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The Influence of Biology Learning Using Concept Attainment Model on Student's Cognitive Learning Achievement

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ABSTRACT

This research aimed to find out the difference of cognitive learning achievement between students taught with Concept Attainment Model and those taught with Discovery Learning model. This study was a quasi-experimental research. The population of research was the 12th Science graders of SMAN 1 Karas of Magetan Regency in school year of 2016/2017. The sample was taken using cluster random sampling technique, consisting of two grades: the 12th Science 4 grade as the first experiment class using Concept Attainment Model and the 12th Science 3 grade as the second experiment class using Discovery Learning model. Technique of collecting data used was t-test technique for data of students' cognitive learning outcome. Data analysis was carried out using unpaired two-sample variance analysis. The result of research showed there was a difference of cognitive learning outcome between the students treated with learning using Concept Attainment Model and those treated with learning using Discovery Learning. The cognitive learning achievement of students taught with Concept Attainment Model was higher than that of those taught with Discovery Learning.

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1. INTRODUCTION

One of National Education Standards, the process standard, states that learning process at education unit level is organized interactively, inspiringly, joyfully, and challengingly, to motivate students in order to participate actively and to provide space for students' initiative, creativity, and independence according to their talent, interest, and physical and psychological developments [1]. Considering the result of survey and interview with teacher and students in SMAN 1 Karas, Magetan Regency, it can be seen that in learning Biology, the students learn concepts and principles in recital manner only. So many concepts and principles to be learnt in science lead to the students' boring in learning science. Learning model and method in SMAN 1 Karas have not been varied in the learning process. Lecturing method is used very dominantly by teacher in the learning process. One of materials in Biology learning is Evolution. Evolution material represents information on the past events broadly, in which the concepts are interrelated [2]. This characteristic of material leads the students to organizing concept, clarifying individual concepts and combining one concept and another difficultly. The delivery of material using lecturing method cannot address the students' difficulty in organizing and clarifying concept so that they cannot acquire the concept independently. Thus, a learning model is required to help students master the concepts of science.

Science learning, according to Ni Ketut Rapi [3], emphasizes on product aspect only such as reciting concepts, principles or formula, but does not give the students the opportunity of participating actively in the

process of Science. Furthermore, some studies [4] and [5] confirm that learning is an interaction between ideas and process; new knowledge is constructed based on prior knowledge; learning improves when students find meaning, and when they participate in discussion about ideas and in the process.

A variety of teaching approaches have evolved to design instruction, but the most appropriate teaching approach/model exerting positive effect that is effective, efficient and interesting can be addressed through a study on the use of such the learning model to find its effect on the students [6]. A study [7] employed Concept Attainment Model to teach certain concepts by comparing and distinguishing the example containing from the one not containing concepts. Concept attainment model builds on students' thinking study conducted by Bruner, Goodnow, and Austin in 1967. This concept attainment model learning is closely related to inductive learning model. Concept attainment model and inductive learning models are designed to analyze concept, to develop concept, to teach concept, and to help the students learn the concepts more effectively [8].

Concept Attainment Model can help students elaborate the concepts using thinking process analysis so that the students can find and acquire its own concept to confirm knowledge in the long term. In this learning, the students are involved in many levels of participation in the learning that can provide information organized from broad topic into the more understandable one for its inductive process [9]. Then, concept attainment model is represented as the means of giving inductive lesson to help the students develop their critical thinking ability and understanding better. This learning model, according to Mayer, makes them thinking more independently, applying their knowledge, and developing inductive thinking skill in order to be more prepared for the future life. The students learn better when using real analogy and examples in Biology learning.

