Development Of Hots-Based Assessment in the Curriculum to Increase Critical Thinking Skills of Elementary School Students

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Abstract
HOTS is an important aspect of learning. Higher order thinking skills are the process of analyzing, reflecting, giving arguments (reasons), applying concepts to different situations, and creating. Given the importance of the HOTS position in learning, teachers need to have knowledge and competencies that can help in developing the higher-order thinking skills of their students. This study aims to develop a qualified HOTS-based assessment instrument so that elementary school teachers can use it to develop students' thinking skills. This research is a research and development with the stages of the ADDIE model: (1) Analyze, (2) Design, (3) Develop, (4) Implement, and (5) Evaluate. The results of this study show that the HOTS-based assessment instrument developed for fifth grader is valid, practical, and reliable so that it is suitable for use in training fifth grader to do HOTS-based questions. The validation results of material experts and linguists show that the HOTS-based assessment instrument developed is valid.

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Abstrak
HOTS merupakan aspek penting dalam pembelajaran. Kemampuan berpikir tingkat tinggi merupakan proses menganalisis, merefleksi, memberikan argumentasi (alasan), menerapkan konsep pada situasi yang berbeda, dan mencipta. Mengingat pentingnya posisi HOTS dalam pembelajaran, guru perlu memiliki pengetahuan dan kompetensi yang dapat membantu dalam mengembangkan kemampuan berpikir tingkat tinggi siswanya. Penelitian ini bertujuan untuk mengembangkan instrumen penilaian berbasis HOTS yang mumpuni sehingga guru SD dapat menggunakannya untuk mengembangkan kemampuan berpikir siswa. Penelitian ini merupakan penelitian dan pengembangan dengan tahapan model ADDIE: (1) Menganalisis, (2) Merancang, (3) Mengembangkan, (4) Menerapkan, dan (5) Mengevaluasi. Hasil penelitian ini menunjukkan bahwa instrumen penilaian berbasis HOTS yang dikembangkan untuk siswa kelas V SD adalah valid, praktis, dan reliabel sehingga layak digunakan dalam latihan siswa kelas V untuk mengerjakan soal berbasis HOTS. Hasil validasi ahli materi dan ahli bahasa menunjukkan bahwa instrumen penilaian berbasis HOTS yang dikembangkan valid.

I. INTRODUCTION

Learning activities are a process of interaction between students and students, students with learning resources, and students with teachers (Daryanto, 2014). Learning activities will be meaningful for students if carried out in a comfortable environment that provides a sense of security for students. Learning is an individual and contextual process, meaning that the learning process occurs within the individual according to his development and environment. Therefore, learning by doing can be more meaningful than just hearing explanations. Elementary school students, namely children aged around 6-12 years are relatively very young, but in the 2013 curriculum it is stated that elementary school students are required to have critical thinking skills in order to be able to solve the problems they face. Currently, students are expected to be able to process information and make the right decisions. According to Setiawan et al. (2019), students need to develop a logical way of thinking and reasoning. This way of thinking is categorized as *High Order Thinking Skills* (HOTS).

HOTS is an important aspect of learning. The ability to think higher order is a process of analyzing, reflecting, providing arguments (reasons), applying concepts to different situations, and creating (Mitana et al., 2018). HOTS is not only the ability to remember, know, or repeat but more than that, HOTS is competence in problem solving, critical thinking, creative thinking, reasoning and decision making (Mitana et al., 2019; Heong et al., 2011). The ability to think at a higher level is one of the essential competencies

needed to face the challenges of the 21st century. Given the importance of the position of HOTS in learning, teachers need to have knowledge and competencies that can help in developing the higher-order thinking skills of their students (Aydin &; Yilmaz, 2010). One of the competencies that teachers need to have is the competence to develop HOTS-based questions in learning. HOTS questions can be applied during the teaching and learning process and in evaluating learning outcomes.

According to Setiawan et al. (2019), teachers still have difficulty developing HOTS-based assessments for students. The difficulties experienced by primary school teachers are caused by: (1) lack of understanding of the concept of HOTS-based assessment; (2) low level of understanding of Operational Verbs of Bloom's Taxonomy; (3) inability to determine basic competencies that can be developed into HOTS-based questions; (4) some practical references on the construction of HOTS-based questions; and (5) training conducted by several relevant agencies is still theoretical. Given that there is still a gap between the ideal situation and the empirical situation in the field, it is necessary to develop a qualified HOTS-based assessment instrument so that elementary school teachers can use it to develop students' thinking skills.

