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Is it difficult to teach higher order thinking skills?

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Abstract. A teacher must be aware of the importance of teaching higher order thinking skills (HOTS) to prepare young generations in 21st Century. But in reality, many teachers find difficulties in teaching HOTS. This research aims to describe teachers' difficulties in teaching HOTS in the classroom. The research is a descriptive explorative research by means of qualitative approach. The data were collected from questionnaire. This research involved 10 high school mathematics teachers in Yogyakarta, Indonesia. The result of the research shows that the teachers still find difficulties in teaching HOTS in the classroom, those are (1) teachers' knowledge about HOTS is still low, (2) teachers' difficulty in delivering apperception to students, (3) teachers' difficulty in designing and applying the assessment based on HOTS, (4) teacher's difficulty in delivering HOTS based learning materials, (5) teacher's difficulty in making learning media based on HOTS, and (6) teachers' difficulty in preparing learning tools based on HOTS.

1. Introduction

The 21st century has produced its own sets of problem. Human life significantly changes from the life of previous centuries, seen from the rapid development of science and technology. It results in the way humans work and sustain life. In general, humans need technology to find information and knowledge, create ideas, find work, share information and opinions, and do transactions. At the same time, humans also face new problems, such as the emergence of various diseases, lack of food and energy, global climate change, and environmental degradation.

In dealing with complex real-life problems, the young generations are required not only to earn money for a better life but also to have various skills to provide social support. As stated by various stakeholders in the P21's Framework for 21st Century Learning that the skills needed in this century ranges from core subject to innovation, ICT skills to Life skills, including higher order thinking skills (HOTS) [1]. The government has responsibilities to pave the way to success for nation. On the other hand, teachers as implementer of education also have responsibility and must be aware of the importance of teaching higher order thinking skills (HOTS) to prepare young generations in 21st Century.

Thinking skills are the most basic skills that can be developed in the classroom and are the key to high achievement for all students [2]. The concept of HOTS comes from Bloom's taxonomy of cognitive domain. This cognitive domain involves knowledge and the development of intellectual skills and hierarchically from concrete knowledge to the abstract [3]. According to Marshall and



Horton, HOTS consist of logical thinking, critical thinking and reasoning skills which are the basic skills for daily life [4], in addition to academic achievement [5]. The main characteristics of HOTS are critical and creative [5]. The 2013 curriculum demand is also one reason to teach HOTS because it can make students think more critically and creatively. Therefore, the teachers are expected to embed the HOTS element to encourage deeper thinking activities among students.

Basically HOTS can be applied in various disciplines, including mathematics. The important role of HOTS in learning mathematics lies in the learning process. Students will be conditioned to think critically and creatively in making decisions and solving problems related to analyze, evaluate, and create [6]. Therefore, HOTS is measured using tasks including analyzing, evaluating, and creating conceptual and procedural knowledge or metacognition. As Brookhart said that HOTS contains several aspects, logic and reasoning, analysis, evaluation, creation, problem solving, and judgment [7]. This means that familiarizing students with HOTS activities is important to help them prepare themselves for dealing with new problems, adjust to a new atmosphere, and make decisions about certain problems [8].

As a skill, HOTS cannot be taught directly to students in a lesson. Students are trained about HOTS through learning activities that support their development [8]. HOTS training activities can also be through active learning and student-centered learning [9][10], such as problem-based learning (PBL) [12][12], discovery learning and question-based learning [13], learning by worked examples [14], or other learning models. Conklin and Manfro also believes that teachers can provide open-ended questions to train students HOTS [5].

But in reality, teachers still find difficulties teaching HOTS. It is due to the lack of teacher's knowledge about HOTS. Not all teachers understand HOTS well. The teacher cannot distinguish HOTS as an ability, skill, learning strategy, learning method, or learning process [8]. The teacher's understanding of HOTS has an impact on how they teach HOTS to students. The less the teachers' knowledge about HOTS, the harder it is taught. Some studies show that teachers still have problems in training students about HOTS, including teachers not skilled yet in developing HOTS-based problems and suitable learning media [15][16][17]. Another difficulty is teachers have not been able to evaluate HOTS students [17]. The low teacher's ability of HOTS also makes it difficult for them to compile HOTS questions, so that students are not trained to solve on HOTS questions in learning [18]. As a result, students will have difficulties solving national exam questions that contain HOTS questions in the form of contextual and narrative questions [19]. This research aims to describe the difficulties of the teachers in teaching HOTS in the classroom and teachers' strategies to overcome it.

