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Higher Order Thinking Skill Instrument for Science Subject in Sixth Grade of Elementary School

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ABSTRAK

Kurangnya pengembangan soal tes yang mengandung unsur HOTS dalam melatih siswa untuk dapat berpikir tingkat tinggi menyebabkan kemampuan berpikir tingkat tinggi peserta didik masih tergolong rendah. Sehingga tuntutan kurikulum tidak dapat tercapai secara maksimal. Penelitian ini bertujuan untuk menganalisis kelayakan instrumen kemampuan HOTS pada siswa kelas VI SD mata Pelajaran IPA untuk mengukur kemampuan berpikir tingkat tinggi peserta didik. Penelitian ini merupakan penelitian pengembangan yang menggunakan model 4D. Model penelitian 4D terdiri dari empat tahap, yaitu define, design, develop, dan disseminate. Subyek dalam penelitian ini adalah Instrumen HOTS. Objek penelitian ini yaitu kualitas butir soal yang dihasilkan. Teknik pengumpulan data yang digunakan dalam penelitian ini yaitu, observasi kuantitatif, wawancara, angket, dan tes. Agar teruji kelayakannya, dilakukan analisis instrumen tes pilihan ganda yang meliputi uji validitas isi, uji validitas butir, uji reliabilitas, uji daya beda, serta uji tingkat kesukaran. Instrumen berbasis HOTS pada siswa kelas VI SD pada mata Pelajaran IPA, mendapatkan hasil analisis data yaitu, uji validitas isi instrument dinyatakan valid, uji validitas butir soal instrument dinyatakan valid, uji reliabilitas dinyatakan mempunyai reliabilitas tinggi, rata-rata hasil uji daya beda masuk dalam kriteria baik, serta uji tingkat kesukaran masuk dalam kriteria sedang. Dari uji yang telah dilakukan instrumen kemampuan HOTS pada siswa kelas VI SD mata Pelajaran IPA layak digunakan untuk mengukur kemampuan berpikir tingkat tinggi peserta didik.

ABSTRACT

The lack of development of test questions that contain HOTS elements in training students to be able to think at a high-level causes students' higher order thinking skills to be low. So that the demands of the curriculum cannot be achieved optimally. This study aims to analyze the feasibility of HOTS ability instruments for grade VI elementary school students in science subjects to measure students' higher order thinking skills. This research is development research that uses the 4D model. The 4D research model consists of four stages, namely define, design, develop, and disseminate. The subject of this research is HOTS instrument. The object of this research is the quality of the items produced. The data collection techniques used in this research are quantitative observation, interviews, questionnaires, and tests. In order to test its feasibility, the multiple-choice test instrument was analyzed which included content validity test, item validity test, reliability test, differentiation test, and difficulty test. HOTS-based instruments for grade VI elementary school students in science subjects, get the results of data analysis, namely, the content validity test of the instrument is declared valid, the validity test of the instrument items is declared valid, the reliability test is declared to have high reliability, the average result of the test of differential power is included in the good criteria, and the test of the level of difficulty is included in the medium criteria. From the tests that have been carried out, the HOTS ability instrument for grade VI elementary school students in science subjects is suitable for measuring students' higher order thinking skills.

1. INTRODUCTION

Assessment is a method for collecting and processing information to measure students' learning outcomes (Fitriana, 2020; Hewi & Shaleh, 2020). Three abilities are assessed to determine these outcomes: knowledge, attitudes, and skills. The assessments administered to students are intended to enhance their higher-order thinking skills, which include critical, metacognitive, reflective, logical, and creative thinking.

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Improving the quality of education can be achieved through effective assessment processes, prompting the government to implement ongoing improvements in the education sector. One notable enhancement in the 2013 curriculum focuses on assessment standards, which are being gradually adapted to international assessment models. The demands of 21st-century assessment emphasize measuring students' abilities to think critically, solve problems, gather information, and make informed decisions (Aryadi & Margunayasa, 2022; Redhana, 2019). Consequently, assessments must be authentic and prioritize higher-order thinking skills.

Higher Order Thinking Skill (HOTS) is a higher level of student thinking that can be developed through learning methods such as problem-solving methods, Bloom's taxonomy, teaching, and assessment processes. In addition, Higher Order Thinking Skill (HOTS) can be interpreted as something that happens to a person so that several characteristics arise, namely 1) talking about the level of understanding, 2) involving more than one answer, 3) having complex tasks, and 4) being free of content and at the same time content-related (Andrian, 2019; Inayati, 2020). In its implementation, the policy on HOTS instruments is usually regulated by the government or certain educational institutions. One form of policy that can be taken is to include HOTS instruments in the curriculum or national exams. This aims to ensure that students not only master the subject matter, but are also able to apply the knowledge and skills they have in more complex situations. In addition, the policy on HOTS instruments can also be implemented through teacher training and development (Antara, 2018; Julianti et al., 2021).

