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THE EFFECT OF POE STRATEGY ON STUDENTS' CONCEPTUAL CHANGE REGARDING WATER DENSITY

Rida Yulianti, Andi Suhandi, Wahyu Sopandi

Universitas Pendidikan Indonesia
ridayulainti61@upi.edu

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Abstract

The purpose of this study was to understand the effect of Predict Observe and Explain (POE) strategy toward students' conceptual change about density of water. This study was conducted because many students have a conception which is not in accordance with the scientific conception of the water. The subjects used in this study were 34 students on 5th grade students in one of primary schools in Bekasi. Research method was pre-experiment method and the design is One-Group Pretest-Posttest Design. The instrument used to view the level of student's conceptual change was a pretest and posttest with four-tier diagnostic test. Test answers were then will be adjusted to conceptual change category consisting of five levels of conceptual change are construction, revision, complementation, static, and disorientation. The results showed that conceptual changes in students given treatment using POE strategy were at the construction level 2% (students were able to construct their understanding), revision 84% (students were able to make improvements (revisions) to their initial understanding), and static as much 14% (Students cannot change their understanding to a better understanding). These results show that the majority of students experience conceptual change after learning to use the POE strategy.

Keywords: Strategy; POE; Conceptual Change

A. Introduction

Education is one of the aspects that play a significant role to prepare quality human resources in a nation. The success of a nation is determined by its citizen's education. The formal education in Indonesia is started from elementary school. One of the subjects taught in the elementary school level is science. Every learning, absolutely, is expected to be able to obtain good result so that the purpose of education can be achieved. However, in fact, nowadays the education of Indonesia still does not achieve the expected goals yet. Based on the assessment result of PISA (*Program for International Student Assessment*) in 2015 regarding science, it is shown that Indonesia was in 62nd rank from 70 countries. In addition, based on the survey result from TIMSS (*Trend International Mathematics Science*) in 2015, generally the students of Indonesia were weak in all aspects both content and cognitive for Mathematics or Science. Those facts reveal that the students' competence on science in Indonesia is not completely good. With this condition, change and renewal are needed for the sake of improving the quality of science learning because if they are not conducted, the learning-teaching process will hamper the improvement in education aspect.

Besides, environment pollution that frequently happens shows that the community's care on the environment is poor. It occurs because the community does not fully understand about the basic concept of earth materials such as water, air, fire, and land. The teaching of appropriate basic concepts regarding water, air, fire, and land can be done to the students of elementary school. The learning is in science. Rahmasari in Jupriyanto & Sari (2019) argues that science learning requires students' process skills to understand in detail, because science learning is a learning that connects the environment around students with existing material. So in the learning process, a process is needed to find out for yourself and construct the knowledge that they have. The Ministry of National Education (cited in Wisudawati and Eka, 2014) states that there are two inseparable parts from Science namely Science as a product and Science as a process. According to Jacobson and Bergman in Susanto

(2013) Characteristics as a basis for understanding science are a collection of concepts, theories, principles and laws therefore nowadays the object of science study becomes much wider including concept, science application in daily life, process, value, scientific attitude, and creativity. In order to be able to solve a problem, a student should firstly understand and master a concept. A student generally has had an initial concept that he obtains from experience and surrounding environment. The student's initial concept will be different one another. In order that the understanding and the mastery of student's concept are good, the student should have right initial concept first. Not all initial knowledge or initial conception on a thing that they believe is right. According to Widodo (cited in Muchyar, 2015) this initial knowledge or initial conception will be used eventually by the students to learn something that has a relation with what they have known. The conceptual knowledge, according to Anderson & Krathwohl (2014), covers knowledge about category, classification, and the relation between two or more categories. Conceptual knowledge includes schema, model, and theory represents human knowledge on how a study is arranged and structured, information and the parts are interrelated systematically and can function collectively.

