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Application of Guided Learning Inquiry Model CmapTools in Physics Learning to Maintain Student Retention

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Abstract: ***The purpose of this research is to know the difference of retention endurance of the students on the direct current electric teaching material between the classes that implement the guided inquiry learning model assisted by CmapTools and the class that implements the guided inquiry learning model without the help of CmapTools. This study used a randomized control group pretest-posttest design study with posttest administered three times in the interval between posttest for seven days (one week). The sample in this research is the students of X-2 and X-3 class in one of the State Senior High School in Bandung City with the amount of 38 and 36 persons respectively. The results showed that the implementation of guided inquiry learning model assisted by CmapTools could further maintain student retention in direct current electric teaching material compared to the use of guided inquiry learning model without the help of CmapTools.***

Keywords: Guided inquiry learning model, CmapTools, students' retention

1. Introduction

The subject of physics is one part of the science which is held in order to develop the ability to think in solving problems related to the events around, both qualitatively and quantitatively, and can develop skills and self-confidence. This is in line with several objectives of physics subjects at senior high school level that the subject of physics aims to have students' ability to cultivate a scientific attitude that is honest, objective, open, tenacious, critical and can cooperate with others. In addition, in other points, it is said that the subjects of physics aim for students to master the concepts and principles of physics and have the skills to develop knowledge, and confidence as a provision to continue education at higher levels and develop science and technology.

From the description above looks at the last point that the implementation of physics subjects at senior high school level is intended as a vehicle or means to train students to master the knowledge, concepts, and principles of physics. In the process physics learning not only emphasizes the mastery of the concept only (content) but also should contain the four things: the content or products, processes or methods, attitudes, and technology so that students' understanding of physics becomes intact and can be useful to solve the problems faced [1]. Content or products means that in physics there are facts, laws, principles, and accepted theories. Process or method means physics is a process or method to gain knowledge. Attitude, meaning physics can develop a scientific attitude such as diligent, thorough, open and honest. Technology means physics related to the improvement of the quality of life.

Judging from the objective, the physics subject is very good for students if it can be implemented as expected. But in fact, what happened in the field still not in accordance with the expected goals. This can be proved by the preliminary study results in one of the senior high schools in Bandung by distributing questionnaires to students, direct interviews with physics subject teachers, and paying attention to the process of learning in the classroom.

From the results of questionnaires to several students showed that physics, including subjects that are less liked by students. Only 26.41% of students who enjoy physics, the rest 73.59% answered did not like. The reason students do not like physics because students assume that in physics lessons are too many formulas that memorized by 35.90%, boring learning method of 53.85%, and less like lessons counted at 10.26%. Then, from the questionnaire results, 52.83% of the students considered physics as a difficult lesson, 43.40% of students considered physics as an ordinary course of difficulty, and only 3.77% of students considered physics easy.

From the data of interviews with one of the physics teachers, it is known that the problems often faced by the teacher, the students easily forget the subject matter that has been taught by the teacher. This is apparent when every beginning of the lesson, the teacher always asks aperception questions, but very few or no students are able to answer correctly in accordance with the wishes of the teacher. In addition, the method often used by teachers in learning physics in the classroom is the lecture method, discussion/question and answer, and drilling questions.

As for the result of observation of physics learning in the classroom, it is known that the teacher more often explains the concept and give the reinforcement at the end of learning. After the explanation of the concept, students are given exercise questions and one student is working on the board then the teacher discusses it.

By looking at the data of preliminary studies that have been done then it can be analyzed that most of the learning process in the classroom is still centered on the teacher and the transfer of knowledge from teacher to the student only so that learning is only directed to the student's ability to memorize information. Students are more directed to remember the various information without interpreting the information obtained. The learning process that occurs in the classroom emphasizes more on the process of transfer of knowledge from teacher to student, so as not to put the students as a knowledge constructor. As a result, when students graduate from school, they do not know the meaning of the memorized theory. This results in low cognitive abilities of students. In the process, physics learning more often uses lecture methods. This lesson is hereafter referred to as conventional learning because it has traits that are exactly the characteristics of traditional learning [2].

From some data above can be concluded that one of the possible causes of low cognitive abilities of students due to the implementation of physics learning in schools still uses conventional learning. Therefore, the learning of physics is more informative than the teacher conveys the material to the students as a whole and less involving the students in the learning process.

In addition, teacher-centered learning and less involvement of students in the learning process can lead to poor retention of students on learning materials that have been studied. Student retention is the amount of knowledge learned by students that can be stored in long-term memory and can be recalled within a certain period of time. This is in line with the results of Magnesen's research, that we recall 10% of what we read, 20% of what was heard, 30% of the views, 70% of what was said, and 90% of what was said and done [3].

In connection with these problems, it is necessary to improve the learning process so that students are more involved in learning. With the involvement of students in the learning process will make it easier for them to find and understand the concepts he studied. The more students involved in the learning process, it is expected the stronger retention (memory) of students about the material being studied and is expected also the higher the likelihood of learning achievement.