Students' thinking abilities can be divided into 3 levels, namely low-level thinking abilities, medium-level thinking abilities and high-level thinking abilities (Mudita et al., 2019; Putra et al., 2018). Low-level abilities involve the ability to remember (C1), understand (C2), medium-level thinking skills, namely, applying (C3) while high-level thinking skills involve analysis and synthesis (C4), evaluating (C5), and creating and creativity. Students who have high-level thinking skills can carry out the process of analyzing and evaluating a problem so as to create a solution. At the elementary school level, high-level thinking skills (HOTS) are something that is very important in order to produce good and competent graduates (Mudita et al., 2019; Putra et al., 2018).

But in reality, the assessments that are currently being conducted are still not in accordance with the demands of 21st century education. Such as research stating that there are still many teachers who have not developed test questions that contain HOTS elements in training students to be able to think at a high level. Similar things are also conveyed by other research stating that HOTS instruments are still very rarely developed at the elementary school level (Aryadi & Margunayasa, 2022; Fatimah, 2020). Therefore, students' high-level thinking skills are still relatively low. So that the demands of the curriculum cannot be achieved optimally. A similar thing was also found at the research site, a problem is that HOTS-based instruments have not been used in student assessment. The instruments developed are still sourced from teacher handbooks only, this can be seen when looking at the tasks given to students. The problem that arises is due to the absence of HOTS instruments, namely students are not trained to think critically and analyze information well. This can affect their ability to solve problems and make the right decisions. HOT instruments also help students to develop creative thinking skills. Without this instrument, students may not be trained to think outside the box and create innovative solutions. In addition, students may not be trained to understand more complex concepts and may have difficulty understanding more difficult subject matter. Without this instrument, students may not be trained to work together in groups, communicate well, and solve problems together.

Activities in the learning process are still lacking in facilitating students to develop HOTS skills, so learning problems need to be overcome. One strategy is to involve students to be more active in the learning process. In addition, high-level thinking skills or HOTS need to be developed early on as a provision for students in facing life's problems (Dewi et al., 2020; Fitriani, 2018). Students are said to be able to solve a problem if they are able to examine a problem and are able to use their knowledge in new situations. Scientific ability is known as higher order thinking skills. Higher order thinking skills are the ability to connect, manipulate, and change knowledge and experience that has been critically and creatively in determining decisions to solve problems in new situations (Fitriana, 2020; Mudita et al., 2019). Cognitive assessments tend to test more on aspects of remembering, while questions that train students' higher-order thinking skills tend to be absent (Fatra et al., 2022; Resnani, 2020). This causes students' high-level thinking skills to be less honed.

The lack of training in students' high-level thinking skills can also be seen from the results of the Mid-Semester Exam. The lack of teacher knowledge about developing HOTS-based test instruments is one of the reasons that many teachers still give questions that only measure students' low-level understanding. The low level of students' high-level thinking skills can also be seen from the urgency of previous research, namely that students' thinking skills that are still at the Lower Order Thinking Skills (LOTS) level are a concern because they are an obstacle for students in understanding the material taught by teachers (Aryadi

& Margunayasa, 2022; Revita & et al., 2018). Based on the results of interviews at the research location, it was obtained that teachers had never applied HOTS ability instruments to measure students' abilities, especially in grade VI. Teachers also did not analyze the level of difficulty, discrimination power, and distractor quality of the questions so that they could not train students' high-level thinking skills optimally. The cause was that the teacher's ability to compose questions that had HOTS elements was still low. Teachers did not understand HOTS ability instruments. The instruments available in the field were still in the range of C1 to C3 only.