A study [11] suggested that the students learning with concept attainment model have learning achievement significantly higher than those learning with traditional model (control group). Bhargava also suggested some findings of research on this model: 1) a study [12] introduces concept attainment model, objective, teachers' and students' role in this model application from pre-school to senior high school levels, and this model effectiveness in the learning; 2) another study [3] compared the achievement level between traditional and concept attainment models in relation to knowledge, understanding, and objective application. The finding of study showed that concept attainment model improves all levels of concept achievement effectively in Chemistry subject; 3) still another study [14] found that concept attainment model is more effective than control method in Arabic lesson in the 9th grade; then, a study [15] also found that the learning achievement of students taught in concept attainment model is better than those taught with control method. And another study [16] reported that teaching with concept attainment model and concept mastery affects the students' academic achievement and cognitive ability. The studies conducted on the learning with concept attainment represent that the students learning better when they are taught using this model.

Considering the elaboration above and to find solution to the students' difficulty, a study on Biology learning model is conducted by applying the learning model that can present organized information from the broad topic to the more understandable one, concept attainment model. In some studies aforementioned, the learning with concept attainment model is compared with the one with conventional model. In this case, the author wants to compare different learning model, rather than using traditional learning model. To find out how successful this concept attainment model is, discovery learning model is used as the control. Discovery learning model is the student-centered one. Discovery learning model is the one give the students the opportunity of finding scientific fact, concept, and principle for themselves, and thus, the students have opportunity of finding and learning science from their participation [17].

The results of previous studies show that the students taught with concept attainment model show better outcome in the term of students' knowledge, understanding, and in their ways of classifying, thinking, and receiving the concept. This model enables the students to have more sophisticated conceptualization, inductive reasoning, domination and knowledge on fission, perspective, tolerance to ambiguity, and sensitivity to logical reasoning in communication.

Considering the background above, the author wants to find out whether or not there is a difference of cognitive learning achievement between the students taught using concept attainment model and those taught with discovery learning in the 2nd semester of the 12th Science grade in SMAN 1 Karas in school year of 2016/2017 in Evolution material.

2. RESEARCH METHOD

This research was conducted in SMA Negeri 1 Karas of Magetan Regency, Kendal Highway, Temenggungan Village, Karas Sub District, Magetan Regency, East Java, in the second semester of 2016/2017 school year. The research started with preparing proposal and ended with research reporting, beginning in the end of 1st semester on October 2016-July 2017. This study was a descriptive quantitative

research with experimental method. The research design employed in this study was Post-test Only with Nonequivalent Groups in which the author treated one experimental group, and then another group as the control. Then, posttest was conducted with both groups. Both groups were employed to find out the effect of independent variable on dependent one. Independent variable was students' cognitive learning achievement, while the dependent one was learning model. The first experimental group was treated with the learning using concept attainment model while the second one with the learning using discovery learning model, and then posttest was given to both groups.

Table 1. Post-Test Only with Nonequivalent Group

Group	*Treatment*	*Posttest*
First experiment	Abstract	O_1
Second experiment	X_1	O_2

Notes:
X1: The treatment given to the first experiment group with Concept Attainment Model
X2: The treatment given to the first experiment group with Discovery Learning
O1: Posttest in the form of students' cognitive learning achievement test given to the first experiment group.
O2: Posttest in the form of students' cognitive learning achievement test given to the second experiment group

The data collected was then processed and analyzed to find out whether or not there is a difference of cognitive learning achievement between the students taught using concept attainment model and those taught using discovery learning model in the 12th Science grade of SMA Negeri 1 Karas Magetan Regency. The population of research was the 12th Science graders of SMA Negeri 1 Karas, Magetan Regency in the school year of 2016/2017 consisting of five classes. The sample was taken using cluster random sampling technique, in which two classes were obtained as the sample treated differently. The 12th Science 4 grade used concept attainment model as the first experiment class and the 12th Science 3 used discovery learning model as the second experiment class.

Techniques of collecting data used in this study were: (1) documentation including the score of four subjects constituting the typical characteristics of majoring in the even semester of the 11th grade as the foundation of class establishment, so that the 12th grade became homogeneous population, and (2) cognitive learning achievement test. Before being used, validity test on syllabus and learning implementation plan instrument was carried out by experts including lecturers and education practitioners.

