Descriptive analysis of online mathematic learning implementation that oriented to HOTS during Covid–19 pandemic

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Abstract. This research is qualitative research aims to describe the implementation of online mathematics learning that oriented to Higher Order Thing Skills (HOTS) during covid–19 pandemic. Beside that this study aims to describe students’ HOTS abilities during the implementation of online mathematics learning. This research was conducted at SMK Telkom Malang. The online mathematics learning was implemented in class X RPL 4. There are 36 students that are included in this online learning. Class of X RPL 4 was selected as subject of this study caused by two reasons. The reasons are the material about trigonometry has been studied in this class and the mathematics abilities of students in this class are balanced among low, medium and high ability. The learning model that is implemented in this research is discovery learning. Discovery learning consist of 6 stages, namely stimulation, problem statement, data collection, data processing, verification and generalization. Data collection in this study was carried out by using observations, interviews and students’ work results. This study presents description of teaching and learning activities that stimulate students’ HOTS in each stage of discovery learning. Beside that, this study indicates that online mathematics learning using discovery learning can stimulate students’ HOTS.

1. Introduction

Covid-19 pandemic has occurred in Indonesia in early 2020 causing learning must be carried out from home. Learning activities from home or also known as online learning are carried out based on form letter No. 4 in 2020 that concerning about Implementation of Education in the Coronavirus Disease (Covid-19) Emergency Period [1]. Learning that is carried out by using online media is very beneficial for both teachers and students to be able to learn even in isolated conditions [2]. The implementation of online learning, of course, must be carried out by all schools in Indonesia at every level from kindergarten to college. This is a challenge for all teachers in Indonesia to plan and implement online distance learning with good quality such that the online learning can provide meaningful learning experiences for students when learning from home.

Meaningful learning experience is an important concern in online learning [1]. Meaningful learning can be defined as valuable learning, learning that has real goals that are related to daily life and occurs in a wide and varied context [3]. Meaningful learning is learning that fostering students’ understanding about what and why they learned about a material to connecting with students’ experiences in real life [4]. HOTS-oriented learning is learning that can be applied as an effort to improve the quality of education in Indonesia [5]. HOTS-oriented learning will require students to use their thinking skills at
a higher level than just memorizing and understanding the concepts that are learned in online learning. Thus, HOTS-oriented learning is appropriate learning that can be applied to online learning for producing students who are responsive in solving problems.

HOTS is defined as thinking skills at more complex level and requires a lot of effort that involves mental work [6]. A question is said can stimulate HOTS when in the process of finding a solution to the problem students must analyze, evaluate or be creative [7]. HOTS type questions are questions that are customized to the level of thinking of students. The HOTS type problem is not a problem that always has a high level of complexity [8]. HOTS-oriented learning implementation must apply student assessments that distinguish between the level of difficulty and the level of students' thinking ability [9]. Thus, to carry out HOTS-oriented learning, the teacher must be able to provide HOTS type questions which are based on the level of student thinking which includes the level of analyzing, evaluating and creating where students need more effort to solve the problem.

HOTS-oriented learning implementation must use an appropriate learning model so that learning objectives can be achieved maximally. There are several learning models that can be used in teaching HOTS in mathematics learning. One of the learning models that can be used is discovery learning model [10]. Discovery learning model is effective to improve students' mathematical problem-solving ability [19]. Discovery learning can stimulate students to improve their abilities [11]. The implementation of the discovery learning model consists of 6 stages, namely stimulation, identifying problems, collecting data, processing data, verifying and generalization [12]. Thus, discovery learning model which requires students to actively find solutions to the problems given through investigation activities for finding their own conclusions can develop students' thinking abilities at a higher level.

The implementation of HOTS-oriented learning by applying discovery learning model that is carried out online during Covid 19 pandemic is a new thing in mathematics learning. Therefore, researchers felt the need to describe the implementation of HOTS-oriented online learning during the Covid 19 pandemic. In addition, researchers also need to describe students' HOTS achievements during the implementation of online learning by applying the discovery learning model.

2. Methods

This research is a qualitative research. Qualitative research is closely related to understanding human experience through an interpretive approach [13]. This study aims to describe the implementation of HOTS-oriented online learning by applying discovery learning models. In addition, this study also aims to describe the HOTS that students have during online learning. The subjects of this study were students of class X RPL 4 at SMK Telkom Malang which consisted of 36 students. Class X RPL 4 was chosen as the research subject because the material used as the subject of research, namely trigonometry, has been taught in this class. In addition, the distribution of students with high, medium and low ability in class X RPL 4 can be said to be balanced based on the results of daily test tests. Further analysis of students' HOTS was conducted on 2 students in order to obtain a specific students’ HOTS profile. The research instruments that are used in this study were the pretest and posttest questions, observation sheets, and interview guideline sheets.

