Urgency of Higher Order Thinking Skills (HOTS) Content Analysis in Mathematics Textbook

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Abstract. Higher Order Thinking Skills (HOTS) is a skill demanded in 21st century. HOTS is trained in mathematics learning which one of its execution uses teaching materials such as textbook. This article aims to describe the urgency of HOTS content analysis in mathematics textbook. The results of literature review show that HOTS is one of the main goals in education and become one of the top five variables that can improve student achievement. HOTS can be developed but cannot be automated and requires practice. Textbook is one of the learning media that can be used in training HOTS because the textbook is the main learning media for teachers and students. Teacher's decisions in selecting teaching materials and strategies are also directly influenced by textbook used by teachers. Some studies even mentioned that there is a strong relationship between textbook used with student achievement. Thus, it can be said that the more HOTS content in a textbook, the greater the probability of HOTS to be trained and taught to the students. Therefore, a mathematical textbook analysis is needed to find out how the HOTS content in textbook is used by teachers and students.

1. Introduction
Mathematics is a branch of science that is widely used in various fields to solve many problems [1]. Mathematics is also an universal language so that the mathematical ability of students in a country can be compared with other countries. In addition, mathematics is also used as a measuring tool to determine the progress of education in a country. PISA (Program for International Student Assessment) and TIMSS (The International Mathematics and Science Survey) are examples of international benchmarking that periodically measure and compare the progress of mathematics education in some countries. PISA focuses on assessing students’ mathematical performance on the ability to solve mathematical problems about daily life [2]. While TIMSS can give important information about factors that influence student achievement such as student background, student attitudes toward subjects, teachers and class characteristics [3]. So that the results of TIMSS can help the government in determining the education policy [3].

The learning process in PISA high-ranking countries focuses on highlevel reasoning, so that it shifts the learning process in which the mastery of matter and practice questions is dominated by memorization for exam preparation or exam execution[4]. In Indonesia, the learning process is guided by the curriculum2013 which is currently being implemented in Indonesia. The curriculum 2013 implemented in Indonesia aims to improve the quality of human resources and the nation's competitiveness because the rapid development of knowledge, technology and language [5]. This curriculum has been applied in Indonesia since July 2013 [5]. The curriculum 2013 is expected to
produce productive, creative and innovative human resources through attitude (spiritual and social) competencies, knowledge competencies and skills competencies [5].

According to Permendikbud Number 81A of 2013, the curriculum 2013 has a basic view that knowledge can not be transferred from teacher to student because students are subjects who have the ability to actively seek, process, construct and use knowledge. Some of the principles of learning used in the curriculum 2013 according to Permendikbud Number 22 of 2016 are as follows: (a) from students are told to the students to find out; (b) from the teacher as the only source of learning to learn by using many sources of learning; (c) from partial learning to integrated learning; (d) from learning that emphasizes a single answer to learning with multi-dimensional truth answers; (e) from learning of verbalism to applicative skills; (f) improvement and balance between physical skills (hardskills) and mental skills (softskills); (g) utilization of information and communication technology to improve the efficiency and effectiveness of learning. This means that the learning principle desired by the 2013 curriculum is that teachers facilitate students to develop their skills and capacities in finding and linking concepts, known as student-centered learning approaches [6].

The learning process, according to the curriculum 2013 standar process as listed in Permendikbud Number 22 of 2016 consists of planning, implementation and assessment. Learning planning includes preparation of learning implementation plan, media and learning resource, learning assessment tool and learning scenario. While learning implementation includes preliminary activities, core and cover that is adapted to the learning principles of curriculum 2013. Then, learning assessment serves to see how students achievement in certain subjects such as mathematics [7].

Textbook as a source of learning is important to note when planning and implementing learning. This is because the textbook describes the minimal effort that must be done by students and teachers to improve the efficiency and effectiveness of learning. The curriculum 2013 has been through several revisions to improve the quality of education. The curriculum 2013 revision in 2017 mentions that the curriculum 2013 integrates four things and one of them is integrating Higher Order Thinking Skill (HOTS) in the learning process. This article discusses the HOTS, textbook, and urgency of HOTS content analysis in mathematic textbook.

2. Higher Order Thinking Skills (HOTS)

HOTS is difficult to define but easily recognizable when it is encountered [8]. Thomas & Thorne declared that higher order thinking is thinking at a higher level than simply remembering facts or retelling something heard to others [9]. Thomas & Thorne stated that higher order thinking requires a person to do something about the fact, that is understanding it, concluding it, linking it to facts in new ways and applying it to find solutions to problems [9]. Higher order thinking occurs when students gain new knowledge and store it in memory, then this knowledge correlates with prior knowledge to achieve a particular goal [10]. In other words, HOTS occurs when a person gets new information, holds it, organizes and associates it with existing knowledge and then passes that information to reach a particular object or solution of a problem [11]. At higher order thinking, students will tend to use logic rather than simply remember and memorize formulas, so students will master the concepts and can solve more complex mathematics problems [12].