One of the learning models considered to be helpful and facilitating for students' cognitive abilities is the inquiry learning model. There are several types of inquiry that can be used according to the student's circumstances. By looking at the state of the student seen in the preliminary study, the type of inquiry that is suitable to use is a guided inquiry. The term guided inquiry is used because in practice teachers provide guidance or extensive instruction to students in planning experiments and the formulation of activities.

Broadly speaking, the process of inquiry-based learning can be poured in five stages, namely 1). ask questions (problems), 2) formulate hypotheses, 3) collect data (experiment), 4) data analysis, and 5) make conclusions [4].

In addition to the use of guided inquiry learning models, one of the other proven attempts to help improve cognitive abilities and retain student retention is the concept mapping method. Nowadays a software (software) which has been developed in the making of concept map called CmapTools.

CmapTools is a software developed by the Institute for Human and Machine Cognition (IHMC) that can be used as a concept mapping tool. By using CmapTools, students actively seek and analyze information widely from around the world. CmapTools is software that can connect to the internet network where students are built together and connected with CmapServer. With CmapTools the visual knowledge model enriched with hypermedia sources (images, animations, videos, HTML URLs, etc.).

The study material studied in this research is direct current electric material, this teaching material is chosen because it is a teaching material which is very close to the phenomenon that is often encountered by students in everyday life. However, this material is also arguably abstract material so that in reality not a few students have difficulty in learning the concepts of this teaching material including to apply it to everyday problems. Therefore, it is expected that students get the benefits of learning more meaningful through this learning.

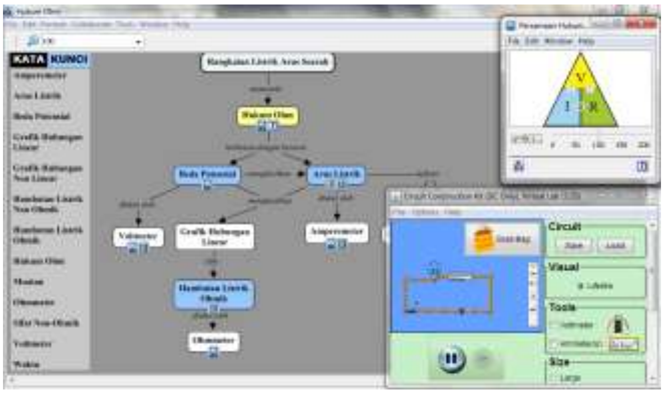

Figure 1: Example of Concept Map Integrated with Image Media and Virtual Laboratory on Direct Current Power Concepts

Based on the problems and statements that have been disclosed, the researcher intends to conduct further research on the differences in the cognitive abilities and retention of students, between classes using guided inquiry learning model with CmapTools with classes using guided inquiry learning model without the help of CmapTools. This is done in order to know how big the role of guided inquiry learning model and concept map using CmapTools in improving cognitive ability and maintaining student retention on direct current electric teaching material.

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2. Method

The research method used in this research is a quasi-experiment method with research design used in this research is randomized control group pretest-posttest design [5]. This study used two classes taken by cluster random sampling from class X which amounted to eight classes, one class will be one control group and one other class become an experimental group. The experimental group received learning treatment by using guided inquiry learning model with CmapTools, while the control group received learning treatment by using guided inquiry learning model without the help of CmapTools. The randomized control group pretest-posttest design pattern is shown in Table 1.

Table 1: Research Design Randomized Control Group Pretest - Posttest Design

Class	Pretest	Treatment	Posttest
Experiment	T_1	X_1	$T_{2.1}$, $T_{2.2}$, $T_{2.3}$
Control	T_1	X_2	$T_{2.1}$, $T_{2.2}$, $T_{2.3}$

T_1 = pretest to measure students' cognitive abilities
X_1 = treatment in the form of implementation of guided inquiry learning model assisted CmapTools
X_2 = treatment in the form of application of guided inquiry learning model
$T_{2.1}$ = the first posttest to measure students' cognitive abilities
$T_{2.2}$ = second posttest to measure students' cognitive abilities
$T_{2.3}$ = third posttest to measure students' cognitive abilities

The instrument is given when the posttest (T2) equals the pretest (T1). The instrument used as a pretest and posttest in this study is an instrument to measure students' cognitive abilities consisting of 33 items of multiple-choice questions that include four of Bloom's six cognitive capabilities that have been revised by Anderson and Krathwohl, memory (C1), understanding (understand / C2), application (apply / C3), and analysis (analyze / C4). The test instrument has been tested for eligibility with a test reliability of 0.79 and a high criterion [6]. The three posttest repetitions are intended to measure the retention endurance of students with a period of one week, either for the first posttest period to the second posttest or from the second posttest to the third posttest.

An analysis of student retention endurance was performed by looking at the mean score of decreasing student retention for each class from posttest 1 to posttest 3.