Cognitive learning achievement test was trialed in one of schools closest to the school becoming the object of research. Reliability test was conducted using reliability method, analyzing the reliability of instrument from one instrument trial. Reliability analysis was carried out using Alpha Cronbach formula [18], with correlational index shown in table 2.

Table 2. Scoring Scale of Item Reliability

No	Scale r_{11}	Note
1	0.80 – 1.00	Very High (ST)
2	0.60 – 0.799	High (T)
3	0.40 – 0.599	Fair (C)
4	0.20 – 0.399	Low (R)
5	0.00 – 0.199	Very Low (SR)

Meanwhile, statistic test used was independent sample T test that has undertaken prerequisite test first using normality and homogeneity tests. Data normality test was carried out using Kolmogorof-Smirnov. The criterion of testing was that when sig > α, the data is distributed normally at significance level of 5%. Homogeneity test was conducted using Levene test. If significance or probability value > 0.05, the data can be stated as homogeneous. The test was conducted with SPSS 18 software help.

3. RESULTS AND ANALYSIS

Before the research was conducted, validity and reliability tests were carried out first on cognitive test instrument. This test was conducted in one of schools in Magetan Regency. The result of validity test is shown in Table 3.

Table 3. Result of Validity Test on Cognitive Test Tryout

Research Instrument	Number of Item	Function Validity Test Decision	
		Valid	Invalid
Cognitive Test	50 multiple choice items	40	10

Considering the result of validity test on cognitive test, out of 50 items, 40 were valid and 10 invalid. The invalid items are items no. 1, 3, 6, 24, 26, 27, 31, 32, 33 and 49, thereby being excluded from the cognitive learning achievement test in this study. Meanwhile, the result of reliability test on students' cognitive test belongs to high category, with score of 0.618, so that it can be used as the instrument of cognitive achievement test in this study.

The learning was conducted in four meetings and cognitive learning achievement test/post test was conducted. The result of post test conducted is presented in table 4.

Table 4. The result of cognitive learning achievement post-test for the first (CAM) and the second experiment (DL) classes

Learning Model	Lowest	highest	Total	Mean
CAM	50	100	1530	76.50
DL	45	100	1465	73.25

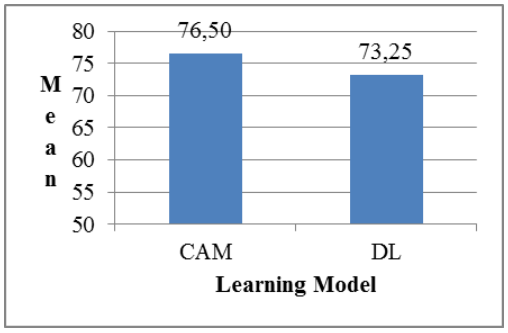


Figure 1. The Difference of Mean Cognitive Learning Achievement between the First and the Second Experiment Classes

From Table 4 and Figure 1, it can be found that there is a difference of cognitive learning achievement between students in the first (CAM) and those in the second experiment (DL) classes. The mean cognitive learning achievement of students taught with Concept Attainment Model is 76.50, while that of those taught with Discovery Learning model is 73.25.

Next, t-test was conducted. Before t-test, the data was tested first for its normality and homogeneity. From the result of normality test, it can be seen that the posttest scores of students' cognitive learning achievement in CAM and DL classes are distributed normally. The rationale of decision making is that if significance or probability value < 0.05, the data is not distributed normally. If the significance or probability value > 0.05, the data is distributed normally. From table of normality test with Kolmogorov-Smirnov, it can be found that students' cognitive learning achievement score in the first (CAM) and the second (DL) experiment classes is higher than 0.05. It can be said that data of students' cognitive learning achievement is distributed normally at significance level of 95%. Meanwhile, from the result of homogeneity test, it can be seen that probability value for students' learning achievement is homogeneous. Data in homogeneity test shows that the cognitive learning achievement score of students in the first experiment class is 0.439 and that in the second experiment class is 0.248; therefore, it can be said that data of students' cognitive learning achievement has same variance or is homogeneous.