The characteristics of HOTS are [8]: (a) non-algorithmic, meaning that action steps can not be fully determined at the beginning; (b) complex, meaning that the steps can not be seen or guessed directly from a particular point of view; (c) produce many solutions; (d) involve dissent or interpretation; (e) involves the application of multiple criteria; (e) involves uncertainty; (f) demanding independence in the thinking process; (g) involves impressive meanings; (h) requires hard work (effortfull). The characteristics of tasks that require HOTS are [6]: (a) not routine (not known before); (b) complex; (c) produce many solutions or points of view; (d) involves uncertainty; (e) involves the process of making meaning; (f) assessed effort and requires mental work. So, we can conclude that the characteristics of tasks that require HOTS are: (a) the steps to solve them are not directly predictable and can not be determined completely at the beginning; (b) not a routine; (c) there are many solutions; (d) requires hard effort.
HOTS deals with the thinking skills that individuals can do. The thinking skills that can be categorized as HOTS according to F.J. King are critical thinking skills, logical thinking, reflective thinking, metacognitive and creative thinking [13]. This is supported by Yen et al who says that the thinking skills that can be categorized as HOTS are critical thinking skills, creative thinking, problem solving, conclusions and metacognitive [14]. Likewise expressed by Conklin who said that the characteristics of HOTS include the ability to think critically and creatively [15]. This is in line with Hassan et al who says that HOTS is a major component of creative and critical thinking ability and is the highest level of cognitive process level [11]. Thus, we can take the slice that the thinking skills categorized as HOTS are critical thinking and creative thinking.

HOTS is also associated with the cognitive level of Bloom's Taxonomy. The cognitive levels according to Bloom's Taxonomy from the lowest to the highest are knowledge, comprehension, application, analysis, synthesis, and evaluation [16]. While the cognitive levels according to Bloom's Revised Taxonomy are remembering, understanding, applying, analyzing, evaluating, and creating [16]. The difference in Bloom's Revised Taxonomy with Bloom's Taxonomy before is that evaluation is no longer at the highest level, but creating. Previously, creating was known as synthesis. Another change is the name of the category on taxonomy is no longer a noun, but a verb. For example, knowledge becomes remembering, comprehension becomes understanding and application becomes applying. Thus, Bloom's Revised Taxonomy illustrates the student's thinking process rather than behavior [16]. The cognitive levels of Bloom's Taxonomy belonging to the HOTS category according to experts are:

| Yen          | Abosalem | Thompson | Fisher | Anderson & Krathwohl |
|--------------|----------|----------|--------|----------------------|
| Application  | Application         |          |        |                      |
| Analysis     | Analysis           | Analysis | Analysis | Analyzing            |
| Synthesis    | Synthesis          | Synthesis | Synthesis | Evaluating       |
| Evaluation   | Evaluation         | Evaluation | Evaluation | Creating |

At the application level, students solve problems by directly applying the information or knowledge they have known. At the analysis level, students need to have the ability to break a whole into parts and determine how the parts are connected to one another to become a whole. The level of synthesis is also called creative behavior because students are said to be able to create if they can create new products by overhauling some elements or parts to a form or structure that the teacher has never explained before. Based on the previous explanation, synthesis is called creating. At the evaluation level, students need to have the ability to make judgments based on certain criteria and standards [16].

In this article, Bloom's taxonomy level used is the level of Bloom's Revised Taxonomy and which belongs to HOTS is analyzing, evaluating, and creating. Applying not included HOTS because HOTS asks students to analyze, categorize, manipulate, and create new ways creatively to solve a problem, not merely memorize facts or concepts and then apply them [17].

Figure 1. HOTS at Bloom's Taxonomy Level
Figure 1. HOTS at Bloom's Taxonomy Level.

If re-linked between the characteristics of thinking ability and cognitive level in HOTS, then analyzing and evaluating is part of critical thinking because the definition of critical thinking is the process of doing evidence based judgment, analyzing arguments, recognizing gaps, and draw a conclusion based on evidence. While creating is part of creative thinking because creative thinking is a process to produce new products or ideas.

Besides cognitive processes, HOTS can also be viewed from the dimensions of knowledge. Four categories of knowledge arranged from the most concrete to the most abstract. They are:

- Factual knowledge. Factual knowledge includes basic elements such as knowledge of terminology or definitions, labels, symbols, notations, or symbols [9].
- Conceptual knowledge. Conceptual knowledge is knowledge of categories, classifications, principles, generalizations, theories, models, or structures related to a particular discipline field [9].
- Procedural knowledge. Procedural knowledge includes knowledge about how to do things using certain algorithms, practicing certain methods to solve problems and choosing the right procedure based on certain criteria [9].
- Metacognitive knowledge. Metacognitive knowledge consists of three, they are knowledge about strategy, tasks and self. Strategy metacognitive knowledge is related to knowledge of strategies for learning, strategies for thinking and strategies for problem solving. Tasks metacognitive knowledge is related to use learning strategies, thinking and problem solving in the right conditions and context. Self metacognitive knowledge is related to self strengths and weaknesses. In other words, metacognitive knowledge can be characterized by the knowledge to reflect on the learning process that has been passed [9].

The level of factual knowledge in the knowledge dimension does not include part of HOTS [9]. This is because the use of the term, symbol, symbol or notation is not an indicator of HOTS. Thus, HOTS when viewed from the dimension of knowledge includes conceptual, procedural, and metacognitive knowledge.

Thus, HOTS when viewed from several dimensions is as follows:

| HOTS Task Character | HOTS from Thinking Ability Dimension | HOTS from Cognitive Level | HOTS from Knowledge Level |
|---------------------|-------------------------------------|--------------------------|--------------------------|
| The steps are not directly predictable | Critical Thinking | Analyzing | Conceptual |
| Not a routine | Creative Thinking | Evaluating | Procedural |
| There are many solutions | Applying | Creating | Metacognitive |
| Requires hard effort | Evaluating | |

Table 2. HOTS is reviewed from Task Character and Multiple Dimensions.
HOTS can be trained in the learning process [9]. Problem-based learning is one of learning process related to HOTS and it can produce and improve HOTS [18][19]. This is in line with Abdullah's finding that problem solving is an activity that can generate HOTS among students [20]. Likewise with research conducted by Setiawan, Sugianto and Junaedi who got the conclusion that the Problem Based Learning model can improve HOTS [21]. Thus, should problem-based learning is often applied in the learning process in the classroom in order to improve HOTS.

3. Textbook
In the process of learning, textbook is an important component. Textbook according to Permendiknas Number 2 of 2008 is a compulsory reference book for use in elementary and secondary education units or colleges that contain learning materials in order to improve faith, piety, noble character and personality, mastery of science and technology, enhanced sensitivity and aesthetic ability, improved kinesthetic and healthcare capabilities compiled based on national education standards. Textbook may also mean school book containing selected material about field particular study in written form and qualified for teaching and learning activities and systematically arranged for assimilation [22]. While Prastowo, interpreting textbook as a book containing science derived from the basic competencies in the curriculum and used by students to learn [23].

The purpose of textbook lessons include[23]: (a) facilitate the educator in delivering the subject matter; (b) allowing students to repeat lessons at home or learn new lessons; (c) providing learning materials of interest to students. A good textbook is a welltested textbook. A welltested textbook can be seen based on four criteria, they are[24]: (a) criteria related to competence; (b) criteria related to material; (c) criteria related to the approach; and (d) criteria relating to the assessment. The advantages of textbook include [23]: (a) textbook to help educators implement curriculum; (b) textbook are also guidelines in determining teaching methods; (c) textbook provide opportunities for students to repeat lessons or learn new lessons; (d) the textbook may be used for subsequent years, and if revised, it can survive for a long time; (e) a uniform textbook gives similarity to materials and learning standards; (f) textbook provide continuity of lessons in successive classes, even if educators change; and (g) textbook provide more solid knowledge and teaching methods if teachers use them year after year. This illustrates that textbook are important in a learning process.

4. Urgency HOTS Content Analysis in Mathematics Textbook
HOTS is a important thing and now becomes a concern in the field of education. Partnership for 21st Century Skills (P21) formulates the skills needed in the 21st Century, they are critical and creative thinking [25]. This critical and creative thinking skill is the scope of higher order thinking skills [9]. According to P21, these skills can help students succeed in their future careers [25]. In addition, HOTS also has become a major goal of education [10] and is one of the top five variables that can improve student achievement [26]. Coupled with the statement of most teachers who agree that teaching HOTS is important, especially to guide students’ ideas [8]. This HOTS is also relevant to global economic growth, the development of information and communication technology (ICT), knowledge-based economy, fast-paced world development and in fact HOTS is indispensable to every individual in the educational environment [8]. HOTS also influences student achievement. The results of study showed that there was a positive correlation between higher order thinking skills and learning achievement [27].

HOTS is needed by students because the problems they face in real world are complex, unstructured, complicated, new and require more thinking skills than just applying what has been learned [28]. In mathematics learning itself, HOTS is one of the most important skills to be developed [29] and indispensable because the subjects of mathematics will equip students with the ability to think logically, analytically, systematically, critically, creatively and the ability to work together [30]. In addition, the real problem that is not routine in learning mathematics requires the ability to think critically and creatively or in other words requires HOTS’s students [30]. Therefore, the process of learning, especially on learning mathematics should be attempted so that students achieve HOTS. This
is due to the discovery that HOTS can be taught and trained in the learning process [26]. However, HOTS cannot be directly taught [31]. HOTS can be developed through learning activities that support HOTS such as active learning and student-centered learning [31]. The development of higher order thinking skills of students will produce student skills in problem solving strategies to be good, students' confidence level in mathematics increases and student achievement on non-routine problems that require higher order thinking skills increase too [12].

The problem is, the teacher's understanding and knowledge about HOTS is still lacking [31], even there are high school teachers who are not familiar with the term HOTS [29]. They are still confused about HOTS's teaching strategies and methods [31]. In addition, the ability of teachers in developing HOTS assessment instruments is also lacking and the availability of instruments specifically designed to train HOTS has not been much [32]. Thus, most teachers have not emphasized the importance of HOTS in the learning process especially in learning mathematics and have not implemented HOTS-oriented learning [28]. In relation to the use of learning media, teachers use only learning media that tend to contain material summaries and a collection of routine questions that are not oriented to HOTS characters [33]. As a result, students' thinking skills have not been directed to higher order thinking skills [33] and are poorly trained in solving problems that measure HOTS [32]. This also caused Indonesian students difficulties in solving HOTS problems [34]. Thus, HOTS Indonesian students are still at a low stage [28] [35]. In order for HOTS students to develop well, students need to be familiarized with the activities that train HOTS itself [32]. One of the things that can familiarize students with HOTS activities is the textbook used in the learning process in the classroom.

Textbook is one of the important components in the learning process, including in mathematics learning. Although textbooks describe the minimal effort that teachers and students should undertake in the learning process, textbook has significant role, including in developing HOTS. Mathematics textbook used by teachers and students at school is not the only sources that teachers and students can use to learn or practice HOTS. Teachers and students can use other sources such as sources from trusted internet or even their own teachers who develop task based HOTS. However, mathematics textbook used in schools reflect what students learn. In other words, textbook represent the actual process of teaching and learning [2]. This is as mentioned by Permendiknas Number 11 of 2005 which says that the textbook is used as a mandatory reference by teachers and students in the learning process. Likewise with Permendikbud Number 8 of 2016 which states that the textbook used by the unit of education, whether in the form of textbook and non-textbook is a means of learning process for teachers and students. Compared with the curriculum, textbook has an important role in the learning process. Teacher decisions in selecting teaching materials and strategies are directly influenced by textbook used by teachers. Some studies even mention that there is a strong relationship between textbook used with student achievement [36]. Thus, it can be said that the more HOTS content in a textbook lesson, the greater the opportunity for HOTS to be trained and taught to the students. Therefore, HOTS content analysis of mathematics textbook used by teachers and students in schools is required.

The theoretical benefit of HOTS content analysis in mathematics textbook is to add insight in the field of education, especially about teaching materials. In addition, HOTS content analysis in this mathematics textbook can also inspire other similar or different studies. While the practical benefits of HOTS content analysis on this mathematical textbook are as follows.

- For the Government. HOTS content analysis in mathematics textbook can be an evaluation material to pay more attention to the HOTS content in textbook that are currently the main objective in education. This can be a reference to the publication of the next textbook.
- For the Teacher. This can be a consideration for teachers in using textbook in the learning process. Teachers can scan the weakness and strength of textbook that they will use so they can prepare the lessons well.

The development of HOTS in the learning process will have many benefits for students. These benefits include student proficiency in problem-solving strategies to be good, students' level of
confidence in mathematics increases, and student learning achievement on non-routine issues that
demand HOTS increases [37].

5. Conclusion
Today, higher order thinking skills (HOTS) is needed by students. Students are not only required to
apply what they have learned, but also to analyze, evaluate, and synthesize the knowledge they have
gained to solve problems in everyday life. Thus, HOTS needs to be trained and taught to students one
of them through textbook on learning mathematics. Therefore, it is necessary to analyze the HOTS
content in mathematics textbook to find out how HOTS opportunities are given by mathematics
textbook.

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