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How mathematics teacher develop HOTS-oriented Learning

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Abstract
The implementation of Higher Order Thinking Skills in teaching and learning mathematics was very important to change the community's stigma on mathematical difficulties. HOTS can also attract students to foster their interest in mathematics. The purpose of this study is to examine the ability of mathematics teachers to develop HOTS-oriented learning. This research is phenomenological research with a qualitative approach involving a mathematics teacher in Subang Regency. The data analysis stage was carried out by observation to observe HOTS-oriented learning and interviews to confirm the findings in each process. The results showed the teacher had tried to do Mathematics oriented to HOTS despite finding some obstacles. Teachers should exchange knowledge and pedagogical knowledge with other teachers and then be consistent in continuing HOTS-oriented learning so that students are accustomed to HOTS.

Keywords: HOTS-oriented learning, mathematics learning, mathematics teacher

Introduction

A high level of skill demanded attention and the right to be owned as a significant educational goal so this ability needs to be triggered in learning. Higher Order Thinking Skills or HOTS will occur when someone takes new information and it stored in memory which rearranges to achieve goals or find possible answers in confusing situations [1]. In general, Afandi and Sajidan stated that HOTS is difficult to define precisely [2]. Although many experts and researchers have different definitions of HOTS, all of them agree that HOTS means the ability to convey information, to instill a critical attitude, and to solve problems. HOTS requires more complex creative activities [3] and also can attract students to foster their interest in mathematics [4].

In developing HOTS mathematical abilities, teachers must then engage students in non-routine activities, facilitate students to develop the ability to analyze, evaluate and encourage them to develop their knowledge with meaningful learning [5]. Meaningful learning can be obtained by activities that involve active students and they feel challenged. Students need to be given a stimulus to trigger the ability to think at a higher level in mathematics. It's not enough just to give questions that need higher thinking. More than that, students need to be given HOTS-oriented learning. Beginning with the provision of motivation and apperception as a prelude, the HOTS-oriented learning process gives teachers the opportunity for students to discover the concept of knowledge with the activities that students participate during the learning. This activity can encourage students to build creativity, think critically and solve problems so that students are expected to succeed in further learning. Not only limited to activity oriented, mathematics learning can also be oriented towards ICT and the problems that are given are open ended problems [4]. Learning activities are also not free from assessment. In HOTS-oriented learning, the teacher can measure students 'HOTS by conducting a written exam at the end as well as students' attitudes and skills during learning [6].

Teachers have an important role to increase students'HOTS. The implementation of HOTS in teaching and learning mathematics is very important to change the community's stigma on mathematical difficulties. Thus, researcher are interested in how the teacher manage the classroom to increase students'HOTS by observation and interview the teacher and students. Previous research by Hardi Tambunan [7] has focused the performance of mathematics teachers to build students' HOTS by asking the students without observed the learning in the class. By observation and discussion the teacher can know what needs to be

improved to achieve students' HOTS.

Method

The method used in this research is phenomenology with a qualitative approach. The subjects of this study was the mathematics teacher in Subang who had teach more 17 years and were involved 30 students. The teacher selected was the teacher had attended training on HOTS-oriented learning. The researcher observed the learning when the teacher had done in class during several meetings and then confirmed the findings in the classroom and also interview the students. The instrument used was adapted from various sources and was validated by experts. The results of the study will be presented descriptively which will then be made into discussions with expert opinions and relevan research.

Result and Discussion

The observation analyze every part of the learning in the class. All of part that could develop higher order thinking skills be delivered below.

Apperception and Motivation

The teacher apperception were by linking the lesson to the previous lesson, this is under Gagne's statement that learning activities will be effective when the teacher can connect new knowledge and skills with the lesson that students have learned before. The appropriate apperception can make the student feel relaxed and passionate in the learning process [8]. In addition, when students learn concepts, students will learn to associate one idea with another idea, so that here students think analytically [9]. The process of motivation by the teacher to students was also seen in observation. The teacher motivated students at the beginning of learning by telling the benefits of learning with daily life. High-level thinking was highly recommended to be integrated into the teaching of subjects by bringing students into a contextual learning atmosphere [10]. The students said by apperception and motivation they can learn how to apply thinking skills to solve problems in a particular context, it was in accordance with result of the study of Sumantri & Whardani [11] that motivation of the teacher can improve the achievement of the students.

