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HOTS-Based Science Learning Outcomes Assessment Instrument for Measuring Elementary School Learning Outcomes

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ABSTRAK

Guru memiliki kewajiban untuk menyusun instrumen penilaian yang efektif agar dapat mengukur hasil belajar siswa dengan baik. Instrumen penilaian juga harus meningkatkan kemampuan berpikir siswa (HOTS). Namun guru mengalami kesulitan dalam menyusun instrumen penilaian berdasarkan KKO Taksonomi Bloom Revisi dan instrumen penilaian yang disusun masih berorientasi pada LOTS. Sejauh ini belum ada penelitian yang membahas mengenai penyusunan instrumen penilaian hasil belajar IPA berbasis HOTS. Oleh karena itu, penelitian ini bertujuan untuk mengembangkan instrumen penilaian berorientasi HOTS pada muatan IPA. Adapun penelitian ini merupakan penelitian pengembangan dengan model 4-D. Subjek penelitian ini yaitu 69 siswa dan melibatkan dua orang dosen ahli/pakar IPA. Pengumpulan data pada penelitian ini menggunakan metode tes pilihan ganda. Teknik analisis data pada penelitian ini adalah validitas, reliabilitas, daya beda, tingkat kesukaran, dan kualitas pengecoh. Hasil penelitian menunjukkan instrumen penilaian yang dikembangkan dinyatakan valid, memiliki reliabilitas tinggi (reliable), tingkat kesukaran berada pada kategori sangat baik, pada daya beda dinyatakan instrumen memiliki daya beda yang baik, dan kualitas pengecoh berfungsi dengan baik. Hasil uji tersebut menunjukkan bahwa, instrumen penilaian hasil belajar IPA berorientasi HOTS layak digunakan dalam mengukur hasil belajar siswa. Implikasi penelitian ini yaitu apabila instrumen penilaian berstandar HOTS digunakan secara terus-menerus, maka akan berdampak pada peningkatan cara berpikir siswa.

ABSTRACT

Teachers should develop effective assessment instruments to measure student learning outcomes well. Assessment instruments must also improve students' thinking abilities (HOTS). However, teachers need help compiling assessment instruments based on Revised Bloom's KKO Taxonomy, and the assessment instruments prepared are still LOTS-oriented. So far, research has yet to discuss the preparation of HOTS-based science learning outcomes assessment instruments. Therefore, this research aims to develop a HOTS-oriented assessment instrument for science content. This research is development research with a 4-D model. The subjects of this research were 69 students and involved two expert lecturers/science experts. Data collection in this study used the multiple-choice test method. The data analysis techniques in this research are validity, reliability, distinguishability, level of difficulty, and quality of distractors. The results of the research show that the assessment instrument developed is declared valid, has high reliability (reliable), and the level of difficulty is in the very good category; in terms of different power, it is stated that the instrument has good different power, and the quality of the distractor functions well. The test results show that the HOTS-oriented science learning outcomes assessment instrument is suitable for measuring student learning outcomes. This research implies that continuously using the HOTS standard assessment instrument will improve students' thinking.

1. INTRODUCTION

Education or learning is one of the most important parts of life (Dewi & Putra, 2018; Pratama et al., 2018; Wijaya et al., 2018). One part of learning is assessment. Assessment is an activity commonly carried out by educators to determine the achievement of students (Handini et al., 2020; Mahirah, 2017). The purpose of assessment is to help students in the learning process. Assessment can also provide an overview of the development of students' learning (Umami, 2018; Yusup, 2018). HOTS, or higher-order thinking Skill,

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is a high-level thinking ability that can encourage students to improve their thinking (Rizal & Wulandari, 2020; Wahid & Karimah, 2018). HOTS in Bloom's revised taxonomy has KKO or operational verbs, namely analysis (C4), evaluation (C5), and creation (C6). Teachers must be able to develop HOTS assessment instruments so that in the learning process, there is an increase in the way students think (M. Z. Fanani, 2018; Pratiwi & Fasha, 2015).

