

Effectivity of Guided Discovery Learning with Concept Mapping to improve conceptual understanding in endocrine system material for grade XI science class

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Abstract. This research aims to examine the effectivity of Guided Discovery Learning with Concept Mapping of endocrine system material. It is a quasi-experimental study with cluster sampling design. The hypothetical population is all students of SMA Negeri 2 Ngaglik, Sleman. The research sample is 67 students of grade XI science class which is divided into two groups; 33 students as the experimental group (Guided Discovery Learning with Concept Mapping) and 34 students as the control group (using 5M strategy). The data for students' conceptual understanding on endocrine system material was collected using multiple choice test. The result shows that the Guided Discovery Learning with Concept Mapping improves conceptual understanding of student with higher average score (83.03) than control class (72.59) on endocrine system material especially for grade XI Science with sig. 0.000 (sig.<0.005). The data analysis showed that Guided Discovery Learning with Concept Mapping is effective to improve students' conceptual understanding on endocrine system material.

Keywords: *Guided Discovery Learning, Concept Mapping, conceptual understanding*

1. Introduction

Education is one of the important sectors in development in each country. It is a conscious and planned effort to create an atmosphere of learning and learning process so that students actively develop their potential to have spiritual strength, self-control, personality, intelligence, noble character, and skills that are it takes itself, the community, developing all the potential possessed by students through the learning process. Thus education is all the effort and make society able to develop the potential of students to have spiritual strength, self-control, personality, intelligence, noble character, and possess the skills needed as members of society and citizens.

In line with the demands of the 21st century so that human resources must have various abilities. One important ability that must be possessed by human resources in the 21st century is the understanding of concepts. Biology learning can be a means to develop the ability to understand a concept because in it there are abstract, complex and many concepts so that a learning innovation is needed so that students easily master the concepts in biology subjects.

The results of Program for International Student Assessment (PISA), it was stated that Indonesia received a score of 403. This score is below the average score that has been set so that Indonesia is ranked 60 out of 68 countries [1]. Compounded with the results of the 2011 Trends in International Mathematics and Science Study (TIMSS) in the biology domain, students have a truth percentage of 46% below the international average, placing Indonesia 31st out of 42 countries.



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The results of the description above show that the scientific ability of students in Indonesia as part of the partnership of 21st century skills has not yet reached maximum. So that innovations or learning strategies are needed to improve the understanding of material concepts that students must master. This is done so that students do not experience misconceptions in the learning process and get an understanding of basic concepts that are intact and structured.

There are several learning models that are relevant in biology subjects based on basic competencies or material characteristics in the 2013 curriculum and the 2013 revised curriculum, including: discovery learning, project-based learning, problem-based learning and inquiry learning. One learning model that is widely used for the learning process is discovery learning. Discovery learning is a teaching model that has the potential to develop critical thinking in students. Some of the concerns of teachers in using pure discovery learning one of which is not fully mastered the concept by students. Therefore, teacher involvement to direct students during the learning process is expected to help students to master a concept.

At the moment learning models are needed that are suitable for improving understanding of concepts, so that the concepts obtained by students are obtained in their entirety and comprehensively in understanding a concept of learning material. Understanding the concept itself is a basic ability that must be possessed by students before the ability to more complex levels in other bloom taxonomies such as the ability to think critically, creativity, and so on. Then researchers want to see how students' understanding of concepts through Guided Discovery Learning. So it is necessary to add a learning strategy into the learning model to complete the deficiencies, one of which is understanding the concept. One strategy that will be added is the concept of mapping. It is expected that students will be able to master the concepts especially in the endocrine system material.

2. Research method

The research method using quasi-experimental. It has been focuses to evaluating the outcomes of learning model on groups [2]. There are the experimental class and the control class. The experimental class using the Guided Discovery Learning model accompanied by Concept Mapping, while the control class using the learning model that applies in his school. The control group is used to determine influence after being given a treatment.

