

The Development of "HOTS" Assessment Instruments in Enhanced Students' Understanding of Elementary School Science Subjects

Widia Indah Rahayu^{1*}, Yuyu Yuhana¹, Ratna Sari Dewi¹

¹ Elementary School Magister Program, Faculty Of Teacher And Education, Sultan Ageng Tirtayasa University, Banten, Indonesia.

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Corresponding Author:

Widia Indah Rahayu

widiaindahrahayu.28@gmail.com

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Abstract: Education is a learning process that enables the younger generation to live their lives more effectively and efficiently. Teacher are one of the purpose of the learning process. Teachers who do learning in a class using a model or a varying learning method will develop abilities and skills. The research was intended for the development of test assessments in the form of hots at the elementary school for the fourth grade. The "r&d" study method used. Research development with a four (4D) model of 4 degrees define, design, development and disseminate. The methods of data collection used to validate the development of instruments to assess students' understanding of the scientific topic of nature are a component of research development. Based on data analysis of the validation team experts in Numbers form, the evaluating stage is scaled at 94%, making a 92% conclusion, integrating 94%, identifying 91%, and on the explaining aspect is obtained 89%. The results of test instruments include cognition with an 85% percentage, a 95% afscreening aspect and a 90% psychomotor aspect. Activate the test tools of the "very good" instruments that enable it in the student's understanding at school.

Keywords: Assessment instruments; Hots; Science subjects

Introduction

Education is a process that enables the younger generation to live their lives more effectively and efficiently and achieve their goals. Values and character may be shaped through education (Lafendry, 2023). Education in the "system no 20 in 2003" law is defined asa deliberate conscious effort in recognizing the learning environment so that a student can maximize their ability by working hard for civilization, country, and nation is a necessary skill of noble character, personality, intelligence, and self-control (Mawati et al., 2023). The current education arrangement focuses more on integrated learning processes, teachers should be able to develop students' maximum potential for the future life-solving skills (Astiwi et al., 2020).

Relevant materials of natural knowledge are linked to student daily activities and included in natural science learning (Azizatunnisa et al., 2022). Students also have the opportunity to develop their curiosity in school science (Widari et al., 2022). A teacher is the focal point

or spearhead of the learning process, the success of an educator determines a student's success during giving learning (Sumar et al., 2020). The learner's assessment in the process requires an assessment technique and good judgment instrument according to the learning application (Fitriawan et al., 2023).

Techniques and assessments are needed to gain learning from students who can accurately represent all the student's capacities in an effort to improve the student's learning results (Wulandari et al., 2018). Teachers can enhance and perfect the learning programs and tasks they assign their students using the assessment results as feedback (Magdalena et al., 2023). Using "Hots" based tests on teaching can help students to gain the capacity to think critical and innovative, as well as prepare them for challenges in modern society, and grow into competent humans (Kosash et al., 2022).

However, elementary school studies reveal that many teachers still use a lower order of thought skills (lots) (Hendriawan et al., 2019). Teachers cannot create hots instruments because they have no knowledge of

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how to do them, have no access to training about how to create the same instruments, and lack sufficient quality of hots content to be used as a reference (Suarti, 2022). Many students also need help in developing high-level reasoning skills because they have not yet attained the purpose of learning (Angela et al., 2023).

This suggests that with the lack of the ability of Indonesians to think critically, according to the study analysis of Pisa. The problem that Pisa validate is the one that has the greatest influence on the lives of everyday students. Loaded in c4 (analysis), c5 (assessment), and the c6 cognitives (creating). A good critical thinking ability through tests by Pisa can foster creativity in students (Udayani et al., 2022). Hots based instrument development in learning can encourage students to become more critical thinkers and increase learning and results activities so that lessons are more efficient, effective, and fun.

A program developed by the based learning and ministry (kemdikbud) that he enrolled in 2018 and focuses on teaching students how to use a higher order of thought skills, also known as hots (Dwijayanti, 2021). The capacity to think is divided into two lower levels of lower order of thought or thought (lot) and higher levels of thought capacity (Rangkuti et al., 2022). In learning, hots' judgments can be used as a guide so that students can modify and create what they already know to make or create something new (Rozi et al., 2019). It is hoped that by training students with learning "hots", students will be able to analyze in their critical way of thinking (Inayati, 2020).

