinking skills. One of the websites that facilitates the creation of E- student worksheets is *liveworksheet.com* which can be accessed for free by teachers. The advantage of using an E-student worksheet can be directly sent to the teacher when students have done it. Furthermore, E- student worksheet can contain images, audio, and videos that the teacher can design.

Based on the description of the problems above, the purpose of this research is to develop E- student worksheet on environmental pollution material to support the science learning process to improve the critical thinking skills of junior high school students in terms of validity, practicality, and effectiveness.

Method

This research was development research (R&D) because this research created a new product using the Thiagarajan 4-D development model. The development model was chosen because the stages used were suitable for developing the E-student worksheet. The stages in the 4-D development model are definition, design, development, and dissemination (Tanjung & Nababan, 2018). However, this study only focused on the development stage because researchers have limited time and money.

The instruments used in this study were validation sheets, learning implementation sheets, critical thinking skills tests, and questionnaires of student responses. The validation test was calculated using the formulation (1), and the validation criteria are shown in Table 1.

$$V-ah = \frac{TSe}{Tsh} \times 100\% \dots\dots\dots(1)$$

- V-ah = expert validation
- Tse = empiric score achieved
- Tsh = expectation of the total score

Table 1. The validation criteria

No.	Aspect (%)	Kriteria Validitas
1.	81 < V ≤ 100	Extremely valid
2.	61 < V ≤ 80	Valid
3.	41 < V ≤ 60	Lack of valid
4.	0 < V ≤ 40	Not valid

(Akbar, 2011)

The Practicality data is extracted from learning implementation. The Result of the learning implementation was consulted in Table 2.

Table 2. Criteria of learning implementation

No	Aspect (%)	Criteria
1	80.1 - 100	Very high
2	60.1 - 80	High
3	40.1 - 60	Moderate
4	20.1- 40	Low
5	0 - 20	Very low

(Akbar, 2011)

Presentation of the learning implementation was calculated using the formulation (2)

$$(p) = \frac{\Sigma x}{n} \times 100\% \dots\dots\dots(2)$$

- P = percentage of the implementation
- Σx = amount of item implemented
- n = amount of question items

Data on the effectiveness of the E- student worksheet were obtained from the normalized gain average score (N-gain) and student responses to the E-student worksheet. The N-gain was calculated using the formulation (3), and the Result was consulted in Table 3.

$$(g) = \frac{S_{post} - S_{pre}}{S_{m-ideal} - S_{pre}} \dots\dots\dots(3)$$

- <g> = Avarage score gain normalized
- S_{post} = Avarage of student’s final score
- S_{pre} = Avarage of student’s initial score
- S_{m-ideal} = Maximum score

Table 3. Category Scale Average Score N-gain

No	Value <g>	Criteria
1	<g> ≥ 0.7	High
2	0.3 <g> <0.7	Moderate
3	<g> <0.3	Low

(Asyhari, 2015)

Furthermore, the data obtained from the distribution of student response questionnaires were processed by the percentage obtained using the formula (4).

$$P = \frac{\text{Skor item yang diperoleh}}{\text{Skor maksimum}} \times 100\% \dots\dots\dots(4)$$

After obtaining the percentage value, then the value obtained was categorized based on Table 4.

Table 4. Student Response Questionnaire Score Criteria

No	Intervals (%)	Criteria
1	25 - 43.7	Not good
2	43.8 - 62.5	Moderate
3	62.6 - 81.25	good
4	81.26 - 100	Extremely good

(Akbar, 2016)

Result and Discussion

Validation analysis

In this study, the product developed by the researcher was E- student worksheet. In the development of E- student worksheet activities, several stages were carried out to obtain an E-student worksheet with the topic of environmental pollution. The Result was in the valid category. The product of the E-student worksheet is shown in Figure 1.



Figure 1. Cover Description and the content of E-student worksheet

At this stage, the validation process was carried out by three experts, namely media experts, material experts, and users. The results of the validator's assessment of E-student worksheet products on environmental pollution materials to improve critical thinking skills in junior high school science learning are described in Table 5.

Table 5. The Result of E-student worksheet Validation

No.	Aspects	Values (%)	Criteria
1.	Formats	91	Extremely Valid
2.	Language	93	Extremely Valid
3.	Content	99	Extremely Valid
4.	Graphics	93	Extremely Valid
Rata-rata		94	Extremely Valid

Based on the results of the analysis of the three validators, the average E-student worksheet validation value showed 94%, and it is included in the Extremely valid criteria.

Practical Analysis

The practicality used in this research was the implementation of learning. After producing a valid E-student worksheet then the development process was continued into the trial stage. The subjects of the development test were 20 students of class VIIC SMPIT Al Ghozali. The development test data obtained in this development research were data on the implementation of learning using an E-student worksheet on the topic of environmental pollution. Learning implementation data using the E-student worksheet was obtained through three observers who assessed the implementation of learning during the learning activities. The analysis of the implementation of learning can be seen in Table 6.

Table 6. The Result of implantation learning

No	Activities	Percenteg each aspect (%)	Criteria
1	Introduction	94	Very high
2	Learning core	94	Very high
3	Closing	88	Very high
Rata-rata		92	Very high

Based on the results in Table 6, it could be seen that the implementation of learning using the E-student worksheet showed an average percentage of the entire meeting of 92% so that the implementation of learning could be said to be very high.

Effectiveness Analysis

The effectiveness of the trial test in this development reseach produced the students' critical thinking skills after learning using the E-student worksheet. It was also student responses after using the E-student worksheet in learning activities. Students' critical thinking skills could be measured and assessed from the results of formative tests in accordance with the indicators of critical thinking skills using six critical thinking indicators adapted from Facione. The tests used were in the form of a pretest which was conducted before the use of the E-student worksheet,

and a post-test which was conducted after the use of the E- student worksheet. Table 7 showed the Result of the students' critical thinking when they utilized the E- student worksheet in their learning process.

Table 7. Critical Thinking Ability Test Results

Components	Pretest	Post-test	N-gain <g>	Criteria
N	20	20		
XMin	10	65	0.70	High
XMax	50	95		

Based on Table 7 showed that the value of N-gain in class VII students was 0.70. This Result could be interpreted as an increase in students' critical thinking skills in grade VII after using the E-student worksheet on environmental pollution with high criteria. Furthermore, an analysis of student responses to the E-student worksheet was carried out. Student responses were useful for measuring student responses after using the E- student worksheet. The results of the student response analysis can be seen in Table 8.

Table 8. The Result of summarizing students' response

No.	Aspect	Presentation (%)	Category
1.	Interesting	76	Good
2.	Material	76	Good
3.	Language	80	Good
	Avareage score	77.3	Good

Based on the results of the average student responses in Table 8, the results of the average value of student responses showed a value of 77.3%. This Result showed that the E- student worksheet received a good response from students and the percentage in each aspect, which indicates that the student's response was included in the good category.

Conclusion

The results of this development research could be concluded that E- student worksheet on environmental pollution improved students' critical thinking skills in science learning in junior high schools. This could be seen from 1) The results of the validation based on the three validators showed a value of 94% with very valid criteria, 2) The results of the analysis of the implementation of learning using E- E-student worksheet showed a value of 94% with very high criteria, 3) The results of the effectiveness analysis after using the E- student worksheet showed an N-gain value of 0.70 with high criteria, and student responses to the E- student worksheet showed a value of 77.3% with good criteria.

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