2. Research Method

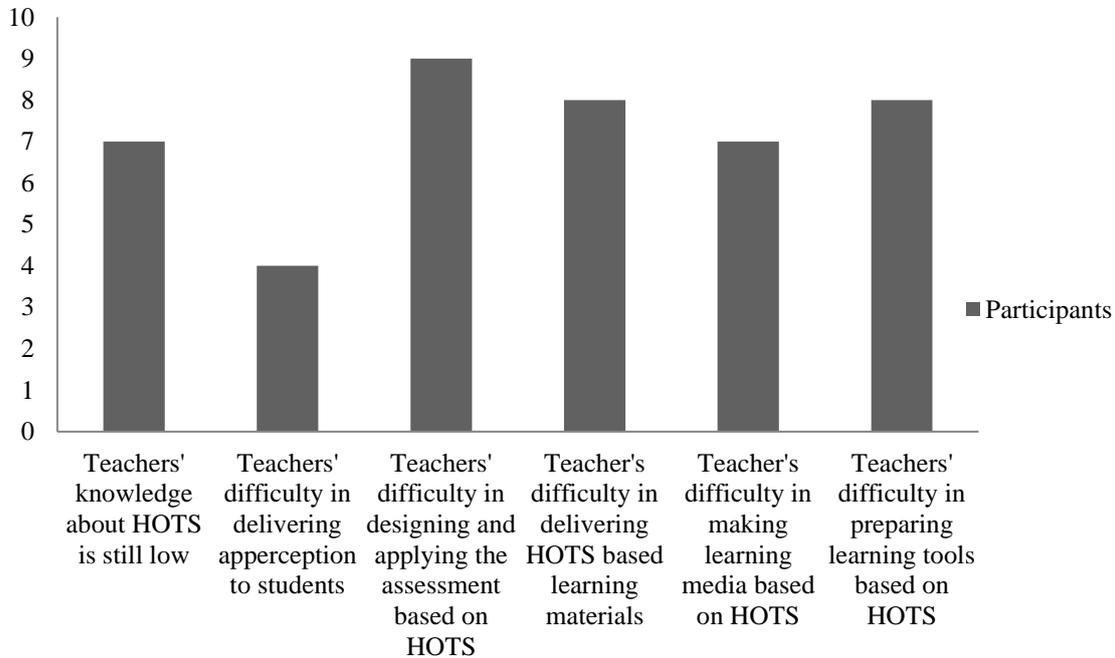
This research is a descriptive explorative research by means of qualitative approach. This research aims to describe teachers' difficulties in teaching higher order thinking (HOTS) in classroom. The data in the research were collected from questionnaire and interviews. There were nine questionnaire items about what difficulties in teaching HOTS. The participants were 10 high school mathematics teachers (6 female against 4 male; A1-A10) in Yogyakarta, Indonesia. They were randomly selected and haven't participated in training for HOTS and its teaching and learning strategy yet. Data from questionnaire were presented in a diagram to be analyzed by descriptive analysis.

3. Result and Discussion

3.1. Result

The results of the data analysis showed that some teachers still have difficulties in teaching HOTS. There are some difficulties that teachers found when teaching HOTS: (1) Teachers' knowledge about HOTS is still low, (2) Teachers' difficulty in delivering apperception to students, (3) Teachers' difficulty in designing and applying the assessment based on HOTS, (4) Teacher's difficulty in delivering HOTS based learning materials, (5) Teacher's difficulty in making learning media based on HOTS, (6) Teachers' difficulty in preparing learning tools based on HOTS.

Diagram 1. Teachers’ difficulties in teaching HOTS.



Based on the Diagram 1, most of teachers have difficulty in designing and applying the assessment based on HOTS. There are eight teachers that lack in delivering HOTS based learning materials and preparing learning tools based on HOTS. There are seven teachers having difficulty in making learning media based on HOTS and they still do not understand HOTS itself. Only four teachers have difficulty in delivering apperception to students. Then the researcher interviewed them to know how well they understand about definition of HOTS. Their answer will be shown in Table 1 below.

Table 1. Teachers’ knowledge about HOTS.

