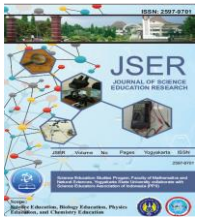
JSER 2021, 5(1), 46-53

JSER

Journal of Science Education Research

Journal homepage: www.journal.uny.ac.id/jser



# Critical thinking skills and sustainability awareness for the implementation of education for sustainable development

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**Keywords:**
Education for Sustainable Development, Sustainability Awareness, Critical Thinking Skills

## ABSTRACT

Education for Sustainable Development (ESD) is very important for environmental utilization while protecting environmental conditions. Therefore, learning needs to facilitate students to have sustainability awareness and critical thinking skills. This study aimed to analyse critical thinking skills and sustainability awareness among junior high school students through the use of teaching materials in science learning. The samples of the study were 213 students and six teachers of junior high school in Bogor municipality. The data collection technique was a Likert scale questionnaire to determine sustainability awareness, a reasoned multiple-choice critical thinking skill test, and an open questionnaire to explore the need for teaching materials. The results showed that the average sustainability awareness of students was 3.65, which is included in the moderate level. The acquisition of each component of sustainability awareness was sustainability practice awareness (37.95%), behavioral and attitude awareness (70.63%), and emotional awareness (86.92%). The average score of students 'critical thinking skills was 28.68%, which indicated the level of students' critical thinking skills was in a weak category.



## INTRODUCTION

Sustainable development is an effort to use the environment for development, but still protect and preserve the environment which aims to support human needs in the present and future (Nursadiah et al., 2018: p. 208; Segara, 2015). Education is the main foundation for sustainable development because it increases the ability to create solutions and find new paths to a better sustainable future (Tristananda, 2018: p. 42; UNESCO, 2012). Environmental problems can only be solved by raising awareness about the problems in the environment. Therefore, one of the most influential initiatives on environmental-protection and increasing environmental-awareness is through strengthening the environmental-education on primary and junior high school education (Ergin, 2019: p. 153; Ntanos et al., 2018: p. 1). For environmental-education, critical thinking skills need to be trained to students as these abilities make a person aware of and find solutions to the problems carefully. Thinking skills, especially in the industrial revolution 4.0, are essential skills that must be possessed by every graduate at every level of education (Zubaidah, 2018: p. 2; Warda, 2018: p. 238).

According to Syarifah & Sumardi (2015), and Ismayawati et al. (2016), qualified and competent human resources (HR) are needed in the 21st century. Critical thinking skills are one of the skills the students need and are very important to be taught and trained, as early as possible, continuously, according to the age and stages of students' development. The purpose is that students can observe various learning problems that may occur in learning activities and find solutions to the problems. The problems in real life are expected to be solved by the ability to find solutions based on the learning experiences.

Besides critical thinking skills, students must also care about the environment in order to support sustainable development. Environmental care is character that must be teached to students. Positive characters also play an important role in social interactions between students and the environment. Schools play the most important role in facilitating environmental awareness. Environmental awareness - as part of education - cannot be ignored by schools (Wangid, 2018; Wihardjo et al., 2017). Learning in schools certainly requires teaching materials. According to Maulida et al. (2019) and Safitri et al. (2019), teaching materials are an important part of the learning process, as they become a guide or a learning resource for both teachers and

students to reach the learning objectives. Teaching materials must be presented attractively and create a better learning process. Also, teaching materials must follow the students' needs and situations.

Based on the importance of critical thinking skills, sustainability awareness in the 21st century, and the implementation of ESD, it is necessary to study the critical thinking skills and sustainability awareness through the use of teaching materials in science learning. Several studies related to critical thinking skills, sustainability awareness, and ESD implementation have been conducted, such as discussing the profile of student sustainability awareness through ESD integration (Nursadiah et al., 2018), the profile of critical thinking skills students on science learning (Hidayati and Sinaga, 2019), and introducing ESD in Indonesia in facing global issues (Tristananda, 2018). These previous studies did not discuss the relationship among students' critical thinking skills, sustainability awareness, the need for teaching materials, and ESD implementation. Acquiring critical thinking skills and sustainability awareness, as well as the need for teaching materials and the implementation of ESD in this particular study can become a consideration in preparing teaching materials. A teaching material that trains students to think critically and have sustainability awareness to support ESD implementation.

