Enhancing Junior High School Students Conceptual Understanding Using the POE-based Demonstration Technique on Electrostatics

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Abstract. Predict-Observe-Explain (POE) based Demonstration has been developed to illustrate the electrostatics concepts turn into more factual and purposeful learning. The design of POE-based demonstration is a technique of learning that allows students to discover the entire concepts of electrostatics in terms of the existing conceptual and practical. To analyze the data genuinely and comprehensively, we have already utilized a developing method of ADDIE which has five-extensive phases: 1) analyzing, 2) designing, 3) developing, 4) implementing and 5) evaluating. The ADDIE developing steps have been used to define comprehensively from the phase of analysis to the evaluation. The data shows that junior high school students have three understanding conditions, that are, students who have high understanding is 70%, moderate understanding is 25% and low understanding is 5%. In conclusion, the POE-based demonstration could effectively raise the concept mastery of electrostatics for junior high school.

1. Introduction

Conceptual understanding is one of the most exciting studies in the world, including in Indonesia. Researchers have done several ways to enhance these conceptual understandings. Some of them are developing books, learning strategies, models of learning, media, etc. One of the most interesting developments to improve conceptual understanding is the development of models of learning as developed by Samsudin [1] & Costu [2]. Samsudin [1] constructed for promoting pre-service teachers’ understanding of the magnetic field and Costu [2] constructed to develop the POE-based teaching strategy to facilitate the effectiveness of student understanding of condensation. Based on that research by Samsudin [1] and Costu [2], researchers established a more in-depth development and found a new thing for sustainable development. The development resulted in Predict-Observe-Explain (POE) based Demonstration. Researcher regards POE as a new innovation in science education to enhance junior high school students’ conceptual understanding.

In order to determine students’ conceptual understanding of several concepts, e.g. optics [3], magnetism [4], heat and temperature [5], many kinds of research have been carried out. Electricity, especially electrostatics, is one of the basic useful scientific topics which still fulfilled by low conceptual understanding or misconception. Research on low conceptual understanding or misconception in electrostatics mainly focuses on the interaction between charges and electrical force [6-10]. According to the finding of research [6-10], most of the students have not clear understanding and difference of the concepts of interaction and electrical force. The researcher underlines that an immature understanding
of the electrical concept as an interaction of charge and electrical force is one of the reasons that could explain the difficulties of the student to observe an abstract concept. These and several other studies have shown that the conceptual understanding of electrostatics can be increased by several treatments. One of the treatment is used and developed in this research, DB-POE. The DB-POE learning activity has collaborated between demonstration model and POE teaching approach. It helps the student to learn interaction of charge and electrical force into more factual learning.

2. Method
A learning material, Predict-Observe-Explain (POE) based Demonstration, is developed using research and development method, ADDIE, which includes the steps of Analysing, Designing, Developing, Implementing, and Evaluating. The development of POE-based Demonstration through ADDIE has been applied to 37 junior high school students who took three times learning, as consequently the students were able to be identified hold the existing concept. The study was conducted in the first semester of the academic year 2016/2017 of 9th grade at 26 Junior High School, Bandung. The research involved one lecturer, two observers, and one lecturer assistant. Each person who was involved had the succeeding role: 1) a lecturer’s role conducted classroom’s learning, set the equipment, and materials for POE-based demonstration, 2) observer observed all lecturer activities and 3) lecturer assistant had role documenting and recording learning activities.

In order to analyze students’ conceptual understanding, we utilized Test Conceptual Understanding (TCU) on Electrostatics concepts. The instrument test items consisted of twenty-three questions (in detail, the twenty was multiple-choices and three was essays).

3. Result and Discussion
The development of POE-based Demonstration on the electrostatics concept was more concern on the conceptual approach to junior high school student more detailed understanding concepts. The teaching strategy development has been utilized with ADDIE developing model which has five comprehensive steps, 1) Analysing, 2) Designing, 3) Developing, 4) Implementing and 5) Evaluating.

3.1 Analysing
This step is also known as a process to recognize the research problem (needs) and to categorize the needs. The output of this phase was more emphasis on the problem that perceived by students, such as low conceptual understanding. It can be seen from the other articles which concern in the same case. Based on further analysis, researchers have been gained the development of teaching strategy on Predict-Observe-Explain (POE)-based Demonstration. Besides that, analyses were also conducted on the syllabus of grade 9th Junior High School and learning plan at that time researchers totally conducted a basic revision of the learning plan and the existing syllabus. The syllabus has been promoted based on conceptual approach through a Predict-Observe-Explain-based Demonstration. With the presence of a basic revision of the syllabus, the analyzing step created the developing teaching strategy shown more emphasis on the real and factual concept of electrostatics.