Teachers comprehension and management of learning

One of the meetings in the observation showed the teacher was wrong in presenting the concept of the lesson provided. The teacher stated that the line is not always straight, but the line is curved like a latitude on the earth. The teacher's statement made students confused to face of further learning. After being confirmed in the interview, the teacher stated that he only wanted to make learning contextual so that she connected the lesson with the latitudes on earth that were not straight. He realized her mistake when one of the students stated that a line could be formed from one point. The teacher stated that she does not yet fully understand the geometry of Euclid and non-Euclid.

Franziska [12] stated learning in the classroom was influenced by the knowledge and skills of the teacher. All teachers, especially mathematics teachers must keep up to date with the latest information about mathematical knowledge to teach in class. In addition to professional knowledge in their fields, every mathematics teacher also needs knowledge of pedagogical content to help students develop and expand their level of understanding of basic mathematical knowledge [13].

The teacher conveyed learning material in classical discussion. According to the participant teacher, the division of groups to get a concept takes quite a long time and makes it must go around to each group explaining the same thing. Classical discussion is considered by the teacher as a solution while still involving students' activeness. Involving participants in learning in the form of questions raised by the teacher and involving students to give examples or do exercises to the front of the class on the board. In fact, according to Saragih, students should be given the opportunity to engage in discussion and be responsible for learning critical thinking [14].

Developing HOTS in learning

The role of the teacher in HOTS-oriented learning appeared in several activities. The teacher facilitates students' thought processes through a series of questions that are put forward as a stimulus so the students can think at a high level. Questions that were raised by teachers to stimulate students' thinking processes which related to real life. In accordance with the statement of Tambunan namely the problems offered in stimuli and questions are useful to trigger students to think in accordance with the knowledge and context presented [7]. However, due to lack of teacher knowledge about the essence of principles, it can prevent them from providing effective materials that can help students do higher thinking processes. Teacher persuasion activities by asking "why" and "how" questions serve as a stimulus for students to develop HOTS [15]. The questions can be open ended questions that have many correct answers [16]. By using open ended question problems student can achieve HOTS [17].

The process of analyzing and evaluating is seen through the learning facilities provided by the teacher in pairing the relationship between the two lines with the intersection points arising from the relations between the two lines. Students are required to analyze with the knowledge they have to analyze what are parallel lines, coincident lines, and cross lines. The process is a learning activity that directs students to solve problems. The work of students shows that almost no group can match with the right answer. One of the factors that influence is the teacher does not ask questions when students observe. The teacher gives questions after all the student presentations, even though this question is very suitable given during the analysis process so that students can think critically of the questions asked by the teacher and get more satisfying results. Mathematics thinking skills are important for students to solve problems in their learning process so as to foster students' competitive thinking skills, develop intellectual students and help avoid mistakes in thinking [18]

While the process of creating and thinking creatively occured when the students were directed to make a line to find out the line comparison by guided questions from the teacher. In this process, the teacher has corrected the mistakes made at the previous meeting so that in this process students think critically and think creatively even though they are not optimal. Creating should cause the formation of something new that has better quality. Activities that lead students to think critically in solving problems appear in every question asked by the teacher. These questions were strategies to motivate students to study gradually from the problem until finding a solution. These questions can be key factors in encouraging students to effectively gain a deep understanding of the lesson, a supportive understanding, not only of

application, analysis and evaluation, but also about facts [12]. A study conducted by Juandi and Tamur [19] stated that the teacher showed a lack of understanding of the requirements needed to teach critical thinking skills in the classroom. It was recommended that structured teaching methods are needed to assimilate both thinking skills and content in education [20]. Barak Miri [21] recommended learning that fosters students' thinking can be in the form of linking learning with real world cases; encourage open class discussion, and encourage inquiry-oriented experiments.

The communication and collaboration activities were not strong in learning. Activities that involved groups only occured at a few meetings, overall learning in the form of discussions and lectures. This discussion is marked by questions and answers conducted by teachers and students. Communication activities of students appeared, but most students present the results in a low voice and not yet confident, but this is not commented on by the teacher and directly invites the group to return to their seats. Communication should enable students to be able to exchange information or ideas according to their needs. Collaborative activities between students were minimal. This can be seen with the small number of students involved in the discussion. Though the previous study showed that the involvement of students in discussions while learning can build knowledge and use the knowledge they have so that demands high-level thinking [14, 15].

The interview results showed that the teacher felt more comfortable teaching in a classical way. According to him, learning with groups makes time wasted. The teacher must go around and ask the same questions. The teacher states that classical learning is felt to be effective enough to save time that can be used to maximize practice. Nevertheless the teacher also realizes that classical learning only leads to some students who are ready to be active in front of the class. The teacher said that the questions on the worksheet can be completed on the board interactively asking students to solve them or answer them without taking too much time. As for students who still do not have self-confidence it is quite difficult to make it active in front of the class. Thus learning through groups should be a solution to overcome this. Sa *et al*. [22] argued that group activities can enhance independent learning to develop HOTS among students.