1. Higher Order Thinking Skills (HOTS)

Higher Order Thinking Skills (HOTS) is a thinking process that requires students to manipulate information and ideas in certain ways that give them new understanding and implications (Gunawan, 2012). Limpan describes higher-order thinking as involving critical and creative thinking guided by ideas of truth that each have meaning. Critical and creative thinking are interconnected, as are criteria and values, reason and emotion (Kuswana, 2012). According to Ernawati (2017), higher-order thinking or HOTS is a way of thinking that is no longer only verbally memorizing but also interpreting the essence of what is contained in it, to be able to interpret meaning requires an integralistic way of thinking with analysis, synthesis, association to draw conclusions towards the creation of creative and productive ideas. This is in line with the opinion of Thorne & Thomas (2009) states that high order thinking skills are the process of thinking at a higher level than just remembering facts or explaining back something they learned to others. HOTS requires a person to understand, infer, relate facts to concepts, categorize, manipulate, look for facts in an event that occurs, and find solutions to a problem that occurs.

According to Arwood (2011) states that the ability to think of each individual can combine concepts, from one concept to another by stringing together a frame of mind, pronounce, write, read, see, and count. Each individual's frame of mind can be cultivated and developed by deepening more meaningful experiences. Such experiential knowledge can be obtained through the development of cognitive thought processes. Based on some of these opinions, it can be concluded that the ability to think higher order/Higher Order Thinking Skills (HOTS) is the ability to think that is not just remembering, reexpressing, and also referring without processing, but the ability to think to analyze information critically, creatively, creatively and able to solve problems.

2. HOTS indicator

Anderson & Krathwohl (2001) stated that indicators to measure higher-order thinking skills include the 3 highest levels of thinking, namely analyzing, evaluating, and creating. Analyzing indicators include being able to analyze incoming information and divide or structure information into smaller parts to recognize the problem or relationship, being able to recognize and distinguish the cause and effect factors of a complex scenario, and identifying / formulating questions.

Evaluating indicators include assessing solutions, ideas and methodologies using suitable criteria or existing standards to ascertain their effectiveness or benefit, making hypotheses, criticizing and testing, and accepting or rejecting statements based on established criteria. While indicators of creating include generalizing an idea or perspective on something, designing a way to solve problems, and organizing elements or parts into new structures that have never existed before (Anderson & Krathwohl, 2001).

II. METHOD

This research is a research and development with the stages of the ADDIE model: (1) Analyze, (2) Design, (3) Develop, (4) Implement, and (5) Evaluate (Branch, 2009). The reasons for choosing the ADDIE development model include the steps in the ADDIE model specific and clear for the development of HOTS-based assessment instruments, revisions are carried out at almost

every step of development, and have conformity with product characteristics in the form of HOTS-based assessment instruments for fifth grader that apply the 2013 curriculum. This research involved elementary school teachers and fifth grader of SDN Dinoyo 03 Malang.

The instruments ugradesed are validation instruments for teaching material experts (elementary school teachers), as well as product practicality instruments for teachers. Data was collected from material expert validation, product practice test results, and trial results. The data were analyzed using quantitative and qualitative techniques. Material expert validation data and practicality were analyzed using the practicality of Akbar's (2013) adapted products. Empirical validity data were analyzed using the correlation formula from Pearson Product Moment. Reliability data were analyzed using Cronbach's Alpha formula. Analysis of empirical validity and data reliability was assisted with the SPSS 17.0 for Windows computing program. The data obtained are used to determine the level of validity, reliability, and practicality as a pre-requisite for the feasibility of the HOTS-based assessment instrument developed for fifth grader.

III. RESULT AND DISCUSSION

The development stages in this study are in accordance with the ADDIE stages, which include the stages of analyzing, designing, developing, implementing, and evaluating. The results and discussion at each stage in this study are described as follows:

1. *Analysis* Phase

At the analysis stage, an initial identification of the gap between the empirical conditions of assessment in learning in schools today and the desired outcomes (theoretically and juridically ideal) is carried out. Identification was carried out by observation, interviews, and preliminary studies at SDN Dinoyo 03 Malang. To strengthen the facts of the initial identification results, a literature study was conducted on HOTS-based assessment theory in elementary schools, ministerial policies related to HOTS-based assessment in elementary schools, and a review of previous research results that discussed similar topics.

The identification results show that there is still a gap between theoretical and juridical ideal studies with empirical facts in the field. Elementary school teachers still face several obstacles and difficulties in implementing and developing HOTS-based assessment instruments for fifth grader.