According to previous studies, hots are a tool for students to think high through c-4 which is analysis, c-5 that is evaluation, c-6 and creative (Lamhatin et al., 2022) By encouraging students to think critically, logically, reflective, constructive, and creative, hots can benefit students' productivity in learning (Dinna Ririn Agustina, 2019). Hots emphasize that education can motivate learners to be creative and use an educational strategy that is centered on active learners, giving them the motivation and the ability to discuss, ask, ask, and communicate (Fanani et al., 2022).

From previous research, we can draw a conclusion that development based on hots instruments is able to understand students' ability to perform tasks based on existing realities and be able to relate different facts. In connection with this, researchers are developing according to the hots based assessments as assessment instruments in science class. As for the purpose developed by the researcher to make a hots evaluation tool, understand its validity, and understand user reactions. Hence, researchers have developed the instruments upon which this investigation is based. "Hots-based assessment tools development to enhance

students' understanding of elementary school natural science materials".

Method

The purpose of the study is the development of R&D research, with the 4D development model used to create r&d research methodology. There are four stages of the 4d research model to define, design, develop and disseminate (Hanik et al., 2021). Steps taken to create a self-reliance learning tool with model 4D are as follows: first, research begins by examining problems that arise in a particular field. Researchers are also looking for references to a newly developed object. Second, during the step of the researchers' planning, a lattice began on the objects to be built. Third, the stage of creation. Researchers began producing a self-reliance study tool that the validator, in turn, validated to see its validity (Audhiha et al., 2022). Fourth, researchers tried intrumen to use on 10 students in the school to ensure that the instruments were valid.

Research was conducted at SDN karawaci baru 1 City of tangerang in 2022/2023. The data-collection technique used to study the development of a hots based assessment instrument is a method of assessing the validity of instrument development that measures students' understanding of scientific topics on scientific learning. Data analysis techniques used to assess the validation of instruments and validity are:

$$\text{Assessment results} = \frac{\text{Min amount}}{\text{Max amount}} \times 100 \% \times \quad (1)$$

If the validation is 0%-19%, then the validity category is not good, if it is by 20%-39%, then the validity category is inadequate, if 40%-59% then the validity category is good enough. If it's 60%-79% then the validity category is good and if 80%- 100% then the validity category is really good.

Table 1. Valiant Criteria (Kurnia et al., 2022)

Result	Category
80 - 100	"Really good"
60 - 79	"Good"
40 - 59	"Good Enough"
20 - 39	"Inadequate"
0 - 19	"Not Good"

Experimental design, data types, data gathering tools, and technical data analysis were all tested to determine the validity of a hots based evaluation simultaneously. Testing of hots based intrumen assessments involves several phases, including the early stages, intrumen hots assessment, testing, and product revisions. Subject with 10 students on SDN Karawaci

Baru 1 City of Tangerang. C1-C5 research indicators are used to develop HOTS based scientific assessment tools.

Result and Discussion

Define

Early stage researchers define problems that arise and analyze problems with a teacher's understanding of HOTS, the capacity to improve HOTS instruments, being able to produce HOTS based tests, overcoming problems and students' ability to understand the HOTS' instruments is inadequate (Kurnia et al., 2022). The information on HOTS based instruments teachers use comes from structured interviews with teachers and assessment instruments at school. Indicates that much of the HOTS learning is based on remembering (C1), understanding (C2), and application (C3). According to the supplementary information, the topic the student studied in class IV is considered to be complex, requiring a strong understanding of concepts that require sharp thinking. Therefore, an evaluation tool is needed for lessons based on HOTS' assessment.

Design

The lattice of "HOTS"-based instruments for measuring student understanding is then developed by researchers at the design stage. The findings from the study of the design process, which is: the first design for developing HOTS based instruments prepared for an evaluation tool using lattices, developing test issues, and making answers. The second design creates HOTS based instrument development for science lessons on growth and development in living things. The third design creates a materials validation sheet, an expert validation sheet, and a user response questionnaire that serves as an assessment tool. The final design of the instrument for testing is distributed and distributed to students (Setiawan, 2019).