Seeing the existing phenomenon, there needs to be a solution to solve the problem. The solution that can be provided is to develop HOTS ability instruments to train high-level thinking skills of students in elementary school in grade VI. In line with previous research which shows that there is an influence of HOTS through the SPPKB method in Mathematics learning on students' creative thinking skills (Susilawati, 2019; Widana & W., 2017). The HOTS ability instrument developed consists of questions that have cognitive levels C4 (analyzing), C5 (evaluating), and C6 (creating). Looking at the cognitive development of students, grade VI children are at the development level in the formal operational phase. In the formal operational phase, students are able to think systematically, develop hypotheses and formulate strategic steps in solving problems. Such thinking abilities require children to be able to think at a high level. Therefore, children's thinking abilities enter the realm of C4, C5, and C6 (Hudiyono & Ilyas, 2020; Putra et al., 2018). From the description above, the development of an instrument consisting of questions containing elements C4, C5, C6 is in accordance with the development of students in grade VI. Therefore, it is necessary to conduct a study entitled Development of Higher Order Thinking Skill (HOTS) Ability Instruments for Science Subjects in Grade VI Elementary School Students.

The novelty of this study is to offer a more precise and empirically tested instrument to help teachers and educators in measuring and improving critical and analytical thinking skills in elementary school students, especially in the context of science learning. Based on the problems and solutions offered, this study was conducted with the aim of analyzing the feasibility of the HOTS ability instrument for grade VI elementary school students in science subjects in measuring students' high-level thinking skills. Through this study, it is expected to be able to produce HOTS instruments for science subjects in grade VI of elementary school with test items that have very high item validity values and very good reliability, so that this instrument can be used by teachers to measure students' HOTS abilities in solving problems, and can train students' critical thinking skills.

2. METHOD

The research conducted is a type of development research. The HOTS-based test instrument developed refers to the four D (4D) development model. The 4D research model consists of four stages, namely define, design, develop, and disseminate. The define stage is carried out by analyzing students, analyzing tasks, analyzing concepts, and formulating learning objectives. The design stage compiles the test instrument grid to be developed, with printed media made in Ms. Word 2010 format, and using multiple choice questions. The develop stage consists of expert appraisal and developmental testing. Finally, the dissemination stage is carried out by socializing through limited distribution to educators in clusters and publishing articles.

The subject of this study is the HOTS Instrument. The object of this study is the quality of the questions produced. Data collection techniques used in this study are quantitative observation, interviews, questionnaires, and tests. The quantitative observation method is used to collect content validity data. The interview method is used to collect needs analysis data. The questionnaire is used to collect needs analysis data and practicality tests. And the test method is used to test the instrument. The instrument grid used in the study is presented in Table 1, Table 2, and Table 3.

Table 1. The Interview Instrument Grid

No.	Indicator	Answer Description
1.	Implementation of learning with the Curriculum	- Answers regarding the learning process carried out in class VI science subjects - Answers regarding whether or not there are differences in terms of methods, models, approaches or learning strategies
2.	Preparation of learning scenarios	- Answers regarding whether or not there are difficulties when teachers prepare learning plans or scenarios - Answers regarding teachers' opinions if learning plans are designed to improve students' HOTS

No.	Indicator	Answer Description
3.	Knowledge of Higher Order Thinking Skills (HOTS)	- Answers regarding teacher knowledge about HOTS - Answers regarding students' high-level thinking skills (HOTS) - Answers regarding learning obstacles in developing students' HOTS
4.	Expectations for development products	Answers regarding what kind of learning scenarios teachers expect to improve students' HOTS

Table 2. The Grid of Material Expert Validation Instrument

No.	Aspect	Assessment Items
1.	Compliance with KI and KD	Appropriate materialwith Core Competencies (KI) Material according to Basic Competencies (KD) Material according to learning indicators Materials in accordance with learning objectives
2.	Product Components	The questions presented are at cognitive domain levels C4, C5, and C6.
3.	Learning	Students are trained to work together in groups and communicate well. Students are trained to think critically and analytically Students are trained to develop their own abilities

Table 3. The Multiple-Choice Instrument Grid

No	Basic competencies	Indicator	Thinking Level		
			C4	C5	C6
1	3.3 Analyzing how living things adapt	Analyzing a phenomenon/ statement theory/concept (C4)	1		
	4.3 Presenting work on how living things adapt with its environment, as a result of exploring various sources.		2 3 4 7		
2		Assess a phenomenon/ theory/statement/draft		5,6	
3		Determining a solution to a problem (C6)		8,9,10	

In order for a multiple-choice test instrument to be declared suitable for use in research or learning evaluation, a series of comprehensive and in-depth analyses are required. First, a content validity test is conducted to ensure that each question item covers material that is in accordance with the learning objectives being measured, so that it is relevant and representative of the overall material being taught. Next, an item validity test is conducted to assess the extent to which each question item individually can measure the intended ability or knowledge. After that, a reliability test is conducted to determine the consistency of the results obtained from the test when used under different conditions. In addition, a discrimination power test is conducted to see the extent to which each question item is able to distinguish between participants with high and low abilities, so that only questions that have good discrimination power are retained. Finally, a difficulty level test is applied to determine whether the questions are too easy or too difficult for participants, so that a distribution of questions with a balanced level of difficulty is obtained.