Today's assessment instruments should include more than low-level thinking skills (LOTS). Still, they should also pay attention to higher levels of thinking (HOTS) so students can develop their thinking skills (Suratmi et al., 2020; Fanani & Kusmaharti, 2018). HOTS assessment is aimed at a person's thinking ability, which requires students to think at a higher level and optimize students' abilities. HOTS can be carried out well if students are directly involved in the teaching and learning process; then, students can analyze, sort, and solve problems (Agustina, 2019; Pamungkas, 2019). If students are given HOTS questions on an ongoing basis, it can challenge them to increase their potential (Sofyan, 2019; Warmi et al., 2019). HOTS is a cognitive level that exists at a high level, starting from analyzing and evaluating to creating to produce evidence that forms the basis of an assessment itself (Otty & Milton, 2019; Nachiappan et al., 2018; Raiyn & Tilchin, 2016). HOTS is a critical thinking process and a basic skill in everyday life (Utaminingtyas, 2020; Tajudin & Chinnappan, 2016). Working on HOTS questions means that students learn to make wise decisions. When developing HOTS assessment instruments, the stimulus must be considered a foundation to attract students to answer HOTS-oriented questions (Handini et al., 2020; Yayuk et al., 2019). HOTS-oriented assessment instruments require students to think at a higher level and use cognitive levels from C4-C6 to form good-quality students. Teachers must develop and implement HOTS questions at the elementary level because this can help train thinking to a higher level.

Based on the results of observations and interviews conducted with homeroom teachers on November 13, 2020, in three schools in Gugus 2 Kubu, namely SD Negeri 1 Sukadana, SD Negeri 3 Sukadana, and SD N 4 Sukadana, the problem was found that teachers had difficulty in preparing assessment instruments. Teachers have yet to compile instruments based on students' cognitive levels, and the assessment instruments prepared by teachers are still oriented to LOTS. This has an impact on the low thinking ability of students. Similar problems were also found in previous research, which showed no development of HOTS-based instruments, so students' abilities were still low (Hanik & Ngazizah, 2020; Suhady et al., 2020). Previous research has discussed the development of HOTS assessment instruments. The results showed that the assessment instruments developed were theoretically and empirically feasible. The results also showed that the instrument was successful or effective in achieving student learning success . Developing HOTS assessment instruments can help form students of good quality, which can improve students' thinking skills. Based on the problems described, this study offers a solution to develop a HOTS-oriented assessment instrument that can improve students' thinking skills. Previous research has been conducted on developing HOTS instruments (Aini & Sulistyani, 2019; Rif et al., 2018; Taufiqurrahman et al., 2018). However, the difference between the current and previous studies lies in the subject and research variables. The current study used elementary school students as subjects, and the variable used was student learning outcomes.

This research aims to develop HOTS assessment instruments to improve students' thinking skills. Preparing this HOTS assessment instrument is expected to have a major impact on improving students' thinking. The learning outcome instrument used in this research is an objective or multiple-choice test. HOTS-oriented science learning outcomes assessment instruments are very feasible to develop because, nowadays, the younger generation must have a higher quality of thinking.

2. METHOD

This research is a type of research and development, and the development model used is the 4D model. The stages in this study are only up to the development or development stage. The 4D model starts from this development, namely the stages of defining (define), planning (design), developing (development), and disseminating (disseminate). The defining stage aims to determine and define the requirements for learning. The second stage, namely design, aims to design or design an assessment instrument; the third stage, namely development, is the stage that produces the product of development. This stage of development produces the final form of the instrument after going through revisions based on expert input. The subjects in this study were 69 students in Gugus 2 Kubu. The number of experts in this study was two science material expert lecturers. The data collection method used is a test with an objective form (multiple choice). The test was prepared by KD TEMA 6 on science content and used KKO from Bloom's Taxonomy after revision with the cognitive level used C4-C6 (HOTS). The test was made as many as 30 items, and each test item had four alternative answers. Meanwhile, the data analysis techniques used in this

study are content validity, item validity, reliability, difficulty level, differentiating power, and quality of the checkers.

In the content validity analysis, the science learning outcomes assessment instrument was tested by two science experts. In contrast, the results of the content validity calculation were included in the 2x2 cross-tabulation table. After that, the results of the content validity analysis would be analyzed using the Gregory formula. Item validity analysis is conducted to determine the number of valid and invalid items and test their validity using the point-biserial formula. Furthermore, the reliability test is carried out to determine the constancy of a measurement. To determine the instrument's reliability using the Kuder Richardson 20 (KR20) formula.

The difficulty level can explain how many test participants answer the question items correctly. The formula used to determine the difficulty level of the question items is the P formula (difficulty index). Furthermore, differential power attempts to determine the ability of questions prepared through the answers of students with low and high abilities. The quality of the exception can be effective if the students who choose the exception come from the lower group. However, if high-ability students answer the question more, the exception is ineffcould be more. The formula used is the IP (Excerpts Index) formula. The quality of an exception is said to have good effectiveness when it is chosen by students at least 5% of the total number of students.