## METHOD

The method used was descriptive quantitative and qualitative. The samples of the study were 213 students and six teachers of junior high school in Bogor municipality. The research was conducted by taking data about the need for teaching materials and the implementation of ESD, sustainability awareness, and critical thinking skills.

### Critical Thinking Skills

The sample of the research was 41 students at three Public Junior High Schools in Bogor municipality. The instrument was multiple-choice with explanation-reasons, which were developed based on aspects of critical thinking skills according to Ennis (1985). These aspects were elementary clarification, basic support, conclusion, advanced clarification, and strategy and tactics.

The data were obtained by analyzing students' answers using a rubric. After that, the scores were converted into a percentage using the following formula:

$$\text{Score of students} = \frac{Total\ Score}{Maximum\ Score} \times 100\% \qquad 1)$$

Then, the scores were calculated to obtain a mean and then tabulated with the criteria in Table 1.

**Table 1**. Criteria for Critical Thinking Skill Level (Riduwan, 2013)

| No. | Percentage (%) | Category |
|---|---|---|
| 1. | 81-100 | Very High |
| 2. | 61-80 | High |
| 3. | 41-60 | Medium |
| 4. | 21-40 | Weak |
| 5. | 0-20 | Very weak |

Students' critical thinking skills were also seen from every aspects of critical thinking skills through the calculation of the students' percentage who answered correctly on aspects of critical thinking skills, e.g: aspects of basic clarification, basic support, inference, advanced clarification, and strategies and tactics. The percentage was calculated through the following formula:

Percentage of students who answered correctly =

$$\frac{Number\ of\ Students\ who\ answered\ correctly}{Number\ of\ students} \times 100\% \qquad 2)$$

This is the percentage of students with correct answers but not all answers are completed with the correct reasons. Students' answers were also analyzed to find out the correct answer with the right reasons.

### Sustainablity Awareness

The sample was 88 students at three Public Junior High Schools in Bogor Municipality. The instrument was a Likert-scale questionnaire, which was adopted from Hassan *et al.* (2010). Sustainability awareness consisted of three categories; sustainability practice awareness, behavioral and attitude awareness, and emotional awareness.

The sustainability awareness of students was analyzed using a Likert-scale in a statement and is followed by five responses of level indicators. The responses were; strongly agree (SS) = 5, agree (S) = 4, doubt (RG) = 3, disagree (TS) = 2, and strongly disagree (STS) = 1. For data processing purposes, many answers of "Agree" and "Strongly agree" in each category were in summed up and converted into a percentage, which is given by the formula as follows:

$$\text{Percentage S} + \text{SS} = \frac{\text{Number who Chose S} + \text{SS}}{\text{Number of respondents}} \text{ X } 100\% \quad 3)$$

**Table 2**. Interpretation of Sustainability Awareness (Hassan et al., 2010)

| Percentage of responses (%) | Criteria of Responses |
|---|---|
| 0.0 – 39.9 | Infrequent or hateful/low of practice |
| 40.0 – 69.9 | Practices that are done/occur with moderate frequency |
| 70.0 – 100 | Practice/Most likely feeling/high |

Then, the results were transformed into criteria of responses based on Table 2. We also calculated the mean of each item in the questionnaire, which aimed to determine students' level of sustainability awareness. The indicators of the latter are presented in Table 3.

Table 3. *Level of Sustainability Awareness*

| Mean | Level of Indicators |
|---|---|
| 1.00 - 2.33 | Weak |
| 2.34 - 3.66 | Medium |
| 3.67 - 5.00 | High |

**The need for teaching materials and ESD implementation**

The sample used was 84 students on the need for teaching materials and six teachers on the need for teaching materials and the implementation of ESD. The sample was taken from three Public Junior High Schools in Bogor Municipality. The instruments were interview questions and open-questionnaires.

