

DEVELOPMENT OF HIGHER ORDER THINKING SKILL TEST INSTRUMENT IN PACKAGED FOODS TOPIC TO ENHANCE CRITICAL THINKING ABILITY OF JUNIOR HIGH SCHOOL STUDENTS

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Abstract: Schools have not fully implemented learning activities designed to improve students' critical thinking skills. The HOTS test instrument can teach students to think critically. This research aims to analyze the level of validation of the HOTS test instrument on the theme of packaged food to foster the critical thinking skills of junior high school students. This study uses the Borg & Gall development model as a research and development (R&D) method. The R&D stages include potential and problem analysis, data collection, product design, validation, and revision. This research results from the HOTS test instrument, which consists of 30 open essay questions. The validation results show that, based on material experts, 82.8% are included in the valid category, 92.3% are included in the very valid category based on evaluation experts, and 87.82% are included in the very valid category based on expert practitioners. The HOTS test instrument on packaged food to foster critical thinking skills of junior high school students is very valid (87.64%) overall.

Keywords: *Instrument Test, HOTS, Critical Thinking Skills*

INTRODUCTION

The 21st century expects individuals to have the option to comprehend and have the opportunity to apply data and correspondence innovation. One of the most essential skills for the 21st century is thinking critically. We need to be able to think critically to find solutions to the global issues we face. People who can be supposed to have the option to consider fundamentally can parse and assess any data they get [1]. Therefore, critical thinking abilities must be utilized, particularly in education.

Critical thinking is the most significant of the four higher-request thinking abilities. It is because critical thinking is the most significant cognitive skill that students must learn [2]. It is in line with the curriculum for 2013. Teachers are expected to adopt a student-centered, scientific approach to learning and emphasize developing thinking habits [3]. Critical thinking skills are vital for understudies to have the option to foster a contention, explore the legitimacy of sources, or decide [4].

Students' ability to think critically needs to be enhanced by the learning process that teachers design. However, most teachers have been unable to prepare the learning expected by the 2013 curriculum optimistically, so in implementing learning, the teacher chooses to use contextual learning [5]. The lack of students' critical thinking skills is caused by learning experiences that have not effectively improved students' abilities [6]. And also, Indonesian students are only able to describe situations and solve problems using general formulas or procedures, so students have yet to be able to learn how to think at a higher level [7].

In this regard, researchers' first interview with a junior high school science teacher in Serang City

revealed that students' critical thinking skills were classified as lacking. Due to the learning activities, most students and teachers must interact reciprocally. The test instruments are still at the LOTS level, even in learning evaluation activities. In addition, the questions asked needed to provide an overview of integration according to science learning in junior high schools.

The level of suitability for learning is determined by the quality of the test instruments used by the teacher in learning activities [8]. Teachers can use the HOTS test to learn more about their students' abilities and help them develop higher-order thinking skills. The pointers in the HOTS questions are analyzing (C4), evaluating (C5), and making (C6) [9]. Test instruments in the form of descriptions and referring to indicators of critical thinking can prepare students to provide views, understand, study, and handle a problem for each item that can potentially foster students' thinking skills [10].

The topic of science learning is closely related to problems that occur around the environment, one of which is regarding packaged food. The public often consumes packaged food, especially for school-age children or students. Students must know the information contained in the packaged food they consume. In addition, the public still needs to realize the environmental impact when consuming packaged food entirely. Educating students regarding awareness and knowledge about packaged food can foster students' critical thinking skills.

Given these issues, scientists need to foster a HOTS test instrument that can teach understudies to boost decisive reasoning abilities and utilize the coordination of science learning with the subject of bundled food. The purpose of this study was to

analyze the validation level of the HOTS test instrument on the theme of packaged food to foster junior high school students critical thinking skills.

RESEARCH METHODS

The innovative work (Research and Development) strategy was applied to this examination. This method can be used to create a product and determine its feasibility and effectiveness [11]. This study altered the Borg and Gall development model, which focuses on five stages: (1) potential and problems, (2) data collection, (3) product design, (4) design validation, and (5) design revision.

The qualitative data for this trial are comments and suggestions obtained from the material, evaluation experts, and practitioners, which will later be used to improve the HOTS test instrument. Meanwhile, the answers to the validation questionnaire produce quantitative data, which will be converted into qualitative data using a Likert scale with a scale of 4 to determine product quality. The assessment score criteria are shown in Table 1.

