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## **The Effectiveness of Students' Worksheet Based on Multiple Representations to Increase Science Process Skills**

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### **Abstract**

This research aimed to analyze the effectiveness of students' worksheet based on multiple representations to enhance science process skill of students class VII of Junior High School. It was a quasi-experiment research with non-equivalent control group design. The population was students class VII of State Junior High School 3 in Langsa for academic year of 2017/2018. The students of class VII-1 and VII-2 were selected as sample by using simple random sampling technique. Data were collected using observation sheet for science process skill. The effectiveness of students' worksheet based on multiple representations was seen by their science process skill analyzed from the average score for n-Gain and independent sample T test. The results showed that there was any differences for average score of n-Gain and significant value between class of control and experiment. Therefore, the students' worksheet based on multiple representations was effective to be used in order to increase students' science process skill.

**Keywords:** Students' worksheet; multiple representations; science process skills.

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## **1. Introduction**

Integrated Natural Science as systematic and holistic science is not only just a knowledge of atoms, forces, cells, earth and the universe. It has methodology that discusses problem-based investigation and resolution natural phenomena [1]. It is a knowledge gathered through a scientific method by applying a scientific attitude. Through science, humans will be able to understand themselves and also the natural surroundings [2].

The teaching and learning process for science cannot be separated from the natural environment and its surrounding. The holistic learning activities are expected to be able to form students to be able for developing their capacity according to demands of 21<sup>st</sup> century. It is a century with the development of science and technology which is growing rapidly. Science and technology are increasingly developing against to all aspects of human life. Problems that occur in human life can only be solved by increasing and mastering the science. This also affects the people who will compete getting tighter into the era of globalization. In order to maintain their existence, then every citizen and community needs to improve the quality of resources human power. Education one of them has an important role to improve the quality of human resources [3].

Science must be taught with learning that allows students to develop their capabilities build their own concepts. Learning science in schools should emphasize the provision of learning experiences directly through the use and development of process skills and scientific attitudes to develop competency. Science process skills are overall skills that can be used in investigative activities to find and develop a concept / principle / theory [4]. Science process skills are also the tools for generating and making information scientific, for doing scientific research and solving the problems [5].

In Indonesia, the quality improvement of science education has appeared in the application scientific approach to the Curriculum of 2013. The scientific approach is an approach learning designed in such a way where the students actively construct concepts, laws, or principles through stages of observing, formulating problems, submitting a hypothesis, collecting data, analyzing data, concluding and communicating the concepts or laws found [6]. The scientific approach aims to provide understanding of students in using scientific methods. Student activities involve science process skills, cognitive processes and stimulate intellectual development. Through science process skills, they can also be trained to improve problem solving skills [7].

Science process skills are very important to be developed for learning science. The existence of science process skills can provide tools and ways of thinking that allows the students to build a strong conceptual framework needed to gain expertise in science [8]. Science process skills allow someone to give a vision of life good and scientific view as standard understanding of science [9]. The characteristic of process skills is the presence of processes and products in getting knowledge or information. This leads the students to work and think with the skills and attitudes in the same way as scientists for obtaining and developing the knowledge with the existence of the process [10]. Science process skills include aspects of deep skills make observations, classification, communication, measurement, estimation, prediction and information [11].

One of the efforts to develop students' science process skills, then the learning activities can be carried out

optimally by involving their roles during learning process. The learning media used to be actively involved in learning activities, by facilitating them with student worksheets and familiarize namely as LKPD. LKPD is a sheet containing tasks that must be done by students which is including of instructions, steps to complete a task adapted to the objectives to be achieved. The use of LKPD for teaching and learning process is very feasible as a supporting tool so that the competencies of students can be granted at the same time [12].

Holistic science learning that involves holistic phenomena must be resolved. Science learning that only focuses on understanding the algorithm and memorization alone, will produce superficial understanding [13]. Related to this, an innovation is needed for creative learning which can interconnect every phenomenon of science with a variety of different formats according to adjust with diverse backgrounds of students. Multiple representations are a way to re-present the same concept in a different format. Knowledge what has been obtained can be re-expressed in various ways [14]. Learning based on multiple representations will shape the involvement of students to play an active role in learning activities. This is because learning multiple representations can create a more meaningful learning environment which can help students shape knowledge and solve the problems and also help them to understand the problem and evaluate the results [15]. The multiple representations-based learning models consist of phase of orientation, imagination, internalization and evaluation [16]. In phase of teaching orientation, the teacher gives apperception and motivation to students by using learning media such as images or videos related to the problem that will be learned. In the phase of exploration, students seek information through the internet or text books after the teacher introduced the concept verbally or demonstrations. On the internalization phase, the students are facilitated by an independent task to train their abilities on the representation. And the final phase is an evaluation phase where the teacher provides feedback to students for the whole learning activity [17].

