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Development of Problems for Higher Order Thinking Skill (HOTS) e-Test on Additive Substance Subject Material

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Abstract
Indonesia is one of the countries with low PISA (Program for International Students Assessment) achievement levels based on survey results due to the low level of higher order thinking skill of students. The causes of the low level of higher order thinking of students in Indonesia include the question given have not met the criteria of HOTS questions and the lack of ability of educations in making Higher Order Thinking Skill (HOTS) questions. This study was conducted to determine the feasibility of HOTS e-questions. The aim of developing higher-order thinking Skill (HOTS) questions in electronic form in the conditions of transition from pandemic to endemic now is so that they are easily accessible to students anywhere and at any time. The method used in this research is research and development (R&D) with ADDIE model which has 4 stages, namely: Analysis; at this stage, needs analysis and performance analysis are carried out, Design; at this stage, the process of designing or creating learning tools occurs, Development; at this stage, learning tools are developed and validated from previously selected learning sources, Implementation, and Evaluation. The form of questions that have been developed consists of multiple choice and eesay questions and scring guidelines. The overall validation results of the HOTS e-questions amounted to 94.47% with very feasible criteria. Based on the validation results, HOTS e-questions on additive are suitable for use in learning activities and are tested during science subjects at school.

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INTRODUCTION

Students are required to be able to think critically in solving abstract chemical questions or problems and require a deeper understanding in this 21st century era. The development of education in Indonesia can be said to have not been as fast as developed countries out there. Indonesia is included in countries with low PISA (Program for International Students Assessment) achievements (Saleha, et. al., 2020).

PISA is an evaluation conducted in the form of tests and questionnaires and is carried out every three years on a recurring basis. The evaluation includes science, reading, and math. In Indonesia itself, interest in reading is very low for both adults and children. Based on the results of the PISA survey conducted by the Organization for Economic Co-operation and Development (OECD), UNESCO stated that the reading interest of the people in Indonesia is only 0.001 percent. The low PISA achievement is inseparable from the role of educators or teachers. Habituation of HOTS (Higher Order Thinking Skill) based evaluation needs to be done so that the acquisition of PISA in Indonesia becomes even better. The low critical

thinking ability of students is partly due to questions that are limited in theory (Saputra, 2016). Learners are faced with the rapid development of science and technology which is a new challenge for them so that they are required to think critically and creatively in solving problems in the 21st century (Driana and Ernawati, 2019: 110).

According to Murni, et. al. (2020) higher order thinking skills do not only require the ability to remember (C1), but even higher abilities such as analyzing problems (C4). Higher Order Thinking Skills (HOTS) is an ability that is expected so that students can create new things from the information or problems obtained. Along with the times, education has also changed from time to time. The world of education is currently focusing on improving students' higher order thinking skills (HOTS). The development of HOTS questions must meet the aspects of analyzing (C4), evaluating (C5) and creating (C6), in accordance with good and correct Indonesian language rules and the use of appropriate EYD. Then to find out whether the question can be used in the learning process both for the Junior High School (SMP) and Senior High School (SMA) levels, question validation must be carried out (Ansari and Eliyati, 2020).

Science is contextual in nature which is expected to be able to make students' thinking skills in solving problems in everyday life develop (Depdiknas, 2016). The importance of students learning additive material in order to distinguish foods that have natural and synthetic (artificial) additives. Most students when buying food in the school canteen do not pay attention to the ingredients or substances contained in it. Even though it could be that the food they buy has a harmful impact on health in the long run. Currently, there are many foods circulating with preservatives and synthetic dyes with the aim of making them look attractive and durable without considering the impact that these substances will cause. Knowledge about these additives needs to be developed through high-level questions so that students not only know the additives but also understand the impact that will be received when consuming food with harmful substances and can be applied in everyday life.

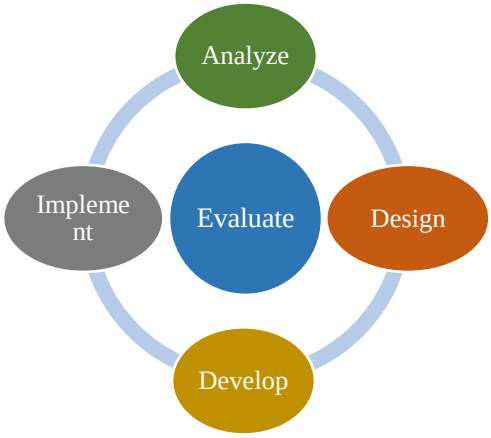
Based on interviews conducted on May 18, 2021 with two science teachers at SMP Negeri 2 Singkawang, they have not developed Higher Order Thinking Skill (HOTS) questions due to a lack of skills in creating and developing Higher Order Thinking Skill (HOTS) questions. This is in line with the statement of Ekawati, Nuriyatin and Ayuningtyas (2021) that educators tend to use questions from supporting books that contain indicators of questioning, understanding and application from Bloom's Taxonomy in the learning process. The results of interviews with students found that the additive material was only studied briefly. They are only told to read the material in the book and watch videos on YouTube and students are not invited to solve a problem that is around them. The questions given by educators are only through the books they use in the learning process.

