

## The Effect of Discovery Learning on Students' Higher-order Thinking Skills

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### Abstract

This study aims to determine whether the Discovery learning model can affect the students' High Order Thinking Skills (HOTS) ability in the blood circulation system. This research was conducted by assessing the cognitive aspects of students, analyzed by descriptive methods using instruments in the form of essay questions and learning observation sheets. The method used in this study is a weak experiment. The subject in this study is 38 students at one high school in Indonesia. Based on the research results, the Discovery Learning model affects the students' High Order Thinking Skills (HOTS) ability by increasing the average pretest score of 52.23 to 69.47 in the average posttest score. Wilcoxon test results obtained asymp. sig. (2-tailed) 0.000 <0.05, then H<sub>0</sub> is rejected and it can be concluded that there is a difference in the average student learning outcomes between the pretest and posttest. it can be concluded, Discovery Learning model can affect the ability of High Order Thinking Skills (HOTS).

Keywords: High Order Thinking Skills, Discovery Learning, Circulation Systems

### INTRODUCTION

The 2013 curriculum has a requirement: changing the learning strategy that was initially teacher-centered (teacher-centered) to student-centered (student-centered). Teachers are expected to be more creative and innovative in presenting the subject matter so that the implementation of learning must be carried out using scientific and creative thinking skills. Learning that can be applied is empowering to think at higher levels. The Program for International Students Assessment (PISA) released by the Organization for Economic Co-operation and Development (OECD) (2016) states that the ability of Indonesian students in science is ranked 62, reading is ranked 61, and mathematics is ranked 63 of the 69 countries evaluated. Furthermore, the Trends International Mathematics and Science Study (TIMSS) (2016) data shows that Indonesia's ability in science is ranked 48, and mathematics is ranked 45 out of 50 countries (Rochman et al., 2018). One of the reasons is the ability of students who have not been empowered to think at a high level, while today's demands require people who can solve complex problems with critical, innovative, creative, and transformative characteristics. Even Tan & Halili (2015) said that higher-order thinking skills are very important and are now a curriculum goal internationally.

Nofiana et al. (2014) stated that high order thinking skills are thinking skills that require the ability to remember and require other higher skills. Higher-order thinking skills are thinking

skills that occur when a person takes new information and information already stored in his memory, then relates the information and conveys it to achieve the goals or answers needed. Riadi & Retnawati (2014) said that students very much need HOTS because the problems they will face in real life are complex, unstructured, complicated, and require thinking skills that are not just applying what has been learned. In addition, learning must make students have an attitude of caring for the environment, and then it is expected to be able to make students aware of having a concern for nature and the surrounding environment (Zuchdi, 2011). Kose (2011) revealed that learning outcomes are good if they can change students' attitudes to be more optimistic about the environment. Fostering an attitude of caring for the environment can be done by familiarizing students with disposing of waste based on the type of waste, taking care of plants, maintaining the cleanliness of the classroom and school, and implementing science materials in everyday life (Yunansah & Herlambang, 2017).

High Order Thinking Skills learning can use the Discovery Learning learning model. This is in line with Anitah (2009), which says that Discovery Learning involves students in problem-solving to develop knowledge and skills. Students learn intensively through this learning model by following the scientific investigation method under the teacher's supervision. The Discovery Learning learning model is very influential in improving student learning outcomes and critical thinking skills, one of the high-order thinking skills (HOTS). Discovery Learning model is very relevant to improving students' High Order Thinking Skills (HOTS), which consists of observing, asking, trying, reasoning, and communicating recommended by the 2013 curriculum. It can improve students' High Order Thinking Skills (HOTS). The results of observations on the biology learning process that the teacher carried out were not following the 2013 curriculum because it had not invited students to observe surrounding phenomena, ask questions about things that were not understood, collect information, process information, and communicate it. In addition, teachers in the learning process still give questions on average at a low cognitive level, ranging from C1-C3. The mental level (C1-C3) states that students can only remember, understand, and apply. Students' activeness in the teaching and learning process is also still lacking. The information is only given by the teacher and students only as recipients of information without any reciprocity. Students' activities are only writing, doing independent assignments, and listening to what the teacher conveys, resulting in students not being involved in thinking activities, especially in higher-order thinking to solve problems.

Today, the world of education is being disrupted by the ongoing Covid-19 outbreak almost all over the world. The Covid-19 pandemic has had a huge impact on various fields of

life, especially the world of education. The outbreak of this virus has resulted in the elimination of face-to-face learning in class because the Indonesian government currently requires all citizens to carry out Large-Scale Social Restrictions (PSBB) to stay at home. This affects the world of education in teaching and learning activities, so the government urges all schools in Indonesia to carry out the online learning process. Although there are still many obstacles, teaching and learning activities must still be carried out to save the nation's education by using technology as a new mode of learning. Likewise, this research was carried out online using the Zoom application

## **METHOD**

The research method used is a weak experiment using one-group pretest-posttest design that can be seen in Table 1.

Table 1 Pattern of The One Group pretest-posttest Design (Sugiyono, 2014)

Pretest	Independent Variable	Posttest
O <sub>1</sub>	X	O <sub>2</sub>

The subject in this study used is 38 students in one high school in Indonesia. The test as a data collection instrument is a series of questions used to measure students' knowledge skills. This test instrument uses an objective test in the form of description questions. This test is used to measure the ability of students' High Order Thinking Skills (HOTS) and is given before learning (pretest) and after learning (posttest). This test is done online via the link on the Google Form application. Observations in this study include observations of students. It aims to determine student activities during the learning process in the classroom. During the learning process, the observer filled out the learning implementation sheet, which was used as supporting data to determine the suitability of the lesson plans that had been used as supporting data to determine the suitability of the lesson plans that had been made with learning activities. Filling in the observation sheet is done by affixing a checklist mark on the pool that has been provided in accordance with the observed picture. We used normality, homogeneity, and t-test to determine the effect of discovery learning on higher-order thinking skills of students.

## **RESULTS AND DISCUSSION**

This study aims to determine the effect of the learning model. The implementation of the learning process using the discovery learning model can be seen in the observation sheet. The application of discovery learning models can improve students' ability to solve High Order Thinking Skills (HOTS) category questions. In addition, students can also find new knowledge from the student worksheets provided by the teacher and can discuss well related to the case studies given by the teacher. Discovery Learning on HOTS in the circulation system concept at

one high school in Indonesia. Data collection is done online through a zoom meeting in the teacher. Students discuss in their respective groups using the WhatsApp application well. Mubarokah (2017) states that the discovery learning model is a learning process that requires students to find a concept. It has not been previously known that doing something by observing and researching the problems given by the teacher aims to make students act as learning subjects who are actively involved in classroom learning. The results of the HOTS statistical analysis showed differences in the students' HOTS after being given treatment using the discovery learning model. These results can be seen in Table 2.

Table 2. Statistical Test Analysis of Students' HOTS

Statistic test	Pretest	Posttest	
Normality test using Kolomogorov-Smirnov	0.007	0.001	The data is not normal
Wilcoxon signed rank test	0.001		H1 is accepted

Based on the statistical test results using SPSS version 25, the average value of students, through a prerequisite test, namely the normality test. The results of the normality test in the pretest obtained sig. 0.007 < 0.05 while the posttest value obtained sig. 0.001 < 0.05 means that the data is not normally distributed, so it can be interpreted that the pretest and post-test data for the HOTS ability are not normally distributed. Because the data results are not normally distributed, the Wilcoxon signed rank test was carried out. The Wilcoxon signed rank test is a non-parametric statistic, this test uses two interrelated samples to determine whether they have a relationship. This Wilcoxon test is another alternative to the t-test for paired data, which uses interval and ratio scales, but specifically for data that are not normally distributed. Wilcoxon test results obtained asym. sig. (2-tailed) 0.000 < 0.05, it can be concluded that H1 is accepted. This means that there is an increase in the learning outcomes of the pretest and posttest scores.

The HOTS of students was assessed using HOTS description questions. Question number 1 is concluding the function of the circulatory system. Question number 2 is analyzing organs in the circulatory system using the HOTS C4 skill. Question number 3 is the pretest and posttest of HOTS to compare the mechanism of small blood circulation and large blood circulation. Question number 4 is to interpret the ABO blood grouping system using C5. Question number 5 relates disturbances to the human circulation system with daily life using C6. The average value of each pretest and posttest indicator obtained by students can be seen in Figure 1 below.

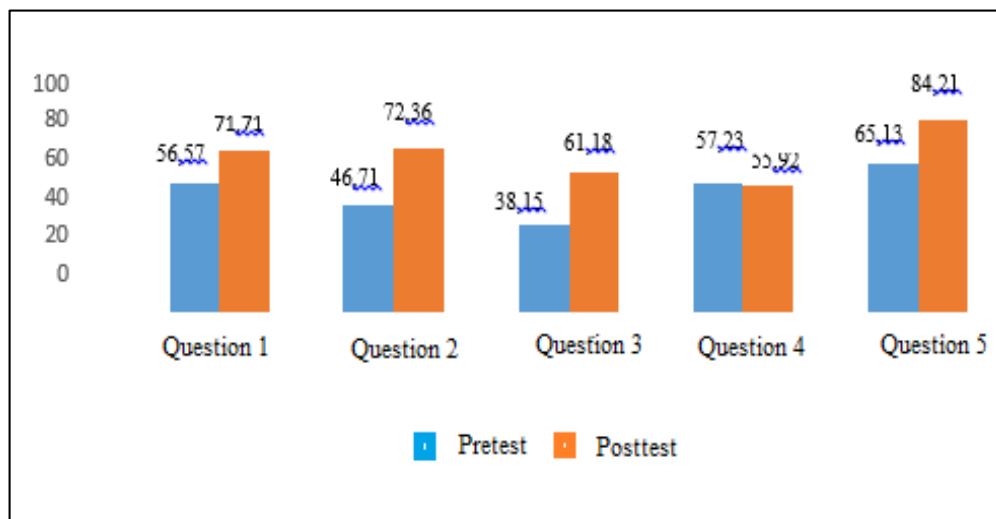


Figure 1. Score of pretest and posttest of HOTS Per Question

Figure 1 shows that the comparison of the average pretest and posttest scores obtained by students has increased for each indicator, except for the interpreting indicator (C5) including the evaluating indicator (C5), the average value of the pretest is higher than the student's posttest score. This happens because students are still unable to prove a statement about the concept of the problem. Besides, students' lack of knowledge about solving problems is proving or investigated. This is in line with Arini's study (2014) stated that students' skills in evaluating the concept of the circulatory system as a whole were still low, reaching 10.71%. Thus the ability of students to evaluate is still low.

The average pretest and posttest scores of students' HOTS abilities can be seen in Figure 2. The difference in the average value of students' HOTS abilities in the posttest was higher than the pretest because, during the process of learning by using discovery learning, students are able to be actively involved in thinking and developing ways of thinking, so that students can solve the problems given by the teacher. This can be seen clearly when discovery learning takes place precisely in the stimulation syntax. Although learning is carried out not face-to-face or online using the zoom application, students are very enthusiastic in answering questions that the teacher has given. According to Ningsih's opinion (2018), HOTS is a measurement instrument used to measure higher-order thinking skills, namely thinking skills that are not just remembering, restating, or referring without doing any processing. HOTS questions measure students' ability to transfer one concept to another, process and apply information, find connections from different information, use the information to solve a problem, and examine ideas or information critically.

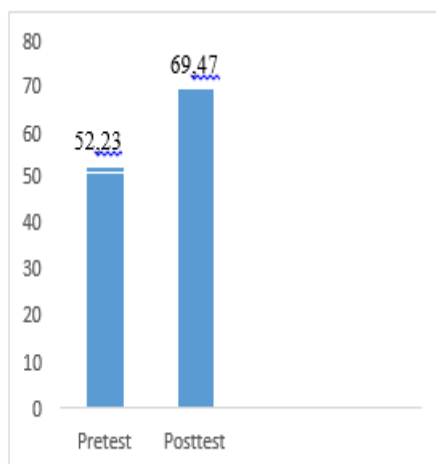


Figure 2. The average of HOTS' pretest and posttest

The implementation of online biology learning is carried out well to achieve the learning objectives even though they are not optimal. The teacher-student interaction method is carried out online, which depends on technology or networks. This is one of the obstacles experienced by learning during the Covid-19 pandemic. Two-way communication between teachers and students as well as between students and students is not optimal because the conditions of the learning process are not, as usual, using face-to-face learning. So that the teacher cannot directly monitor the understanding of the material in students but can only be known based on the value alone. Virtual face-to-face meetings conducted by teachers and students are not carried out at every stage of the discovery learning model. However, the teacher will conduct an online meeting using the zoom application in the stimulation and identification stage. Meanwhile, at the stages of data collection, data processing, verification, and generalization, the teacher uses the WhatsApp group application to connect with students. This is due to save students' internet quota in accessing learning.

The learning process using the discovery learning model has stages that can improve HOTS abilities. The stages of the discovery learning model are, stimulation, problem statements, data collection, data processing, verification, and generalization. Learning activities are divided into two meetings using an online zoom application. Before carrying out learning activities, the teacher conducts a pretest using the Google Form application with a link shared with students via the WhatsApp group to find out the students' basic abilities. After doing the pretest, students are given a link to access online activities through the Zoom Meeting application. Then before doing the lesson discovery learning, the teacher mentions the learning objectives and explains the activities to be carried out so that students are more focused on the

knowledge that needs to be achieved in the learning process. In the first stage of discovery learning, namely stimulation, the teacher asks questions by providing problems or descriptions that contain a problem. This stimulation stage provides conditions for learning interactions that can develop and explore materials and stimulate students' initial knowledge of the material to be taught. Based on observations during learning, several students are enthusiastic in answering questions posed by the teacher, this makes students more active during the learning process.

The second stage is the problem statement. At this stage, the teacher allows students to identify as many problems as possible and then formulate them into temporary answers. Next is the third stage, namely data collection. Then, students collect relevant information to find out the truth of the hypothesis that has been made: the teacher divides the students into six groups with 6-7 students in each group, then the teacher gives worksheets. The fourth stage is data processing. At this stage, students process the data that each group has obtained. Here students will exchange information with members of their respective groups to gain new knowledge about the answers from the worksheets that the teacher has given. At this stage, the teacher continues to condition students by guiding each group by conducting a question and answer session. The fifth stage is verification; students discuss by linking the analysis that has been found with the hypothesis that has been made. Students relate the material that the teacher and literature have delivered from other sources to answer the student worksheets. The results obtained from the verification show that the hypothesis made by the previous students is in accordance with the results of the analysis that each group has carried out. At this stage, the teacher allows students to understand from the examples they encounter every day. The last stage is generalization at this stage, namely drawing conclusions where the teacher reinforces the material that has been taught to determine the extent to which students understand the material.

Based on the learning process activities that have been carried out using the stages of the discovery learning model, it turns out that all the stages in the discovery learning model affect the HOTS skill process. In this study, the student worksheets given to students at the first meeting did not include the discovery learning model, the contents of the student worksheets were like student worksheets in general, but students could still do the student worksheets correctly. The learning process continues to run according to the syntax of the discovery learning model; it is measured using a learning implementation sheet to ensure that none of the syntaxes in the discovery learning model is missed to improve student learning outcomes. This is in line with Hosnan (2014) opinion, which states that discovery learning is a model learning

that aims to improve active learning by finding their own, investigating themselves so that the results obtained will last a long time in memory. So in the learning process, students can understand the concept of learning by practicing higher-order thinking skills. The research results stated above are in line with what was stated by Sinambela (2013) that the discovery learning model has a significant effect on higher-order thinking skills.

The study results on students one high school in Indonesia obtained an average score of 78.45 environmental care attitudes in the good category. The average score per attitude component is in a good category, namely: the cognitive component (awareness) of 79.9; the affective component (feeling) of 77.05; the conation component (behavior) is 78.4. Schools should be the most effective media in building environmental awareness and concern, not only limited to mastery of concepts. Therefore, teachers are required to transfer knowledge to students and be creative in using learning strategies that can activate students and develop positive attitudes in students.

## **CONCLUSION**

The study results concluded that The Discovery Learning model affects the students' High Order Thinking Skills (HOTS) with an increase in the average pretest score from 52.23 to 69.47 in the posttest average. Wilcoxon test results obtained asymp. sig. (2-tailed)  $0.000 < 0.05$ , then  $H_0$  is rejected, and it can be concluded that there is a difference in the average student learning outcomes between the pretest and posttest. The study results on students one high school in Indonesia obtained an average score of 78.45 environmental care attitudes with good categories. The average score per attitude component is in the good category, namely: the cognitive component (awareness) of 79.9; affective component (feeling) of 77.05; the conation component (behavior) is 78.4.

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