3.2 Designing
This phase was also known as making a plan, as the building, before it was built there must be planning first. The design in question is the design of learning to solve the problem which is low students’ conceptual understanding and instrument that will support the research. DB-POE was designed to solve that problem. This learning design focused on electrostatics concept given that the electrostatics is an abstract concept. This learning model design included the phase of telling the problem, make a prediction, explain the phenomena, observe the phenomena, discuss and explain. This the following design that has been constructed:
On the other hand, this phase was not only making a learning model but also an instrument which supported the research. Instruments used in this research are student worksheet and test conceptual understanding.

3.3 Developing
Developing phase is the process of development of learning model and instrument become more perfect. This means that in this step everything desired or would sustenance the implementing phase should have been completely prepared. The development was undertaken involving two experts in this field. There are two steps in this phase which are 1) validating by two experts and 2) revision. Figure 2 is the example of validating phase.

3.4 Implementing
In this phase, the model of the teacher is implemented by using it in the learning process. The student at 24 Junior High School, Bandung, is chosen as the subject of implementation. The implementation phase took three-session time, each time consists of 45 minutes. The learning model is used in the learning process in the classroom. The physics phenomenon which shown the interaction between proton and electron is shown through a demonstration at class. Here is an example implementation of DB-POE learning model.
The module, which developed before, composed of the POE task containing the three steps mentioned above is presented as shown in appendices, just for one session time.

3.5 Evaluating
In this step, the pre-test and post-test are conducted by the students. The pre-test and post-test consist of the question about subject electrostatics in physics. The achievement of this learning using POE-based demonstration was able to be evaluated by using test items which have three categories as high understanding (HU), understanding (U), low understanding (LU). They can be concluded the level of students’ conceptual understanding of electrostatics. Here the frequency and proportion of students’ responses for the test item.

| Electrostatics Conception | Category | Pre-test (f max. is 40) | Post-test (f max. is 40) |
|---------------------------|----------|-------------------------|-------------------------|
|                           |          | F | %    | F | %    |
| HU                        |          | 6 | 15   | 28 | 70   |
| MU                        |          | 7 | 17.5 | 10 | 25   |
| LU                        |          | 27 | 67.5 | 2  | 5    |

The table shows that the students’ understanding highly increases from pre-test to post-test. It can be concluded that the DB-POE could effectively increase the learning output on electrostatics.

4. Conclusions
A learning model consists of the model of learning and instrument of electrostatics in the daily life experience has been developed. The final product is appropriate as the learning model, DB-POE, for helping the student to learn electrostatics. It can be concluded that the development of DB-POE on the electrostatics through ADDIE developing model, Analysing, Designing, Developing, Implementing and Evaluating, was able to highly increase the students’ understanding on electrostatics.

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Appendices

The module of the first session

A. OBJECTIVE
To know the occurrence of electrostatic phenomenon.

B. TOOLS and MATERIALS

| Tool               | Quantity |
|--------------------|----------|
| Fiberglass/ruler   | 2        |
| Wool               | sufficiently |
| String             | sufficiently |
| Stative Pole       | 1        |
| Quill              | sufficiently |
| Glass              | 1        |

C. STUDENT ACTIVITY

What image do you observe on the right side? .................................................................
Have you ever tried rubbing it with the wool? What will happen if rubbed? ..........................

Now, we try rubbing it with wool. Explain your observation! .............................................

Then, try to close the rubbed object with paper flakes and observe it! What happened? Do you notice any difference there? Discuss in your group! ..................................................

Try to do the same thing with other objects around you, and observe what changes happened?

In this activity, you will learn to investigate the phenomena similar to the above phenomena. Follow the steps below, discuss the question in your groups, and fill the blank! Have a good study 😊

 Predict (P)
What happens to a fiberglass/ruler that has been scrubbed with a wool close to another fiberglass/ruler that hangs on the stative pole? Answer and explain the reasons for your prediction! ..................................................

 Observe (O)
Observe changes in the hanging fiberglass/ruler. What happened? Do you notice any difference there? Why do you think these happen? Discuss in your group! ..................................................

 Explain (E)
Explain in detail what would happen? Compare between your prediction and observation! What did deduce from the above experience? Please write your deduction below! ..................................................

Now, we try to use another object that is available on your desk.

 Predict (P)
What happens to the glass that has been scrubbed with a wool close to quill that hangs on the stative pole? Answer and explain the reasons for your prediction! ..................................................

 Observe (O)
Observe changes in the hanging quill. What happened? Do you notice any difference there? Why do you think these happen? Discuss in your group! ..................................................

 Explain (E)
Explain in detail what would happen? Compare between your prediction and observation! What did deduce from the above experience? Please write your deduction below! ..................................................

Make the conclusion below using your experience gained from the activity

Name : 
Group Number : 

Name: Group Number: