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*Research Article*

# The Effectiveness of SETS Learning Tools in Improving Student's Higher-Order Thinking Skills

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## Abstract

This research aims to determine the effectiveness of learning tools based on the SETS approach in training student's high order thinking skills (HOTS) of seventh-grade junior high school science subjects on waste management sub-point. Problems that occur in the community will be brought into the classroom to find the solutions by using SETS education that combines components of science, environment, technology, and society reciprocally. The research method in this research uses one pretest-posttest design group. The assessment instrument uses test instruments. HOTS indicators include C4 (analyze), C5 (evaluate), and C6 (create). The Data was obtained from high-level thinking skills tests and analyzed by n-gain calculations. The results of this research showed that 1). There is an increase in student's test scores at n-gain = 0.66, and 2) There is an average increase of high order thinking skills indicators at n-gain = 0.68. This result showed that the learning tools based on the SETS approach effective in training the high order thinking skills of junior high school students. Similar research can be done by applying other waste treatment methods, by identifying other environmental problems or developing learning devices which focused on one of the HOTS indicators.

**Keywords:** high order thinking skill, learning tool, SETS approach.

## 1. Introduction

The SETS approach, better known as Salingtemas in Indonesia, is a combination of science, environment, technology, and society. In this learning, the concept of STS (science, technology, society), EE (environmental education), and STL (science, technology, literacy) have an inseparable connection. In SETS, science has a significant role in developing technology products. In this century, it had a strong influence on all human activities and society, but in the development and utilization of these technological products, it should pay attention to the various impacts that have been caused to the community and the surrounding environment too. So that the link between science, technology, environment, and society in SETS becomes intact unity in producing products that benefit both the environment and society (Smitha & Aruna, 2014). Science possessed by students can be a source of ideas for new technologies, meanwhile combining human technology and information technology, can be used for information technology, which is used as material for development and improvement technology, and as a benchmark for information technology for social and environmental conditions.

In general, various technology products that are produced from various scientific disciplines are fulfilling various needs in society because both of them have a great

influence. The enormous progress in science and technology in this century has had an influence on all human activities and with the presence of various sciences from various sources, presenting several extreme competitions (Smitha & Aruna, 2014). By using the SETS approach, a person will be brought to utilize science as a productive concept in creating and developing technology, but still by paying attention and minimizing the negative impacts that arise for the environment and society (Maknun et al., 2018). For this reason, in the face of the 21st century, everyone must have the provision to deal with various changes and increasingly complex problems.

In school, the role of educators is needed in preparing the generation who are ready to face the 21st century by facilitating students in learning so that later, when they go into the community, they will be prepared to face various problems that exist (Smitha & Aruna, 2014). In the 21st century, several competencies are critical for students to have. Four skills that must be possessed by students include communication, collaboration, critical thinking, and creativity. These four competencies should be trained to students in the learning process to be able to achieve 21st-century goals. The ability of critical thinking and creativity are two of the four indicators of high order thinking skills. High order thinking skills (HOTS) is a thinking ability at a higher cognitive level (Heong et al., 2011). Cognitive domain on high order thinking skills, namely at the level of C4 (ability to analyze), C5 (ability to evaluate), and C6 (making/creating) (Kusuma et al., 2017). According to Saputra (2016), skills on HOTS include critical thinking in analyzing a problem, creative thinking to find solutions for issues given based on knowledge, problem-solving, and making decisions in complex situations.

High-level thinking skills are needed to integrate complex SETS components including science, environment, technology, and society. Several studies have applied the SETS approach based on local environments such as the Maknun study (2017). However, the application of SETS in training high-level thinking skills is still limited. Therefore, this research is essential to do. The educators/teachers at school must be able to choose various tools that can be used to train the four competencies. The four high-level thinking competencies can be started by providing problems/issues that are developing in the community (Khasanah, 2015). This problem will later invite students to explore their thinking skills by analyzing the problems that occur related to the causes and various consequences/effects causes. From the results of the analysis carried out students will then be directed to develop their creative thinking skills in finding solutions to problems that occur using the knowledge that they already have so that eventually, students will be able to make the most appropriate decisions from the issues that arise (Hairida, 2017).

However, the reality that occurs in school is that students have not been able to get used to high-level thinking. At school, teachers only provide materials with most of the methods are given by lecturers. Problems with the surrounding environment, especially those caused by industrial waste, are limited to explain and waste

management activities have not been carried out, even though the problems caused by this type of waste has a terrible impact if it occurs in the long term. For this reason, students need to be trained to deal with problems around their lives so that they can think at a higher level and solve problems that occur with their various creative ideas. According to Juairiah et al. (2014), one of the environmental problems that can be raised to train students high-level thinking skills in environmental damage or environmental pollution.