3. RESULT AND DISCUSSION

Result

The results of this development research are in the form of HOTS-oriented science learning outcomes assessment instruments. The instrument used to measure science learning outcomes in theme 6 is an objective test or multiple choice of 30 items. The development of HOTS-oriented learning outcomes instruments starts from the defining stage. This stage is divided into several stages, including initial analysis. This stage is carried out to find out the basic problems in developing assessment instruments to prepare for the needs of the field and the analysis of students. At this stage, it is very important to do task analysis to know students' character; task analysis aims to define or determine the material used in compiling science learning outcomes instruments. The second stage is the design stage, which aims to design an assessment instrument for science learning outcomes that will be used. As for this design stage, a grid is prepared to facilitate the instrument preparation. The grid in this study is a grid of HOTS instruments for science learning outcomes, designing initial instruments that aim to make the initial framework of an instrument. The grids made are sourced from the fifth-grade teacher's book SD / MI Thematic Curriculum 2013 Revised 2017. The question grids are presented in Table 1.

Table 1. HOTS Assessment Instrument Grid for THEME 6 Elementary School Science Content

Basic competencies

3.6 Apply the concept of heat transfer and temperature in everyday life

Indicator		Knowledge Aspect	Total Question	Question Number
3.6.1	Analyze the types of heat transfer in everyday life.	C4	4	1, 2, 3, 4
3.6.2	Analyze surrounding objects that can conduct heat.	C4	4	5, 6, 7, 8
3.6.3	Analyze temperature and heat differences.	C4	1	9
3.6.4	Analyze the heat transfer process	C4	2	10, 11
3.6.5	Analyze objects that can conduct heat in everyday life	C4	2	12, 13
3.6.6	Analyze the concept of temperature and heat changes in everyday life	C4	2	14, 15
3.6.7	Select the properties of heat in everyday life	C5	4	16,17, 18, 19
3.6.8	Summarize the heat transfer process in everyday life.	C5	1	20
3.6.9	Find parts of objects that can conduct heat.	C6	1	21
3.6.10	Proving the misuse of heat in everyday life	C5	1	22
3.6.11	Proving the effects of temperature on life daily.	C5	2	23, 24
3.6.12	Analyze examples of heat transfer activities.	C4	1	25
3.6.13	Analyze the function of objects in heat transfer.	C4	4	26, 27 28

Indicator	Knowledge Aspect	Total Question	Question Number
3.6.14 Analyze the concept of heat transfer and temperature in everyday life.	C4	2	29, 30

The third stage is the development stage. This stage aims to produce instruments that have been revised by experts or experts, and instrument trials, at this stage, consist of expert validation (expert appraisal) and developmental testing expert validation (expert appraisal). This expert validation is a step that must be carried out to determine which instruments are relevant and which are irrelevant. This expert validation is carried out by analyzing the content validity of expert experts. Experts will assess the instrument made to perfect it. Product testing (development testing), development testing is an activity to test the design of the assessment instrument; at this stage, a limited trial is carried out through two stages, namely the first stage of individual testing and then in the second stage, a small group trial is carried out. The fourth stage, dissemination (dissemination), was not carried out due to the researchers' limitations, time, and finances. Based on the calculation mechanism that has been carried out and involving two science expert lecturers, the content validity coefficient of the HOTS assessment instrument for science learning outcomes is 1.00. This means that the content validity results obtained are in a very high category. Furthermore, the item validity analysis was carried out. Based on the tests that have been carried out, there are two invalid questions and 28 valid questions. The reliability analysis results of 28 questions are obtained as r11 = 0.7124. This question has high reliability (good) because the correlation coefficient value is high.

Based on the test of the level of difficulty of the science learning outcomes instrument that has been carried out from 30 items of the instrument, two items of the instrument are included in the easy category, 25 items of the instrument are included in the medium category, and 1 item of the instrument is included in the difficult category (Pp = 0.2898). Based on the differentiation test conducted on 28 items of science learning outcomes instruments, 1 item of the instrument with very good criteria was obtained, five items of the instrument including good differentiation, 20 items of the instrument including moderately good differentiation, 1 item of the instrument including poor differentiation and 1 item of the instrument with very poor criteria. Based on the exception quality test conducted on 30 science learning outcomes instrument items, 30 were obtained with acceptable (good) criteria, with P>5% as many as 90 and P <5% as many as 0. It can be interpreted that all items have good exception quality at 100%.