The research using cluster sampling. The unit chosen is not an individual but a group of individuals who are naturally together. This constitute a cluster insofar as they are alike with respect to characteristics relevant to the variables of the study. A common application of cluster sampling in education is the use of intact classrooms as clusters. All the members of the class must be included in the sample [3]. After that the two classes are given different treatment, then both classes are given a posttest. It aims to determine the extent of student knowledge after treatment on the endocrine system material.

Location/place and time the study was conducted at SMA Negeri 2 Ngaglik, Sleman, DIY. Data collection was carried out in the XI MIPA class in the even semester in the 2018/2019 school year in March-April 2019.

The population in this study were students of class X MIPA in SMA Negeri 2 Ngaglik 2018/2019 school year consisting of four classes. The sample in this study was class XI MIPA 1 consisting of 34 students as the control class and class XI MIPA 4 consisting of 33 students as the experimental class.

Research variable, the independent variable in this study is the learning model of the influence of the Guided Discovery Learning learning model accompanied by Concept Mapping. The dependent variable is a variable that is influenced by the independent variable. The dependent variable in this study is the ability to understand concepts. Control variables are controlled variables so that the influence of independent variables on the dependent variable is not influenced by external factors not examined. Variables in this study include teachers who teach, curriculum, learning materials, learning media, and duration of learning.

The validity of the research instrument using the validation test. The content and construct validation of the instrument was carried out by material and education experts. This is done to increase the validity of a research instrument so that it is appropriate to be used for the data collection process.

3. Results and Discussion

3.1 Results

3.1.1 Implementation of Guided Discovery Learning Combine with Concept Mapping. The first stage in the Guided Discovery Learning model is an 'stimulus' that begins by dividing students into groups of 4 people and giving a Student Worksheet to each group. The teacher orientates students on the subject that appears based on pictures of food ingredients that contain protein, fat, and amino acids. At this stage, the teacher asks various questions to stimulate students' curiosity so students know what concepts will be learned. The next activity students formulate things they want to know based on the pictures displayed by the teacher. The teacher as a facilitator has the role of guiding students to compile questions that cover all learning objectives. In the experimental class, students are given the opportunity to make a Concept Map to find out the initial knowledge that students have.

The second stage is problem statement by formulating a temporary hypothesis on the Student Worksheet that has been provided. Students write a temporary hypothesis based on questions that have been prepared at the orientation stage and write temporary answers to questions that have been made. The interim answers illustrate students' initial knowledge about the concepts being learned.

The third stage, data collecting, at this stage the teacher guides students how to solve the problems that have been formulated by students about the endocrine system. Problem solving is done by the students themselves by exploring various learning resources. The teacher gives students the freedom to find answers in their own way to prove the temporary answers that have been made. Students are given the opportunity to collect data, process and analyze data obtained at home. It is intended that students have plenty of time to find concepts to be learned.

The fourth stage of the data processing, in the experimental class the teacher asks students to make a Concept Map based on concepts they already know after doing learning and exploration. The new Concept Map which is more complex than the initial Concept Map before learning shows that students have better knowledge on the concept of the material being studied. The results of the Concept Map created by students show an increase in knowledge understood by students. After creating a Concept Map students are asked to conclude the results of the discussion and group analysis. Learning in the control class does not use the Concept Map so that at the conclusion stage students are only asked to conclude the results of the discussion and group analysis.

The fifth stage of verification, the teacher asks students to present the results of the discussion of each group in front of the class then continued question and answer with other groups. The results of presentations and questions and answers made by students can be used as a reference understanding students' concepts. The more explanations given by the presentator, the better understanding of students' concepts. At this stage, the teacher monitors whether the learning objectives have been achieved through presentation material delivered by students. After all group presentations are finished, the teacher gives confirmation and generalization about the material being studied so that it will strengthen students' understanding of concepts.