The use of media and ICT

The use of ICT in learning can increase HOTS of students [23]. The use of ICT changed the processes of the learning environment into a new culture. ICT transform traditional education into a more interactive and attractive environment facilitating the transmission of authentic knowledge where students become producers of knowledge under guidance. Learning became more interactive when students were given the opportunity to use ICT as a complementary tool to promote their learning outcomes [20, 24]. However, the participant teacher still did not use ICT to the fullest, the teacher stated that the provision of advice from schools greatly influenced the provision of ICT media in schools. Participant teachers try to utilize existing media while still trying to make learning oriented towards higher-order thinking. The teacher also tried to balance with the available resources. The teacher asked students to use the book facilities in the library to be used in learning.

Teacher's Language and Personality

Learning was done by the teacher using spoken and written languages that seem to be understood by students. The teacher did not blame the students for wrong answers but told them with explanations. The teacher also had an empathetic attitude to students, it seem that during learning the teacher went around and asked students the difficulties in learning. The teacher had a friendly body gesture, neat and polite appearance and still has high spirits despite his teaching time reaching 17 years.

The interpersonal approach allows the teacher to help students progress without being frustrated. Teacher skills in choosing languages were easily understood by students can make the closeness of teachers with students formed. As Franziska et al believe [12] that the approach to students is very necessary to foster students' closeness with the teacher. Thus, it will reduce their opportunities to misbehave and violate school rules.

Reflection and Assessment

The closing activity began with the teacher inviting students to summarize the lessons learned. The teacher invites students to reflect on the stages of learning that have been carried out and filled with assessments at the end of learning. The process of reflection to discover the reasons why students choose or use certain methods or concepts in solving problems can develop students' HOTS abilities [15].

Affective and psychomotor assessments conducted by teachers in the form of assessments carried out during learning takes place. The teacher stated that the most important assessment was during learning. Affective assessment by participant teachers in the form of an assessment of the attitude of discipline, responsibility, and curiosity that students have. Assessment does not only improve students 'cognitive skills but also students' affective skills [25]. In this context, affective skills refer to several attitudes displayed by students towards their learning such as motivation and discipline. The cognitive abilities were performances that can be observed as the results of activities or processes of gaining knowledge through one's own experience [6]. Coginitive assessment is done by teachers giving written tests and oral tests. The teacher gives HOTS questions for students to work on. Although in the results, there are still many students who get small grades but the teacher acknowledges that there is an increase in grades in students [7].

Conclusion

The teachers has tried to implement HOTS-oriented learning even though some activities have not been maximized. This could be seen from the efforts of teachers who maximize the existing media to continue implementing HOTS-oriented learning. The process of critical thinking, creative thinking and problem solving were raised by providing stimulus and questions from the teacher. Teacher still often used discussion classically rather than small groups, thus minimizing collaboration and involving students in learning so it can affect the improvement of students' critical thinking and problem solving.

From the results of the study, the researcher recommends that teachers be able to make teacher associations for sharing knowledge in HOTS-oriented Mathematics learning.

Teachers can consult with other teachers who are more experienced to improve pedagogical competence or mathematical concepts given to students. Teachers can also exchange experiences related to creative learning that each teacher has. Whether it's in planning, implementing, or assessing. Mathematics teachers can also take part in seminars or webinars related to Mathematics teaching and learning to increase their knowledge. Mathematics teachers can maximize the ability of students by continuing to carry out HOTS-oriented learning. Teachers should not give up on implementing varied learning.

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References

1. Brookhart, How to assess higher-order thinking skills in your classroom. ASCD, 2010.
2. Afandi A, Sajidan S, Akhyar M, Suryani N. Pre-Service Science Teachers' Perception About High Order Thinking Skills (HOTS) in the 21st Century, Int. J. Pedagog. Teach. Educ. 2018; 2(1):p.107, doi: 10.20961/ijpte.v2i1.18254.
3. H Schulz, B FitzPatrick. Teachers' understandings of critical and higher order thinking and what this means for their teaching and assessments, Alberta J. Educ. Res. 2016; 62(1):61-86.
4. B Tanujaya, J Mumu, G Margono. The Relationship between Higher Order Thinking Skills and Academic Performance of Student in Mathematics Instruction, Int. Educ. Stud. 2017; 10(11):p. 78. doi: 10.5539/ies.v10n11p78.
5. SN Kane, A Mishra, AK Dutta. Preface: International Conference on Recent Trends in Physics (ICRTP 2016), J. Phys. Conf. Ser. 2016; 755:1, doi: 10.1088/1742-6596/755/1/011001.
6. H Setiadi. Pelaksanaan Penilaian Pada Kurikulum 2013," J. Penelit. dan Eval. Pendidik. 2016; 20(2):166. doi: 10.21831/pep.v20i2.7173.
7. H Tambunan, T Naibaho. Performance of mathematics teachers to build students' high order thinking skills (HOTS), J. Educ. Learn. 2019; 13(1):111, doi: 10.11591/edulearn.v13i1.11218.
8. LH Puteri, S Borneo. The Apperception Approach for Stimulating Student Learning Motivation. 2018; 2(1):7-12, doi: 10.33094/6.2017.2018.21.7.12.
9. A Madu. Higher Order Tingking Skills (HOTS) in Math Learning, IOSR J. Math. 2017; 13(5):70-75, doi: 10.9790/5728-1305027075.
10. H Tambunan. The Dominant Factor of Teacher ' s Role as A Motivator of Students ' Interest and Motivation in Mathematics Achievement. 2018; 11(4):144-151, doi: 10.5539/ies.v11n4p144.
11. MS Sumantri, PA Whardani. Relationship between Motivation to Achieve and Professional Competence in the Performance of Elementary School Teachers. 2017; 10(7):118-125, doi: 10.5539/ies.v10n7p118.
12. F Baier, A Decker, T Voss, T Kleickmann, U Klusmann, M Kunter. What makes a good teacher ? The relative importance of mathematics teachers' cognitive ability, personality, knowledge, beliefs , and motivation for instructional quality. 2018, doi: 10.1111/bjep.12256.
13. T Scheiner, MA Montes, JD Godino, J Carrillo, LR Pino-fan. What Makes Mathematics Teacher Knowledge Specialized ? Offering Alternative Views. 2017, doi: 10.1007/s10763-017-9859-6.
14. S Saragih, E Napitupulu. Developing Student-Centered Learning Model to Improve High Order Mathematical Thinking Ability. 2015; 8(6):104-112, doi: 10.5539/ies.v8n6p104.
15. H Retnawati, H Djidu, Kartianom, E Apino, RD Anazifa. Teachers' knowledge about higher-order thinking skills and its learning strategy, Probl. Educ. 21st Century. 2018; 76(2):215-230.
16. NSA Alhassora, MS Abu, AH Abdullah. Inculcating higher-order thinking skills in mathematics: Why is it so hard? Man India. 2017; 97(13):51-62.
17. R Ulinnuha, SB Waluya, R Rochmad. Creative Thinking Ability With Open-Ended Problems Based on Self-Efficacy in Gnomio Blended Learning. 2021; 10:1.
18. D Juandi M Tamur. Does Problem-Based Learning Enhance Students' Higher Order Thinking Skills in Mathematics Learning ? A Systematic Review and Meta-Analysis, 4th Int. Conf. Big Data Educ, 2021, 44-51.
19. M Tamur, U Katolik, I Santu. The impact of problem-based learning toward enhancing mathematical thinking : A meta-analysis study toward enhancing mathematical thinking: no, 2021.
20. MG Ganapathy, MKM Singh, S Kaur, LW Kit. Promoting higher order thinking skills via teaching practices," 3L Lang. Linguist. Lit. 2017; 23(1):75-85, doi: 10.17576/3L-2017-2301-06.
21. B Miri, BC David, Z Uri. Purposely teaching for the promotion of higher-order thinking skills: A case of critical thinking, Res. Sci. Educ. 2017; 37(4):353-369, doi: 10.1007/s11165-006-9029-2.
22. K Sa, A Muchyidin, N Izzati. Application of Collaborative Teamwork Learning Model and Guided Note Taking Model and Their Influence on Students' Ability to Understand Mathematical Concepts. 2022; 1(1):14-26.
23. NM Tajudin, M Puteh, M Adnan. Guiding Principles to Foster Higher Order thinking skills in teaching and learning of mathematics, Int. J. Eng. Technol. 2018; 7(4):195-199, doi: 10.14419/ijet.v7i4.15.21445.
24. AW Mcculloch, K Hollebrands, H Lee, T Harrison, A Mutlu. Factors that influence secondary mathematics teachers' integration of technology in mathematics lessons, Comput. Educ, 2018, doi: 10.1016/j.compedu.2018.04.008.
25. DRG Schraw. Assessment of higher order thinking skills, 2011.