The problem that occurs in the present time is the student's initial conception is not in accordance with the scientific conception or it is calld misconception. Misconception can hamper the science learning process so that it should be minimized by implementing conceptual change process (Dahar, 2011). According to Sinatra cited in Nadelson et. al. (2018) Conceptual change, or the restructuring of existing knowledge, has been studied extensively in science education where students often hold incorrect or naïve conceptions about physics, chemistry, astronomy, engineering, and other scientific phenomena that conflict with what students learn in school. Through conceptual change, the students are able to learn about science in which the students actively develop their knowledge to achieve meaningfulness (Driver cited in Dahar, 2011). If the new concept learned by the students is in line with the concept that they have

learned, the students will apply the knowledge in the new situation; while, if the new concept is totally different from what they have, they should change it so that conceptual change process occurs. Muchyar, et. al. (2015) state that to stimulate conceptual change to occur, it is suggested that the selected instructional activity to be effective and *student-centered*. The selection of appropriate strategy for students' conceptual changes highly depends on the students' involvement in the learning process. According to Nurhayati, Panjaitan, & Djuanda, (2016), in the science learning in elementary school, not all science materials taught by the teachers' explanation only, but many science materials in elementary school should be conducted by having observation and experiment in order that the students experience it directly; the skill can be developed through practice activity in the school.Damanhuri, et al, in Endah (2017) suggested that the learning process is said to be effective if students are actively involved in all things, both mental, physical and social. One of the strategies that involve practice activity and involve students actively in the learning process is strategy of POE or *Predict, Observe and Explain.*

Predict-Observ-Explain (POE) is a constructivist teaching strategy developed by White and Gunstone. Gustone and Mitchel cited in Rahman (2012) said that The POE strategy is often used in science teaching. It requires three tasks to be carried out. First, this strategy helps to uncover individual students' *predictions*, and their reasons for making these about a specific event. Second, students describe what they see in the demonstration - *observation*. Third, students must reconcile any conflict between their prediction and observation – *explanation*. POEs can therefore be used to explore students' ideas at the beginning of a topic, or to develop ideas during a topic, or to enhance understanding at the end of a topic. By this way, the concept obtained by the students will be into their memory and the students will understand about what they learn. Through this teaching procedure, students are assisted in attempting to apply their learning to a real context. It is not about telling students the right answer at the end (Loughran, 2010).

POE provides a learning experience for students actively thinking. So according to Usmaedi (2017) a person's thinking ability can be increased by understanding processes that involve thinking activities. By getting used to activities that require thinking activities, our brain will be educated and accustomed. With this habit, it will result in an increase in our ability to think. According to Liew cited in (Muna, 2017), the learning step of POE consists of three main steps namely: 1) *Prediction*; prediction is a process of make assumptions on an event. In making assumptions, the students are asked by the teachers to explain the reasons of their assumptions regarding how they choose the prediction. In this process, the students are given freedom to make assumptions with reasons; the teachers do not limit the students' thoughts so that there will be many ideas and concepts coming from the students' thoughts. It is because many assumptions coming from students' thoughts will help teachers understand on how the concepts and the students' thoughts on the problem discussed; 2) *Observation*, Observation is a fundamental scientific skill. Students use all the senses in observing. In this phase, students are invited to conduct experiments in which its goal is to examine the prediction truth that they convey. Students observe what happens; the most important in this step is confirmation of their predictions; 3) *Explanation*, namely giving an explanation, especially about the compatibility between the assumptions and the experimental results at the observation phase. If the prediction results are in accordance with the observation results and after they get an explanation of the truth of the predictions, the students are increasingly convinced of the concept. However, if the assumptions are not correct, the students can look for explanations about the mistakes in their predictions. Students will experience a change in concept from an incorrect concept to a true one. Here, the students can learn from mistakes, and usually learning from mistakes will not be easily forgotten. Broadly, it can be concluded that the learning process in this POE focuses students on activities directly and also brings students into someone is brave to express their thoughts.

The selection of this POE strategy is based on the results of several studies that have been conducted such as the research result done by Sumirat, (2017) which shows that POE is effective in facilitating changes in students' concepts in heat energy and earth energy. The further research conducted by Kibirige, Osodo, & Tlala, (2014) suggests that learning by using POE is better than traditional learning to straighten a misconception about salt solubility. Similarly, the research from Rosdianto, Murdani, & .,(2017) reveals that POE can improve students' understanding of concepts in Newton's legal material and research from Jasdila, Fitria and Sopandi (2019) shows that Predict Observe Explain (POE) strategy has effect on the change of mental model of primary students.

