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Effect of Implementing Guided Discovery and Free Discovery Model into Student's Metacognitive Knowledge on Respiratory System

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ABSTRACT

This *quasi experimental* research aims to investigate the effect of *guided discovery* (GD) and *free discovery* (FD) models on student's metacognitive knowledge on respiratory system. This research uses *pretest-postest design*. About 6 classes of grade-11 science students of were involved as research subject. Through *cluster random sampling* about three classes consist of 38 students each, were selected. Science class-6 taught by using GD, science class 5 taught by using FD, and science class 4 taught by using conventional teaching method. So the total sample is 114 students. The metacognitive knowledge analyzed by covariate analysis techniques (*Anacova*) and advanced *Tukey's* with significant level $\alpha = 0.05$. *Anacova's* results show that there is a significant effect of implementing learning models (GD, FD, and conventional) into students' metacognitive knowledge ($F = 4,989$; $P = 0,008$). The mean postest of metacognitive knowledge of students taught by using GD learning models were higher than those by using FD and conventional models.

Keywords: *Guided Discovery, Free Discovery, Metacognitive Knowledge.*

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INTRODUCTION

Anderson & Krathwohl (2001) divides the knowledge dimension into four categories: factual knowledge, conceptual knowledge, procedural knowledge, and metacognitive knowledge. Graduation standards for knowledge domain in senior high school consists factual, conceptual, procedural, and metacognitive knowledge (Kemdikbud, 2013). Metacognitive knowledge is the ability of students to link tasks with the material learned (*declarative knowledge*), know how to accomplish tasks/investigate the information needed (*procedural knowledge*), and can give a reason for using them in solving a task (*conditional knowledge*). Metacognitive knowledge of students also needs to be developed. Students with good metacognitive will be able to become independent learners. According to Arifin (2014) currently the learning process has not been able to empower awareness and metacognitive knowledge to the maximum. Students have not studied independently, do not empower the logic they have to understand and state the biological concepts studied and analyze their implications in life and the environment. The development of student's metacognitive in learning was conducted by applying appropriate teaching models (Corebima, 2010). Metacognitive knowledge can be achieved if the learning process is supported by teachers in the classroom.

Based on Ministry of Education and Culture Regulation (2013), learning process standard can be achieved by teacher in class throughscientific approach. This provides

students with the experience to acquire knowledge based on the scientific method independently so that the knowledge transfer process from the teacher to students is not only with lectures (Daryanto, 2014). The scientific approach can be applied by teachers with discovery-based learning models. Understanding natural phenomena requires the ability to ask and discover. Learning through discovery prioritizes reflection, thinking, experimenting, and exploring. People who use discovery in learning become more confident (Bruner, 1961, Balim, 2009).

Discovery learning delivers students to arrive at a conclusion based on their own activities and observations. Discovery-based learning activities in the teaching of science are essential for meaningful and lifelong learning. Trying to solve problems and knowledge will produce a truly meaningful knowledge. Discovery learning is a mental process to assimilate a concept or a principle. The mental process includes observing, digesting, understanding, helping-classify, hypothesize, explain, measure, and make conclusions. Learning with this model prefers the process rather than the outcome. (Bruner, 1961; Kaptan & Korkmaz, 2000; Mulyasa, 2007; Sund, 1989).

Learning by using the GD model aims to improve the pattern of teaching that has been memorizing facts, but not giving students a sense of the concepts and or principles contained in a subject matter. In learning GD students do experiment, observe, collect data, analyze results, answer questions on student worksheets to find concepts based on data obtained and compare them with theories contained in textbooks. Students can develop their thinking skills by finding their own concepts so that students' conceptual understanding is permanent or will not be easily lost. In the free discovery model (FD) the learning is centered on the student and not centered on the teacher. It is students who determine the desired learning objectives and experiences, the teacher only gives students problems and situations to learn.

MATERIAL AND METHODS

This research aims to investigate the effect of guided discovery and free discovery models on metacognitive knowledge of students on respiratory system. This quasi experiment design usedpretest-postest design. The sample of this research are senior high schoolstudents divided into 3 groups. The first group is taught with GD, the second class is taught by the FD and the third class with the conventional. All three groups were given pretest at the beginning of the treatment. Posttest are given at the end of the course. Essay test were administered to measure metacognitive knowledge refers to tests developed by Rompayom (2010) consisting of: 1) declarative knowledge, 2) procedural knowledge, 3) conditional knowledge tailored to the material of the respiratory system. The influence of learning model (GD, FD, and conventional) on metacognitive knowledge was analyzed by covariance technique (Anacova) then continued with Tukey's test.