3. Results and analysis

HOTS-oriented mathematics learning in this study was carried out in teaching trigonometry material. HOTS-oriented learning in this study was carried out after students who were research subjects had learned about trigonometry material. HOTS-oriented online learning that are carried out in this study consisted of 3 online learning meetings using discovery learning models. Pretest and posttest were carried out to obtain a description of the HOTS profile of the students who were the research subjects.

3.1. Implementation of online mathematics learning that is oriented to HOTS

Online learning in this study was carried out by utilizing technological advancement in the form of online meetings via webex. Webex is a web-based conference service provider that can be used in learning [14]. Webex application is used in this study provides facilities for teachers to provide
presentation in the form of images and videos for students. This application also provides a tool for teachers to provide important notes in real time. Online learning in this research is also carried out by utilizing the WhatsApp group application.

There are several obstacles that are faced by students and teachers in implementing the online learning. The biggest obstacle is internet connection which is sometimes not always smooth. Online learning cannot be implemented without IT support [14]. In addition, student motivation in online learning tends to be unstable. This instability is due to students having no interaction with teachers or other students in online learning directly. Students must be independent in solving problems that are given in online learning. This is in line with the statement from Mackay & Fisher which states that students feel they have to struggle on their own in solving the problems given in online learning [14].

Student-centered learning by requiring students to actively carry out learning activities is the key to the success of any online learning so that students actively contribute to creating meaningful learning experiences for themselves. In line with this, Gillett-Swan stated that facilitators, namely teachers, must be able to provide a platform that encourages active students to communicate with other students and teachers to develop their own abilities in online learning [2]. Implementation of online learning by applying discovery learning model is carried out in the same way as when we carry out offline learning in the classroom, namely through 6 stages consisting of stimulation, identifying problems, collecting data, processing data, verifying and generalization. Description of the implementation of online learning using the online discovery learning model at each stage will be described as follow

3.1.1. Stimulation stage. At this stage students get a stimulus in the form of problems that must be observed by students. This in line with statement that is stated by In’am & Hajar that is one of activity in giving stimulus stage is giving question related to materials that would be discussed [17]. The problem given as a stimulus is a problem related to the cognitive level of analyzing, evaluating, or creating. The teacher gave stimulus through presentation at online meetings using the webex. The following table 1 presents the stimulation provided by teacher and the responses that are given by the students.

| Meeting | Stimulus that are given by teacher | Students’ Responses |
|---------|-----------------------------------|---------------------|
| 1       | Teacher gives a presentation related to the quadrant system. Teacher asks students to give reasons why the value of sine is only positive in quadrants I and II only | Students cannot provide answers to question that is given by the teacher |
| 2       | The teacher presents a picture of an isosceles right triangle that length of right side is 4 cm. Teacher asks about students’ approval about statement that state that “Pythagoras is the only one formula that can be used to determine the length of hypotenuse. Teacher also ask students the reason about students’ statements. | A student state that Pythagoras was not the only way to determine the length of the hypotenuse. However, the students can’t present the steps for determining the length of the hypotenuse using the sine rule correctly. |
| 3       | The teacher presents the graph of the function $y = \sin x$ and $g = \sin x + 1$. Students are asked to describe the relationship between the two graphs | Students can state the relationship between the graph of the function $y = \sin x$ and $g = \sin x + 1$ by displaying several angles at certain angles. |

Based on Table 1, it can be said that the stimulus is very important to encourage students to develop their thinking skills. In addition, stimuli in the form of questions that encourage students to think and reason can be given at online meetings to make students actively find out about the material being studied. This is in line with the opinion of Ballakrishnan & Mohamad which states that one of the strategies to teach HOTS is questionings [15]
3.1.2. Identifying problems stage. Teacher displays the HOTS type questions that are on the student worksheets related to the trigonometric material. Teacher requires students to write down at least 1 question or statement that comes to the students’ mind when students understand the given problem. In this stage, teacher gives students time to write down whatever is on their mind related to the given problems by teacher on the Student Worksheet. Then teacher randomly assigns students to state what the students have written for each given problem. Teacher also provides follow-up questions that can stimulate students related to the statements that are given by students. Teacher requires students to be active in finding any information related to the given problem. This is inline with the statement from the ministry of education and culture which states that in the stage of identifying problems students must find as much as possible information related the problem that must be solved [12].

3.1.3. Collecting data stage. In this stage students are asked to leave the online meeting on the webex to join the whatsapp group that is provided by teacher where members of the group have been classified based on students' abilities. Before leaving the webex meeting, the teacher asked several questions that could stimulate students to be able to collect data. One of the questions that is asked by teacher, for example, state all the formulas that you used to solve the problem and why you think that you need the formula. Students are allowed to find all the information they need by utilizing the internet and taking advantage of all information technology media that students have. This is in line with the opinion of the ministry of education and culture that at the data collection stage, students are asked to collect various information to solve problems [12].