The renewal of this research is in the material which will be used in the research. The material is about the water density. This water density material is chosen because the concept of water is very close to student life but it cannot be denied that students still have a misconception on the concept of water; one of them is on the material density of water. The example of misconceptions is in the concept of water density in which the students still assume that when an object is put into the water, the object can float or sink is only influenced by the weight of the object itself without knowing that the water density also affects the condition of the object when it is put into the water. Therefore, based on the description that has been explained aforementioned, this research is intended to know whether there is an "Effect of POE Strategy on Students' Conceptual Changes about Water Density.

B. Research Methodology

The research design used in this study is a pre-experimental research in the form of One-Group Pre-test & Post-test Design where the experimental group is not randomly selected. The study sample is given treatment for a certain amount of time. Pre-test is given before the treatment, and post-test is given after the treatment (Sugiyono, 2014). An overview of the research design is presented in the following table:

Table 1. One-Group Pre-test & Post-test Design

O1	X	O2

Remarks:

O1: Pre-test in experiment class

O2: Post-test in experiment class

X : POE Strategy

The population in this study is the population of conceptual change score in grade V students of Public Elementary School Sertajaya 05. The determination of the sample is based on the sampling technique used, namely the Non-probability sampling technique of the purposive sampling type. The sample used in this study consists of 34 students. This research was conducted in class V of Public Elementary School, Bekasi Regency by using one class specifically class VA. This research was conducted in the even semester of the 2018/2019 academic year.

The instrument used to know the conceptual changes of students is by tests. The tests used are pre-test and post-test. To express the level of conception in students, the researcher uses diagnostic tests in form of a four-tier test. The instrument consists of two questions, each of which has four levels. The following is the example of the instrument used:

1. A student conducts an experiment by providing plain water in a glass and then inserting objects such as stones, quail eggs and cork into a glass of water. What will happen to these objects?
   a. Stones = sink; Quail eggs = float; Cork =drift
   b. Stones = sink; Quail eggs = drift; Cork = float
   c. Stones = sink; Quail eggs = sink Cork = float
   d. ……..
2. Are you sure with your answer?
   a. Yes b. No
3. Why is it so? Give your explanation!
4. Are you sure with your explanation?
   a. Yes b. No

The next step is the learning step by using the POE strategy related to water density material:

Predict:

At this phase, the teacher brings the materials needed for the experiment related to the water density and the

experiment steps. Then, the teacher explains the experiment steps that will be done and then gives prediction questions to students regarding the experiment. The following are the examples of questions given to students:

1. What will happen to gravel, quail eggs and cork when put in water?
2. Provide your reason (s) why do you predict so?

Observe

At this phase, the students conduct experiments in groups and fill out worksheets that have been provided by the teacher. They are given the opportunity to utilize existing resources in answering some of the questions on the worksheet. The following are the observation tables as well as sample questions on the worksheets given to students:

Table 2. The Result of Experimental Observation

Object Name: Stone

Water Type	Object Condition		
	Sink	Drift	Float
Plain Water			
Salted Water			

1. Based on the results of experimental observations that you do, what happens to gravel, quail eggs and cork when put in plain water?
2. Are your experiment results in line with your prediction?
3. Give your explanation why it can occur!

Explain

In the phase of explain, the students are given the opportunity to explain the observation result on the experiment and explain the discussion result from the answers to questions given on the student worksheet. The teacher gives additional information if the student's explanation is not correct.

The results and the answers of students' pre-test and post-test will then be adjusted according to the category based on Anam (2019) to see how students' conceptual changes after the learning process is conducted by using the POE strategy. The pattern of conception change consists of five change levels, namely: 1) Construction; 2) Revision; 3) Complementation; 4) Static, and 5) Disorientation. Table 2 will explain the patterns and the students' conceptual changes before and after learning by using the POE strategy.

Table 3. The Patterns and the Students' Conception Change Levels

Response Change		Conception Change Level
Initial	**Final**	
HNC	LC	*Construction*
	ASC	
	SC	
MSC	LK	*Revision*
	LC	
	ASC	
	SC	
LK	LC	
	ASC	
	SC	
HNC	HNC	*Static*
MSC	MSC	
LK	LK	
LC	LC	
ASC	ASC	
Changes that occur backward from the initial to the final category		*Disorientation*
ASC	SC	*Complementation*

SC: Scientific Conception; ASC: Almost Scientific Conception; LC: Lack of Confidence; LK: Lack of Knowledge; MSC: Misconception; HNC: Have No Conception

