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Designing and Implementing HOTS-Oriented Learning by Mathematic Teachers

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Abstract: Higher-Order Thinking is a skill to be achieved to face the 21st century. Some previous research shows HOTS-oriented learning can improve students' higher-order thinking skills. This research aims to analyze the plan and implementation of HOTS-oriented learning by mathematics teachers. This research is a phenomenological research with a qualitative approach with the subject of 20 mathematics teachers in junior high schools who have attended the training. The teachers designed the lesson plan, implemented it in their school and then the FGDs are conducted to find out the experiences of each teacher. Research shows that mathematics teachers have tried to do HOTS-oriented learning, but still have many obstacles and difficulties in its implementation. Thus, HOTS learning must be done continuously to make students accustomed to doing HOTS-oriented learning activities.

Keywords: higher order thinking skills, HOTS-oriented learning, mathematics teacher, lesson plan

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1. Introduction

Higher Order Thinking Skills happens when someone takes new information and information stored in memory and is interconnected and or rearranges to reach a goal or find possible answers in a confusing situation. (Lewis, Smith, & Lewis, 2009) Bookhart defines the ability to think high level or HOTS in three definitions, namely HOTS in the form of knowledge transfer, HOTS in the form of critical thinking, and HOTS in the form of problem solving. Learning to transfer is meaningful learning because students can apply their knowledge and skills and associate information with one another. There is also learning with critical thinking so students can argue, reflect, and make their own decisions. Problem-based learning aims so that students can identify and solve problems both academically and in everyday life (Bookhart, 2010).

According to Kuhn, a high level of skill demands attention and its right to be possessed as a significant educational goal, so this ability needs to be triggered in learning (Kuhn, 2009). HOTS requires more complex creative activities and quality learning (King, 2010). All students must be given high quality learning to improve higher order thinking skills in mathematics (Murray, 2011). High quality is when teachers understand the knowledge provided and understand HOTS-oriented learning. There is a significant relationship between teacher knowledge and skills with teaching in the classroom (Wilkins, 2008). While there are still many teachers who are still weak in understanding HOTS learning itself (Yen & Halili, 2015).

Teachers themselves are still confused about the definition of thinking skills (Beyer, 1984) and they sometimes find it difficult to distinguish levels of thinking (Marzano, 1993; Rajendran, 2000). This lack of knowledge about HOTS can ultimately lead to the inability of teachers to assess HOTS students. The teachers are not always sure about how to teach HOTS (Rajendran, 2002; Sparapani, 1998).

When teachers are confused, they sometimes think that they are teaching HOTS when in reality they could be encouraging low-level thinking among their students (Rajendran, 2002; Sparapani, 1998). Conversely, some teachers may not realize that they have unconsciously integrated HOTS into their learning so far (Zohar, 2004). Some teachers only depend on Bloom's taxonomy without realizing that the taxonomy is not specifically determined for HOTS learning (Ivie, 1998).

The teacher must be able to design learning that can make students have higher-order thinking skills. This design starts with the determination of the learning model undertaken. The teacher must be able to choose the right learning model that can be given to students according to the characteristics of the students in the class they are in (Gitomer & Zisk, 2015). In implementing learning, teachers must be able to guide and work on aspects of HOTS that students must have (Tajudin, 2015).

2. Method

This research is a qualitative study with a phenomenological approach. The participants of this research are 20 junior high school mathematics teachers from eight school districts in Subang Regency Indonesia. Teachers were asked to be participants for this research while attending workshops Increasing Learning Competency. All of the teachers participated in the training of HOTS implementation. Data collection of the research was divided into three steps. First, participants were asked to write the lesson plan of HOTS-oriented learning. Second, participants were asked to implement the lesson plan in their school and observed by their headmaster. Third, in the next meeting participants were involved in Focus Group Discussion (FGD) so that the researcher could get detailed information on their lesson plan and their implementation in the classroom.

The instrument of lesson plan and implementation of learning was adapted from the department of education of Indonesia. And the data was presented by percentage and analyzed by descriptive. FGD is chosen

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to clarify the participants about the experience before. The topic of FGD was designing HOTS-oriented learning and implementing HOTS-oriented learning. Data from FGD was analyzed and presented in a table to be classified into sub-themes to know the relationship among sub-theme.