Table 1. Rating Score Scale

Score	Rating Category
4	Very Good
3	Good
2	Less
1	Very Less

[12]

The data obtained is then calculated using the formula:

$$NP = \frac{R}{SM} \times 100\%$$

Information :

- NP : The desired percentage value
- R : The score acquired
- SM : The maximum score
- 100% : A fixed amount

[13]

The information acquired is information from rate values, then the information got is ordered given the classifications recorded in Table 2 beneath:

Table 2. HOTS Test Instrument Validity Percentage Category

Percentage Range (%)	Category Validity
81.25 < x ≤ 100	Very Valid
62.50 < x ≤ 81.25	Valid
43.75 < x ≤ 62.50	Less Valid
25 < x ≤ 43.75	Not Valid

(Modified from Sudijono) [14].

Analyze the difficulty level of the questions using the formula:

$$I = \frac{\text{Number of Students Answer Correctly}}{\text{The Number of Students}}$$

Information:

- I : Index of Problem Difficulty Level

[15]

Table 3. Interpretation of Item Difficulty Levels

Interval	Interpretation
0.00-0.30	Difficult Question
0.31-0.70	Medium Question
0.71-1.00	Easy Question

[15]

Analysis of the discriminating power of questions using the formula:

$$DP = P_A - P_B$$

Information:

- DP : Discriminating Power of Questions
- P_A : Proportion of Upper Group Participants
- P_B : Proportion of Lower Group Participants

[16]

Table 4. Interpretation of the Problem Discriminating Power Index

Interval	Interprstasi
0.70-1.00	Very Good
0.40-0.69	Good
0.20-0.39	Enough Good
0.00-0.19	Very Less

[15]

RESULTS AND DISCUSSION

The product design work to be developed is regarding the HOTS test instrument. Researchers began to develop a test instrument based on an analysis of student needs obtained during the interview process and data collection supporting the development of this HOTS test instrument.

The chosen theme is packaged food with the webbed integration model using KD 3.8 in class VII and KD 3.5 and 3.6 in class VIII. The researcher designed the HOTS test instrument using Microsoft Word software. The researcher began compiling a grid of test instruments, which became a guideline for making questions. The grid includes several items such as question identity, basic competence, material, question indicators, question numbers, indicators of critical thinking skills, and cognitive levels shown in Figure 1.

The questions were based on problems regarding packaged food, which affects environmental pollution, and substances contained in packaged food that can cause health problems, especially in the human digestive system, as shown in Figure 2. Development of a HOTS test instrument to foster critical thinking skills on the theme of packaged food totaling 30 open essay questions containing five indicators of critical thinking skills, namely indicators of formulating problems, indicators of analyzing arguments, indicators of making observations and assessing reports of comments, indicators of making and considering the value of decisions, and indicators of determining actions.

HOTS Test Instrument Grids						
School Level : SMP/MTs Subjects : Natural Science Theme : Packaged Foods Class/Semester : VIII/I Question Form : Open Essays Time Allocation : 120 Minute						
No	Basic Competencies	Material	Question Indicator	Cognitive Level	Critical Thinking Ability Indicator	Question Number
1.	3.8 Analyzing the occurrence of environmental pollution and its impact on the ecosystem.	Impact of environmental pollution due to packaged foods.	3.8.1 Analyzing the impact of environmental pollution due to packaged foods on the ecosystem.	C4	Formulate the problem Analyze arguments Make observations and assess reports of observations	26, 28 8 24,29

Figure 1. The form of the HOTS Test Instrument Grid

1. Look at the picture below.



(pulsk.com, 2013)
 The BPOM agency visited the market and found packaged food with striking colors like the picture above. Based on the results of laboratory tests, it turns out that the packaged food contains dangerous dyes, namely textile dyes. In your opinion, what is the feasibility of the packaged food product, and explain your answer!

Figure 2. Examples of Questions Created

The questions are designed according to the material that has been analyzed and the following indicators for critical thinking skills. Researchers created items that represent each material and question indicators. Then each question is entered into the HOTS test instrument scoring rubric. In this assessment rubric are question numbers, questions, material, cognitive level, critical thinking indicators, answers, assessment criteria, and scores shown in Figure 3.