3. Result and Discussion

Here's the average score of posttest 1, posttest 2, and posttest 3 that students get on the experimental class and control class.

Table 2: Average Posttest Score Recapitulation 1, Posttest 2, and Posttest 3 Cognitive Ability of Experiment Classroom and Control Class

Class	*Posttest*	X_{ideal}	X_{min}	X_{max}	$\overline{X}$	Decrease Retention
Experiment	1	1	0,58	0,94	0,76	0,10
	2	1	0,55	0,85	0,70	
	3	1	0,52	0,82	0,66	
Control	1	1	0,36	0,88	0,66	0,18
	2	1	0,30	0,79	0,55	
	3	1	0,24	0,73	0,48	

The exponential comparison chart of the decrease in student retention in each cognitive domain between the experimental class and the control class can be seen in Figure 2.

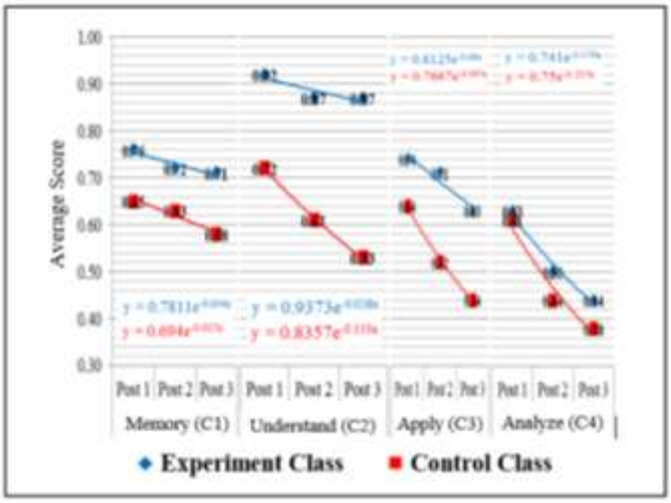

Figure 2: Average Posttest Scale 1, Posttest 2, and Posttest 3 On Each Level of Student Cognitive Ability between the Experiment Class and Control Class

Based on Figure 2, it appears that students' cognitive abilities for the experimental class and control class decreased in posttest 2 and posttest 3 by referring to the scores obtained by each class on posttest 1. This indicates that student retention in the experimental and control classes decreased. The decrease in retention experienced by students in the experimental class is relatively lower than the retention rate experienced by students in the control class. In the experimental class, the average score of Posttest 1, Posttest 2, and Posttest 3 were respectively 0.76, 0.70, and 0.66. The mean score of Posttest 1, Posttest 2, and Posttest 3 for control classes were 0.66, 0.55, and 0.48, respectively. Based on this data we can obtain a decrease in the average score of posttest 3 and posttest 1 for the experimental class and control classes respectively by 0.10 and 0.18. That is, the students in the experimental class experienced a decrease in retention (memory) of direct current electric currents by 13%, while the students in the control class experienced a decrease in retention of direct current electric currents by 27%.

The results of the data processing and analysis above show that the implementation of guided inquiry learning model assisted by CmapTools is better in maintaining student retention than the application of guided inquiry learning model without the help of CmapTools.

Better guided inquiry learning model assisted CmapTools in maintaining student retention, can be explained based on the stages of the learning model itself. In guided inquiry learning with CmapTools, there are several stages that fundamentally require students to recognize (recall) the knowledge they have gained in each stage before. The first stage, which is at the stage of making concept maps using CmapTools. The second stage, which is when the students try to connect the source of teaching materials, whether in the form of text, images, video, or the other with concept maps that have been made using CmapTools. And the third stage, that is when the CmapTools are displayed that have been integrated with various sources of learning materials as information that can be used to compare, justify and or strengthen the knowledge they gain from experimental activities.

These three stages lead to student retention in the experimental class more enduring than the student's retention in the control class. This is in line with Porter and Hernacki's exposure, that we will remember information very well if the information is characterized by the following qualities [3]:

a. The existence of sense associations, especially the sense of sight. Experiences involving vision, sound, touch, taste or movement are generally very clear in our memory.
b. The existence of emotional contexts such as love, happiness, and sadness.
c. The quality is prominent or different.
d. Intense association.
e. The need for survival.
f. Things that have personal virtue.
g. Things are repeated.

In addition, Novak and Gowing reinforce that, student concept maps can also be used as research tools that can be used to improve students' conceptual understanding and retention of knowledge [7]. This is because the effort in creating and building concept maps requires students to recognize their memories and understanding of the relationships between key concepts and some sub-concepts [8]. This led to a prominent comparison between the decrease in retention of experimental class students and control class students for the realm of understanding (C2). In the experimental class, the average retention rate decreased by 5% while in the control class it was 26%.

4. Conclusion

Based on the analysis of the research data, it can be concluded that the implementation of guided inquiry learning model assisted by CmapTools can better maintain student retention on the direct current teaching material compared to the guided inquiry learning model without the help of CmapTools.

5. Acknowledgments

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