## RESULT

**Critical Thinking Skills**

Critical thinking skills are important skills and crucial to face challenges in the 21st century (Hidayati & Sinaga, 2019). Critical thinking plays an important role in the world of education and the main goal in learning. Critical thinking skills are not innate, so they can be applied, trained, and developed through the learning process. Critical thinking skills foster students to master and understand the material content and apply it to life (Fitriani & Setiawan, 2018); (Ritdamaya & Suhandi, 2016). The percentage for each item is presented in Table 4.

**Table 4.** Percentage of score of students' critical thinking skills and the number of students who answered correctly

| No Item | Aspects of Critical Thinking Skills | Percentage of score | Percentage of score on every aspect | Percentage of students compare to correct answer | Percentage of students compare to correct answer with correct reason |
|---|---|---|---|---|---|
| 1. | Elementary clarification | 39.00% | 39.00% | 65.9% | 7.31% |
| 2. | Build basic | 13.00% | 16.25% | 22.0% | 2.43% |
| 3. | support | 19.51% | | 36.6% | 0.00% |
| 4. | Inference | 21.95% | 21.95% | 34.1% | 0.00% |
| 5. | Advance | 26.82% | 33.73% | 46.3% | 0.00% |
| 6. | clarification | 40.65% | | 58.5% | 12.19% |
| 7. | Strategy and tactics | 39.83% | 39.83% | 56.1% | 17.07% |
| | Mean | 28.68% | | | |

Table 4 shows the mean of acquisition of students' critical thinking skills of 28.68%. The data shows the weak category of critical thinking skills of students. The weak level of students' critical thinking may be caused by the learning process that does not train critical thinking skills. According to Ritdamaya & Suhandi (2016), critical thinking skills are not innate, so they can be applied, trained, and developed through the

learning process and assessments. The teacher as a mediator and facilitator designs and implements methods, models, or strategies to train and develop students'critical thinking skills.

The percentage of students who answered correctly on the aspects of elementary clarification, advanced clarification, and strategies and tactics are 65.9%; 52.4%; and 56.1%, respectively. The data imply that more than 50% of the students answer correctly on three aspects, especially on the elementary clarification aspect. The percentage on the aspect of basic support and inference are 29.3% and 34.1%, respectively. In these aspects, many students answer without including the correct reasons. Analysis of students' answers show that less than 10% of students answer correctly with the correct reasons. Therefore, students' critical thinking skills need to be improved. According to Hatari *et al*. (2016), students' thinking skills may be developed through thinking training in responding to or solving a problem. Critical thinking skills needed to be trained as they provide skills for future life. Critical thinking skills combined with science are very useful for the future life of students (Nur & Widodo, 2015).

The level of students' critical thinking skills is weak in all aspects, especially in the aspects of basic support and inference, due to the learning process that does not train critical thinking skills. According to a study by Hidayati & Sinaga (2019), the profiles of students' critical thinking skills show different results on each indicator, but are still in the weak category. In this case, a certain method is needed to increase students' critical skills in each indicator. The weak critical thinking skills, certainly, need to be improved. As argued by Fianti *et al.* (2018), the work field in the future is full of challenges. It is not only focused on awareness and understanding of technology but also includes thinking skills.

**Sustainability Awareness**

Environment awareness is very important for life today or in the future as many environmental damages occur. Educational activities with a material of environmental awareness must be well-managed (Wihardjo *et al*., 2017; Ergin, 2019) due to human damages to the environment. Moreover, students must gain environmental awareness from an early age. Developing environmental awareness and empathy must also be developed and used to solve environmental problems. Here, students must develop positive attitudes towards the environment (Ercan *et al.*, 2017). Sustainability awareness can be built with knowledge and awareness of what or not to do (Salsabila *et al*., 2019). Sustainability education aims to raise awareness and help students shift to more sustainable behaviors (Baldwin, 2016). The percentage and mean for each item are presented in Table 5.

