

THE CONCEPT OF HOTS AND RELEVANT LEARNING MODEL

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Abstract - *It is a truism that the effective way to attain the educational objectives is by developing the students' thinking skills. School, for example, provides a large space whereby the teachers can undergo the teaching and learning process through its subjects, like mathematics. Learning mathematics not only requires the students to think critically, but also to comprise reasoning to derive conclusions that is called "Higher Order Thinking Skills (HOTS). This paper attempts to descriptively discuss the results from a theoretical study which aims to investigate the concept of HOTS and its relevant learning model in classroom implementation. Several articles and books related to the issues on what HOTS basically means and how it should be taught in the real classroom were studied. Teachers' awareness and perception about HOTS are essentially needed to select the relevant learning model in order to design learning activities in the classroom. The results of this study highlight that the inquiry-based learning, such as Discovery Learning, Inquiry Learning, Project Based-Learning and Problem Based-Learning can be implemented as a way to encourage the students to pose high-quality questions. Besides, the teachers need an authentic assessment that can provide an obvious image about the process of students' thinking and how the results of the evaluation can be valid and reliable.*

Keywords - *Higher Order Thinking Skills (HOTS); Learning model; Assessment; School Mathematics.*

I. INTRODUCTION

Quality human resource is a demand in the era of globalization and also a strain in the ASEAN Economic Community. A qualified human resource can be generated through well-organized education system. Education is one of the factors that affect the quality of human resources. The criteria of qualified human resources are to have critical, systematic, logical, creative thinking, and a willingness to cooperate effectively. All these criteria are expected to be improved through well-managed education. Improving the quality of education can be started from improving the quality of learning. Improving the quality of learning can be enrolled by preparing the appropriate learning objectives because without proper learning goals then the implementation of education will be meaningless. This is in line that education objectives serve as a guide for designing how the educational process should be implemented, and what outcomes are expected in the educational process [1,2].

The development of educational programs that focus on the development of thinking skills is one way that can be

acquired to achieve educational goals. Development of students' thinking skills can be pursued through learning at schools. One area of science that plays an important role in students' thinking ability is mathematics. Math is considered to encourage the development of students' thinking skills because mathematical concepts are structured hierarchically, structurally, logically, and systematically from the simplest to the most complex, requiring good mathematical thinking skills to overcome them. In addition, states that mathematics has great potential to provide the various abilities, and attitudes that are needed by humans so that he can live intelligently in his environment, and that he can manage the various things that exist in this world with the best [3,4].

Pointed out another important point is mathematics trains students' thinking and reasoning to draw conclusions, for example through investigation, exploration, experimentation, showing similarity, difference, consistency and inconsistency [2,5]. No wonder the ability to think mathematics is one of the benchmarks of achieving the goals of learning mathematics, especially high-order thinking skills (high order thinking skills), such as the ability to think critically, creatively, logically, analytically, and reflectively. If the goal of learning can be achieved then students can be born as human beings who have high quality in science so hopefully be ready to compete in the global arena.

HOTS is a skill does not only to remember, but also to understand and apply. HOTS in the cognitive domain (based on the latest Bloom Taxonomy) includes analysis, evaluation, and creation. So students are not just remembering a formula, then understand it and apply the formula to a problem. However, the student is able to analyze (solve the problem into several parts, then determine the parts that relate to each other and the whole), evaluate (assess which includes checking and criticizing), and creation (making something from the existing).

The explanation above reveals how important mathematics is in enhancing high-level thinking skills which ultimately can produce quality human beings who can compete globally. Therefore, high-level thinking skills (HOTS) should be one of the goals of mathematics learning in class. For this reason it is important for teachers to be able to implement learning that can support the emergence of this high-level thinking ability. This is in line with what was expressed by the states that the teaching of mathematics is now time to focus on thinking and reflection learning skills, interaction and development of specific thinking concepts [4].