3. RESULT AND DISCUSSION

Result

This study uses the Borg and Gall development model. The stages of the Borg and Gall model development in this development are simplified into 5 stages, namely, the preliminary study stage, the development stage, the validation stage, the field test stage and the product revision stage. In the preliminary stage, a curriculum analysis was carried out to determine the content of science learning for grade VI. The next stage is the development stage. In the development stage, the first step is to create a grid according to the KD and Indicators in the science subject. Next, compile questions according to the grid that

has been made. In this study, the researcher initially made 20 questions. The third stage is the validation stage. The validation stage is carried out to determine whether or not the questions that have been made are feasible. In the validation stage, there are 10 questions that are eliminated, leaving 10 questions that are tested feasible to continue to the next stage. After the questions are declared feasible, proceed to the fourth step, namely the field test stage. The field test stage aims to obtain respondent responses which will later be used as data analysis material. The field test in this study was conducted at SD N 2 Ped. The fifth stage is the revision stage. This revision stage is carried out to perfect things that are still not quite right. There are several questions that do not match the instructions with the intended question number so that students ask the meaning of the question. However, all of the inaccurate things have been corrected at this revision stage. By conducting this development research, it is hoped that it will produce a HOTS instrument that is suitable for measuring students' ability to solve problems and train students' critical and creative thinking skills.

To determine the feasibility of the developed instrument, several data analyses were conducted. The data analysis in question is the content validity test, item validity test, reliability test, question discrimination test, and question difficulty level test. The recapitulation of the data analysis results is presented in Table 4.

Table 4. The Data Analysis Recapitulation

No	Types of data analysis	Average Results	Category
1	Content validity test	0.40	Valid
2	Item validity test	0.40	Valid
3	Reliability test	0.71	Tall
4	Differential power test	0.45	Good
5	Difficulty level test	0.54	Currently

Discussion

In this study, an expert test was conducted before the instrument was distributed to determine the validity of the content using 5 experts, namely lecturers from the Faculty of Education, Undiksha. Content validity is the ability of a test to reflect the whole that is to be measured (Widana & W., 2017; Yusuf, 2018). The instrument is declared valid in terms of content if all experts have accepted the instrument without any further revision. The content validity test of this study uses the CVR (Content Validity Ratio) formula. Based on data analysis, valid content validity results were obtained. The calculation of content validity is carried out using the Gregory formula in the equation. Based on the results of the calculations of 5 experts, the result is 1.00. This shows that the expert test score is in the very high category. Thus, the assessment instrument can be used in research.

After knowing the validity of the content, then the analysis of the validity of the test items is carried out. A test of the validity of the device or test items is carried out to determine the ability of the questions to measure what should be measured. The analysis of the validity of the test items plays an important role in the quality of the questions developed. If there are still deficiencies, the questions can be improved to get maximum results. The validity of the items is analyzed using the point-biserial correlation formula. From the data analysis carried out, the results of the test items were obtained with an average score of 0.40. The level of significance used was 1% (0.36). From the results of the item analysis, the results of the validity test were obtained which were greater than the level of significance that had been determined or (rpbi > r table) meaning that each test item was declared Valid. This means that the test items can be relied on to measure the desired construct accurately. This is very important in ensuring that the measurement results can be used to make the right decisions, such as determining the abilities of students or employees in a field (Widana & W., 2017; Yusuf, 2018).

Next, a reliability test of the developed instrument was conducted. Reliability indicates the degree of consistency of student results in repeated assessments. An assessment instrument is said to be reliable if it obtains the same results when tested on the same respondents with different time spans. The reliability test of the instrument uses the KR-20 formula. The results of the reliability test obtained an average score of 0.71. From the results of the reliability test, it can be stated that the High Order Thinking Skill (HOTS) ability instrument in the Science subject of grade VI of elementary school that was developed has high reliability. High reliability indicates a small error in obtaining measurement results. The greater the reliability of an instrument, the smaller the measurement error, and vice versa, the smaller the reliability of the score, the greater the measurement results (Fatimah, 2020; Hujjatusnaini et al., 2022).