The distribution of test instruments is given to 10 students in class IV SDN Karawaci Baru 1 to determine the effectiveness of learning and response by using a test instrument based on HOTS. Regarding the HOTS evaluation indicator is found at Table 2.

The indicators that have been established are at the cognitive level of HOTS, which enables students to think broadly and deeply, analyze, integrate, and connect knowledge to solve problems. Multiple choice question styles continue to deal with analysis levels with problem solving indicators, understanding problems with linked data. Alternatives to solutions offered in answer options are still available for students who analyze the problem (Rini et al., 2021). This intriguing stimulation is intended to encourage students to learn. This stimulation can be an actual illustration, graph, table, or event in daily life.

Table 2. Problem Indicator (Rizky, 2022)

Indicator	Lattice
C5	Knowing the elements of science in difficult circumstances. Projecting, megcritics and redirecting into appropriate empirical data to respond to circumstance. Creating arguments and explanations based on fact and critical analysis
C4	Linking knowledge of natural science to current technology Combining the study of science into all aspects of life Make use of the information and evidence available, and consider the results of the choices made.
C3	Breaking up a science that appears in different spheres of life Sequencing science in facts as well as in phenomena
C2	Presents common knowledge in scientific knowledge and technology. Do research on critical technology-related problems
C1	Indicates conditions that are often encountered in the applied situation. Explain information scientifically

Table 3. The Lattice on HOTS

Examples of problem	Cognitive level
Determine the correct butterfly's life cycle by looking at the picture below:	C4



- Butterfly - cocoons - caterpillar - egg
- Butterfly - caterpillar - egg - cocoons
- Egg - caterpillar - butterfly - cocoons
- Egg - caterpillar - cocoons - butterfly

Develop

The concept of HOTS is used to hone students' abilities. A higher level of reasoning, also known as high level of thinking or HOTS, is a method of thinking that is more likely to rely on logic than memorizing facts or formulas, thus allowing for more difficult problems (Rangkuti et al., 2022). A unified science assessment instrument encompassing an assessment is based on the purpose of learning to deepen a disciple's understanding. Used to assess students' ability to deepen their understanding of problems relating to the growth and development materials of living creatures.

Through analysis of the assessed aspect criteria, the results of the validation by three validator checked on the 5 items on HOTS based tests to increase student understanding with indicators: explaining, developing, making conclusions, explaining, and creating strategy and tactical rules (Trimawati et al., 2020).

Table 4. Results Validating by The Expert Validator

Assessment indicator	Validator 1	Validator 2	Results	Category
Evaluation	95	92	94	Really good
Conclusion	94	90	92	Really good
Integrating	95	92	94	Really good
Identifying	92	90	91	Really good
Explain	89	89	89	Really good
Amount	465	453	459	Really good
Average	93%	91%	92%	Really good

Assessment by the validator matter is focused on the HOTS based assessment with a c1-c5 indicator that is: Explain, identify, integrate, make conclusions, and evaluate. As for the results of validation by the validator indicated by the validator of materials experts on table 3 which indicates that the findings of data analysis and the confirmation of a team of experts on the element evaluated received a percentage of 94%. On the aspect of drawing a 92% conclusion, student achievement integrates 94%, on the capitulation identifies 91%, and on the explaining aspect gained an average of 89%.

Validation percentage of the validator expert with an average of 92% with excellent results. This instrument in the HOTS based assessment development is effectively made with five material items on a science lesson with a subject of growth and development in living beings. Each validator was asked to evaluate the evaluation tools that researchers have created and to offer suggestions for improvement. From the results of the validator researchers came up with suggestions and improvements.

As to the suggestions and input of the validator, one is to increase the HOTS indicator. The suggestion is, to match the problem, use both learning indicators and problem indicators, compose the development of the problem text, and provide further problems by measuring learning. HOTS based evaluation tools that have reached c4 and c5 levels are created in accordance with assessment components, but, on instruments, the cognitive level of c6 does not arise because researchers only do problem solving.