Then designing, the HOTS test instrument by designing the cover, entering the identity of the questions, student identities, and instructions for

carrying out the test, and including each of the questions that were previously designed.

To find out the validity level of the HOTS test instrument, the researcher carried out the validation test stages on three expert validators. This validation test was carried out by one material expert validator, one evaluation expert validator, and three practicing expert validators, namely, a science teacher at SMP Kota Serang. The validation technique is a validation test using a validation questionnaire as an evaluation and assessment. Also, the researcher receives comments and suggestions from expert validators. Quantitative data calculated from all validators can be seen in Table 5.

Table 5. HOTS Test Instrument Assessment Rubric Form


No	Question	Material	Cognitive Level	Critical Thinking Ability Indicator	Answer	Assessment Criteria	Score
1.	 <p>(pulsk.com, 2013) The BPOM agency visited the market and found packaged food with striking colors like the picture above. Based on the results of laboratory tests, it turns out that the packaged food contains dangerous dyes, namely textile dyes. In your opinion, what is the feasibility of the packaged food product, and explain your answer!</p>	The negative impact of additives in packaged food on health	C5	Make and consider value decisions	The packaged food product is unfit for consumption.	If students answer as many as three answers	3
					Textile dyes are not intended for food but for fabrics	If students answer as many as two answers	2
					Harmful textile dyes can harm the body both in the short and long term.	If students answer as many as one answers	1
						If the student answered incorrectly or did not provide an answer	0

Table 6. Expert Validation Results

No.	Validators	Percentage	Category
1.	Material Expert	82.8%	Very Valid
2.	Evaluation Expert	92.3%	Very Valid
3.	Expert Practitioner	87.82%	Very Valid
Average		87.64%	Very Valid

The results obtained in Table 5 show that the material expert's assessment is 82.8% (Very Valid). The evaluation carried out by evaluation experts scored 92.3% (Very Valid). The practitioner's expert assessment obtained 87.82% (Very Valid). So, the overall average value of the validator is 87.64% (Very Valid). From the results obtained from expert validators, it was stated that the HOTS test instrument on the theme of packaged food to foster critical thinking skills met a predetermined level of validity. The details of the assessment from the expert validator are described below:

Material Validation

The validation carried out by the material expert covers three aspects of the assessment: material, construction, and language. The material aspect consists of 2 sub-components with a total of 6 assessment indicators, the construction aspect consists of 2 sub-components with a total of 8 assessment indicators, and the language aspect consists of 2 sub-

components with a total of 5 assessment indicators, which an assessment expert then validates by conducting an assessment using a questionnaire from a scale of 1-4. Figure 4 illustrates the material expert validation results.

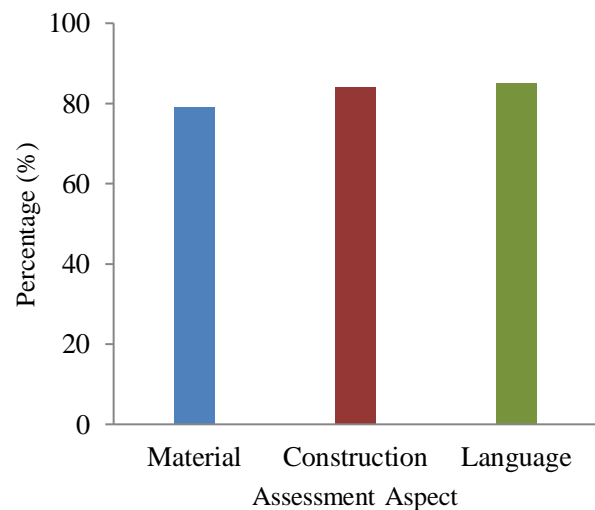


Figure 3. Expert Material Validation Results

The first aspect of the assessment is the material that gets a percentage of 79.1% in the "Valid" category, indicating that the questions developed follow the material on the theme of packaged food. In compiling item items, educators need to adjust to the indicators of a lesson. This

indicator is used as a benchmark for asking questions to achieve learning goals [17]. The main questions apply the integration of science learning with the theme of packaged food, consisting of three essential competencies, namely KD 3.7 in class VII and KD 3.5 and 3.6 in class VIII in the webbed integration model. The webbed learning model has the advantage of providing a holistic view of the interrelationships between activities from various disciplines [18].

