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Enhancing Students' Conceptual Understanding in Magnetic Properties Using Interactive Conceptual Instruction Approach Assisted Virtual Simulation

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Abstract. An application of interactive conceptual instruction assisted virtual simulation media oriented conceptual construction to strengthen students' understanding in terms of the level consistency has been studied. The research method used was pre-experiment using design one group pretest-posttest. The population is Class XII students of one high school in Bandung. Physics content examined is magnetic properties using virtual simulations media program developed by researcher using macromedia flash. The results showed that the use of interactive conceptual instruction simulation assisted virtual simulation media can enhance the understanding of the concepts of magnetic properties with the category average medium increase. This is showed by the average of the normalized gain score, <g>, by 0.66, the level of consistency in each concept tested get value 1.4 with category of consistency is enough. These results showed the application of interactive conceptual instruction on learning physics has good potential in optimizing understanding concepts among high school students.

INTRODUCTION

Teaching and learning on nationally held curriculum a competency teaching and learning by enhancing the process and its authentic assessment to achieve some competencies such as behavior, knowledge and skill. In order to enhance the teaching and learning process, it was done through a process which make the students to be able to achieve the goal. It is called a scientific approach. In senior high school level, physics is a subject that is taught to students in order to fulfill the curriculum requirements. And in order to fulfill the curriculum requirements and to hold the teaching and learning process which emphasize on acquiring knowledge and information. This of course could fulfill the curriculum requirement as physics is part of science that include three aspect of science (behavior, process, and product).

Teaching and learning physics in senior highschool is aimed to be a process for students to acquire knowledge, concept and principal so the students are expected to acquire knowledge and skill. Some method and media were used in order to achieve the goals of physics teaching learning process, by doing so a teaching and learning process that could embed and train students to achieve many competency during their study. A problem appears when it came to the process of teaching abstract content. It would be a great challenge for teachers because during the teaching process it could not be accomplished by using practice tools. Event with the real experiments it would be hard. Such limitation would only show the physics phenomenon. Because of the limitation, conducting experiment in the real lab could only show a dependency correlation between some macroscopic physics quantity, it is still a problem at Senior high school until today due to a curriculum that require the students' knowledge acquiring process through a proper one in order to the margin between process and the goal.

One of the approach that is designed to focus on embedding concept among the students is interactive conceptual instruction (ICI). This approach has four main features which are conceptual, class interaction, experiment based material, and using textbook by Anti Savinainen, *et al.*[5]. In an experiment by Dadi Rusdiana, *et al.* [4], Yuyu R Tayubi, *et al.* [8], and AndiSuhandi, *et al.* [7] which has the same topic shows that by using this approach, it would significantly increase students' understanding as it compares to traditional

approach. In this approach, during the introduction and understanding, some props are usually used in order to show some physics phenomenon that are related to some concept studied by the students. Such as demagnetization process by heating. Some magnetic metal took longer time to be demagnetized by heating. And such practice has limitation. It can only show the macro phenomenon, such as how metal lose its magnetic and compare it to the other material with different characteristic. Even with such props, it could not show the dynamic correlation between some physic quantity such as how magnetic material behave on how big the magnetic induction in electromagnetic concept. The limitation could limit the achievement on the concept of understanding.

In order to solve the limitation, researcher develoved a media base on computer simulation, especially a virtual simulation about magnetic characteristic in material. This develovement is possible as it is supported by the existing technology, especially computing technology (hardware and software). Researcher design a story board through the same steps and improvements. The design would be a basic in making a virtual simuation with software Macromedia 8 and its experts. After validated by some experts, the simulation could then be used in the teaching learning process as media in order to strengten the explanation of phenomenon demonstrated by the props, or even replace the tools that impossibly brought a demonstration to a class due to its price and rarity. To test the effectivenesof the simulation, a research has been conducted in a senior high school. The topic is the study on material's magnetic charactheristic. Conceptual interactive is employed on this research. It is a little bit different from a research conducted by Savanainen. This conceptual interactive approach has some features which are emphasize on concept understanding in the begining, there is always a monitoring process in every level of understanding during the study, using demonstration method, a collaboration system in small-group, and prioritze on class interaction.

Students' understanding were monitored by using an instrument develoved by researcher. This article explains how a simulation media was used on interactive conceptual instruction in enhancing students' conceptual understanding in magnetic properties using interactive conceptual instruction assisted virtual simulation.

EXPERIMENTAL

Research Design

This research is conducted by using pre-experiment method and on group pretest and post test design. This design is applied by giving pretest to the experiment group and then give them treatment which is using virtual simulation media as a tool of construction and conception for students on magnetic properties and ended by post-test. The design is described in the following chart.

