A needs analysis of HOTS-based assessment instruments for elementary school mathematics learning

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ABSTRACT

This study aimed to analyze an assessment needs based on Higher Order Thinking Skills (HOTS) in mathematics subjects of the fifth-grade elementary school. Analysis needs are required to find out the conditions needed in learning to achieve an educational goal. This research was conducted in a qualitative descriptive manner, with the research subject being the educators who taught the fifth grade of elementary school, with 4 educators. Research data was obtained through a questionnaire. The data analysis technique used is Miles and Huberman which consists of data reduction (data reduction), data display (data presentation), and conclusion (concluding). The result showed that it is necessary to develop Higher Order Thinking Skills (HOTS) mathematical assessment instruments to assist educators in making assessments, become a reference for educators to design or make HOTS-based assessments and help improve students' mathematical critical thinking skills.

KEYWORDS

Higher Order Thinking Skills, Assessment Instruments, Mathematics Learning

Introduction

Many challenges arise in the 21st century, one of the ability to think critically in solving problems. The 2013 curriculum in learning activities aims to prepare Indonesian people to have the ability to live as individuals and citizens who are faithful, productive, creative, innovative, effective, and able to contribute to society of life, nation, state, and world civilization. The learning required in the 2013 curriculum activates critical thinking, analytical, and creative thinking skills. Students are expected in every learning activity to emphasize problem-solving learning, which is based on Higher-Order Thinking Skills thus it provokes every student to improve critical thinking skills (Ahmad, 2020). HOTS trains students to have critical thinking and creativity to be able to survive today's global challenges thus they can develop and become quality human beings (Badjeber & Purwaningrum, 2018). Indicators of higher-order thinking skills or HOTS include critical thinking and strategic thinking in which there are indicators of creative thinking skills (concepting and making decisions) and problem-solving (Pratiwi & Fasha, 2015). Ramos et al., (2013) mentions that “The type of thinking process that students must develop to prepare them to confront the real world must go beyond simple learning of facts and content. Knowledge obtained through higher-order thinking processes is more easily transferable, so that students with a deep conceptual understanding of an idea will be much more likely to be able to apply that knowledge to solve new problems”. The thinking process of students must be able to develop to prepare for problems that will arise, through the process of high thinking makes it easier for students to understand a concept and process thoughts to make decisions in solving new problems. Critical thinking is a skill that must be developed continuously in learning.

According to Hanafy (2014) learning is a system, namely a unified component that is interrelated and interacts with each other to achieve results following the goals set. The success of learning objectives can be realized through formal education, in formal education, several subjects must be taken, one of that is mathematics. Mathematics is a subject that has an important role in the development of science and technology. Mathematical abilities need to be developed, especially in elementary schools, thus the students can think logically, systematically, critically, and creatively, and be able to work together in solving a problem. According to (Widana, 2018) mathematics subjects need
to be given to all students, to equip them with logical, analytical, systematic, critical, innovative, and creative thinking skills, as well as the ability to work in a group. These competencies are needed. In implementing mathematics learning, it is expected that the students should be able to feel the usefulness of learning math. Mathematics subjects need to be provided to students to equip them with the ability to think logically, analytically, systematically, critically, innovatively, and creatively, as well as the ability to work together. Students are expected to feel the benefits of learning mathematics.

Learning cannot be separated from assessment. Assessment is important because assessment can be used in making decisions based on measurement. The measurement uses a set of instruments guided by the goals that have been set. The assessment instrument is a tool to measure what competencies or achievements will be measured. An assessment instrument is an assessment tool used by educators to assess student achievement through test and non-test techniques (Suryana, 2015). Tests are used to measure cognitive competence, while non-tests are used to measure students’ affective and psychomotor competencies.

Assessment of students should follow assessment standards and require methods or techniques as well as instruments. This must be considered and prepared in the assessment process of student learning outcomes. As described by (Abosalem, 2015) namely Developing students’ skills requires creating assessment techniques that have abilities to help teachers in their job and reveal students’ skills. Moreover, teachers are supposed to implement various types of assessment methods such as performance-based assessment and stay away from the tests that require recalling knowledge such as observations, short answer questions, and multiple-choice questions which are most frequently used by teachers. Educators need assessment techniques in developing students’ skills by applying various assessment methods and reducing the use of tests in short answer questions. Assessment is considered one of the problems in education, educators tend to apply assessments using the level of LOTS (Low Order Thinking Skills) or low thinking skills and MOTS (Middle Order Thinking Skills) or moderate thinking skills. Assessment tends to test the ability to remember and calculate formulas. The test made by an educator must measure the ability of students following the demands of the applicable curriculum. However, some educators still find problems in preparing assessment instruments, especially mathematics at the C4-C6 level. (Giani et al., 2015) conducted research on the cognitive level of mathematics textbook questions, the results showed that the questions given to students in the mathematics learning process were still at a low level of thinking ability.