2. *Design* Phase

The second stage of this development research is the design stage. At this stage, a grid of questions was developed in the form of competency achievement indicators derived from basic competencies for fifth grader (KEMDIKBUD, 2018), instrument design, number of items, and answer keys because the instruments developed were in the form of multiple-choice questions. In this process, the design is obtained from a HOTS-based assessment instrument in the form of a grid of questions. Grid design is important as a guideline to facilitate teachers in developing assessment instruments (Rogier, 2014; Brookhart, 2010). The question indicators on the developed grid are derived from the basic competencies of four subjects in grade five, namely Indonesian, Science, Social Studies, and Civics. Details of the distribution of indicators can be seen in Table 1 below.

Table 1. HOTS-based Assessment Instrument Grid

Subject	Basic Competencies	Cognitive Level	Number of Indicators	Number of Questions
Indonesian	3.6	C4 – C5	5	5
IPA	3.2, 3.3, 3.4	C4 – C5	4	10
IPS	3.2, 3.3	C4 – C5	4	4
Civics	3.1, 3.2, 3.3	C4	6	6
	Sum		19	25

3. Development Stage

The development stage is carried out by compiling HOTS-based assessment instrument products for fifth grader in the form of multiple-choice questions. Products are structured and developed according to the product specifications designed on the grid presented in Table 1 above. The stage before validation of results is to produce an initial product or *prototype*. The purpose of this development stage is to produce an initial product/ prototype and validate the *prototype* that has been developed to experts (Branch, 2009). This stage consists of three sub-stages, namely (a) producing *prototypes*; (b) validation of prototypes by experts and revisions; and (c) planning field trials for validated products.

a) Sub-stage 1: *Prototype* Product Development

The initial sub-stage is the product development process based on grid design.

The initial product developed was a multiple-choice question to train fifth grader to apply higher-order thinking skills. The questions also include grids, answer keys, and score processing guidelines for teachers.

In the context of this study, HOTS questions were prepared using simple stimuli but close to students' lives such as awareness about waste, cleanliness of water, soil, air in the city of Malang, and also simple daily life events such as social interactions, and economic activities. In addition to developing students' thinking skills, this method can make students sensitive to daily events and relate them to learning materials at school to find solutions. There are 25 questions developed at this stage.

b) Sub-Phase 2: Expert Validation and Revision

The second substage is carried out to test the validity of the *prototype*. Content validity relates to the accuracy of the instrument arranged in measuring the material that has been taught (Arikunto, 2012), while construct validity shows how far the items arranged in the assessment instrument can measure what should be measured (Basuki &; Hariyanto, 2016).

The HOTS-based test prototype that has been developed is tested with experts in basic materials and languages to assess the level of validity. The assessment uses validation questionnaires that have been developed at the design stage as a measuring tool to test product feasibility. The prototype validation results from material experts and linguists are presented in Table 2 below.

Table 2. Material and Language Validation Results

Validation Aspect	Indicators	Value	Percentage of Validity	Criterion
Materials and Languages	Relevancy, accuracy, and clarity of language	87,5	87,5%	Very valid

In addition to quantitative data, qualitative data was also obtained in the form of suggestions for the development of HOTS questions. The input and suggestions from validators for the questions developed are: (1) simplification of the use of words and sentences because the questions are intended for elementary school students; (2) pay attention to the correct use of punctuation marks such as periods and commas; (3) remove some questions that are less relevant to feedback and suggestions; and (4) pay attention to several answer choices so that students are not confused (*ambiguous answer choice*).

Based on the validation scores of material experts and linguists described in table 2, it can be stated that the instruments developed are very valid, reaching a score of 87.5. The validity of the content has been fulfilled, meaning that the instruments developed have represented the material in the curriculum taught to fifth grader. The results of validity tests by experts also show that the instrument is feasible to use to record and train students to apply HOTS. The questions developed are in accordance with the concept of HOTS-based assessment.

c) Subphase 3: Field Trial Planning

The third substage is the planning of product trials that have been revised based on expert validation tests. This trial was conducted on fifth grader of SDN Dinoyo 03 Malang. This stage involved one teacher and 28 fifth graders as the main subjects of this study. The data collected at this stage are about the practicality of the instrument, empirical validity and reliability data of the instrument.

4. Implementation Phase

This stage is the implementation of a product in the form of 22 HOTS questions that are declared valid based on expert validity tests. This stage aims to test the empirical validity, reliability, and practicality of the product. Empirical validity refers to empirical facts (practical experience). Data on empirical validity were carried out through testing assessment instruments developed in teaching practice in schools Akbar, 2013; Arikunto, 2012). Analysis of empirical validity data is described in table 3 below.