The content validity analysis states that the instrument has high content validity because of the high relative coefficient value. In the item validity analysis, a valid assessment instrument means that the assessment instrument is of good quality and has performed its function appropriately. Meanwhile, there still needs to be more adjustments on basic competencies, grammar, and material for invalid questions. The question items are said to be valid if rcount> rtable, rcount is obtained through the results of data analysis, while finding rtable is done by determining the significance level of 5%, then obtained rtable = 0.2335. In the reliability test, the results were obtained in the good category because the coefficient value was relatively high.

HOTS assessment instruments on the difficulty level of all questions are feasible. They are in the good category because an assessment instrument must use a measure of 25% in the difficult category, 25% in the easy category, and 50% in the medium category so that the assessment instrument is said to be feasible to use. The difference test results are good because, from the difference analysis, 26 questions were used to measure the next learning outcomes, and two questions were set aside because they had poor differentiation. In the results of the quality of the exterminators, the results are very good because the quality of the exterminators is said to be good if at least 5% of the test participants are selected, and all test participants answer more than 5% of the exterminators.

Discussion

Every teacher must check students' understanding using assessment. Educators generally routinely assess students' achievement. The assessment should measure students' higher-level thinking skills, often called HOTS. HOTS in Bloom's revised taxonomy includes operational verbs such as analysis (C4), evaluation (C5), and creation (C6). Teachers must develop HOTS assessment instruments to improve students' thinking. HOTS assessment emphasizes higher-order thinking skills that require direct student involvement in the learning process, including analysis, sorting, and problem-solving. HOTS questions require students to think at a higher level using the C4-C6 cognitive level, which can shape the quality of good students. Especially in elementary schools, teachers must develop and implement HOTS questions well to train students' thinking to a higher level. The instrument in this study has undergone several stages, namely the planning, design, and development stages. In addition, the instruments made have also gone through content validity. Validity is the accuracy in measuring the quality of question items (Anita et al.,

2018; Aji & Winarno, 2016). The results of the instrument's validity showed that the instrument has high validity. Factors that can affect the validity of invalidation are divided into two; the first is the factor of the instrument itself, meaning that as effectively as the instrument can measure student learning outcomes appropriately, if the instrument cannot measure learning outcomes properly, it will produce invalidation. The second factor is related to students; in this case, the researcher must be able to know the aspects that exist in students and adjust them to the instrument to be tested.

The reliability test is intended to measure the level of consistency of the answers to the learning outcomes instrument (Subakti & Prasetya, 2020; Aji & Winarno, 2016). The reliability test results show high reliability and correlation coefficient values. All questions in the HOTS assessment instrument have an appropriate difficulty level and can be considered good for use. The assessments prepared should have a fair level of difficulty to be suitable for students. This aligns with previous research stating that good questions are challenging for students to answer (Solichin, 2017; Aji & Winarno, 2016). We got very good results on different tests. Items with good and very good differentiating power will be included in the question bank and later used for the following measurements.

Question items with poor or very poor differentiation should be included in the next test because the quality of the questions could be better and more adequate. The distinguishing power of an instrument is the ability of the instrument to separate intelligent subjects from less intelligent subjects in a group (Prihatiningtyas et al., 2017; Aji & Winarno, 2016). Likewise, when assessing the quality of distractors, the results showed that they were very good. The presence of distractors can trick children into choosing answers. This is in line with previous research, which revealed that the goal of distractors is to trick children into choosing answers that are difficult to differentiate (Akbar, 2020; Muluki et al., 2020).

Overall, this latest instrument is suitable for measuring student learning outcomes. This research implies that if the HOTS assessment instrument is used continuously, it will impact students' way of thinking, which will experience improvement. The advantage of this research lies in the complete and more accurate analysis of the data used, which will improve the quality of the instrument. Meanwhile, the limitation of this research is that the instrument created is only limited to KD Theme 6, so it only covers some aspects of science material as a whole. Future research can develop a broader HOTS assessment instrument for science learning to improve students' thinking abilities.

4. CONCLUSION

Referring to the results and discussion, it can be concluded that the latest assessment instrument that has been developed is declared valid, has high reliability (reliable), the level of difficulty is in the very good category, in terms of different power it is stated that the instrument has good different power and the quality of the distractor functions. The test results show that the HOTS-oriented learning outcomes assessment instrument for science content is suitable for measuring student learning outcomes.

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