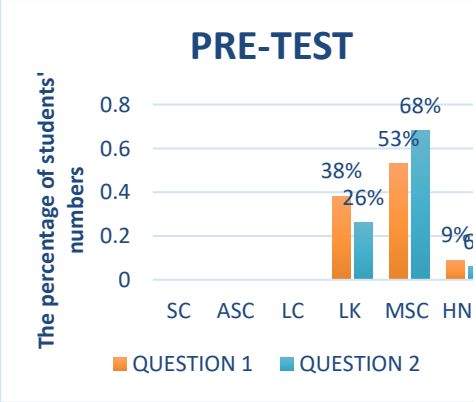
The following is an explanation of the conception change level based on the table above:

1. *Construction*: The students are able to construct their understanding.
2. *Revision*: The students are able to make improvements (revisions) to their initial understanding.
3. *Static*: The students cannot change their understanding into better understanding.
4. *Disorientation*: The students experience changes in understanding but the final understanding is no better than the initial understanding.
5. *Complementation*: The students are able to revise their incomplete initial understanding to be more complete and in accordance with scientific conception.

The results that will be obtained from the students' pre-test and post-test answers will then be grouped according to the conceptual change level based on the table above.

C. Research Result and Discussion

The result of this research is the profile of students' conceptual changes in the material of water density obtained from the results of the pre-test and post-test where the form of the test used is a five-tier diagnostic test. Pre-test results obtained will be illustrated in form of the bar chart below:

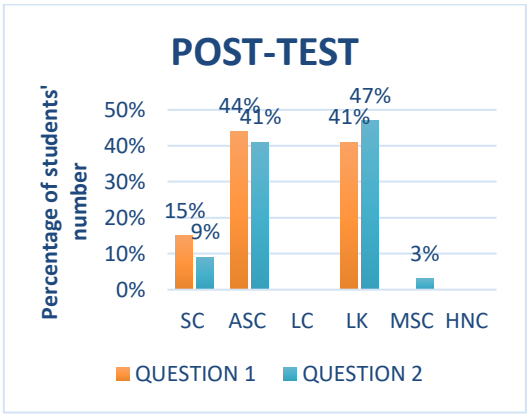


Picture 1 The Result of Pre-test

Based on the figure shown above, in question number 1, there are 38% of students categorized as Lack of Knowledge, 53% of students categorized as Misconception, and 9% of students categorized as Have No Conception. Besides, in question number 2, there are 26% of students categorized as Lack of Knowledge, 68% of students categorized as Misconception, and 6% of students categorized as Have No Conception.

Based on the results of the pre-test obtained, it seems that more than half of the students in the class have misconceptions or still have concepts that are not correct in the material of water density.

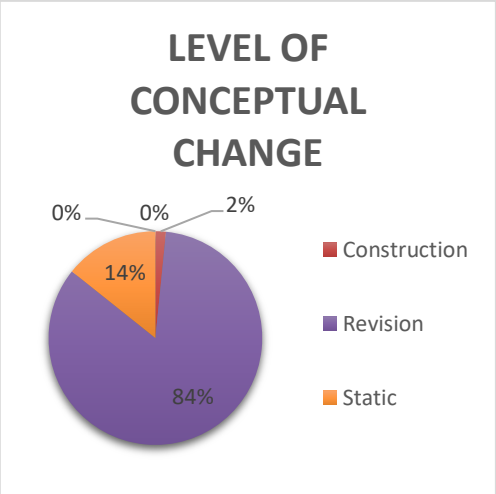
Then, the result of post-test will be illustrated by the diagram below:



Picture 2. The Result of Post-test

Based on the figure above, the results of the post- test in question number 1 are 15% of students categorized as Scientific Conception, 44% of students categorized as Almost Scientific Conception, 41% categorized as Lack of Knowledge. While, in question number 2, there are 9% of students categorized as Almost Scientific Conception, 47% of students categorized as Almost Scientific Conception, 41% of students categorized as Lack of Knowledge

category, and 3% of students categorized as Misconception category. If viewed from the results of the post-test, there is a quite significant difference between the categories before and after learning by using the POE strategy. If the results of the pre-test show almost most of the students are categorized as Misconception and Lack of Knowledge meaning that there are still many students who have the wrong concept and there are even students who have the category of No Conception, meaning that the students do not have the initial concept of the water density, the results of the post-test show an increase in which there are students who are categorized as Scientific Conception and Almost Scientific Conception and there are only 3% of students who still have the Misconception category. This category improvement can be an indication that the POE strategy used by the researcher in the learning process has an effect on the students. To examine whether there is a conceptual change in students or not, the data processing of the pre-test and post-test results is conducted to get the conceptual change level. The following is the presentation diagram of the students' conceptual change level in the material of water density:



Picture 3.
The Percentage of Students' Conceptual Change Level Achievement on Water Density Material

Based on the figure above, it can be seen that the type of student change in the concept of water density consists of 3 levels of change, namely 14% is at statistical change, 2% is at construction change, 84% is at the revision level and none of the students is at the complementation and disorientation level. By seeing the pattern of changes that occur, it can be concluded that the majority of students (84%) make improvements (revision). It happens because the concept of water is indeed extremely close to students' life; besides, the learning process that

actively involves students is one of the reasons why students can improve the initial understanding that they have. The students are at the static level (14%) because the initial and final categories of students are in the same position. This is because the answers to the pre-test and post-test are almost the same and there is no change or improvement between the initial concepts that students have with the concepts obtained by students after getting learning by using the POE strategy. Moreover, the students who are at the level of construction (2%) mean that these students are able to construct their understanding of the concepts they learn. The construction process and students' conceptual changes are obtained from observations and explanations during the learning process because in these two phases, students are forced to think, observe, and understand a concept.

The results which reveal that the majority of students are at the revision concept change level show that the POE approximately affects the students' understanding of concepts in which when predicting and answering pretest questions, the categories of misconception, lack of knowledge, and have no conception can turn into almost scientific conception or even scientific conception in the final test. Liew (in Muna, 2017) states that if the predicted results during POE learning are in accordance with the results of observations and after they get an explanation about the correctness of their predictions, the students will be more confident in the concept. However, if the assumptions are not correct, the students can look for explanations about the mistakes in their predictions. The students will experience a change in concept from an incorrect concept to a true one. In line with the opinion of Rustaman cited in Muchyar et al. (2015) in order that a concept can be mastered well, the students should experience two kinds of adjustments. If the new concepts learned by students match the concepts they have learned, the students will apply the knowledge to new situations, whereas if the new concept is completely different from what they have, they students need to change it so that a conceptual change process occurs. This happens when the research is on-going where the majority of students'

prediction results are different the observations results in which they must look for an explanation that shows why the prediction results are incorrect. Therefore, the results of the conceptual change level is at revision level and some are at the construction level. Conceptual change that occur indicate that these changes change the initial concept that was previously less appropriate to be more scientific this is in line with the opinion of Utter (2018) Conceptual change transforms students' misconceptions and previous beliefs into concepts that are more aligned with scientific theory and data.

POE learning conducted in this study uses cooperative learning in which the students conduct a practice in groups. Pimthong, (2015) suggests that the importance of science teachers caring about affective attitudes and social factors to develop learning strategies can facilitate the conceptual change. It means that in order to change the students' conceptualism, an educator must facilitate learning with the right strategy. Therefore, the researcher uses the POE strategy in which the learning activities in it not only concern about the content of the material, but also concern about the practice of the scientific attitude and the social attitude through practical activities. Another opinion is from Nahdi (2015) revealed that students as learners are stimulated through the learning activities to be able to build their knowledge through the active learning process that they do themselves, with POE students' knowledge will be stimulated by the learning activities they do.

Other researches revealing that POE gives effect on conceptual change like the research from Kibirige et al., 2014; Rosdianto et al., 2017; Sumirat, 2017 show that POE gives effect on the conceptual changes, misconceptions and understanding of students' concepts in line with the results obtained by the researcher. Although 14% of students are at the static level which means that there has not been a change, but the majority of students are at the revision level of 84% (students are able to make improvements (revisions) to their initial understanding), it shows that POE has an effect on students' conceptual changes in water density type material.

D. Conclusion

The conceptual changes in students who are given treatment by using the POE strategy are at the level of construction by 2% (students are able to construct their understanding), revision by 84% (students are able to make improvements (revisions) to their initial understanding), and static by 14% (students cannot change their understanding into better understanding). These results show that the majority of students experiences conceptual change after learning by using POE strategy. Therefore, POE strategy is an alternative choice that can be used by teachers in teaching science concepts to students.

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