3. Result

3.1. Designing The Learning

Designing the learning by teachers was delivered in the lesson plan. The lesson plans made by the teachers were analyzed and presented in following table with scale: 1 = none, 2 = weak, 3 = strong

Table 1 - Teacher's Lesson Plans

Observed Aspect	Scale		
	1	2	3
Learning Objectives			
Learning objectives include attitudes, knowledge and skills		25%	75%
Using operational verbs that can be measured on indicators of competency achievement with the developed basic competency		25%	75%
Learning objectives consist audience (A), behavior (B), condition (C), and degree (D)		60%	40%
Write down the character values that will be raised in learning	20%	40%	40%
Learning Materials			
Learning material related to all basic competencies and indicators to be achieved			100%
Preparing the subject matter systematic and complete.		20%	80%
Learning Activity			
Pre Activity			
Preparing the students psychologically and physically to participate in learning.		25%	75%
Motivate to the students contextually	15%	30%	55%
Asking the previous material that relates to the material	50%	15%	35%
Explaining the learning objectives or basic competencies to be achieved			100%
Main Activity			
Using appropriate models, methods, and approaches for effective and efficient learning in the form of scientific approaches that facilitate students in achieving basic competency indicators and 21st-century skills		75%	25%
Learning steps adjust to the syntax of the learning model used	5%	60%	35%
Centre subjects of the learning are the students (students oriented).		20%	80%
Bringing up 21st Century skills (creativity, critical thinking, collaboration, and communication)		30%	70%
Bringing up HOTS aspect *transfer knowledge*, *critical thinking* or *problem solving*		20%	80%
The main activity involved assessment for learning.		60%	40%

Post Activity			
Bringing up reflection and evaluation throughout the series of learning activities.		30%	70%
Providing feedback on the process and learning outcomes		25%	75%
Performing follow-up activities in the form of assignments	15%	20%	65%
Informing the next material	30%	20%	50%
Assessing at the end of learning			100%
Media, Materials and Learning Resources			
The Media related to the learning objectives, material and class condition.		55%	45%
The media and the materials relevant to the lates.		60%	40%
The media was interesting, varied, and related to achieving competency indicators.		60%	40%
The materials can be consist of printed materials, using ICTs, or the natural/social environment.		60%	40%
Assessment			
Including techniques, forms, and examples of assessment instruments in the realm of attitudes, knowledge, and skills according to indicators.	5%	20%	75%
Relating to the learning objectives		30%	70%
Consisting the grid of the questions, questions, answer key, attitude instrument, skill instrument, and scoring rubric.	15%	35%	50%
Planning enrichment and remedial activities.			

The result shows that some of the teachers were still weak in determining learning objectives in ABCD sentence, using appropriate models or method and their syntax, involving assessment in the main activity, and using variation and lates media. Most of the teachers have designed well in some parts.

3.2. Implementation of Learning

The implementation of the lesson plans were observed by their headmaster that presented in the percentage in the following table :

Table 2 - Teacher's Implementation of the Lesson Plans in The Classroom

Aspect Observed	None	Any
Pre Activity		
Motivating the students to start learning		
Conditioning a comfortable learning atmosphere (seating arrangements, media, the readiness of learning media)	20%	80%
Delivering objectives, competencies, indicators, time allocation and learning activities scenarios.	10%	90%
Main Activity		
Facilitating Learning Ability		
Mastering the materials.	20%	80%
Delivering materials systematically.	30%	70%
Managing the class.		100%
Do the learning due to the planned time allocation	70%	30%

Involving the students in the learning		
Fostering active participation of students in learning activities		100%
Respond positively to student participation.	20%	80%
Fostering the enthusiasm of students in learning	25%	75%
High Order Thinking Aspect		
Implementing learning steps that reflect active learning.		100%
Involving the HOTS aspects of transfer knowledge, problem solving and critical thinking	20%	80%
Involving the skills of analyzing, evaluating or creating.	20%	80%
Includes dimensions of knowledge (conceptual, procedural or metacognitive)	30%	70%
Involving 21st-century skills (creative, critical thinking, communication, collaboration)	35%	65%
Using media and resource in the learning		
Demonstrating the skills in the use of learning media	40%	60%
Demonstrating skills in the use of learning resources	60%	40%
Involving participants in the use of learning media	30%	70%
Implementation of learning assessment		
Carrying out an attitude assessment	80%	20%
Carrying out a knowledge assessment		100%
Carrying out a skills assessment	50%	50%
Using correct language		
Speaking clearly and fluently	30%	70%
Writing clearly and easy to be understood.	35%	65%
Post Activity		
Facilitating participants to summarize the subject matter	40%	60%
Reflecting on the process and subject matter	45%	65%

Most of the teachers doing the learning exceed time allocation and not carrying the attitude assessment. But overall most of them realized most of the parts of HOTS-oriented learning.

3.3. Forum Grup Discussion

The results will show how was the experience of the teacher in designing and implementing HOTS oriented learning to clarify the data. First, the teachers were asked how to plan the lesson and what was their problem in designing the HOTS-oriented learning. The results can be seen in Table 3 below:

Table 3 - Teacher's experience in designing HOTS-oriented learning

Experience in designing HOTS-oriented learning by the teachers	Verification Results
Not knowing the syntax of the model Not knowing how to determine the appropriate model with basic competence. Found it difficult to determine the appropriate method. Found it difficult to determine the appropriate assessment.	Most of the teachers still confuse about designing HOTS-oriented learning. They were unable to determine the method appropriate with basic competence, the syntax

Adopted the lesson plans from the internet. Adopted the lesson plans from other teachers. The media in the school did not support the learning. Designing HOTS-oriented learning was challenging.	of the learning model, the assessment and the media which not provided by the school.