3.1.2 Implementation of 5M. Implementation of 5M in the control class that has been carried out in class XI MIPA 1 which contains 34 students. 5M is an approach based on a scientific approach that engages students to be active in learning. This approach has 5 main stages that students must go through in the learning process in class. These stages are described to find out students' understanding of the material of the endocrine system

The first stage in 5M is 'observing' which begins by dividing students into groups of 4 and giving students a Worksheet on each group. The teacher orientates students on the subject that appears based

on pictures of food ingredients that contain protein, fat, and amino acids. The teacher also stimulates students to connect with endocrine system material. The second stage is 'asking', students construct questions that cover all learning objectives related to endocrine system material. Students formulate a temporary hypothesis on the Student Worksheet that has been provided. Students write provisional hypotheses based on questions that have been compiled students' initial knowledge about the concepts being studied.

The third stage 'collecting data', at this stage the teacher guides students how to solve the problems that have been formulated by students about the endocrine system. Problem solving is done by the students themselves by exploring various learning resources. The teacher gives students the freedom to find answers in their own way to prove the temporary answers that have been made. Students are given the opportunity to collect data and facts from various learning sources.

The fourth step is 'to associate', the teacher asks students to discuss the findings of the learning resources they have been looking for. Students and group members discuss the results of data and facts based on information related to the endocrine system material. Then students are asked to conclude the results of group discussion and analysis.

The fifth stage 'communicates', the teacher asks students to present the results of each group's discussion in front of the class then continued question and answer with other groups. The results of presentations and questions and answers made by students can be used as a reference understanding students' concepts. Then the teacher evaluates the achievement of student understanding by confirming the material of the endocrine system.

3.1.3 Statistic analysis. The research data obtained were in the form of concept understanding tests using 25 multiple choice questions about the endocrine system material. Data from the students' posttest results were analyzed using the t test to find out the differences between the models in the experimental class (Guided Discovery Learning with Concept Mapping) and using the scientific approach (5M). The results of inferential statistical tests must meet the homogeneity and normality prerequisite tests to see their distribution. The following are the results of the prerequisite test analysis for each class:

Table 1. Result of normality test

Class	Variable	Sig.	Result
Control	Pretest	0.365	Normal
	Posttest	0.191	Normal
Experiment	Pretest	0.234	Normal
	Posttest	0.228	Normal

The results in table 1 show that the control class pretest data were normally distributed, that is 0.365 (sig.> 0.05), posttest results of 0.191 (sig.> 0.05) also showed normal results. Likewise for the pretest and posttest results in the experimental class (sig.> 0.05). So that all data show normal results. Then for the results of homogeneity of data, the analyzed data obtained homogeneous results for the distribution of data, this is shown in table 3 with a significance value of 0.470 (sig.> 0.05).

Table 2. Result of homogeneity

Variable	Sig.	Result
Concept understanding	0.470	Homogen

The results of the statistical analysis of the influence of the Guided Discovery Learning model with a Concept Map and a scientific approach (5M) approach to understanding students' concepts are presented in table 3.

Table 3. Result of concept understanding and critical thinking's hypotesys

Variable	df	Sig.	Result
Concept understanding	65	0.000	H_0 rejected

Based on the results of the t-test calculation it is known that H_0 is rejected (sig. <0.05), meaning that there is a difference between the application of the Guided Discovery Learning model along with the Concept Map with 5M to the students' understanding of the XI concept in the 2018/2019 school year. Frequency distribution of the number of concepts understood by students based on post test scores can be seen in table 4.

Table 4. Result of descriptive statistic

	Control class	Experiment Class
Total	34	33
Mean	72.59	83.03
Median	56	84
Variance	36.98	53.03
Std. dev	6.081	7.282
Minimum	40	48
Maximum	72	96

Based on table 4, the average understanding of the concept of the experimental class is higher than the control class. The average experimental class is 72.59 while the control class is 83.03. The minimum value in the control class is 40, while in the experimental class 48. The maximum value of the control class is 72, while in the experimental class 96. In general it can be concluded that students' understanding of concepts in the experimental class (Guided Discovery Learning) is better than the control class (approach 5M).

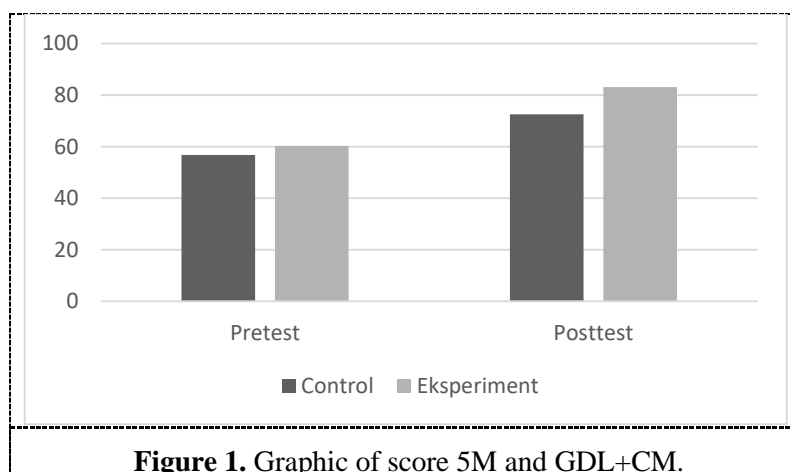


Figure 1. Graphic of score 5M and GDL+CM.

Figure 1 is a graph of the average value between the pretest and posttest in each class on understanding students' concepts. The control class before being given treatment has an average of 56.82, while the experimental class has a value of 60.24. After treatment, there is an increase in the value of understanding students' concepts. In the control class (5M) has a post-test value of 72.59 while the experimental class (Guided Discovery Learning + Concept Mapping) 83.03. This means that the value of the experimental class is higher than the control class.

3.2 Discussion

The Guided Discovery Learning model is a learning model developed based on a cognitive view of learning and the principles of constructivity. The Guided Discovery Learning model has 5 learning steps, namely orientation, hypothesis generation, hypothesis testing, conclusion and regulation [4] The learning process requires students to try to find concepts, formulas and theories with or without teacher guidance. The learning process in the experimental class uses the Guided Discovery Learning model with Concept Map, while the control class uses the 5M approach (observing, asking questions, collecting data, associating and communicating).

The addition of the Concept Mapping strategy in learning is used as an aid to identify concepts, identify relationships between concepts, differentiate concepts from concepts, add links to produce a complete Concept Map and explain the definitions of each concept in the material. Thus encouraging students to learn and understand the material to be learned.

The advantages of Concept Map have been studied in various learning studies. One of them is [5]'s research which shows that the emphasis of Concept Mapping on identifying concepts and relationships between concepts provides an opportunity to explore abstract concepts and difficult concepts that are not usually covered in learning so as to identify errors in understanding [6] states that the activities of working in small groups on Concept Mapping activities will provide feedback between students in groups and the activity of presenting a Concept Map that has been created will allow students to reflect on their own learning and can see the content of missing material. Reflective discussions of Concept Maps provide opportunities for students and teachers to discuss what they know and understand. So it helps to express students' understanding of concepts and thoughts. In addition, according to [7] that Concept Mapping can be used to evaluate the integration between new and existing knowledge in understanding topics.

Concept Mapping is the effect of collaborative learning [8]. The students providing feedback like emphasised by [9], who state that "Concept Maps without feedback have no significant effect on student performance, whereas Concept Maps with feedback produced a measurable increase in student problem-solving performance and a decrease in failure rates". In the other research result, [10] are correct that Concept Mapping came as a direct transfer of an educational solution from one context to another. Based on [11]'s opinion, before considering how Concept Mapping may actively contribute to students' learning to ensure that we do not promote an inappropriate structure within any mapping activity. So that Guided Discovery Learning accompanied by Concept Mapping can increase student's knowledge.

4. Conclusion

Based on result that Guided Discovery Learning with Concept Mapping can toward conceptual understanding of student in endocrine system material. It's mean that Guided Discovery Learning with Concept Mapping is one of alternatives teaching model to improve that.

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