Table 3. Empirical Validation Test Results

Validation Categories	Number of Questions	Percentage	Score	
			Lowest	Highest
Valid	17	77%	0,354	0,696
Invalid	5	23%	0,094	0,316

Empirical validity results showed that 17 items were declared valid and 5 items were declared invalid. Valid items obtain a high *r Pearson Product Moment* coefficient , which is in the range of 0.354 – 0.696. As for invalid question items, the value of the r coefficient is in the range of 0.094 – 0.316. The percentage of valid items is 77% and invalid instruments is 23%. Invalid questions have been removed. Thus, the number of question items in the final product that can be used to train HOTS for fifth grader is 17 items. Invalid items are not only found in one subject, but evenly, one question item in social studies subjects, one question in Civics subjects, and three questions in science subjects so that the assessment instruments developed can still be used to measure HOTS in 4 subjects .

Product reliability relates to the constancy and stability of an instrument that produces data about student learning processes and outcomes (Arikunto, 2012; Joseph, 2015). The results of the reliability analysis of 17 points of HOTS questions are presented in Table 4 below.

Table 4. HOTS-Based Assessment Instrument Reliability Test Results

Number of valid questions	*Alpha Cronbach* Coefficient	Predicate
17	0,857	Reliable

The result of calculating the product reliability coefficient is based on *the Cronbach Alpha coefficient* (α) of 0.857. The reliability coefficient criterion of this instrument is included in the high category, therefore HOTS-based assessment instruments can be said to be reliable. These results are in line with [13] that the instrument is said to be reliable if tested on the same subject repeatedly, the results will be relatively the same, consistent, stable, and not statistically different.

Product practicality refers to the extent to which the developed instrument is easy to use and apply and easy to manage. An instrument is said to be practical if the teacher does not find difficulties in planning, implementing, checking, interpreting the results, reporting, and storing the instrument (Arikunto, 2012; Basuki &; Hariyanto, 2016; Joseph, 2015). Product practicality tests are carried out through direct assessment by teachers of the developed instruments. The instrument used is the practical instrument of the teacher. The results of product practicality assessment data are presented in the following table 5.

Table 5. Practical Test Results of HOTS-Based Assessment Instruments

Subject	Practicality Indicators	Score	Percentage	Criterion
Class V Teacher	Practicality, Clarity and Completeness of instruments	86	86%	Very Tactical

The qualitative data resulting from the practicality assessment in the form of suggestions and criticisms from teachers is the use of punctuation periods (....), where each question ends with the word is and it must be consistent. In addition, the use of 4 dots at the end of each question must also be in accordance with the rules of writing questions. Based on this feedback, questions are revised in the editorial section of sentences and punctuation suggested by the teacher. Revision does not reduce the item and content of the problem.

Based on the results of the practicality assessment from practitioners, namely grade V teachers of SDN Dinoyo 03 Malang, a practicality score of 86 was obtained. Based on these values, the products developed are categorized as very practical. The high practicality value shows that the instrument is suitable to be used to train fifth grader to be able to think higher order because the instrument is easy to use, easy to understand, easy to process and easy to report the results.This finding is in accordance with the results of previous studies on development assessment in elementary schools which found that the assessment instrument developed is feasible to be used to record and train students' HOTS because the instrument is easy to apply, understand, process and also reported by teachers in fifth grade (Setiawan &; Tumardi, 2019; Setiawan et al., 2019)

IV. CONCLUSION AND SUGGESTION

A. Conclusion

The validation results of material experts and linguists show that the HOTS-based assessment instrument developed is valid.

This can be seen from the percentage of values given by validators in aspects of construct validity and content that is categorized as very valid. Of the 25 questions on the initial *prototype*, 17 questions were categorized as valid according to expert assessment. In addition, the questions were also tested at SDN Dinoyo 03 Malang and the results showed that the HOTS-based assessment instrument developed obtained a high percentage of empirical value, reliability, and practicality. Based on the analysis that has been done, it is concluded that the HOTS-based assessment instrument developed for fifth grader is valid, practical, and reliable so that it is suitable for use in the exercise of fifth grader to do HOTS-based questions.

The development of HOTS-based assessment instruments has not been widely carried out by teachers in elementary schools. Therefore, further research and development is needed to create a broader HOTS assessment instrument, especially for grades 4, 5, and 6 elementary schools. In addition, variations in thinking levels need to be further developed not only at the C4 and C5 levels but also at the C6 thinking level. Future research is expected to use validity tests involving more experts, and large-scale field trials, and socialize products in the form of books or HOTS-based question banks for elementary school students.

B. Suggestion

Discussion regarding this research is still very limited and requires a lot of input. Suggestions for future authors are to study more deeply and comprehensively about the Development of Hots-Based Assessment in the Curriculum to Increase Critical Thinking Skills of Elementary School Students.

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