**Table 5**. Mean and Percentage of Responses to 'Agree' and 'Strongly Agree'

| No Item | Statements | Mean | Percentage of 'Agree' and 'Strongly Agree' (%) |
|---|---|---|---|
| 1. | I read about environmental issues in the mass media | 3.44 | 53.4 |
| 2. | I care about environmental problems in my place | 4.13 | 90.9 |
| 3. | I always discuss environmental problems with my fellow friends | 3.32 | 38.63 |
| 4. | I feel disappointed with air pollution | 4.04 | 86.36 |
| 5. | I feel disappointed with river pollution | 3.86 | 78.40 |
| 6. | I appreciate the biodiversity | 4.13 | 96.59 |
| 7. | I care about the smoke from vehicles | 3.19 | 53.4 |
| 8. | I try to reduce the amount of garbage at home by collecting the recycled materials | 3.55 | 57.95 |
| 9. | I compost the leftovers food into fertilizer | 2.84 | 4.54 |
| 10. | I do not use plastic bags to wrap goods | 3.11 | 30.68 |
| 11. | I save electrical energy at home | 3.89 | 79.54 |
| 12. | I save on clean water usage | 3.84 | 82.95 |
| 13. | I convey information about the environment to my family members | 3.55 | 57.95 |
| 14. | I participate in environmental activities at school | 3.55 | 85.22 |
| 15. | I realize my responsibility towards the environment | 4.35 | 92.04 |
| | Mean | 3.65 | |

Based on the data in Table 5, a total mean of 3.65 shows a moderate level of students' sustainability awareness of grade VII at the three Public Junior High Schools in Bogor municipality (Table 3). The acquisition score of sustainability awareness in each group is presented in Table 6.

**Table 6**. Categories and Percentages of Sustainability Awareness

| Category of Sustainability Awareness | Statements | Percentage of Sustainability Awareness (%) |
|---|---|---|
| Sustainability practice awareness | 3, 9, 10, 13, 14 | 37.95 |
| Behavioral and attitude awareness | 1, 6, 7, 8, 11, 12 | 70.63 |
| Emotional awareness | 2, 4, 5, 15 | 86.92 |

Table 6 shows the highest acquisition score of sustainability awareness is emotional awareness (86.92%) and the lowest is sustainability practice awareness (37.95%). The results indicate, emotionally, that students have a high concern for their environment, but rarely or never take action in the sustainability practice. The lack of efforts to persuade the students with practice of sustainability awareness may become the factor that leads students rarely or never take sustainability actions. Aliman *et al*. (2019) argued that increasing environmental awareness is a representation of the knowledge, attitudes, behavior, and skills in solving environmental problems. Knowledge is the basis for strengthening attitudes and behavior. Meanwhile, the category of behavioral and attitude awareness obtains a score of 70.63%, which means the students often or even always do it. The main problem of environmental education is how to encourage and develop students' sense of connection with the environment, which can turn into pro-environmental behavior (Nazarenko & Kolesnik, 2018). Environmental awareness as part of education can not be ignored by schools. Educational institutions are obliged to increase the environmental awareness of students since in school. The pattern of human consumption that continues to develop also has an impact on the environment. Moreover, using natural resources is the only way to meet the needs of human life that are massively growing. On the other hand, it also disturbs environmental sustainability (Wihardjo *et al.*, 2017). Therefore, students' sustainability practice awareness needs to be strengthened.

The results of this study are in line with Nursadiah *et al*. (2018), which show the moderate level of sustainability, behavioral and attitude, and emotional awarenesses with percentages of 30%, 83.8%, and 93.7%, respectively. Wangid (2018) stated that schools are one of the foundations for achieving their function in building humans who care about the environment. Schools must give learning experiences and positive motivation to students to build an environmental-care character. Also, Susilo *et al.* (2016) argued that integrating conservation education to develop an environmental-care attitude is a challenge for science teachers (Susilo *et al*., 2016). Environmental awareness is a part of environmental literacy and it may be grown through learning science, that is oriented towards pedagogy for sustainability (Susilowati, Wilujeng, & Hastuti, 2018).