After the data has been normal and homogeneous, t-test (independent sample t-test) is conducted to find out whether or not there is a difference of cognitive learning achievement between students treated with concept attainment model and those taught with discovery learning model. From the result of t-test, F-test for students' cognitive learning achievement is 0.634 with probability of 0.36. Because probability value < 0.05, Ho is not supported. It means that there is a difference of cognitive learning achievement between students in the first (CAM) and those in the second (DL) classes.

The result of data analysis on learning achievement score of the 12th Science graders of SMAN 1 Karas in the school year of 2016/2017 in Evolution material statistically shows that there is a difference between class taught with concept attainment model and the one taught with discovery learning model. The learning with concept attainment model is used more effectively as it has some advantages. It is in line with a previous study [19] finding that: 1) the learning achievement of students taught using concept attainment model is better than that of those taught using conventional method; 2) Concept attainment model is more effective in acquiring the concept of science; 3) Concept attainment model is more effective in concept retention than the conventional method. It is also confirmed by a study [20] explaining that concept attainment model is required by the students to learn how to classify, to think and to receive concept. This model enables the students to have more sophisticated conceptualization, inductive reasoning, domination and knowledge on fission, perspective, tolerance to ambiguity, and sensitivity to logical reasoning in communication.

The learning with concept attainment model is conducted in some phases packaged into syntax form. This syntax, according to [21], is divided into three phases: 1) data presentation and object identification; 2) testing the acquisition of a concept; and 3) strategic thinking analysis. Joyce & Weil furthermore explain that in the 1st phase of model, the students should develop a hypothesis about the essence of concept based on example and non-example presented. In the 2nd phase, the students test their concept acquisition, firstly by actually identifying additional examples, secondly, by making their own examples. In the 3rd phase, the students start to analyze the concept strategy acquired, and construct their own concept. This procedure of learning process with concept attainment model will practice the students to identify a problem, and then to formulate and to test the hypothesis. Thus, when the students often practice to identify problem, to formulate problem, and to test hypothesis, their insight will increase and they will develop concept to improve their learning achievement.

The indicators of students' cognitive learning achievement in this research is in accordance with the ones specified in learning set, standard competency, basic competency, and with the indicators and the objective included in Learning Implementation Plan (Indonesian: Rencana Pelaksanaan Pembelajaran or RPP). There are 15 indicators of students' cognitive learning achievement assessment in Evolution material. The 15 indicators are distributed into 40 multiple-choice items. The mean score gain of each indicator is presented in Table 5.

Table 5. Mean Score Gain of Each Indicator for Students' Cognitive Learning Achievement

No	Item Indicators	CAM Group	DL Group
1	Describing the scholars' thinking explaining the evolution theory.	0.023	0.024
2	Describing the difference between Lamarck's and Darwin's opinions on the evolution of giraffe's neck as evolution phenomenon.	0.023	0.023
3	Explaining details of Darwin's thought about evolution theory	0.019	0.016
4	Describing the phenomenon of *Biston betularia* butterfly population number as a natural selection phenomenon.	0.021	0.020
5	Describing the difference of Finch bird's beak shape in Galapagos Island	0.018	0.014
6	Counting the frequency of gene in a population in certain patient group/a group of those developing certain anomalies.	0.016	0.017
7	Explaining the history of horse evolution based on fossil discovery record.	0.023	0.021
8	Exemplifying five homologies of living organism's body organ as the clue of evolution.	0.021	0.019
9	Explaining body organs remained as the evidence of evolution.	0.021	0.021
10	Explaining modern abiogenesis theory	0.015	0.016
11	Explaining experiment making abiogenesis theory considered as untrue	0.021	0.019
12	Explaining the reason of why Cosmozoik theory is opposed by many scholars	0.015	0.018
13	Explaining and expressing opinion about Special Creation theory.	0.023	0.019
14	Explaining 3 reasons of why Harun and Yahya decline Darwin's Evolution theory	0.024	0.021
15	Explaining the public opinion about evolution theory	0.023	0.023
	Mean	0.020	0.019