The second assessment aspect is the construction, which gets 84.3% in the "Very Valid" category. The researcher designed the items according to the test grids that matched the competencies, materials, and indicators of critical thinking skills and C4-C5 cognitive levels. Items must be prepared based on learning objectives, indicators of achievement of competence, and subject matter based on the applied essential competencies [19]. Thinking critically about packaged food produces the ability to analyze, create, apply objective criteria, and assess data from problems regarding the impact it causes [20].

The third assessment aspect, language, contributes 85% to the "Very Valid" category. The language component in the material expert validation makes it the highest percentage. The researcher used PUEBI's Indonesian language guidelines to compile the item questions so that students could understand the importance of communicative language in learning activities. The formulation of the things must relate to the life of the students. It is intended so that students can work on questions and think critically about problems close to their environment. Preparing HOTS questions requires a contextual stimulus closely related to everyday issues and attracts and encourages students to read [21].

This research raises the theme of packaged food. This theme is closely related to the problems found in everyday life. The public often consumes packaged food, especially for school-age children or students. So students must know the information contained in the packaged food they consume. Students must actively participate in problem-solving and find the best solutions to everyday problems. Learning must link real issues based on daily life, so it is expected that students can implement learning ideas in class to deal with these problems [21]. Therefore, it is vital to educate the public, especially students, about packaged food so that they can develop their critical thinking skills.

Evaluation Validation

Validation carried out by evaluation experts includes four assessment aspects: language, presentation, content, and graphics. The language aspect consists of 2 sub-component with a total of 3 assessment indicators; the presentation aspect consists of 2 sub-components with a total of 5 assessment indicators; the content aspect consists of 2 sub-components with a total of 3 assessment indicators; and the graphic aspect consists of 2 sub-components

with a total of 3 assessment indicators, which evaluation experts then validate by conducting an assessment using a questionnaire from a scale of 1-4. The evaluation expert validation results are shown in Figure 4.

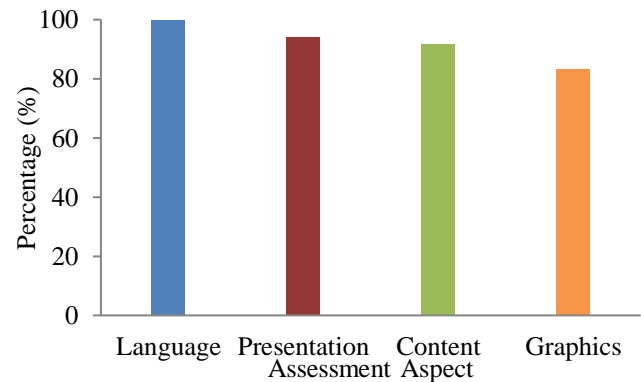


Figure 4. Evaluation Expert Validation Results

The first assessment aspect is the presentation, which gets 93,75% in the "Very Valid" category. It shows that the presentation on the HOTS test instrument is appropriate both in terms of an attractive appearance and the completeness of the presentation in the form of student identity, the material being asked, and instructions for working on the questions. The researcher combined letter variations, colors, and backgrounds with contrast to make it more attractive, clear, and easy to use. Display presentation must have good image quality and a color scheme that is straightforward and attractive [22].

The second assessment aspect, language, has the highest percentage of the four evaluation expert validation aspects, 100% in the "Very Valid" category. Researchers are trying to make test instruments that are easy to understand based on the sentences used in the items. Communicative language must be used in preparation, so students can easily understand and absorb questions [23].

The third assessment aspect is the content that gets a percentage of 91,6% in the "Very Valid" category, which shows that the content in each item follows KI, KD, and learning indicators. However, in the aspect of content assessment for the accuracy sub-component, the maximum score has yet to be achieved due to the incompatibility between the duration of the questions and the difficulty level of the questions. The suitability of the timeframe for working on questions can help students become independent and controlled in solving questions according to the time allotted. [24]. So the researchers added the time to work on the questions so that students could complete the questions well.

The fourth assessment aspect is graphics, which gets 83,3% with the "Very Valid" category, in formulating the items using discourse, cases, pictures, or representations that can support students in solving problems. The stimulus is presented clearly so that students understand well [25].

The four aspects of the assessment, namely language, presentation, content, and graphics of the HOTS test instrument, obtained very valid criteria, according to the findings of the validation assessment conducted by the evaluation expert. It shows that the evaluation tool in the form of a HOTS test instrument can help cultivate students' critical thinking skills in learning evaluation activities.

