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Enhancing Science Process Skills through Conceptual Teaching and Learning Related to Water-Savings and Natural Events Concept

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ABSTRACT

This study aims to enhance science process skills (SPS) through contextual teaching and learning (CTL). This research method used the Quasi-Experiment None-equivalent Pretest-Posttest Design Group. This research was conducted at SDN 002 Ujung Batu with a sample of 54 students. The results obtained that the science process skills of students who learn with the CTL model are better and have more significant improvement than those who learn with conventional models. The experiment group obtained a posttest score with an average of 90.71, while the control group obtained an average of 51.42. N-gain of students' SPS in the experiment group is 0.56 (medium category) higher than the control group that is 0.24 (low category). These indicate that the CTL model can enhance the SPS of fifth-grade elementary school students in the saving-water and natural events concept.

1. Introduction

Elementary school is one of the most important levels of education in a child's psychological and cognitive development. Science learning is one of the most critical fields at the elementary school level because science is related to students' daily activities in interacting with nature. Science knowledge is not only the concept of memorization, but students also try to find the concept. This is in line with the opinions raised by Tani, et al. 2018, who said that the process of learning science must be carried out scientifically to foster the ability to think and communicate it and the concepts discovered by students.

Science learning is one of the requisite knowledge given in elementary schools. Science learning is beneficial for a nation; the welfare of a society depends a lot

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on the capability of the country in the ground of technology; when taught science in the right way, then science is a subject that provides opportunities for critical thinking. Science subject matter has educational values that have potential that can shape the overall personality of children. Science is a scientific product, scientific process, scientific attitude and scientific application. Students must have complete knowledge and feel the learning process clearly so that they can understand natural phenomena through an investigation or scientific method called scientific process skills.

Science process skills (SPS) are overall scientific skills that are directed and are not separate between cognitive and psychomotor which are used as a vehicle to compile knowledge, think about problems and make conclusions (Karsli, Sahin, 2009; Harlen, 1999).

The SPS are part of the cognitive domain in science learning. In this case, SPS are elements of the cognitive area that can hone thinking skills. SPS is a learning approach that emphasizes the activities and creativity of students in gaining knowledge, values and attitudes, and applied in daily life (Greeno, 1988; Rogoff, 1984; Suchman, 1987) (Roth, Roychoudhury, 1993). The science process skills used in elementary school (Padilla, et al., 1984) include Observing, Classifying, Measuring, Using tools, Communicating, Interpreting, Predicting, and Conducting experiments.

According to Hermita (2008), the SPS are typical intellectual skills that are used by all scientists and can be used to understand any phenomenon, where these skills are needed to acquire, develop and apply concepts, legal principles and theories science. Through this SPS, students are expected to be able to experience the process as experienced by scientists in solving natural mysteries and will be the driving wheel of discovery, the development of facts and concepts as well as the growth and development of attitudes, insights and values.

Science learning is focus by using real contexts to deepen students' understanding of science material that is relevant to the surrounding environment. Contextual knowledge is a science learning that uses real context to explain scientific concepts or phenomena by showing how ideas applied in solving everyday problems (Nashon, Madera, 2013). Zulirfan et al. (2018) say in science learning students must learn contextually related observations of scientific phenomena experienced by students in their environment. According to Jhonson (2007), CTL is a system that stimulates the brain to arrange patterns that embody meaning. CTL is learning that connects academic content with the context of students' daily lives. Thus in CTL learning the teacher does not present the concept of science in a ready-made form, but through problem-solving activities, students led to finding their thoughts (reinvention).

CTL is a constructivist process such as critical thinking, inquiry and discovery, problem-solving must be placed in relevant physical, intellectual, and social contexts. CTL is consistent with the constructivist approach to teaching science in schools. The CTL approach provides opportunities for students to connect their diverse lives and experiences in learning (Glynn, Winter. 2004). CTL helps teacher's link subject matter with the real world and makes students more motivated in learning (Hudson, Wishler, 2007).

The effectiveness of this model is that students are more active in thinking and understanding material in groups by conducting investigations and inquiry of real problems around them so that they get a deeper and more meaningful impression about what they are learning. With this concept, learning is more significant for students. The learning process is not a transfer of knowledge from teacher to student but takes place naturally in the form of direct experience. Because students need to understand what learning means, what its benefits are in their status, and how to achieve it. The contextual learning syntax is there are four components.

The first components of invitation, at the invitation stage students, are encouraged to express their fundamental knowledge of the concepts discussed. If necessary, the teacher provokes by giving problematic questions about the phenomena of daily life through the association of concepts discussed with opinions held. Secondly, students are allowed to explore and find ideas through collecting, organizing, interpreting data in an activity that has been designed by the teacher. As a group, students conduct activities and discuss the problems they present. Overall, this stage will satisfy students' curiosity about the phenomena of life around them.

Based on the background stated above, this study purposes to find out differences in the improvement of students' science process skills by implementing the CTL to fifth-grade students of SDN 002 Ujung Batu.

2. Methodology

The method used in this research was quasi-experimental nonequivalent control group design. In the experiment group, the CTL model applied while in the control group, the conventional learning model applied (Sapriadil, et al., 2018; Malik, et al., 2018; Suhandi, et al., 2018).