II. DISCUSSION

Many studies are related to High Order Thinking (HOT). Bloom states that High Order Thinking (HOT) is an abstract ability that is in the cognitive domain that includes analysis, synthesis, and evaluation. Unlike Resnick that reveals that High Order Thinking (HOT) is a mental process, such as classification, induction, deduction, and reasoning. Another opinion was given by [6] who defined High Order Thinking (HOT) as a strategy with high-level thinking process, in which students are encouraged to provide new insights and implications by manipulating information and ideas in a particular way.

The concept of HOTS is presented in the discussion of cognitive domains, ie domains involving knowledge and thinking skills. Bloom (in Ramli) outlines the level of cognitive processes from the simplest to the most complex, known as the level of cognitive skills. Level categorization is arranged into 6 levels, namely knowledge, comprehension, application, analysis, synthesis, and evaluation. These levels were then revised by Bloom's students to be remembering, understanding, applying, analyzing, evaluating, and creating or known as codes C1 to C6. From the level of thinking ability can be seen that a student is said to achieve the highest thinking ability when he was able to create something based on the knowledge he has.

From some theories about High Order Thinking (HOT) above can be concluded that High Order Thinking (HOT) is a high-level thinking process that encourages students to search and explore information using the facts available effectively and appropriately to find the structure and its relationship as an effort to solve the problem. High-level thinking will be able to stimulate students to interpret, analyze previous information so it is not monotonous. This is in accordance with the opinion expressed by [6] that high-level thinking in mathematics requires not only the students to know the general patterns and principles of mathematics, but also that they are able to understand the relationship between these patterns and principles and apply that knowledge. This high-level thinking skill involves the right decision, content mastery, and conceptual understanding. Students use high-level thinking as they adjust initial understanding based on new evidence, identify patterns, create and test allegations, then propose and defend their opinions.

In fact, students' thinking ability in Indonesia is still low. This is in line with those disclosed that based on PISA results reported by the Organization for Economic Co-Operation and Development (OECD) [7]. Indonesia is in 64 ranks 65 countries (OECD 2012). This shows that most Indonesian students still have low ability, when viewed from the aspect of cognitive (knowing, apply, and reasoning). The suspected factor is that Indonesian students are not trained in solving contextual questions, which require intellectual activity, provide arguments and creativity in solving them. This is related to the characteristics of the PISA question which gives a HOTS estimate because the PISA questions require not only the ability to apply concepts, but rather to how they can be applied in various situations.

States that there are five points to consider in developing critical thinking skills: (1) determining learning objectives, (2) teaching through investigation, (3) practicing, (4) reviewing, improving and enhancing understanding, and (5) training feedback and assessing learning. All five of these things must be the attention of teachers to be able to uncover the ability to think high-level students [8].

Teachers are instrumental in exposing students' high-order thinking skills. Teachers should be able to devise questions that will require learners to think at a higher level so that students can solve problems. We recommend that the learning process in the classroom begins by stimulating students to think more actively by providing real problems that students have experienced or can be thought of the students. So students are accustomed to first solve problems based on his reasoning so that in such a way, the students are not immediately treated to theories and mathematical formulas that have been so. In conventional learning, teachers typically overwhelm their students with a lot of information that must be memorized and remembered by students, but to reveal Higher Order Thinking Skills (HOTS), teachers should teach children how to find sources of information, how to evaluate information obtained and how they can use information for themselves and for others.

Many studies have been done by teachers relating to the application of learning that is able to uncover HOTS conducted through Classroom Action Research (PTK), lesson study, or quasi experimental research. These studies are generally related to the teaching model (teaching strategy) that can reveal the ability to think high-level students and also the way of measurement (assessment) HOTS. Ramli explains that it takes carefulness in preparing the right learning design [9]. The designed learning design should be able to encourage students to be able to think high-level in the settlement of scientific cases it faces through a series of planned and systematic training processes. The biggest challenge for teachers is how to construct a learning design that can train students during learning to be able to do so. According to Ramli incorporating the method of discussion or practices in learning and combining it with a particular model may not necessarily train HOTS that is eternal if the instructional design is only compiled based on the syntax of the model, and not designed with a good learning structure. The states that based on published studies, inquiry-based learning models and cooperative learning models have been shown to train students' high-order thinking skills [1,9]. The application of inquiry learning models is recognized and proven in many researches powerful enough in training students for higher-order thinking. This is in line with that revealed by the states that other teaching techniques that many advocated by researchers to reveal students' high-order thinking ability is to make students learn in groups [10]. This is based on research conducted by [12] suggesting that students study in groups with project-based learning models. Goethals expanded their studies to research group co-operation among science, mathematics, and engineering lessons [10]. Chi Lun also studied cooperative work at high school and college level in mathematics lessons.