Because the researchers' limitations in formulating problems, the cognitive level of c6 does not include in instruments created for HOTS based evaluations, which are already on c4 and c5 levels. Regarding the cognitive level of c4 and c5, which has been attained by researchers developed and encouraged. Regarding the

cognitive level of c4 and c5, this study is still in its infancy, but it has stimulated student thinking ability, with an average overall percentage of 92% in very good categories.

Discussion

Validity of the instrument

The next step is to test and involve the HOTS based assessment system on science materials to increase students' understanding of the growth of living things and its development. Experiments are conducted on students for test observations based on HOTS, because rarely get a HOTS based problem on questions, many students are having trouble responding.

This led to the conclusion that students needed a wide range of intelligible problem - solving ideas and analysis. HOTS based evaluation tools encourage critical thinking and develop high levels of ability, so with these HOTS based instruments able to help students develop their ability to understand their own concepts and solve problems. Although students already can recognize the problem but further analysis is needed to produce a valid answer. Based on table 5. To determine whether the HOTS' basin-based test is accurate or not, a reliable analysis can be used.

Table 5. Results the Validity of the HOTS-Based Question Instrument

Validity index	Question	Amount	Percent
> 0.349	1,2,4,5	4	80%
< 0.349	3	1	20%

There are 4 valid test questions as well as 1 invalid test questions from the 5 test questions given to learners. The results of verifying the issue must be taken into account. The validity of the problem given to students is low with some of the factors at most, many students still do not understand how to answer with critical thought analysis, students are not accustomed to reading and reasoning from long texts. Students say that giving instrument HOTS is more challenging than a teacher's test.

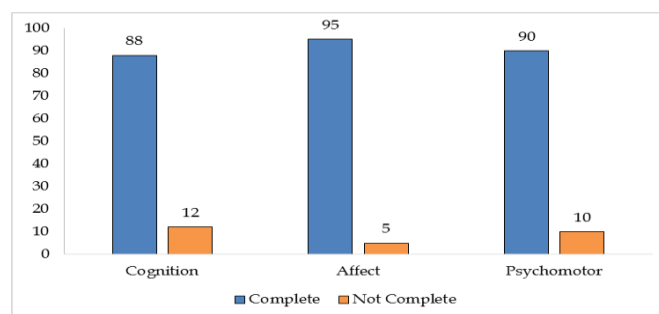


Figure 1. Diagram of Test Results

The process of assessment must be done objectively, and it is arranged according to a subjective

element asa consideration of judging (Destiana et al., 2020). To that researchers make the "Hots" assessments through cognitive domains, affective domains and psychomotors. It is then necessary to evaluate both cognitive, affective and psychomotor learning in order to show the results of student achievement at school. As for the hots based value-based response results shown on Figure 1.

From the graph results can be seen on the cognition aspect 85%, affective aspect 95%, the psychomotor aspect 90%. As a result, student responses reach 90% with excellent results. This harmonizes with cognitive reactions, which is an illustration of what a person knows, understands, and trusts (Hanik et al., 2021).

Conclusion

The following conclusions are derived from research on the development of hots based test instruments. A product with a lattice of problems, evaluations, test problems, answer sheets, and answer keys has been made using a hots based testing device. The product can be used asa source of assessment to introduce current problems to new students IV SDN Karawaci Baru 1. Established, defining, designing, defining, and developing phases of development. In the material expert to evaluate the ability of the test and establish a value. On the aspect of identification obtained a percentage of 94%. Capitation of aspects leads to a conclusion of 92%, student achievement integrates 94%, on capitation identifies 91%, and on the explaining aspect is obtained rerata 89%. The results of the test on learners in the cognitive region get an 88% percentage, an aspect of the perception gets 95%, the aspect of psychomotor gets 90%, so the average response result is 90% good. As a result, students are better able to understand the science learning topic more quickly after obtaining a variety of information, using their knowledge to solve problems creatively, and making decisions in complex circumstances.

Author Contributions

Widia Indah Rahayu conceptualization, which includes research ideas, design with methodology, data analysis, and coordination of respondents. Yuyu Yuhana conceptualization has been carried out by reviewing investigation research, literature review and provided feedback on the manuscript.

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Conflicts of Interest

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