Based on the explanation above, we optimize the learning process by using students' worksheet based on multiple representations. In addition we also need to know the effectiveness of students' worksheet to improve their science process skills.

## **2. Material and Methods**

This research was conducted on February until March 2018 in State Junior High School 3 of Langsa. It used quasi-experiment method with non-equivalent control group design [18]. The population is student of class VII in State Junior High School 3 of Langsa for Academic Year of 2017/2018, and the sample is students of class VII-1 and VII-2 which were selected by using simple random sampling method, where class VII-1 as class of experiment and VII-2 and class of control. The research design used pretest-posttest control group design. The science process skills were assessed first by doing pre-observation to the students both class of control and class of experiment. Then, students' science process skills were assessed during learning activities using worksheet based on multiple representations developed by researcher in class of experiment, while the class of control still used the usual students' worksheet. The development of students' worksheet is done by adapting 4-D development models which are consisted of define, design, develop and disseminate [19]. After that, the worksheet developed will be assessed by experts which were 2 lectures, 2 science teachers and 2 peer reviewers.

Data were collected using observation sheets which were assessed by observer team. The effectiveness of students' worksheet based on multiple representations will be analyzed by determining the average score of n-Gain between class of control and class of experiment after doing learning process using the proposed worksheet. And the statistical test was oriented with independent sample T test. The score for pretest and posttest are gained using this formula:

$$\text{Value} = \frac{\text{student's total score}}{\text{maximum score}} \times 100$$

The score is used to indicate n-Gain for class of class of control and class of experiment. The analysis for the effectiveness for students' worksheet was determined by the deviation between score of pretest and posttest using the equation [20]:

$$n - \text{Gain} = \frac{\% \text{ posttes} - \% \text{ pretest}}{100 - \% \text{ pretes}}$$

and the criteria are below [21]:

**Table 1:** Score Interpretation of n-Gain

Score of n-Gain	Interpretation
-1.00 g 0.00	Declined
g = 0.00	None of Improvement
0.00 g 0.30	Low
0.30 g 0.70	Middle
0.70 g 1.00	High

Before it was continued by independent sample T test, it was needed to do pre-calculation at first. The prerequisite test was divided into test of normality and test for homogeneity. Normality and homogeneity test were done using SPSS application version 22.

Both of the test for normality used Shapiro-Wilk with significant level 0.05 and the homogeneity used Levene test with significant level 0.05. After it was met, then continued by the test for the effectiveness of students' worksheet based on multiple representations to enhance science process skills using independent sample T test with significant level of 0.05. Then, H0 will be accepted if the significant level is greater than 0.05 ( $\geq 0.05$ ). There are hyphotesis for T-test:

H0: students' worksheet based on multiple representations cannot improve science process skill significantly to the students class VII of State Junior High School

H1: students' worksheet based on multiple representations can improve science process skill significantly to the students class VII of State Junior High School

### 3. Result

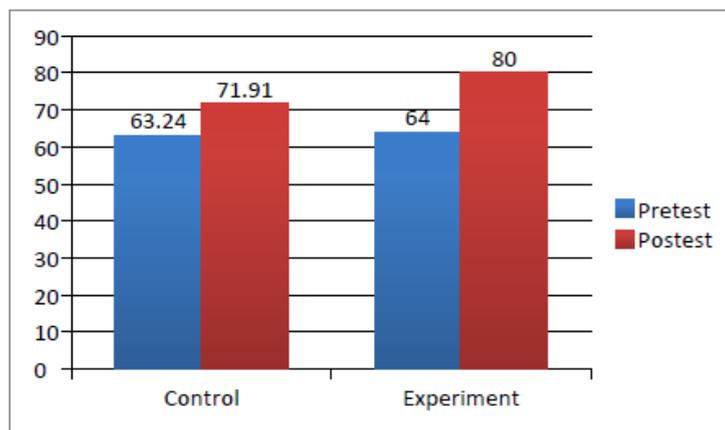
#### 3.1 Students' Worksheet Based on Multiple Representations to Increase Students' Science Process Skills

The students' worksheet was developed using four social systems of learning model based on multiple representations which are orientation, exploration-imagination, internalization and evaluation. It consists of three sub-topics focused on environmental pollution which are water pollution, air pollution and soil pollution. It was validated by experts which are lectures, science teachers and peer reviewers. The criteria for assessing the developed worksheet are content feasibility, presentation, graphics, characteristics of students' worksheet and component of the worksheet.

The students' worksheet based on multiple representations obtained score of percentages of 86.77% by lectures, 93.23% by science teachers and 91.94% by peer reviewers. According to the results, the developed worksheet for special topic of environmental pollution is feasible to improve science process skills and it can be used for class of experiment.