Findings show that people prefer to work in groups because they tend to gain a broader understanding of the material being studied [12]. This finding is not to show that students do not trust their teachers, but instead, students are more likely to ask questions of probing and exploring problems while learning among their peers. Looking at this it can be concluded that group work may be effective because students tend to challenge the ability to think with each other.

Christine Chin of the National Institute of Education Singapore in [9] states that a learning model that is able to encourage students to ask quality questions and also express quality responses is a learning model that can be used to train HOTS. The results of his research show that the ability to ask questions is a reflection of the students' level of thinking. The same study was conducted by [11] by applying four inquiry-based learning models, namely Discovery Learning, Inquiry Learning, Project Based Learning, and Problem Based Learning at a number of high schools in Solo. The students' thinking ability is measured by recording all the questions and statements that take place during the lesson, both presented by teachers and students. The results showed that all the models used proved able to encourage students to ask questions, and improve the quality of the questions. However, the level of questions asked by the student has not yet shown that the student has had HOTS, as it still revolves around C1, C2 and on conceptual and factual dimensions. Few students are able to reach HOTS.

In addition to teacher pedagogic skills, one of the most reliable teaching support is learning material. The material characteristics of HOTS are contextual material, real-world problems, localization, and follow the scientific mindset. Other studies have also revealed other difficulties faced by teachers in an effort to develop an authentic assessment that can clearly and clearly reflect the thinking process experienced by the learner, and how the results can be valid, reliable, reliable, and the data can be accessed quickly by parties who need it

Authentic assessment is a formidable challenge in HOTS assessment development research because it is difficult to see this thinking process significantly during the learning process. The studies that have been conducted so far in relation to the authentic assessment are recording the students' ability to ask questions and opinions during the learning process, and then transcribe, and analyze the quality of questions and opinions. However, this technique of course requires an agreement in translating students' questions and opinions into the HOTS measurement component. Authentic assessment of HOTS can actually also be viewed through written works or representations in the form of pictures, media, and other products made by students, but this is not enough if not followed by a description of the students' thinking process when composing the work. HOTS assessments that need to be developed are not only assessments that play a role to measure achievement levels of learners, but also assessments that will train students to think critically, and supplemented with feed backs that will inform learners about the weaknesses that need to be improved.

III. CONCLUSION

Quality of human resources is a demand in the era of globalization. The criteria of qualified human resources is are have critical, systematic, logical, creative thinking, and a willingness to cooperate effectively. Mathematics is considered to encourage the development of thinking ability. Mathematics is also able to train thinking and reasoning in drawing conclusions. This makes the ability of mathematical thinking to be one of the benchmarks to achieve the goals of learning mathematics, especially high-order thinking skills (high order thinking skills), such as the ability to think critically, creatively, logically, analytically, and reflectively.

High Order Thinking (HOT) is a high-level thinking process that encourages students to search for and explore information using the facts available effectively and appropriately to find the structure and its relationships in an effort to solve the problem. In fact, students' level of thinking ability in Indonesia is still low. This is because among other things because the learning model that is commonly implemented by teachers in the class is considered not able to facilitate this thinking ability. The results of the study suggest that effective learning model is enrolled to facilitate students' high-order thinking includes a discovery-based learning (inquiry) as well as learning that applies group discussion.

Many teachers who have not yet applied learning-based models of discovery or learning with cooperative models are generally caused by a lack of teacher knowledge about the learning model. In addition, teachers are also less able to create contextual problems, real-world problems, localization, and follow the mindset of scientists. Another obstacle is that teachers are not skilled in making an authentic trial to measure students' high-order thinking skills. Therefore, the thing that also needs to be done is to train educators as the party who will trill this ability, through the development of teacher competence.

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