Models, methods, techniques, and teaching materials that are following the SETS approach are expected to develop various competencies possessed by students so that they are ready to face the times that occur (Smitha & Aruna, 2014). SETS-based learning tools that have been developed have obtained the results of validity with perfect criteria, and it is expected that useful learning tools in training student's ability to think at a higher cognitive level. For this reason, this study aims to determine the effectiveness of learning tools based on the SETS approach in improving students' high-level thinking skills (HOTS).

## 2. Materials and Methods

This research was conducted in March 2019 at Arosbaya 1 Junior High School, Bangkalan Regency, Madura, Indonesia. The objects in this study were 20 students of the seventh grade of junior high school who take natural science subjects in the academic year 2018/2019. They are between 13-15 years old, who had homogeny of high-order thinking skills. At this age, the child's intellectual development is at the formal operational stage, where the child has been able to form a more structured and abstract operation from his concrete activities. In other words, at this age children should be able to solve problems (Ibda, 2015).

The research design was to use the design of one group pre-test post-test with the $O_1 \rightarrow X \rightarrow O_2$ scheme. In the first step ($O_1$), a pre-test was conducted to determine the student's high order thinking skills before treatment. In the second step (X) students are given medication by applying the SETS-based learning tool, which consists of a lesson plan, student textbook, student worksheet, and high order thinking skills tests. The activities carried out in the learning activities include the analysis of the causes, impacts, and solutions of pollution of the aquatic environment due to batik liquid waste, batik waste processing activities using phytoremediation techniques, the effectiveness of batik waste treatment tests on the physical condition of fish, and making posters for environmental preservation. After learning is carried out, then the final test of high order thinking skills by carrying out a post-test to find out the results of increasing students' level thinking skills ($O_2$).

The research instruments used high-level thinking skills test sheets. The seven essay test items are based on C4, C5, and C6 cognitive indicators. C4 is an analyzing activity, C5 is an evaluation activity, and C6 is making or creating.

Data collected by the test method. The data of student's high order thinking skill tests are obtained by analyzing with formula 1:

$$T_{individual} = \frac{\sum S_s}{\sum S_{maks}} \times 100 \quad (1)$$

Information:

$T_{individual}$ : individual completeness

$\sum S_s$ : Number of scores obtained by students

$\sum S_{maks}$ : Maximum number of scores

Students are said to be complete if they get value $\geq 75$. This criterion is adjusted to the minimum completeness criteria of the test school. Then increase student's high order thinking skills are analyzed with the formula 2:

$$\text{N-gain} = \frac{S\,post - S\,pre}{S\,maks - S\,pre} \quad (2)$$

Information:

$S_{post}$ : post-test score

$S_{pre}$ : pre-test score

$S_{maks}$ : maximum score

If the results of n-gain are obtained $\leq 0.30$, then the increase in HOTS is categorized as low if the scores obtained $0.30 < g > 0.70$ is classified as moderate, and if n-gain $\geq 0.70$ is categorized high (Lambertus, 2010).

## 3. Results and Discussion

### 3.1. Results

The results obtained from the application of SETS based learning tool to students high order thinking skills (HOTS) are listed in the following Table 1:

**Table 1.** Student's Pre-Test, Post-Test, and N-Gain Result

| Test Result | | | | N-Gain | |
|---|---|---|---|---|---|
| **Pre-test** | **Category** | **Post-test** | **Category** | **Score** | **Category** |
| 50.79 | Complete | 83.95 | Not complete | 0.66 | Moderate |

Based on the pre-test and post-test of 20 students, the results showed that students who prepared by applying the SETS learning tool, there is an increase in scores of 83.95 with a complete category from before treatment of 50.79 with the group not complete. The results of the rise in student high-order thinking skills from n-gain results were 0.66 with a medium category. This result shows that before learning is carried out students have not trained their high-level thinking skills, while after treatment, students

have trained their high-level thinking skills. The results indicate that SETS based learning tools that have been developed are useful in preparing students high order thinking skills in the medium category on waste management sub-point in the subject matter of environmental pollution. SETS-based learning tools consisting of lesson plans, textbooks, student worksheets, and test questions. Those are a set of learning tools to train students' high-level thinking skills, which are related to each other, and through those device components, all aspects of SETS can be trained.

SETS learning related to the real world or based on problems in the environment. For that, students will be trained in a variety of abilities, both in communication, conducting investigations or gathering information, and the ability to think to help solve problems following various creative ideas to make decisions according to their strengths (Hairida, 2017). From here, the character values of environmental care, discipline, and cooperation in students will be embed (Sugiyono et al., 2017).