Many teachers still confuse to determine the model, the method, the media, and the assessment that will be chosen. Based on the teacher responses show not all teachers design the lesson plan well. Some of them did not make the lesson by their self but they adopted from the internet or other teacher.

The table below shows the results of the teacher's experiences in implementing HOTS-oriented learning. Teachers were asked how was their experience in implementing the plans they made before.

Table 4 - Teacher's Experience in implementing HOTS oriented-learning

Experience in implementing HOTS-oriented learning by the teachers	Verification Results
Student's motivation was low. Time allocation was limited. Many resources were not available in the school. Student literacy skills were still low. Learning ran slowly not according to what was planned because of student's responses. Teacher's knowledge of HOTS oriented learning was still lacking. Students were not familiar with HOTS-oriented learning. Student's communication skills were still low so they cannot deliver what they mean. Many students have low skill in mathematic.	The teachers realized HOTS oriented learning but the student's responses show that the students not ready yet to receive HOTS-oriented learning.

The result showed most of the teachers have realized HOTS learning but they found many problems in the class. Student's responses show that they were not familiar with HOTS-oriented learning so the learning ran slowly not according to the lesson plans. On the other hand the resource was not supporting the learning.

4. Disscussion

Retnawati (2018) said the standard of socialization and training is very important in order that teachers can get more understanding of ability and skills about HOTS through these activities. After attending training of implementation of HOTS, not all mathematics teachers can design and implement HOTS learning properly. Teachers still find obstacles in practice. The obstacle was found because the students and the teachers still not familiar with learning. But overall the teacher can realized step by step how to design and implement HOTS-oriented learning.

In designing the lesson plan of learning, the teachers have difficulties to determine the appropriate model or method in the learning. It happened because the teachers did not fully understand the syntax of the learning model. Meanwhile Gitomer said that design starts from the determination of the learning model undertaken. The teacher must be able to choose the right learning model that can be given to students according to the characteristics of the students in the class they are in (Gitomer & Zisk, 2015). In implementing HOTS-oriented learning the result shows that all teachers have tried to implement all of the parts in the plan. Some of them have trouble with the student, media, or resources. Most of them could not manage the time because most of the students could not understand well. It happened because the students not familiar with the learning.

Based on previous research, in developing students' HOTS mathematical abilities, learning must involve students in non-routine activities, facilitate students to develop the ability to analyze, evaluate and encourage

them to develop their knowledge with meaningful learning (Kane, Mishra, & Dutta, 2016). Meaningful learning can be obtained by activities that involve student activity and students feel challenged.

Students need to be given a stimulus to trigger higher-order thinking skills in mathematics that emerge. It is not enough just to give questions that need higher thinking. More than that, students need to be given HOTS-oriented learning. In the HOTS-oriented learning process the teacher provides space for students to find the concept of activity-based knowledge. Activities in learning can encourage students to build creativity and critical thinking so hopefully students will succeed in further learning. Not only limited to activity-based, but mathematics learning can also be ICT-based and the problems provided are open-ended. (Heong et al., 2011; Prayitno, 2013; Tanujaya, Mumu, & Margono, 2017; Yaniawati, 2013)

Therefore HOTS-oriented mathematics learning can be applied by 1) making sure students have a new basic concept to a more difficult level 2) categorizing concepts in learning 3) providing stimulus 4) students are encouraged to identify problems 5) students are encouraged to ask questions 6) students do activities and feel challenged 7) students built learning awareness. (Yen & Halili, 2015; Thomas, 2009)

The result of the research related to terms of the perception that teachers still hold to the idea that HOTS is only intended for excellent students (Hashim, 2003; Lundquist & Hill, 2009; 2001; Zohar & Dori, 2003; Zohar & Schwartzer, 2005). For them, weak students have very little thinking capacity, and their thinking skills are mostly hampered by their low language skills (Lundquist & Hill, 2009). HOTS can be applied to every student and can be reflected in learning. The role of the teacher in HOTS learning becomes very important. Teachers who have to function as facilitators must be able to plan, implement and evaluate learning well (Kennedy, 2019).

5. Conclusion

The teachers have tried to design and implement HOTS-oriented learning well. Meanwhile many obstacles found by them. The students still not familiar with the learning. So teachers have to try more and more so the students enjoy the activities and can reach high order thinking skills. Students have to familiarize the HOTS problem. It can be given from the low level until the high level.

On the other hand, this case is not the teacher's problem but also for the parents, headmaster, school, the government, and the next generation. The headmaster and school can support all of the teachers to implement it by providing media, complete resources, or give them training in the school. The government also has to give the teacher more socialization and teacher training to improve the teacher's skills in designing and implementing HOTS-oriented learning.

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