**The Need for Teaching Materials**

The interviews on ESD with six teachers from three Public Junior High Schools in Bogor municipality found that the implementation of ESD is important to solve various environmental problems today. Anjar *et al.* (2019) expected that ESD makes students have sustainability awareness, especially in facing global problems, and critical thinking to solve problems by analyzing the impact of the damages upon various aspects of life.

Furthermore, the result of the interview shows that the development of ESD e-module teaching materials is urgent to facilitate the implementation of ESD because e-modules are usually packaged with pictures, videos, animations, and quizzes to attract students' attention. Hence, students are motivated to apply "what is expected" in education, especially for sustainable development by acquiring the knowledge, skills, attitudes, and values for a sustainable future. In accordance to Nawawi (2017), the module contains materials with a series of activities, training, and self-assessment to monitor the level of students' learning mastery. The module is also potential as a means of empowering critical thinking.

Developing teaching materials on global warming links economic, social, and environmental aspects makes students to have education on those aspects from an early age to understand the effects of global warming. As the output, they would reduce harmful activities related to global warming. These data are obtained during the observations.

Teachers believe that critical thinking skills are needed to solve environmental problems because a response involving the ability to evaluate systematically will be needed to follow up on environmental problems that occur in the community. Syarifah & Sumardi (2015) stated that students with critical thinking skills could able to take decisions and solve problems, in school, personal life, and working-environment. Students might act as agents of change and answers the challenges of the 21st century and bring this country to a better future. To solve environmental problems, sustainability awareness is needed to eliminate the attitude of disrespect for the environment and life around. Mutiara & Widiyatmoko (2014: p. 618) stated that the character of environmental-care needs to be increased to solve environmental problems.

The majority of teachers stated that learning today used books as teaching materials. But, they also believe that printed teaching materials have many limitations, such as may easily be damaged, blur images, and require a lot of paper and ink for a lot of materials. During a pandemic, printed teaching materials are considered difficult to distribute or inaccessible. On the other hand, electronic teaching materials are considered more accessible to students because the technology to access them is available. So, students can access teaching materials anywhere and anytime, and using their gadgets. The observations also found that accessible material is currently needed, especially during the current pandemic condition, which requires students to study at home. The pandemic requires students to study at home and limits direct (face to face) meeting with the teacher. Here, teaching materials should be more easily understood by students, even though they do independent-learning. Therefore, more studies should be conducted to produce interesting teaching materials that can be accessed independently by students.

The majority of students (83.3%) stated that the learning used books as teaching materials. Printed teaching materials have many limitations. Thus, electronic teaching materials are preferred compared to printed teaching materials. Most of the students argue that electronic teaching materials are more practical to use compared to printed teaching materials. According to Kimianti and Prasetyo (2019, p. 91), student worksheets and printed books have limitations, which lead to opportunities for integrating teaching materials with the latest information technology to support the achievement of 21st-century skills.

The majority of students (84.5%) also assumed that advanced development of teaching materials is needed to increase learning motivation. Many students wish there are efforts in developing accessible teaching materials and used them independently by students. Darmayasa *et al*. (2018, p. 55) defined the module as a book written with the aim that students can learn independently. The development of information technology has enabled changes of teaching materials, such as printed modules into digital format or electronic modules (E-Module). E-Module allows students to learn independently and teachers are no longer the only source of learning.

## CONCLUSION

ESD should increase students' sustainability awareness and critical thinking skills. Sustainability awareness and students' critical thinking skills are very important to solve environmental problems. Therefore, the implementation of ESD is important. The development of ESD-based teaching materials is able to facilitate the implementation of ESD. The teaching materials needed today are accessible teaching materials and can be used independently by students. The level of students' sustainability, behavioral and attitude, and emotional awarenesses are moderate with percentages of 37.95%, 70.63%, and 86.92%, respectively. Therefore, efforts to strengthen students with practice of sustainability awareness are needed. The mean of students' critical thinking skills is 28.68%, which is in the weak category. Analysis of student answers shows the percentage of students who answered correctly with the correct reasons for each aspect of critical thinking skills is less than 10%. This shows that students' critical thinking skills need to be improved.

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