The cognitive domain of the HOTS indicator consisting of C4 (analyzing), C5 (evaluating), and C6 (creating) in the pre-test and post-test scores improved. The results of the HOTS indicator completeness are presented in Table 2 below:

**Table 2.** Result of HOTS Indicators

| Cognitive domain | Test score | | N-Gain | |
|---|---|---|---|---|
| | Pre-test score | Post-test score | Score | Category |
| C4 | 55.0 | 86.3 | 0.69 | Moderate |
| C5 | 59.6 | 87.8 | 0.70 | High |
| C6 | 34.6 | 77.9 | 0.66 | Moderate |
| **Average** | **49.7** | **84.0** | **0.68** | **Moderate** |

The results listed in Table 2 show that each cognitive domain, C4, C5, and C6 have increased results from before treatment as indicated by the results of pre-test and after treatment suggested by the results of the post-test. The results showed that the highest cognitive domain increases at C5 (evaluating). Based on the taxonomy of revision Blooms, cognitive levels from lowest to highest are C4 (analysis), C5 (evaluation), and C6 (creating). It can be said that the thinking ability of students at the level of study should be better than evaluating because, in order to be able to evaluate, the students have been able to analyze. However, the result shows the opposite. This is alleged because the students only provide to answer by assessing the problems given without analyzing or testing deeper on their answers. For example, when students are asked to answer a question in the form of a picture that shows an environment with a lot of garbage, they will explain that the environment is polluted because of the waste without considering the reason for the analysis of why a lot of waste accumulates there.

The average results obtained by the value of increase (N-gain) of 0.68 with the medium category. That is, the whole indicator in the HOTS has been well trained in the learning that has been done. The answers to the questions on each test item at the pre-test and post-test are shown in Table 3 below:

**Table 3.** Comparison of Student Answers in Pre-Test and Post-Test

| Student name | Cognitive domain | Question | Pre-test answer | Post-test answer | HOTS indicators prepared |
|---|---|---|---|---|---|
| Dina Putri Maha-rani | C4 Analyze |  The picture shows polluted waters. Explain why this was said, and why did it happen? | Because of a lot of trash | Pollution, as shown, is caused by excessive disposal of plastic waste. This is due to the increasing use of plastic and the lack of landfills so that many people throw it into the river. This includes environ-mental pollution. | Critical thinking<br><br>Creative thinking |
| Evi Susanti | C5 Evaluate | One of the environmental damage is caused by human activity. In Bani s family, every day, the members of that family collect vegetable waste or food residue into a closed barrel so that the waste decomposes and produces thick liquid. Every once a month this liquid is given to the soil and plants. Based on the habits of the Bani family, does this include environ-mental pollution? | Yes, because collecting & removing the trash on the ground causes the plants to wither and die. | No, because waste is a fertilizer that is beneficial to plants and good for the environment. | Critical thinking<br><br>Making a decision |
| Yunda Hanifatus Samha | C6 Create | Batik industrial waste is thrown into the environment continuously without being processed first can cause the quality of the environment to decline, and the organism will be disrupted. How can you do this so that the waste does not damage when it is thrown into the environment? | Batik waste should be processed first. | Batik waste should be processed with the phytoremediation method. The way to prepare Kayu apu (*Pistia stratiotes*) and batik wastewater, then put the plant into the surface of the waste. | Critical thinking<br><br>Problem-solving<br><br>Creative thinking<br><br>Making a decision |

The results listed in Tables 2 and 3 are evidence of an increase in the indicators of high-order thinking of students. SETS-based learning shows an increase in the results tests of high-order thinking skills of students means that students are taught to be

skilled in examining issues or problems from a variety of different perspectives based on science and technology as well as from a social and environmental perspective. From the ability to think on the four components of SETS (science, environment, technology, and society) students can develop their ability to critical thinking, creative thinking, problem-solving, and making a decision based on information or knowledge they have (Mapeala, 2015). As stated by Yoruk (2010), said that in practice, students who receive education in SETS are related to the teaching approach, more competent in dealing with new situations and concepts.

A previous study conducted by Marwah et al. (2017), on environmental pollution material seventh grade of junior high school showed that SETS-based learning was effective in improving student's high-level thinking skills with the acquisition of significant results on tests between before and after learning. Similar results are also shown in the results of a study by Usmeldi, et al (2017) that high-level thinking skills of students have increased by 85% after learning using the SETS approach because all of the SETS components, which include science, environment, technology, and society are able to spur students to understand science as a whole and apply it to technology, and learn various impacts of these technological products on society and the environment. Akcay (2015) argues that learning that uses the SETS approach can improve students understanding of the nature of science and improve student attitudes towards science when compared to traditional education.

## Conclusion

Learning tools based on SETS (science, environment, technology, society) approach, which consists of the lesson plan, student textbooks, student worksheet, and high order thinking skills tests prove effective in training students high-level thinking skills on waste management sub-point in the subject matter of environmental pollution. These results are shown from 1) there is an increase in students' high-level thinking from pre-test and post-test with n-gain of high-level thinking skills in the medium category, and 2) n-gain of high order thinking skill indicators included in the medium category.

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