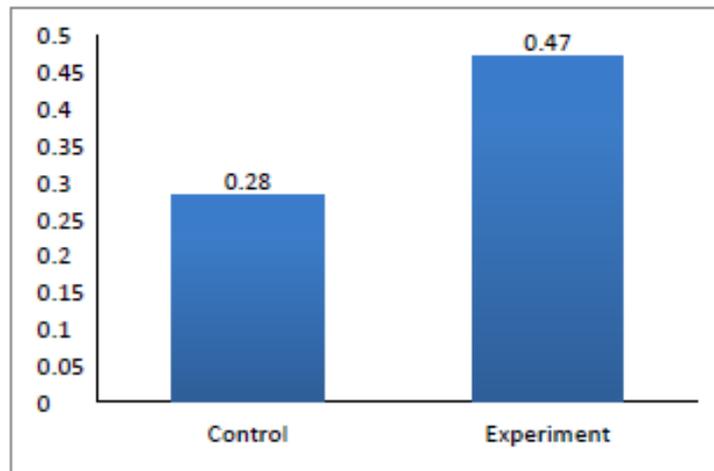
#### 3.2 Calculation results for pretest and posttest score

The science process skills are known by observing the differences of average score for n-gain between class of control and class of experiment. The descriptive result for average score of pretest and posttest can be seen in Figure 1.



**Figure 1:** Average score for Pretest and posttest of science process skills

According to Figure 1, there is improvement of science process skills before and after learning activities. However, there is a difference for average scores for pretest and posttest between class of control and class of experiment. The learning using students' worksheet based on multiple representations showed the average score for class of experiment is greater than class of control used usual worksheet developed by school. Then, the improvement of average score for pretest and posttest in both of classes was analyzed using n-Gain. The final calculation of n-Gain for class of control and class of experiment is presented in Figure 2.



**Figure 2:** Average n-Gain for class of control and class of experiment

Based on Figure 2, it can be understood that the average score for n-Gain of class of experiment is higher than class of control. According to the interpretation on Table 2, the n-Gain score for class of experiment is 0.47 which is categorized as ‘middle’, and the n-Gain score for class of control is 0.28 at category of ‘low’. The difference of n-gain between class of control and class of experiment explained that the use of students’ worksheet based on multiple representations for special topic of environmental pollution can enhance students’ science process skills. The analysis result was then continued by statistical test with independent sample T test. Before doing the test, it was started by prerequisite tests which are normality test and homogeneity test using Shapiro-Wilk test and Levene test. The result for the rest can be seen in Table 2.

**Table 2:** Normality Result using Shapiro-Wilk test

Classes	Total data	Sig
Control	34	0.075
Experiment	30	0.103

According to Table 2, it can be seen that significant scores for class of control and class of experiment are greater than 0.05. And the score of homogeneity test used Levene test is 0.940 which is also greater than 0.05. Therefore, it can be concluded that data for both of classes are normally distributed and have the same variety (homogeny). After the prerequisite test was done, then it was continued by independent sample T test. The result for T test for average n-Gain of science process skills can be seen in Table 3.

**Table 3:** The Result of Independent Sample T test

t	df	Mean difference	Sig. (2 tails)
-2.1414	60.062	-.18402	0.019

According to Table 3, it can be indicated that the result of independent sample T test on average n-Gain of science process skills obtained significant value of 0.019 which is less than 0.05. If the significant value is less

than 0.05, so the H<sub>0</sub> will be rejected and H<sub>1</sub> will be accepted. Thus, it can be concluded that students' worksheet based on multiple representations can improve the students' science process skills.

Based on the analysis, it can be seen that students' worksheet based-multiple representations can enhance the science process skills of students in class VII of State Junior High School. The effectiveness for the use of students' worksheet can be seen from the increasing result of science process skills for class of experiment is greater than class of control. It was caused by the worksheet based-multiple representations provided the learning steps related to multiple representations. One of the steps is orientation where the students can directly observe to the object. This kind of observation is capable of creating students' science process skills through the development of their thinking and the chance to do observation, thus it can improve memorizing skills and give intrinsic satisfaction to the students [22]. On the step of exploration-imagination, the students are able to do investigation to the object that will be learned. They have active contribution by giving support to develop investigation skills naturally, so they can solve the problems [23]. Another step is internalization where the students can train their representation to the knowledge. Besides that, this step also provides an opportunity to the students so that they will be braved to perform the communication of their work. The learning with multiple representations is able to build students' confidence, so they will not be feared and be braved in presenting their idea relation to the problem solving [24]. The use of students' worksheet is also positively influenced to the students' science process skills [25]. The use of students' worksheet which is supported by learning based-multiple representation is able to create the learning condition which is actively contributed by students so the learning will be more meaningful [15].

#### **4. Conclusions**

The students' worksheet based-multiple representation is effectively improve students' science process skills according to the analysis results presented by statistical differences to the improvement of significant values between class of control which still used usual worksheet developed by school with and class of experiment which is optimized by using students' worksheet based-multiple representations.

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