Definition of HOTS according to teachers	
A1	Higher order thinking skills
A2	Difficult problems
A3	High level mathematics problems
A4	Learning prosses with high level thinking
A5	Ability to solve various problems
A6	Problem with unusual solving
A7	Skill to solve high problem
A8	High level thinking ability, such as critical and creative thinking
A9	Problem solving ability
A10	Learning method to teach higher order thinking problems

The results out of data analysis and reduction of teachers’ knowledge about HOTS in Table 1 show that teacher's knowledge about HOTS is still low. Some teachers (A1, A8) still know the HOTS term without understanding what the definition of HOTS itself is. Some answers (A2, A3, A6) indicate that teachers still think HOTS as a difficult and unusual problem. In fact, There are many teachers (A4, A5, A7, A9, A10) cannot distinguish HOTS as an ability, skill, how to solve problems, or method. Although the term HOTS often appears in teacher training activities and socialization of Curriculum 2013, teachers cannot understand its definition well.

3.2. Discussion

Higher order thinking skill (HOTS) is one of the components of Curriculum 2013 that has been implemented in Indonesia since 2013. HOTS is a level of thinking that emphasizes the application of knowledge that has been received, reasoning reflection, solving problems, making decisions and then formulating new things. Based on the revised Bloom's taxonomy [6], HOTS is an incision between the components of cognitive process dimension (analyse, evaluate, and create) with the components of knowledge dimension (conceptual, procedural, and metacognitive). HOTS also involves the development of intellectual skills and ways of thinking from concrete to abstract gradually [3]. Therefore, it is possible that the teachers do not understand the concept of HOTS well. Moreover, the teachers will have difficulties in implementing HOTS in teaching learning process if not given socialization or training about HOTS by the government.

The results of this research indicate that not all teachers understand HOTS well. Based on the result in Table 1, the teacher still cannot distinguish HOTS as ability, skill, learning strategy, learning method, or learning process. Even though they realize that teaching HOTS is important [8], but their knowledge about HOTS is still lack. After the interview, the teachers confess that they had not received HOTS training regularly so they applied HOTS according to their knowledge about HOTS. The government as a policyholder needs to give socialization about HOTS periodically as an effort to provide teachers' understanding about the concept of HOTS so they can implement HOTS-based learning well.

The second is teachers still have difficulty in delivering apperception to students. Apperception is important given as a bridge for students to remember previous concepts related to the concept being taught. In learning process, a concept that is taught cannot be separated from the knowledge that students have. Teachers need to help students to connect the concepts that will be given with the concepts that have been taught, especially learning materials that contain HOTS where students need more thinking skills. If apperception is not given, students will have difficulty in understanding the concept [20]. As a result, students are not ready to accept lessons because students' attention has not been centered on the things they will learn.

Teachers also have difficulties in assessing HOTS. The teacher does not understand the indicators such as what measures HOTS. Some teachers assume that higher order thinking is a difficult matter. Based on the revised Bloom's Taxonomy that the indicators for measuring HOTS include analyzing (C4), the ability to separate concepts into several components and connect with each other to gain an understanding of the concept as a whole; evaluate (C5) an ability to determine the degree of something based on certain norms, criteria or standards; and create (C6), the ability to fit elements into something new, complete and broad, or make something original [6]. Research in mathematics education has found that knowledge and skill are best developed when the students are allowed to wrestle with new ideas, create and maintain problem solving and participate in the community of mathematics students [21].

Implementing HOTS in the classroom is not easy, there must be an effort to make it happen. The teachers have important role in regulating and motivating students. There are four things teachers can do in teaching HOTS according to Conklin and Manfro [5], those are: opening lesson with questions that lead to HOTS to start discussions and debates, ending lessons with HOTS questions that are used as assessment tools, placing brainstorming activities in the middle of the lesson to encourage students to find ideas and think creatively, and provide open-ended tasks as homework to find out their creativity and understanding of the lessons that they have learned.