If validity and reliability have been obtained, it is continued by determining the discriminating power and level of difficulty of the instrument. Discriminating power is the ability of the instrument to distinguish students with high and low abilities. If the higher the ability of the question to distinguish

between the high and low groups, the higher the discriminating power index obtained. From the results of the data analysis calculations in this study, an average discriminating power score of 0.45 was obtained. From these results, it is stated that the High Order Thinking Skill (HOTS) ability instrument in the subject of grade VI of elementary school that was developed has good discriminating power. The test questions are said to have good discriminating power because they have a discriminating power figure of 0.40 <DP≤ 0.70 (Anggraini et al., 2021; Putri et al., 2021).

The next test is to determine the level of difficulty of the instrument. The level of difficulty is the proportion of students who answer the developed instrument correctly. The level of difficulty of the questions is determined by the number of students who answer correctly or incorrectly. The greater the percentage of students who answer the question correctly, the easier the question is. Likewise, the smaller the percentage of students who answer the question correctly, the more difficult the question is. From the data analysis test conducted, an average score of 0.54 was obtained, so that the level of difficulty of the High Order Thinking Skill (HOTS) ability instrument in the science subject of grade VI of elementary school that was developed was included in the Medium category (Abraham et al., 2021; Saraswati & Agustika, 2020). The instrument is categorized as moderate difficulty because it is neither too easy nor too difficult for students to answer. The questions in the instrument require students to use high-level thinking skills, such as critical thinking, creative thinking, collaboration, and communication, to solve problems and answer questions related to the theme. The questions are designed to challenge students' thinking skills and encourage them to think deeply and critically about the topic (Khaldun et al., 2019; Oscar & Ofianto, 2019).

HOTS-based learning is learning that develops critical thinking skills. Developing critical thinking requires practice in finding patterns, constructing explanations, making hypotheses, generalizing, and documenting findings with evidence. This study is supported by previous studies which state that the HOTS ability assessment instrument developed is feasible to be developed (Fitriani, 2018; Haryati et al., 2021). In addition, it is also in line with research stating that HOTS development research on science subjects with a total of 10 questions obtained valid criteria. The reliability test obtained an average score of 0.764 which is included in the high category (Dewi et al., 2020; Fadzam & Rokhimawan, 2020).

The instrument difficulty level test obtained 8 questions with medium criteria, and 2 questions with difficult criteria. For the results of the question discrimination test, the results were 2 questions with low discrimination power, 7 questions with good discrimination power, and 1 question with very good discrimination power. Not only that, this study is also supported by previous studies which state that the development of HOTS-based instruments using the QUIZISS application obtained a content validity test result of 94%, including in the very strong category, the item validity test obtained valid results (Dewi et al., 2020; Haryati et al., 2021). The reliability test of the instrument obtained a result of 0.77, which is included in the very strong category. The test of the level of difficulty of the instrument obtained a result of 1 question included in the difficult category, 7 questions included in the easy category, and 2 questions included in the moderate category. So, it is believed that the HOTS instrument in the Science subject is suitable for use in elementary schools in measuring students' HOTS abilities in solving problems.

From the results of the data analysis above, as well as previous studies, the HOTS ability instrument for grade VI elementary school students in the Science subject is declared feasible to be used to measure and train critical thinking skills and problem-solving skills of students. The HOTS ability instrument that was developed can be used to measure 3 levels of student thinking skills, namely, C4 (analyzing), C5 (evaluating), and C6 (creating). Therefore, the HOTS instrument is very important to be developed in order to train students to think at a high level (Cholis Sa'dijah, 2021; Inayati, 2020).

The implication of this study is the production of HOTS instruments for Science subjects in grade VI of elementary school with test items that have very high item validity values and very good reliability. This instrument can be used by teachers to measure students' HOTS abilities in solving problems, and can train students' critical thinking skills (Hulukati & Rahmi, 2020; Novitasari & Wardani, 2020). In addition, the development of this HOTS instrument can be used as a guideline for teachers in compiling HOTS instruments. However, of course this study has shortcomings such as the scope of the study which is still limited, it is hoped that this study can be used as a guideline for other researchers to develop similar instruments but with much more innovative updates.

4. CONCLUSION

Based on the results of the research and data analysis conducted, the High Order Thinking Skills (HOTS) assessment instrument for science subjects in sixth grade elementary school students has been shown to have high validity and reliability. This instrument effectively measures three levels of thinking: C4 (analyzing), C5 (evaluating), and C6 (creating), with adequate question quality in terms of discriminating power and level of difficulty. Therefore, it is suitable for assessing students' critical thinking and problem-

solving abilities, and it provides guidelines for teachers in compiling HOTS-based questions. Although this study has limitations, its results make an important contribution to the development of similar instruments in the future.

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