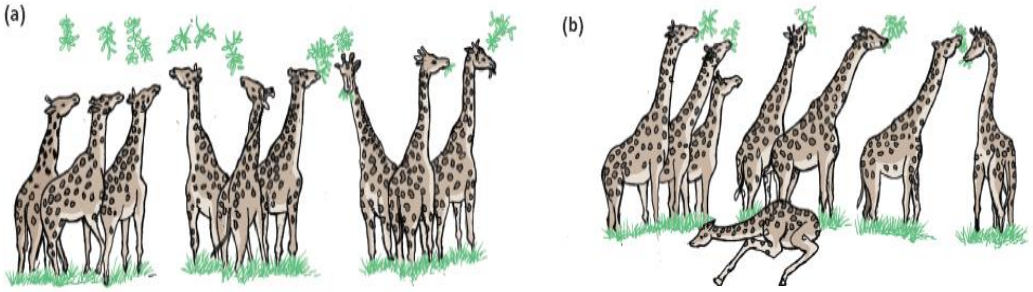
From Table 5, it can be found that there is a difference of mean score of cognitive learning outcome indicator achievement between students taught with concept attainment model and those taught using discovery learning. From each of indicators, it can be seen that some indicators obtain equal mean score and some others obtain unequal mean score in the learning using concept attainment model and discovery learning. Certain indicators have higher mean score than concept attainment model, for example in the 3rd

indicator (Explaining details of Darwin's thought about evolution theory) obtaining mean score of 0.019. Meanwhile, those with discovery learning model obtain mean score of 0.016. Another indicator, the 12th one (Explaining the reason of why Cosmozoik theory is opposed by many scholars) obtains mean scores of 0.015 in the learning with concept attainment model and of 0.018 in the learning with Discovery learning model. It means that in this indicator, the class with Discovery Learning model has higher mean score. The score gain is varying. It is reasonable because the students' abilities are varying in the same indicators. However, generally the cognitive learning achievement of students using concept attainment model is better than that using discovery learning model.

In the learning process in CAM class, according to the syntax of concept attainment model, the students will participate actively in the learning process, for example, by observing the examples presented by teachers, proposing hypothesis, understanding conceptual structural and establishing inter-concept relation. The students will also test their concept acquisition, firstly by actually identifying the additional examples presented by teacher. Secondly, the students will make their own examples. In the following phase, the students begin to analyze the concept strategy they have acquired. Meanwhile the learning process in DL class using discovery learning model is adjusted with discovery learning syntax. In discovery learning, according to [22], the students are encouraged to learn independently through their active participation in concepts and principles, and teacher encourages the students to get experience and to conduct experiment enabling them to find the principles themselves. The syntax of discovery learning model includes: Stimulation, problem identification, data collection, data processing, verification and generalization or conclusion. The implementation of learning process using discovery learning in stimulation phase is the process of guiding the students to observe figures (pictures) leading the students to problem formulation. The second phase, problem identification, is the process of guiding the students to formulate the problem based on the figure available. From observing the figure, the students will raise some questions corresponding to the context of figure. In the third phase, data collection, the students are given opportunity of collecting necessary data and information such as reading literature and observing the object to answer the question. In Evolution material, the students observe different opinions suggested by Lamarck and Darwin on the phenomenon of giraffe's neck evolution. The fourth phase is data processing. Entire information resulting from reading, interview and observation is classified and tabulated. The students prepare table of Darwin's and Lamarck's opinion on giraffe's neck evolution. The fifth phase is verification; in this case the students verify the data organized with the existing reference source. The sixth phase is generalization, in which the students draw a conclusion from the learning outcome. The learning process using discovery learning model is different from that using concept attainment model. The learning with discovery learning is the learning of discovering, while the one with concept attainment model is the implementation of learning using syntax to achieve the concepts.