Practitioner Validation

The validation done by practicing experts includes three aspects of the assessment: the content's

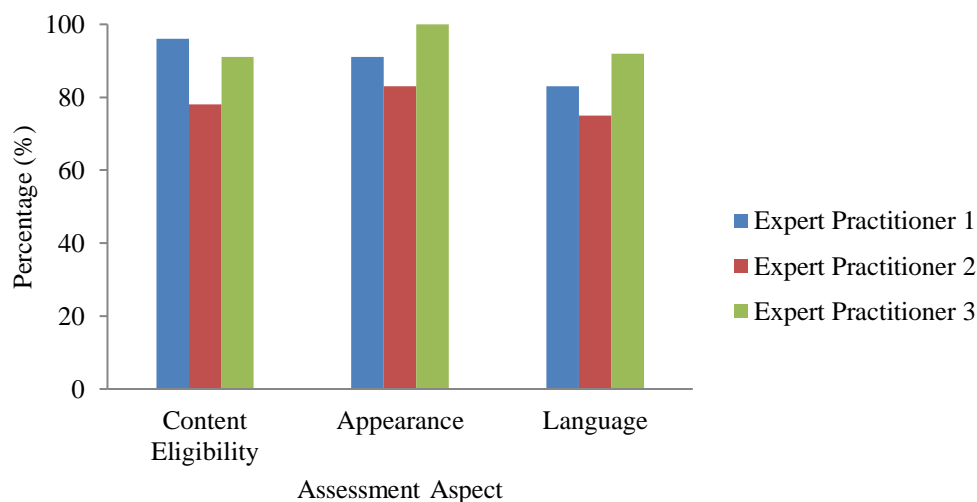


Figure 5. Expert Practitioner Validation Results

The first aspect of the assessment is feasibility which gets an average percentage of 88.5% in the "Very Valid" category. It shows that the developed HOTS test instrument follows learning indicators, critical thinking indicators, and cognitive levels. The use of the HOTS test instrument can foster critical thinking skills based on real situations that are contextual or based on everyday life [26]. Questions that increase higher-order thinking skills are evaluation activities that originate from actual conditions in everyday life [27].

The second assessment aspect is the display which gets the highest percentage of the three aspects of expert practitioner validation assessment with a percentage of 91.63% which is included in the "Very Valid" category. It is because the researcher is trying to design the items by using a stimulus and also contains instructions for working on the questions that are useful to support students in working on the questions. The items are equipped with instructions for working on the questions to assist students in using them [28].

The third assessment aspect, namely language, received an average percentage of 83.3% in the "Very Valid" category, indicating that the writing of sentences and the choice of words used follow PUEBI and students' level of understanding. In compiling effective sentences, words (diction) must be precise,

viability, appearance, and language. In the feasibility aspect, the range consists of 3 sub-components with a total of 8 assessment indicators, the appearance aspect consists of 2 sub-components with a total of 3 assessment indicators, and the language aspect consists of 2 sub-components with a total of 6 assessment indicators, which expert practitioners then validate by conducting an assessment using a questionnaire from a scale of 1-4. The results of expert practitioner validation are described in Figure 5.

general, and appropriate [29]. Therefore, a correction must be built using the correct vocabulary and spelling so that the reader quickly understands it.

The aspects of assessing the feasibility of the content, appearance, and language of the HOTS test instrument obtained very valid criteria following the results of the validation assessment carried out by expert practitioners, which indicated the need to use the HOTS test instrument in learning evaluation activities. These limitations arise because teachers must conduct evaluation activities that foster higher-order thinking skills, specifically critical thinking skills, during teaching activities.

Empirical Data

After the validation expert corrects the test instrument, the next step is to determine the item's difficulty level and discriminating power results. Analyzing the difficulty level of the questions means examining test questions in terms of difficulty so that questions can be obtained which are easy, medium, and complex [15].

