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# Factors Affecting Teachers in Collecting HOTS Questions: A Description Analysis

*Abstract*

*In the hierarchy of cognitive processes, Higher Order Thinking Skills (HOTS) is the highest level that requires high-level creative thinking and action which includes the ability to analyze, evaluate, and create. The purpose of this study was to identify the factors that affect the ability of teachers in preparing HOTS-based assessments. This study uses a descriptive or exploratory approach with a qualitative descriptive strategy involving 28 high school mathematics teachers in the provinces of Bali, NTB, and NTT. Research data were collected through in-depth interviews, questionnaires, and documentation analysis. The results showed that in general the teacher's ability in compiling HOTS-based assessments was in a fairlygood category with a percentage of 48.90. The indicator of understanding the HOTS concept is in the good category with a percentage of 72.14%; indicator of completeness of references related to digital literacy with a percentage of 35.71%; 72 in the low category the indicator of developing a HOTS assessment related to motivation has a percentage of 34.82%; and the indicator of modifying the content for HOTS questions related to creativity has a percentage of 17.86%. It is recommended that intensive training be carried out for teachers, especially high school mathematics teachers in preparing HOTS-based assessments.*

*Keywords:* HOTS, Creativity, Digital Literacy, Motivation.

## Introduction

The results of the World Economic Forum provide an overview of the ten key skills most needed in the industrial revolution era (RI) 4.0, which include: complex problem solving, critical thinking, creativity, people management, coordinating with others, emotional intelligence, judgment and decision-making, service orientation, judgment and decision making, and active listening (WEF, 2020b). To achieve these skills, 21st century competencies are needed, namely: creativity and innovation, creativity and innovation, communication, collaboration (Ross, Changhee & Matthew, 2020). At the primary and secondary education levels, 21st century competencies can be developed through learning activities and assessments in schools. In the assessment, an assessment model is needed that can measure higher order thinking skills (Brookhart, 2010).

Higher order thinking skills (HOTS) are abilities that are very important for one's future success (Ramirez & Bell, 1994). The HOTS concept is something that has become very popular in recent years, because this skill distinguishes thinking skills obtained from low-level learning outcomes in the form of memorization. Thus, HOTS requires students to go beyond simply memorizing facts. Experts sort high-level and low-level thinking skills based on Bloom's taxonomy. Starting from the "lower end", remembering, understanding, applying (Anderson & Krathwohl, 2001; Mogan, 1996) as low-level thinking skills (LOTS), as well as "top end", analyzing, evaluating, creating (Anderson & Krathwohl, 2001) as higher order thinking skills

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(HOTS). Brookhart (2010) reveals HOTS is the ability to analyze, evaluate, create, logical reasoning, critical thinking, problem solving, and creativity and creative thinking.

Sternberg (1995) states that HOT consists of three components, namely: meta components; performance components; and the knowledge acquisition component. Madhuri & Goteti (2012) describes several components of HOTS: performance component (achievement of new analytical skills), planning, decision making, integration of knowledge application and analysis, as well as evaluation, planning and execution. Furthermore, Watson (2019) said that HOTS includes synthesis, analysis, reasoning, understanding, application, and evaluation. There have been many analyzes of teacher assessments in the last few decades. However, most of the assessments made by teachers are still limited to the memory stage, namely recalling the knowledge that has been learned (Kelly, 2020). This is done because writing questions to measure memory is very easy to make (Brookhart, 2010). Thus HOTS can be interpreted as the highest cognitive level that requires high-level creative thinking and action which includes the ability to analyze, evaluate, and create. HOTS questions have the following characteristics: measuring higher-order thinking skills, oriented to contextual problems, and using various forms of questions.