Overall, the implementation of concept attainment model syntax in CAM class, according to [23], includes: 1st phase: Data Presentation and Data Identification. In this phase, teacher presents the examples labeled either positive or negative. In Evolution material, for instance, in Basic Competency 1 (Explaining theory, principle, and mechanism of biology evolution), the teacher displays example and non-example. The "positive" labeled examples are: a change, gradually, natural selection, long period of time, new species, and process. The "negative" labeled examples are: quick, butterfly, giraffe, species, life, and phenomenon (symptom). Later, the students will compare the characteristic of positive and negative examples. The students will provide and then test hypothesis. In this first phase, the students are expected to find the definition of word "evolution" from the positive examples available. Finally, in this 1st phase, the students mention a definition, in this case the definition of evolution, according to essential characteristics. The second phase is to test the Concept Acquisition. In this phase, the students identify additional examples not labeled "Yes" and "No". The "Yes" labeled examples are: Cutting the rat's tail up to 21 generations; body cell is not affected by environment; Lamarck's evolution theory is untrue; Natural selection phenomenon against genetic factor. The "No" labeled examples are: Struggle for life; There is an unbalance between food amount and living organism number; The increase of food production follows arithmetic; and The increase of population number follows geometry. Those "Yes" and "No" labeled examples leads to the definition of some evolution theories according to the scholars such as august Weisman, Lamarck, and Thomas Robert Malthus. Then, teacher will confirm hypothesis and names of concept, and restate the definition according to its essential characteristics. Finally, in this 2nd phase, the students will provide new examples. These new example can be obtained from teachers' presentation in the form of figures, words or phrases not labeled either "positive" or "negative", either "yes" or "no", so that the students will find the concepts from the examples without label themselves. The presentation of non-labeled example and non-example is illustrated in Figure 2. The figure below represents the difference of opinion between Lamarck and Darwin concerning the phenomenon of giraffe's neck development, and word/phrase list as example-non-example. From the

figure, the teacher will lead the students to organize definitions by figure, words, and phrases according to the example-non-example. Thus, the students will find the concepts of evolution theory themselves from list of figure and list of words or phrases available with reference help.



giraffe's neck;	inter-individual variation;
those not surviving will die;	natural selection;
needing sufficient food and space;	affected by environment;
Charles Darwin;	there are limiting factors;
use and disuse;	predisposition to increase in number
adaptation to environment;	*struggle for live;*
acquired characteristic inheritance;	competition for reaching food;
environmental change;	Lamarck;

Figure 2. Non-labeled Example and Non-example

The 3rd phase is Thinking Strategy Analysis. The procedure of activities conducted in this phase includes: firstly, the students explain their thinking. Secondly, the students discuss the role and characteristic of hypothesis. Finally, the students discuss type and number of hypothesis. The learning process with such the model will involve the students in acquiring their concept. As such, the students will understand better the material they learn. The concept they acquire themselves will help them find the effective learning method to improve their learning outcome, particularly to construct a better understanding. It will encourage the students to re-explain the concept according to their understanding. It is in line with a previous study [24] finding that concept attainment is a means of providing inductive learning to help the students develop their critical thinking ability and better understanding. The implementation of concept attainment model can give the students the better outcome in learning new concept, and will guide the students to reconstruct new learning process using the examples and then to draw conclusion thereby resulting in new concept. This learning model leads the students to think more independently, to apply their knowledge, and to develop inductive thinking skill in order to be prepared for the future life. The students will learn better when they use analogy and real examples in Biology learning.

The result of research shows that the cognitive learning achievement of students using concept attainment model is better than the learning using Discovery Learning model..

4. CONCLUSION

From the result of research, it can be concluded that there is a significance difference of cognitive learning achievement between the students taught using concept attainment model and those using discovery learning model. The cognitive learning achievement of students taught with concept attainment model is better than the one with discovery learning model.

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