The results of the average difficulty level of questions are already in the medium and difficult categories. The results obtained prove that the test instrument is very good, with details in the following table:

Table 5. HOTS Test Instrument Difficulty Level Results

Question Number	Indicators of Critical Thinking Ability	Difficulty Level of Questions	
		Index	Criteria
1	Make and weigh the value of decisions	0.1	Difficult Question
2	Determine action	0.2	Difficult Question
3	Determine action	0.6	Medium Question
4	Analyze arguments	0.2	Difficult Question
5	Analyze arguments	0.6	Medium Question
6	Determine action	0.7	Medium Question
7	Formulate a problem	0.1	Difficult Question
8	Analyze arguments	0.5	Medium Question
9	Determine action	0.5	Medium Question
10	Make and weigh the value of decisions	0.3	Difficult Question
11	Make and weigh the value of decisions	0.2	Difficult Question
12	Analyze arguments	0.3	Difficult Question
13	Analyze arguments	0.4	Medium Question
14	Formulate a problem	0.1	Difficult Question
15	Determine action	0.4	Medium Question
16	Analyze arguments	0.2	Difficult Question
17	Make and weigh the value of decisions	0.1	Difficult Question
18	Formulate a problem	0.3	Difficult Question
19	Make observations and assess reports of observations	0.3	Difficult Question
20	Analyze arguments	0.1	Difficult Question
21	Make and weigh the value of decisions	0.5	Medium Question
22	Formulate a problem	0.3	Difficult Question
23	Make observations and assess reports of observations	0.6	Medium Question
24	Make observations and assess reports of observations	0.6	Medium Question
25	Determine action	0.1	Difficult Question
26	Formulate a problem	0.5	Medium Question
27	Make and weigh the value of decisions	0.1	Difficult Question
28	Formulate a problem	0.3	Difficult Question
29	Make observations and assess reports of observations	0.7	Medium Question
30	Make and weigh the value of decisions	0.2	Difficult Question

Discriminating power analysis means studying test questions regarding the test's ability to distinguish students who fall into the weak/low category and strong/high presentation categories [30]. The discriminating power of item items has the benefit of improving the quality of each item through empirical data and finding out how far each item can distinguish students' abilities.

These, namely, students have understood or have yet to understand the material being taught by educators [15].

The average item discriminating power results were already in the good, good, and very good categories. The results obtained prove that the test instrument is very good, with details in the following table:

Table 6. Results of Discriminating Power HOTS Test Instrument Questions

Question Number	Indicators of Critical Thinking Ability	Discriminating Power of Questions	
		Index	Criteria
1	Make and weigh the value of decisions	0.2	Enough
2	Determine action	0.4	Good
3	Determine action	0.4	Good
4	Analyze arguments	0.4	Good
5	Analyze arguments	0.4	Good
6	Determine action	0.6	Good
7	Formulate a problem	0.2	Enough

8	Analyze arguments	0.6	Good
9	Determine action	0.2	Enough
10	Make and weigh the value of decisions	0.2	Enough
11	Make and weigh the value of decisions	0.2	Enough
12	Analyze arguments	0.2	Enough
13	Analyze arguments	0.4	Good
14	Formulate a problem	0.2	Enough
15	Determine action	0.4	Good
16	Analyze arguments	0.4	Good
17	Make and weigh the value of decisions	0.2	Enough
18	Formulate a problem	0.2	Enough
19	Make observations and assess reports of observations	0.2	Enough
20	Analyze arguments	0.2	Enough
21	Make and weigh the value of decisions	0.2	Enough
22	Formulate a problem	0.2	Enough
23	Make observations and assess reports of observations	0.8	Very Good
24	Make observations and assess reports of observations	0.4	Good
25	Determine action	0.2	Enough
26	Formulate a problem	0.2	Enough
27	Make and weigh the value of decisions	0.2	Enough
28	Formulate a problem	0.2	Enough
29	Make observations and assess reports of observations	0.6	Good
30	Make and weigh the value of decisions	0.4	Good

Based on the test of difficulty level and item discriminating power, it was concluded that the test product made had been well developed. This test instrument can be used in science learning evaluation activities.

CONCLUSION

Given the research and development that has been done concerning the HOTS test instrument on the theme of packaged food to foster critical thinking skills of junior high school students, the validation results from material experts are 82.8% (Valid), evaluation experts are 92.3% (Very Valid), and expert practitioners of 87.82% (Very Valid). The overall evaluation results from experts, as can be seen, show the HOTS test instrument has a validation level of 87.64% which belongs to the "Very Valid" category, so that the HOTS test can be used in learning activities that help cultivate critical thinking skills.

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