Preparation of HOTS questions requires mastery of teaching materials, question writing skills, and the creativity of educators in choosing the stimulus questions according to the conditions of the surrounding area, by analyzing Basic Competencies, compiling a grid of questions, choosing the right stimulus, writing questions according to the grid, and making guidelines. scoring or answer key (Setiawati, 2019). According to Sumaryanta (2018) the questions used in HOTS are not just any questions, but questions that have properties such as non-algorithmic, tend to be complex, have more than one solution (open-ended approach), and require effort to find a structure, questions that have these characteristics, encourage students to analyze, evaluate, or create a way needed to solve problems.

Research (Rahayu, 2010) states that for students to have higher-order thinking skills in learning mathematics, it is necessary to have regular practice in working on HOTS-type questions. Research by (Intan & Kuntarto, 2020) found that the high-order thinking skills of fifth-grade elementary school students were in the sufficient category, the study explained that educators should be able to motivate students in working on HOTS questions, especially mathematics. Educators can provide continuous training in the HOTS questions thus students are trained and accustomed to working on HOTS questions and that can support higher-order thinking skills.

Based on the statement, it is necessary to create and develop a HOTS assessment instrument in improving students’ mathematical critical thinking skills. It aims to train students’ critical thinking skills in solving a problem, while educators can train the ability to develop HOTS-based questions. Therefore, it is necessary to study more deeply the development of the HOTS assessment instrument in improving students’ critical thinking skills, especially in learning mathematics.

**Methods**

This research aims to describe the application that will answer the problem of the need for assessment based on Higher Order Thinking Skills (HOTS) in mathematics learning in class V State Elementary School 3 Sumberejo. This study uses a qualitative descriptive method. The subjects of this research are all educators who teach in class V State Elementary School 3 Sumberejo totaling 4 educators. The data collection technique in this study used a non-test technique, namely a questionnaire. The questionnaire used was an open questionnaire and a closed questionnaire. Questionnaires were given to all educators who teach in class V via a google form. This research questionnaire was used to obtain data on the implementation of assessments commonly used by educators, students’ critical thinking skills, the level of questions used, the Higher Order Thinking Skills (HOTS) assessment instrument, as well as the obstacles and expectations of educators in the preparation of the HOTS assessment. The data analysis technique of this research uses the Miles and Huberman, there are three steps in Miles and Huberman’s analysis, namely data reduction (data reduction), data display (data presentation), and conclusion (concluding) (Sugiyono, 2010).
Result and Discussion

From filling out the questionnaire, the researcher obtained information about the needs and opinions of educators regarding the assessments carried out so far. The teachers that teach grade V at State Elementary School 3 Sumberejo, Kemiling District, Bandar Lampung.

1. Is the formulation of question indicator that you made formulated from Basic Competence?

2. Do the questions that you made measure what has been learned by students?

3. What kind of test that you usually make to evaluate Mathematics learning?

4. Where do you get the sources of assessment instrument used in Mathematics learning evaluation?

Educators and the questions that are made measure what students learn. This is following the Regulation of Minister of National Education No. 41 of 2007, indicators of competency achievement are behaviors that can be measured and/or observed to show the achievement of certain basic competencies that become the reference for assessing subjects. Indicators of competency achievement are formulated using operational verbs (KKO) that can be measured, which include knowledge, attitudes, and skills. This means that the indicator of competency achievement is a formulation of the abilities that must be carried out or displayed by students to show the achievement of Basic competencies.

The type of test used is 75% of educators use multiple-choice tests and 25% use essays. The sources used in compiling the assessment instrument are generally educators using books and the internet. (Suryawan et al., 2017) said that if the questions that are made are questions similar to textbooks, then these types of questions can be categorized as routine questions, namely questions that prioritize skills and are less able to develop participants’ reasoning power.

5. Is students’ critical thinking in the class good already?
6. Is students’ creativity in Mathematics problem solving good already?