In the hierarchy of cognitive processes, HOTS is the highest level that requires high-level creative thinking and action. HOTS is the most fundamental tool in reasoning (Grossen, 1991). When asked how often teachers assess HOTS, they answered very often (McMillan, 2001; McMillan, Myron, & Workman, 2002; Mahendra, et. al., 2020). This indicates that teachers strongly believe that they have assessed students' HOTS, when in fact they have not (Brookhart, 2010). The technique for developing HOTS is to focus on students' cognitive activities (Yoad et al., 2009), such as: comparing, analyzing, synthesizing, making assumptions, asking questions, and reasoning (Gil-Glazer, Walter, & Eilam, 2009). 2019). In Indonesia, learning strategies to improve students' higher-order thinking skills have been widely carried out, and have even become a 2013 curriculum policy (Subadar, 2017), but they still rarely provide training to teachers to be able to compile HOTS-based assessments (Jin & Boling, 2010).

Implementing and developing a HOTS-based assessment is not as easy as one might think. The results showed that only 5.4% of the teacher-made formative questions were classified as HOTS (Pratiwi, Dewi, and Paramartha, 2019) and only 2% of the summative questions were classified as HOTS (Mahendra, et al., 2020) which was dominated by the cognitive level of analyzing (C4). The two studies did not explain in detail the factors that influence the low ability of teachers in preparing HOTS questions. It takes understanding, creativity, motivation, and teacher literacy in developing the HOTS assessment. For this reason, this study attempts to describe the obstacles and challenges faced by high school mathematics teachers in developing the HOTS assessment including the factors that influence it.

## Research Methods

This study uses a descriptive or exploratory approach (Joseph, at al., 2019) with a qualitative descriptive strategy that has multiple facts and includes various data collection procedures (Long, 1982). The data generated is in the form of written and spoken words that can be understood by the reader (Bogdan & Taylor, 1975). This preliminary study aims to find out the factors that affect the ability of high school mathematics teachers in preparing HOTS-based assessments. The results of this study will provide information as a basis for further research which can later determine the constellation of variables that affect the ability of high school mathematics teachers in compiling HOTS-based assessments. This research was conducted on high school mathematics teachers in the provinces of Bali, NTB, and NTT. The province of Bali was represented by 10 public schools, and NTB and NTT were represented by 9 schools each. One school was represented by a mathematics teacher, so the number of teachers involved in this study was 28 people. The data collected in the form of: 1) the ability score of high school mathematics teachers in compiling HOTS, 2) the factors that influence teachers in preparing HOTS questions, and 3) the percentage of HOTS questions prepared by the teacher.

Data were collected using questionnaires, interviews, and documentation methods. To collect data on the ability of teachers to make HOTS questions using a questionnaire developed by researchers with 4 sub indicators with 13 statements. This questionnaire had previously been validated by two research and measurement experts and the coefficient of its content validity was calculated using the formula from Gregory (Mahendra, 2020).

| Evaluator I | | Evaluator II | |
|---|---|---|---|
| Very Relevant (score 3-4) | Less Relevant (score 1-2) | Very Relevant (score 3-4) | Less Relevant (score 1-2) |
| 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13 | 0 | 1, 2, 3, 4, 5, 6, 8, 9, 10, 11, 12, 13 | 7 |

From table above, it can be seen that evaluator I said that all components of the statement were very relevant, while evaluator II said that the components of item 7 were less relevant and needed to be revised.

So, the validity coefficient is

$$VI/VK = \frac{D}{A + B + C + D}$$

12/(12+0+1+0) = 12/13 = 0,923.

For the percentage of the average quality of teacher answers on each indicator, the following guidelines are used.

| No | Range (%) | Criteria |
|---|---|---|
| 1 | 81 - 100 | Very Good |
| 2 | 61 - 80 | Good |
| 3 | 41 - 60 | Moderate |
| 4 | 21 - 40 | Poor |
| 5 | 00 - 20 | Very Poor |

In-depth interviews were conducted to find out the factors that hinder teachers in compiling HOTS questions. The data obtained is used to support the teacher's understanding of the HOTS data, while the documentation method is used to collect data about the questions made by the teacher whether in the HOTS category or not. The data were analyzed by comparing the revised Bloom's Taxonomy (Anderson & Krathwohl, 2001) with the questions made by the teacher. The simplest step is to compare the operational verbs used. Verbs from Bloom's taxonomy can be used to design assessments, curricula, lesson planning, personalization, and differentiation of learning, and almost anything else a teacher or student has to do. Determination of the criteria for HOTS questions begins with the data reduction stage, data presentation, and ends with drawing conclusions (Miles, Huberman & Saldana, 2014). To check the validity of the data, a triangulation method was used (Moleong, 2011). Meanwhile, the instrument for analyzing the HOTS questions was modified from Widana (2017).

**Research Results and Discussion**

The subjects in this study were 28 high school mathematics teachers in Bali Province. The selection of research subjects was carried out randomly, with the consideration that each district was represented by three schools and each school was represented by at least one teacher. The results of interviews generally found that the obstacles faced by teachers in developing the HOTS assessment were the lack of socialization activities, time constraints, socialization in seminar activities that were not maximized, and the lack of supervision from schools and the education office. Barriers are a challenge for teachers to teach something they do not fully understand. Meanwhile, data on teachers' understanding scores on HOTS were collected using a questionnaire on the Guttman scale (Engelhard, 2008) with alternative answers of "yes" and "no". In the following, the data from the questionnaire analysis of teachers' understanding of HOTS is presented.

*Table 1.*

*Recapitulation of Teacher Understanding Scores about HOTS*

| Indicator | Sub Indicator | Component | Response | |
|---|---|---|---|---|
| | | | Yes | No |
| Composing HOTS questions | The concept and nature of HOTS | understanding the concept of LOTS and HOTS | 85,71% | 14,29% |
| | | knowledge of the characteristics of HOTS questions | 78,57% | 21,43% |
| | | knowledge of cognitive level from Bloom (revised) | 71,43% | 28,57% |
| | | knowledge of operational verbs | 60,71% | 39,29% |
| | | knowledge of the steps of compiling HOTS | 64,29% | 35,71% |
| | Reference equipment | completeness of the guidebook or module for the preparation of HOTS questions | 32.14% | 67.86% |
| | | strategies for finding supporting materials on the internet | 46.43% | 53.57% |
| | | The questions used are from the internet | 39.29% | 60.71% |
| | Compiling and developing HOTS | looking for information on how to compose HOTS questions | 42,86% | 57,14% |
| | | integrate HOTS assessment in learning tools | 39,29% | 60,71% |
| | | trying to arrange HOTS questions independently | 25,00% | 75,00% |
| | | collaborate with colleagues to compose HOTS | 32,14% | 67,86% |
| | Modify content | modify the content of math material to compose HOTS questions | 17,86% | 82,14% |
| **Average** | | | **48.90%** | **51.10%** |

The teacher's ability questionnaire in preparing HOTS questions has four sub-indicators. Each of the sub-indicators are factors that are considered to have an effect on the ability of teachers to prepare HOTS questions, namely: competence, motivation, creativity, and digital literacy (Murdikah, 2020). Batubara (2019) found the low creativity of teachers in teaching, including conducting learning assessments. In general, the teacher's ability to construct HOTS questions with an average of 48.90% is quite good.

Sub indicator 1 (the concept and nature of HOTS) has the largest average of 72.14% which is classified as good. This finding is in line with the research results of Rapih & Sutaryadi (2018) that teachers have understood the concept of HOTS and even found the results of up to 91.43%. The sub-indicators of completeness of references as well as the ability to compose and develop HOTS with an average percentage of 35.71% and 34.82%, respectively, are classified as lacking. While the sub-indicator of modifying the content for the HOTS questions has the lowest average of 17.86% which is classified as very poor. The results of this analysis show that teachers have understood the concept of HOTS assessment. Some components (sub-indicators) actually show the lack and weakness of the teacher's ability to construct HOTS questions. Conceptually, teachers understand HOTS, but are weak in practice and implementation. To clarify the data obtained through filling out the questionnaire, an in-depth interview with the teacher was conducted. From the results of the interviews, it was obtained an overview of the inhibiting factors in compiling HOTS questions, such as: not being used to writing HOTS questions, lack of training and workshops carried out by schools and the government, limited guidebooks or modules, rarely collaborating with colleagues, I guess. Motivation to design material content into HOTS questions, including teachers have not been able to create effective learning to grow HOTS (Mufit & Wrahatnolo, 2020).

Sub-indicator 2 is a description of teachers' digital literacy in relation to searching for relevant sources on the internet. Gilster (1977) defines digital literacy as the ability to understand and use information in various forms from a very wide variety of sources that are accessed through computer devices. Digital literacy requires cognitive and technical skills in using information and communication technology to find, understand, evaluate, create, and communicate digital information (American Library Association, 2013). The Indonesian government is very concerned with the use of technology by teachers in learning and is an important part of developing teacher competence. This can be seen from Permendiknas No. 16 of 2007 and Law No. 14 of 2005 on Teachers and Lecturers which explain that a teacher must utilize information and communication technology (ICT) in learning as one of the pedagogic competencies. These two regulations indicate the importance of a teacher having digital literacy.

The interview results show that teachers are still lazy to find reliable sources of information related to HOTS. The teacher does not want to "pick up the ball", it is better to wait for instructions from the superior, this is done because of the many other administrative burdens that the teacher has to do. Weak teacher digital literacy is caused by several factors, such as after the teacher is old, lack of time to study, and low self-confidence (Landa, Sunaryo, & Tampubolon, 2021). This condition is one of the obstacles in finding sources related to HOTS in cyberspace. In fact, various digital teaching resources which are termed as e-resources are available in abundance on the internet. Teachers lack strategies and techniques in exploring sources of information related to HOTS, in the sense that they do not have adequate literacy (Diputra, Tristiantari, & Jayanta, 2020). So that the information obtained is not in accordance with the needs and cannot be accounted for. The JISC Digital Capabilities Framework outlines five elements of digital literacy, namely: information, data, and media literacy; literacy of digital creation, problem solving, and innovation; digital learning literacy and development; digital communication literacy, collaboration, and participation; and digital identity literacy and well-being (Johnston, 2020).

Sub-indicator 3 is related to teacher motivation in preparing HOTS questions. An average of 34.82% indicates that teacher motivation in preparing HOTS questions is still low. This is in accordance with the research by Handayani & Amirullah (2019) which shows that the teacher's self-motivation is still weak in compiling lesson plan K13 based on 4C, literacy, and HOTS. This happens because teachers' understanding of the HOTS-based learning evaluation system is still very lacking (Maryani & Martaningsi, 2020). Motivation is considered as energy or drive to do something naturally (Han & Yin, 2016). This energy includes reasons for doing something, deciding to do something, or persisting in doing something (Williams and Burden, 1997). Motivation determines people's motives for doing something, how long to do it, and how hard they will continue to do it (Han & Yin, 2016).

It is as if the teacher does not have a strong enough motive to make HOTS questions, persists in making HOTS questions or continues activities in making HOTS questions. It was explained through interviews that the limited existing facilities (internet, laptop), lack of training, and

lack of time because they were busy with other administrative tasks were factors causing the low motivation of teachers. Motivation is very important in developing HOTS in addition to competence. With good motivation, teachers will be able to create a problem that explores students' reasoning in solving problems at a higher level of thinking, namely analyzing, evaluating, and creating (Wulandari, et al., 2020).

Sub indicator 4 relates to the creativity of teachers who have an average score of 17.86% which is classified as very low. The creativity of a teacher greatly affects the quality and variety of stimuli used in writing HOTS questions (Siregar, 2019). Teachers are sometimes reluctant to write HOTS questions because they prefer to write questions that measure low-level knowledge in the form of memorization, because they are easy to make. Teachers sometimes feel pressured to get the right answers from students instead of giving creative responses (Kettler, at al., 2018) from answering HOTS questions. Memorization questions to measure students' analytical abilities are collectively preferred and discriminate against students who have extraordinary creative abilities (Sternberg, 2006).

The assessment of the questions made is done using the documentation method. Each teacher is asked to show questions that have been made and are believed to be HOTS questions. The questions were then analyzed using pre-defined guidelines. Each teacher submits 2 items that are considered HOTS as samples. So that the total items analyzed were 56 items. From the 56 essay tests that were collected, a picture of the quality of the questions was obtained as shown in Table 2 below.

**Table 2.**

*Results of Analysis of HOTS Question Instruments in the Form of Description*

| No | Aspects Analyzed | Amount Item | Percentage |
|---|---|---|---|
| 1 | Question according to the indicator (for the description test requires a written test for the description form) | 56 | 100% |
| 2 | The question does not contain elements of ethnicity, religion, race, inter-group, pornography, politics, propaganda, and violence | 56 | 100% |
| 3 | Questions using an interesting stimulus (new, encouraging students to read) | 27 | 48.21% |
| 4 | Problems using contextual stimuli (images/graphics, text, visualizations, etc., according to the real world) | 25 | 44.64% |
| 5 | The question measures the cognitive level of reasoning (analyzing, evaluating, creating) which in its completion is characterized by one or more of the following stages of the thinking process. a) Transfer from one concept to another b) Processing and applying information c) Looking for links from different kinds of information d) Using information to solve problems e) Examine ideas and information critically | 5 | 8.93% |
| 6 | Implicit answer to the stimulus | 32 | 57.14% |
| 7 | The formulation of a question or question sentence uses question words or commands that demand unravelled answers | 56 | 100% |
| 8 | Make clear instructions on how to do the questions | 48 | 85.71% |
| 9 | There are scoring guidelines/rubrics according to the criteria/sentences that contain the keywords | 52 | 92.86% |
| 10 | Pictures, graphs, tables, diagrams, or the like are clear and functional | 54 | 96.43% |
| 11 | Using a language that is in accordance with the rules of Indonesian, for regional languages and foreign languages according to the rules | 56 | 100% |
| **Average** | | **42.45** | **76.81%** |

The results of the qualitative analysis of the questions made by the teacher based on Table 3. obtained the following description. 1) has been prepared based on the indicators contained in the syllabus and learning implementation plan, 2) does not use taboo language and contains elements of ethnicity, religion, race, inter-group, pornography, politics, propaganda, and violence, 3) the formulation of the question sentence or question uses question words or commands that demand unravelled answers, 4) contains clear instructions on how to do the questions, 5) there are scoring guidelines/rubrics in accordance with the criteria/sentences containing keywords, 6) pictures, graphs, tables, diagrams, or the like are clear and functional, and 7) use language that is

in accordance with Indonesian rules, for regional languages and foreign languages according to the rules. By paying attention to the percentage (points 1, 2, 7, 8, 9, 10, 11) for each element, it is clear that the criteria for teacher-made questions are in the very good category.

However, there are several elements in the poor category, such as: 1) some questions use a stimulus that is less attractive, 2) questions use a textual stimulus that is not contextual, and 3) some questions show that the answer is implied in the stimulus. Even the main elements of HOTS (analyzing, evaluating, and creating) have the lowest percentage, namely: 8.93% with a very poor category. This means that the teacher-made questions have not measured the cognitive level of reasoning. It can be said that the use of HOTS-based questions at the high school level is still not given to students (Pasaribu, 2020). Teachers rarely assess students' HOTS, no more than 2% of the total summative questions made by teachers are classified as HOTS (Mahendra et al., 2020) and no more than 5.4% of the number of formative questions made by teachers are classified as HOTS (Pratiwi, Dewi, and Paramartha, 2019). The two results of this study further confirm the findings in this study, that the teacher-made questions are still far from the HOTS question category.

## Conclusions and Suggestions

The results showed that in general the teacher's ability in compiling HOTS-based assessments was in a fairly good category with a percentage of 48.90. Indicators of understanding the HOTS concept in the good category with a percentage of 72.14% However, indicators of completeness of references related to digital literacy and compiling and developing HOTS assessments related to motivation have a percentage of 35.71% and 34.82%, respectively, in the low category. Even the sub-indicator of modifying the content for HOTS questions related to creativity has a percentage of 17.86% which is classified as very low. Based on the findings in the study, several suggestions were put forward including: 1) it is necessary to conduct intensive training for teachers, especially high school mathematics teachers in preparing HOTS-based assessments, 2) teachers should be more active and creative in finding references in cyberspace (internet), and 3) collaborate with colleagues or with universities in preparing HOTS-based assessments

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