One Group Pretest-Postest Design

Pretest	Treatment	Posttest
O	X	O

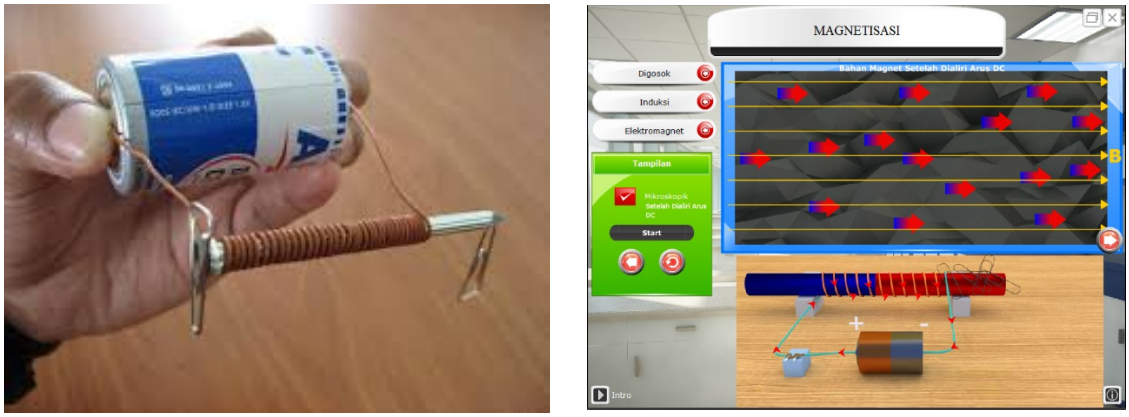
Description:
O : Pretest and post test
X : Treatment by using virtual simulation media

Population and Sample

The population on this research is Class XII grade students in one of senior high school in Bandung Regency in 2016/2017. The sample on this research is a XII grade class in the school which randomly chosen by purposive sampling. The class became the experimental class was given a treatment as the chart above.

Research Instrument

The instrument which was used in the whole activity on this research consist of one set conceptual test which measure students' understanding on the topic of charachteristic of magnetic properties. That was for evaluating students' conception before and after given the treatment. The props for phenomenon demonstrated activity as it is shown in picture 1a. Picture 1b is showing physics mechanism phenomenon.



(a) (b)

FIGURE 1. a) is an example demo media used and b) is an example of media simulation used.

The improvements of students' understanding through simulation media in physics instruction as reviewed base on normalized average gain comparison that was achieved by experimental group after each treatments; each treatment is more effective than the other If the gained score is better than the previous one by Oligiv [3]. It means that the data of students' improvements could be a standard on how big the improvement was. In order to recognize the improvements as a construction of understanding, the normality gain score was analyze. The score is a comparison between average actual gains and average maximum gains. Average actual gains is a deviation of posttest on pretest. Normalized average gain formula is also called a factor<g> or factor Hake as follows

$$\% \langle g \rangle = \frac{\text{posttest score} - \text{pretest score}}{\text{Ideal Maksimum Score} - \text{pretest score}} \times 100\% \quad (1)$$

While students conception consistency in the research adopted analyze technique is used by Nieminen [2].The level of students conception consistency is based on the score gain in the test.Every concept became three questions which has the same level of difficulties but the context could be different. Every students' score is determined by calculating the score for all concept as the formula below

$$\text{Consistency Score} = \frac{\square\ \text{score from each concept}}{\square\ \text{Students}} \quad (2)$$

In order to get the score from each concept, it could be known by taking average score of all students from certain concept as the formula below.

RESULT DAN DISCUSSION

Achievement which is seen as an impact of virtual simulation in general including the pretest and posttest score gained from comprehension test. To see the effect of virtual simulation media on embeding the concept of students understanding, N-gain is used, which is adopted based on Hake equation. The effect and improvements is shown in the chart below. Graphic 1 shows that average pretest score is 40.21% while the post test is 79.80% and theaverage N-gain is 66%. So the score is categorize as high.

The result shows that the media give a real result on improving students comprehension. The use of virtual simulation media could visualized physics mechanism model from a phenomenon even until the micro order. And it is hard to do it with the real tool. The visualized microscopic behaviour from a phenomenon could help students in constructing their conception so their possibility on misconception could be prevented. Media simulation could also be used for showing some abstract concept that the real tool could not. The props could only show some physics phenomenon but could not be able to show how connected physics quantity interact with each other until it shows the phenomenon as observed. For example, a magnetic property in electromagnetism could cause a material become magnetic. But the molecul behaviour change in the material because of the influence of the magetic field could not be visualized by the tool. Even if it could, it still could not show how the magnetic element is transfered, how is the correlation with the electron movement on atom in this phenomenon; atom is the source of this magnetic phenomenon so the physics mechanism the concept of how this phenomenon appears could not be described. Simulation media could solve this. By using the media, the students could observe the physics mechanism on a phenomenon.