7. Did you ever made questions which required students to think critically?

From filling in the questionnaire regarding the students' mathematical critical thinking skills in class V, 100% of educators stated that their critical thinking skills and creativity in solving mathematical problems were not good. 100% of educators have made questions that require students to think critically. This result means that although educators have made questions that require students to think critically, the ability and creativity of students' mathematical critical thinking have not been maximized. According to (Haniffah & Manoy, 2014) the low ability of students to solve problems can be corrected by providing practice HOTS questions. This is supported by the opinion (Hidayati, 2017), that educators can provide interesting and challenging questions to foster curiosity and creative ideas thus the students respond critically.

8. What is the assessment level that you use in making Mathematics questions?

9. What are the levels of cognitive domain that you use in making Mathematics questions?

From filling out a questionnaire regarding the cognitive level and The levels used by educators, 100% of educators still use the MOTS assessment level or moderate thinking ability, and the levels of cognitive domains C4, C5 and C6 are still below 50%, meaning that the questions used are not in the HOTS category. These results indicate that educators have not implemented HOTS-based assessment, it shows from the level of questions used is still at the C1-C4 level. (Shalikhah et al., 2021) state that the problem of students' critical thinking skills shows that students' abilities in the reasoning aspect are low, due to the lack of availability of HOTS-based questions, not all of the test questions that are referred HOTS, while HOTS is part of the HOTS in the form of operational verbs consisting of C4 (analyze), C5 (evaluate), and C6 (create).

10. Do you understand what Higher Order Thinking Skills (HOTS) is?
11. Do you know the question characteristics of Higher Order Thinking Skills (HOTS)?
12. Did you ever make HOTS Mathematics questions?
13. Do you have obstacles in making HOTS questions?
   Respondent 1 : determining HOTS cognitive level
   Respondent 2 : knowledge limitation about the right arrangement
   Respondent 3 : determining question form, students' skill, and determining HOTS based cognitive KKO
   Respondent 4 : time limitation when making the assessment

HOTS Taxonomy and its characteristics are available and easy to understand, but educators still have some obstacles. This result is strengthened by research of (Ramadhanti, 2020) which states that the obstacles experienced by educators in making HOTS questions are the limited time to prepare HOTS questions, not understanding in finding and matching operational verbs for HOTS questions, selection of Basic competencies which is sometimes inaccurate,
lack of socialization regarding making HOTS questions, still making questions with the same model. Solutions to overcome some of these obstacles include educators having to manage time well, and educators can also attend workshops or Teacher Working Group regarding making HOTS questions. This is supported by research (Maryani & Martaningsih, 2020) which states that training and preparation of HOTS questions for educators in elementary schools can expand educators’ knowledge and skills in preparing HOTS-based assessment instruments.

14. Do you need HOTS questions in evaluating Mathematics learning?

15. Is the ability of solving Mathematics HOTS questions needed by students?

16. Do you need a valid and reliable question instrument?

17. What is your expectation of if HOTS based assessment is developed?
   Respondent 1 : to help teachers in designing or making HOTS assessment and could help improving critical thinking skill
   Respondent 2 : to help students increasing their critical thinking skill
   Respondent 3 : so that students are used to critical thinking skill in solving the problem
   Respondent 4 : to help teacher in carrying out assessment

These results indicate that educators need a valid and reliable HOTS assessment instrument, educators hope that the development of a HOTS-based mathematics assessment instrument can help or become a reference for educators to make HOTS-based assessments and help improve students’ critical thinking skills in mathematics. (Widana, 2018) state that the use of HOTS assessment in mathematics learning is proven to effectively improve students’ critical thinking skills. Therefore, it is recommended for educators to use the HOTS assessment as an assessment to improve students’ critical thinking skills, especially in learning mathematics.

Conclusion
The assessment instruments used by educators are sourced from books, worksheets, the internet, and other relevant sources that are following the Basic Competencies. Implementation of the mathematics learning assessments using multiple-choice questions and essays which are at the MOTS level. Some of the obstacles for educators in making HOTS-based mathematics assessments are time constraints, and the selection of cognitive operational verbs that is following HOTS. The hope of educators for the development of HOTS-based mathematical assessment instruments is that in the future they can help educators design or make HOTS-based assessments and can help improve students' mathematical critical thinking skills in grade V Elementary School. Based on this, it is necessary to develop a HOTS-based mathematical assessment instrument to improve the mathematical critical thinking skills of fifth-grade elementary school students.

References


Permendiknas No. 41 Tahun 2007 tentang Standar Proses untuk Satuan Pendidikan Dasar dan Menengah.