3.1.4. Processing data stage. At the processing data stage, students are asked to discuss through chats, voice notes or video calls on the WhatsApp group depending on the needs of each group. In this discussion, all students use their thinking skills to solve given problems in students’ worksheet. Discussions in small groups are still facilitated by teacher. Teacher is member of all whatsapp groups in all small groups in this online learning. If students face problems in solving given HOTS type questions, the teacher facilitates students by asking several questions. Teacher does not immediately give answers to students when students face difficulties. Teacher often asks questions that require students to analyze, for example the question "what if I buy another 10 m long wood, how many ABC triangles can I make?" It aims to make students use the thinking skills that students have at a higher level. This is in line with the opinion of Asa’ri, et al which states that questions that require students to analyze or be creative really need to be considered in teaching HOTS [8].

3.1.5. Verification stage. At this stage, students verify the correctness of the results of group work discussions that have been carried out in small group discussions. Classical discussions were held after each group had verified their answer in the small group. At this stage students are welcome to join again in online meetings via webex meetings. Teacher asks two or more representatives of group to present the results of their discussion at the webex meeting. After the presentation is done, the teacher asks other students to give opinions or questions about what the presenter said. At this stage all students are expected to verify the results of their group work to get the right answer. This is in line with the opinion of the ministry of education and culture which states that at this stage, students must verify the correctness of the results obtained by students [12].

3.1.6. Generalization stage. At this stage, each group representative is asked to provide a final conclusion regarding the problem given. Teacher asks each group to convey the final conclusions that they get from the classical discussion. Teacher requires students to provide reasoning for the conclusions that they take. After each group presents their conclusions based on group discussion, teacher asks several students at random to present the conclusions about their understanding. Thus, conclusions can be obtained through understanding in groups and individuals. This is inline with the statement given by In'am & Hajar which claims that in the concluding stage, conclusions can be obtained through group and individual activities [17].
3.2. HOTS profile of students in implementing online learning
Pretest and posttest questions each consisted of 3 questions which were HOTS type questions according to the cognitive level, namely 1 question at the level of analyzing, 1 question at the evaluating level and 1 question at the creating level. In-depth analysis related to the results of the posttest was carried out by researchers on 2 subjects, namely student A and student B. Based on the pretest results, neither student A nor student B could solve the HOTS type questions at all levels. Student A and student B wrote down only what was known and what was asked. The following Figure 1 and Figure 2 present the posttest results of students A and B at the level of analyzing questions.

![Picture 1](image1.png)  
**Picture 1.** Posttest results of students A at analyzing questions level

![Picture 2](image2.png)  
**Picture 2.** Posttest results of students B at analyzing questions level

Based on the results of the student's posttest, it was clear that there was a change in the mindset of students in solving HOTS type questions. Student A uses the graphs $\sin x$ and $\cos x$ to express relation between $\sin 25^0$ and $\cos 75^0$, while student B uses related angles in trigonometry. Based on the results of the interview, student A realized his mistake. Student A did not quite accurately present the relationship between $\sin 25^0$ and $\cos 75^0$, because the picture that he used to answer was incorrect. Meanwhile student B can explain why the value of $\sin 25^0 > \sin 15^0$ in the interview session by using related angles in trigonometry. Thus, it can be said that online learning which is implemented using discovery learning model can stimulate HOTS owned by SMK Telkom Malang students. This is in line with the statement made by Syahputra & Nasution which states that learning with discovery models is effective in teaching HOTS [16]. In addition, Mackay & Fisher stated that online learning can be said to be effective in learning [14]. Another opinion stated that e-learning method in mathematic learning give positif influence to students such as on students' participation and also in students’ mathematical concepts [18].

4. Conclusions
Based on the results of the analysis and discussion, some conclusions that can be conclude are 1) online learning in teaching HOTS in mathematics is very possible using the discovery learning model which consists of 6 stages, namely stimulation, identifying problems, collecting data, processing data, verifying and generalization, 2) HOTS-oriented online learning that using discovery learning model can be said stimulate HOTS owned by SMK Telkom Malang students based on student posttest results compared to pretest results. There is change in students' thinking in answering the questions asked by the teacher from time to time in the implementation of HOTS-oriented learning.

Further research related to the effectiveness of HOTS-oriented online learning to increase students' HOTS is needed. Beside that, some important things that must be considered in online learning are teacher must apply high discipline regarding the limit of assignment collection and punishment for students who exceed the collection time limit. Teacher also must actively ask questions that require students to reason at every opportunity on each stages of the discovery learning model. Thus, students can be more active in using their higher thinking skills in solving HOTS questions.
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