The population of this research was the students of SDN 002 Ujung Batu of the academic year 2017/2018. The sample used was 54 fifth grade students consisting of 28 students (15 male students and 13 female students) in the experiment group and 28 students (14 male students and 14 female students) in the control group. Class determination was determined based on the pretest, the lower pretest results used as the experiment a group and the higher pretest students used as the control group. The research instrument in this study was a science process skills test. Improvement of students' science process skills calculated using the average gain value (n-gain).

The improvement of science process skills developed through learning calculated from the final test score and the initial test which is normalized by the formula g factor (normalized gain score), (Meltzer, 2002) as follows.

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

Information:

S_{post} : Final test score S_{post} : Initial test score S_{post} : Ideal maximum score

The criteria for obtaining a gain score can be seen in Table 1.

Table 1. Gain score category

n-gain Score	**Category**
g > 0,7	High
0,3 ≤ g ≤ 0,7	Medium
g < 0,3	Low

The difference in the development of science process skills between the experiment group and the control group calculated using the t-test, then the normality test was calculated by the liliefors test and the homogeneity test (Supardi, 2013).

3. Results and Discussion

CTL models in the experiment group begin with learning activities, as in general, the difference is in the core activities that begin with the invitation. In this activity, the teacher provokes students by giving questions related to water saving material, and here also occurs a question and answer process between the teacher and students. Next is an exploration activity; students and groups conduct experiments on the water purification process. Followed by explanations and solutions; at this stage, students make a summary of a brief explanation of the water purification they will present. Action taking becomes the last core activity; at this stage, students make the right decision on a comparison of 3 bottles of the water purification process. The same activity (Figure 1) is carried out at three meetings or face-to-face in class with different learning material, namely: water-savings, natural events (mountains erupting), and natural events (flooding). Average scores of initial and final tests and n-gain scores of students' SPS in the experiment group and the control group can be seen in the following Table 2.

Table 2. The average value of pretest and posttest experiment and control group and n-gain values

Group	Total students (n)	Pretest average	Posttest average	N-gain
Experiment	28	56,42	90,71	0,56
Control	28	38,57	51,42	0,24

Figure 1. Experiments (a) the water purification process, and (b) the flooding

N-gain of students' SPS in the experiment group is 0.56 (medium category) higher than the control group that is 0.24 (low category). Furthermore, the results of statistical tests of students' SPS in the experiment group and the control group can be seen in the following table 3.

Table 3. Normality, homogeneity and t-test of the experiment group and the control group.

<table>
<tr><th rowspan="2">Group</th><th colspan="2">Normality
(α=0,05)</th><th colspan="2">Homogenity
(α=0,05)</th><th colspan="2">Uji-t
(α=0,05)</th></tr>
<tr><th>Significant level (0,161)</th><th>Decision</th><th>Significant level (1,88)</th><th>Decision</th><th>Significant level (2)</th><th>Decision</th></tr>
<tr><td>Experiment</td><td>0,104</td><td>Normal</td><td rowspan="2">1,84</td><td rowspan="2">Homogeneous</td><td rowspan="2">5,789</td><td rowspan="2">Significant</td></tr>
<tr><td>Control</td><td>0,154</td><td>Normal</td></tr>
</table>

Based on the table presented above can be seen that there are significant differences in science process skills between the experimental group and the control group. The difference in the improvement of science process skills of students in the science concept of water-saving and significant natural events was caused because the treatment given to the two groups was different. In the control group, the procedure given is the implementation of conventional models which results in a low increase in student learning outcomes. While in the experimental group, the treatment given is a CTL.

According to Semiawan (1992), there are 13 necessary skills indicators of process skills that developed in learning in elementary schools. These skills are observation, calculation, measurement, classification, space/time relations, making hypotheses, planning research/experiments, controlling variables, interpreting data, interim conclusions, forecasting, applying, and communicating. Not all parts of the process skills developed in a learning process. CTL depends on the learning model used and the material presented. In the concept of water-saving and natural events, indicators that developed are Observation, Classification, Making hypotheses, Application and temporary Conclusions. Through the implementation of the CTL Model, students are encouraged to practice science process skills, and students are more active in conducting experiments and finding concepts learned. The implementation of CTL in the experiment group provides an increase in students' science process skills compared to the application of conventional learning models to the control group.

Students are directly involved in conducting experiments using CTL so that students are more addictive in interacting and building creative ideas between friends in the group. Interaction between the environment and students can cause students to develop their intellectual functions because knowledge built on the student's mind. Agree with Piaget, 1988; Yerdelen, Sungur, 2019; Chen, et al., 2019, that experience that is the result of changes in learning is formed by individuals so that individuals are in continuous interaction with their environment. While the climate is also changing, the existence of an interaction between the environment and students can cause students to develop intellectual functions, because knowledge built on the student's mind. Besides that, in CTL, students are required to help each other friends, driven by the demand that the success of individuals in the group reflects the success of all other group members. So that between individuals will be positive interdependence, mutual need between friends with one another. Due to the relationship of friends in the group, interactions occur in learning.

4. Conclusion

Based on the results of the t-test with a significance level of 0.05, it was concluded there was a difference in the increase in SPS between students who got learning with CTL and students who got conventional learning. From the normalized N-gain value shows that the use of CTL further increases the SPS of students compared to students who use conventional learning.

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