The difficulty of implementing HOTS in the majority learning activities is in designing evaluation activities. Evaluations that can measure and develop HOTS at students must be arranged by prioritizing the values in HOTS itself. The teachers' difficulty in preparing the evaluation by emphasizing HOTS values was also found in the research conducted by Hidayati [18]. In addition, the teachers also found difficulty in teaching how to solve problems properly. It is caused some mathematics teachers have not performing well in solving HOTS problem [8]. Most of them do not include clear procedures in solving the questions. This indicates that teachers' mathematical content

knowledge (MCK) is still low, especially in relating to their ability in solving HOTS-based questions. This result is consistent with research by Zulkpli, Mohamed, and Abdullah [22] which shows a low level of thinking ability among primary and secondary school teachers in one province in Malaysia. This condition will certainly affect student learning achievement that is not optimal [23][24][25]. In addition, these results also showed inconsistencies in teacher responses in measuring HOTS and answering HOTS-based problems. Although the teacher has revealed that judging HOTS should not ignore the process or completion of problem solving steps, when solving HOTS problems, most of them only write the final results and do not enter the completion process.

To instill HOTS values in evaluation, one strategy that can be done is to compile non-routine or open-ended problems. Open ended is a problem based on problems formulated to have multiple correct answers or called incomplete problems. The main purpose of students given an open problem is that students emphasize more on how to arrive at an answer [26]. Thus, students will be trained to think multi-perspective and non-routine so that it has an impact on students' thinking abilities that are increasing.

Teachers will have difficulty in implementing HOTS to student if they do know how to compile and develop higher order thinking problems that need to be applied to students. Basically, any form multiple choice and essay problems can be used to assess the HOTS aspect with the note that the teacher is able to compile it properly. Both in multiple choice and essay problems, not only asked about facts, concepts, principles, or procedures, but also the ability to think analytically. Some teachers also still lack understanding in developing questions that fulfill HOTS question requirements. They cannot adequately distinguish specific keywords for a certain level from HOTS questions [27].

Higher order thinking problem do not mean difficult questions, the questions are long and convoluted so they waste a lot of time reading it and at the same time confusing students, but the problems are arranged proportionally and systematically to measure students' HOTS. The teachers' ability to solve higher order thinking problems is also still low. Some teachers find it difficult when they faced the problems. If the teachers still have difficulties in solving higher order thinking problems, how they can make these types of problems and train to the students. Some mathematics teachers did not answer HOTS problems properly and correctly [8].

Delivering material based on HOTS is also difficult for some teachers. They are not used to teach HOTS in class. In addition, teachers have not received training on HOTS implementation. Another difficulty is teachers have not been able to evaluate students' HOTS [17]. Teacher responses also show that teachers still have difficulty in making media and teaching materials based on HOTS. Some studies show that teachers still experience problems in training students about HOTS, including teachers not skilled yet in developing HOTS-based problems and suitable learning media [14][15][16]. The teachers also have not been able to choose the right teaching approach, methods, and techniques that can help improve student understanding. As a result, teachers will apply traditional teaching methods and not use any innovation in teaching HOTS to students [27].

Findings from previous research have highlighted important features of what HOTS and how teachers can effectively develop these HOTS [28][29][30][31][32][33]. There are several strategies that can be used in teaching HOTS in classroom. This must be seen as several ways in which HOTS can be taught effectively [34], those are: taking the mystery away and teaching the concept of concepts, teaching concept of concepts, naming and categorizing concepts, moving from concrete to abstract and back, teaching inference and connecting concepts, teaching question-answer relationships, including brainstorming activities in the lessons, using teaching techniques that provoke HOTS, and emphasizing feedback generation for students.

In addition, teacher's skills on how to develop high-order thinking questions are very important. Lack of knowledge in developing high-order thinking questions is one of the inhibiting factors in applying teaching and learning to instill elements of HOTS in the classroom. Teachers also need to know how to ask questions to students, because good questioning techniques are useful to attract students' attention when they are less interested or bored in class. So good technique can help students to improve HOTS [35].

4. Conclusion

There are six difficulties in teaching HOTS in the classroom those are: (1) teachers' knowledge about HOTS is still low, (2) teachers' difficulty in delivering apperception to students, (3) teachers' difficulty in designing and applying the assessment based on HOTS, (4) teacher's difficulty in delivering HOTS based learning materials, (5) teacher's difficulty in making learning media based on HOTS, and (6) teachers' difficulty in preparing learning tools based on HOTS.

The answers given by the participants were in line with the previous data, namely the main difficulty faced by the teacher was in designing the next evaluation on the delivery of material ranked second as a teacher inhibiting factor in applying HOT values in learning activities. This finding provides input that is very useful for other researchers or stakeholders in the preparation of teacher competency improvement activities in order to be able to instill HOT values in every learning activity.

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