RESULTS AND DISCUSSION

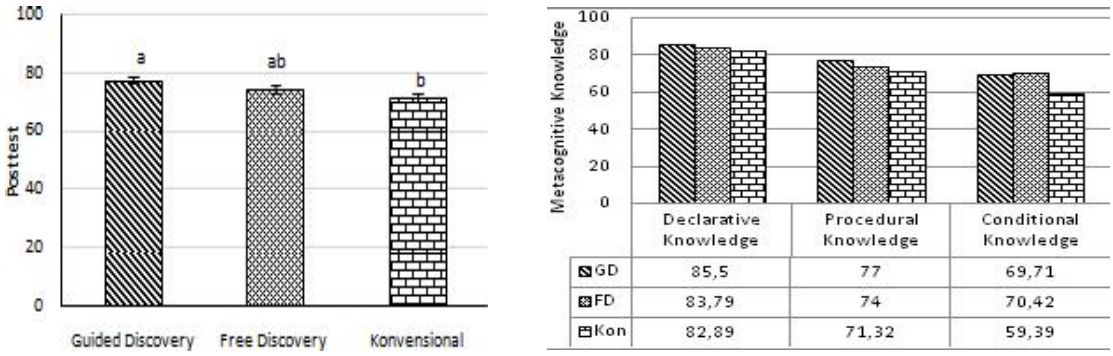
Student's Metacognitive Knowledge

Description of pretest and posttest data of student's metacognitive knowledge taught by GD, FD and conventional models on respiratory system material can be seen in Table 1.

Table 1. Pretest and posttest data of student's metacognitive knowledge on respiratory system

Test	Model	Maximum	Minimum	Means
Pretest	GD	61	14	34,47 ± 11,73
	FD	56	19	35,24 ± 8,58
	Conventional	50	19	34,71 ± 8,50
Posttest	GD	92	56	77,50 ± 7,19
	FD	92	42	74,18 ± 10,51
	Conventional	86	53	71,13 ± 9,92

Table 1 shows the mean posttest of student's metacognitive knowledge who were studied with GD higher compared to students taught by both FD and conventional models. The lowest post test is students who were taught by conventional models (Table 1). Analysis hypothesis with Anacova showed a significant influence of learning model (GD, FD, and conventional) to students' metacognitive knowledge (F = 4,989; P = 0,008). Tukey's test results show that metacognitive knowledge taught by GD model (77,50 ± 7,19) did not differ significantly with learning model FD (74,18 ± 10,51) (P = 0,271) but differed significantly with conventional learning (71.13 ± 9.92) (P = 0.010). The metacognitive knowledge of students who were taught by the FD model did not differ significantly with conventional learning (P = 0.330) (Fig. 1, a).



(a) (b)

Figure 1. (a) Effects of learning models (GD, FD, and conventional) on student's metacognitive knowledge (F = 4,989; P= 0.008). The different letters above the diagram mean significantly different, (b) Student's metacognitive knowledge who were taught by GD, FD and conventional models based on the Rompayom (2010) indicator on the respiratory system material.

Students who were taught with GD had a declarative knowledge mean (85,50), procedural (77.00) and conditional (69,71) higher than students taught by FD and conventional models. Students who were taught with the FD had a declarative mean (83.79) procedural (74.00) and conditional (70.42) higher than the conventional model (Fig.1, b).

Based on the result of the research, there is a significant influence between GD, FD, and conventional to metacognitive knowledge of students. The metacognitive knowledge of students who are taught by the GD model has the highest mean on each indicator. Metacognitive knowledge is the highest level of knowledge according to Anderson & Krathwohl taxonomy (2001). Discovery learning model can develop students' metacognitive knowledge. Discovery learning can support student's metacognitive (Kamel, 2014; Kunsting et al, 2013). This is because the learning stages in this model support students to learn from direct experience in finding concepts/solving problems. Through the application of GD model students are trained to learn independently. According to Coutinho (2007) metacognition and content knowledge are interrelated. Students who have metacognition will be able to organize and control the cognitive processes and can increase their knowledge and will increase their cognitive retention then they will excel academically. Therefore, it is very important for teachers to assess and improve students' metacognition to improve academic achievement.

Stage of stimulation, students are stimulated to think and explore. The second stage, the problem statement, the student is given the responsibility to formulate the hypotheses of questions that have been identified. The third stage, data collection, students are given the opportunity to experiment. This stage students use scientific methods in solving problems, so as to improve students' procedural knowledge and student cooperation.

Experimental activities will keep students' memories longer on the subject matter. The fifth stage, verification, students perform the proof, improvement, and justification of the results obtained through presentation and class discussion. The final stages of generalization, students make the conclusions of learning outcomes. Students who find problem solving and knowledge independently can produce meaningful and memorable knowledge (Dahar, 2011; Syah, 2004; Yani, 2014).

Based on the observations, students who are taught by GD are more active and motivated in learning, as seen from the readiness of the students to provide the necessary tools and materials, the students' activeness to ask, and good cooperation in the group. After the discussion is completed each group makes a presentation in front of the class. Students who are taught with FD are also active in learning, students are together thinking about the experience they choose in solving the problem. Learning with conventional model makes the teacher as the center of information so that students become passive, students receive information directly from the teacher and record it in the book.

CONCLUSIONS

There is a significant influence of learning models (GD, FD and conventional) on student's metacognitive knowledge. The student's metacognitive knowledge who were taught by the GD model did not differ significantly with the learning of the FD model but differed significantly from the conventional learning. Meanwhile, students who were taught by the FD model did not differ significantly with conventional learning. The mean postest of metacognitive knowledge of students taught by using GD learning models were higher than those by using FD and conventional models.

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