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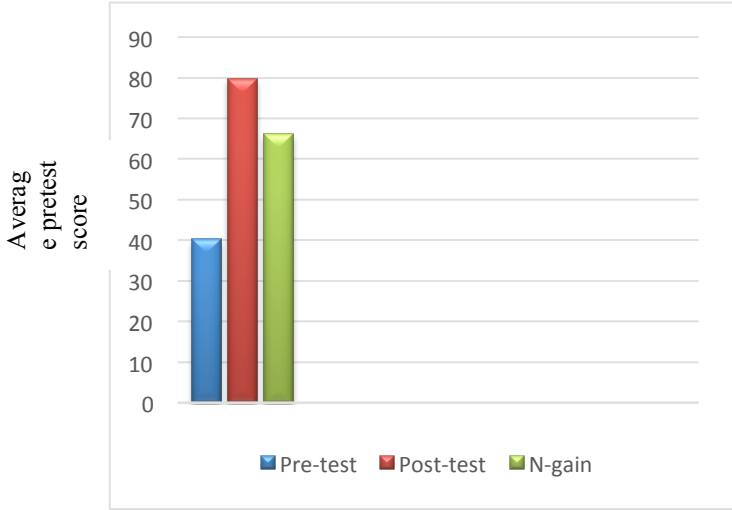

FIGURE 2a. The average score of the ability to understand students

Learning through observation is believed more meaningful then just listen to a lecturing. Beside, it could preven misconception. The students' concept could last longer in their understanding. This advantages could make the improving effectiveness of interactive conceptual instruction approach possible in improving conceptual understanding and minimize the quantity of misconception. In line with this, Suhandi [7] state that using virtual simulation media could improve students' conceptual understanding on medium category. But there are still some weaknesses. Those are it took time for students to understand science and it could not instantly be done. Besides, students' behaviour through science could change by the time. The result is also in line with [9] who state that teaching and learning media could create a more meaningful process. Next one [6] explain that multimedia technology could give positive effect on teaching and learning process.

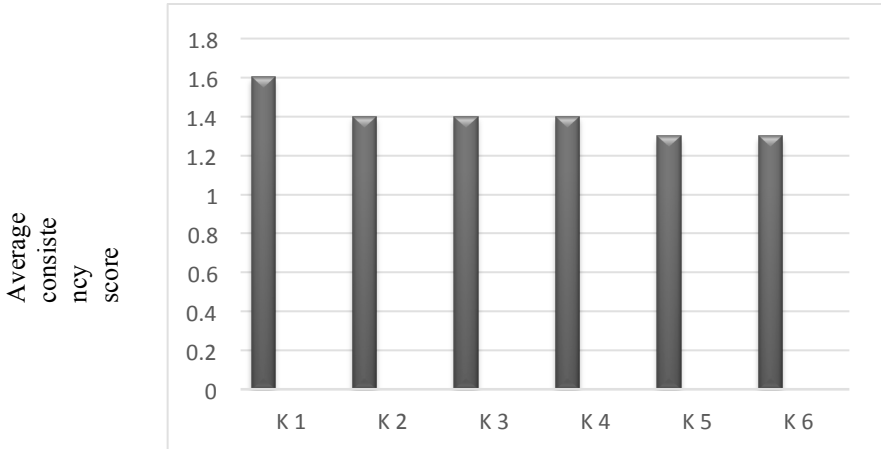

FIGURE 2b. Student's Average Gained conception consistency score from every tested concept

Description:

Concept Label	Keterangan
K1	Physics mechanism of magnetism material
K2	The application of magnetism concept on electromagnetic phenomenon
K3	Artiphysics from susceptibility equation
K4	Heated Demagnetization concept
K5	Comparison between Currie Temperature from magnetic material
K6	Artiphysics of permeability magnetics

Based on conception consistency test that was held at the end of the treatment, as it is reviewed from ten tested concepts, generally the average score of conception consistency 1.4. it is categorized as enough the level of students' conception consistency is shown in Figure 2b.

Generally the students' conception consistency level in six concep is categorized as enough and in 1 concept is categorized as consistent.

From six tested concept, students reach conception consistency level in enough category. Each of them are K1 (Physics mechanism of magnetism material) gain is 1.6, K2 (The application of magnetism concept on electromagnetic phenomenon) gain is 1.4, K3 (Artiphysics from susceptibility equation) gain is 1.4, K4 (Heated Demagnetization concept) gain is 1.4, K5 (Comparison between Currie Temperature from magnetic material) gain is 1.3, K6 (Artiphysics of permeability magnetics) gain is 1.26. Base on the explanation above it is clear that ICI that is oriented based on construction of students understanding that emphasize on constructivism could make conception consistency level higher for the students. It could be cused by more effective teaching and learning process as the impact of virtual simulation media the students could understand the concept better. There were some students that inconsistent to some concept. It is possible that such inconsistency was caused by the lack of their involvements during the process so the result could not be maximize.

CONCLUSIONS

Based on the result and its analysis, it could be conclude that the use of virtual simulation media on conceptual interactive teaching and learning approach could improve students' comprehension and resulted on higher level of consistency. It is shown by the improvements of students' average normalized score who were given the treatment.

The score is 0.66 and categorized as high improvements. Conception consistency as an effect of the implementation of virtual simulation media on physics is consistent enough. Generally the conception consistency average score is 1.4 and it is categorized as consistent.

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