Based on several journals that have been read, two of them are research on the development of Higher Order Thinking Skill (HOTS) assessment instruments on additives and addictive substances. Research conducted by Baharizki (2021) was tested on 26 students of SMP Negeri 1 Gresik, with high validation results, namely 0.05 for 11 question items and 1 question item with sufficient validity, as well as a very high reliability value of 0.889. Based on research conducted by Saleha, et. al. (2020), the Higher Order Thinking Skill (HOTS) assessment instrument on additive material is very feasible to use in learning activities with a percentage of 93.72% and 97.02% with very high criteria for the results of the response questionnaire by science teachers from SMP Negeri 10 Pontianak, SMP Negeri 12 Pontianak and SMP Negeri 16 Pontianak where HOTS questions only reach the C4 (analyze) and C5 (evaluate) levels. Based on these two studies, no one has made questions using data on the comparison of two products and in the research of Saleha, et. al has not made questions with cognitive level C6 (creating). Indicators that will the questions used are

different from previous studies and are made in electronic form with the help of PDF media. The purpose of developing Higher Order Thinking Skill (HOTS) questions in electronic form in the transition from a pandemic to an endemic like today is to make it easily accessible to students anywhere and anytime.

METHOD

This research was conducted from June 20, 2022 to August 23, 2022. The subject of this research is Higher Order Thinking Skills (HOTS) e-questions. This research uses data in the form of numbers obtained from the results of the validation sheet of Higher Order Thinking Skills (HOTS) e-questions by experts. This research used the research and development method with a quantitative approach. The development model used is the ADDIE development model with five stages, namely (1) Analysis; at this stage, requirements analysis is carried out by looking for information about the school curriculum, learning competencies, and teaching materials used and performance analysis are carried out to determine possible problems arising from the learning device, (2) Design; at this stage, the process of designing or creating learning tools occurs , (3) Development; at this stage, learning tools are developed and validated from previously selected learning sources, namely in the form of questions in textbooks, (4) Implementation, (5) Evaluation. The next two stages, namely implementation and evaluation, were not carried out in this research because they only reached the development stage. The following is a diagram of the development model used in this research.



The subject of this research is Higher Order Thinking Skills (HOTS) questions. Data collection techniques in this study used direct communication techniques in the form of semi-structured interviews with science teachers and students of SMP Negeri 2 Singkawang. The tools in this study used research instruments in the form of validation sheets for Higher Order Thinking Skills (HOTS) e-questions whose indicators were adapted from Nur Fadilah's research, etc. (2014) as for these indicators including (1) material, (2) construction, and (3) language with 11 items of statements and interview guidelines for students and educators. The source of person data in this study are experts who assess the feasibility of Higher Order Thinking Skills (HOTS) e-questions on additive materials. The source of paper data in this study is the validation sheet for the feasibility of Higher Order Thinking Skills (HOTS) e-questions.

For the data from the validation sheet of the feasibility of Higher Order Thinking Skills (HOTS) e-questions, data processing is carried out with the following steps.

Calculate the percentage of the total score of each statement by the following formula.

$$P = \frac{\sum X}{\sum Xi} \times 100\%$$

Description :
P = percentage of score gain
∑X = sum of scores (total score)
∑X = sum of ideal scores (highest score)
(Riduwan, 2008)

Calculate the average percentage of feasibility of Higher Order Thinking Skills (HOTS) e-questions on additive material as a whole by the following formula.

$$V = \frac{\sum P}{n}$$

Description:

V = average percentage of feasibility
∑P = average number of percentage scores per aspect
n = the number of aspects assessed (Riduwan, 2008)

Determining the eligibility criteria for Higher Order Thinking Skills (HOTS) e-questions on additive material based on the eligibility criteria by Anjani (2019), including very feasible, feasible enough, less feasible, and not feasible.

Tabel 1. Percentage of feasibility level

No.	Feasibility Percentage	Rating Scale	Interpretation Criteria
1.	75%-100%	4	Very Feasible
2.	50%-74,99%	3	Feasible
3.	25%-49,99%	2	Not Feasible
4.	0%-24,99%	1	Very inappropriate

RESULTS AND DISCUSSION

Results

The feasibility assessment of the Higher Order Thinking Skills (HOTS) research instrument on additives was reviewed from the aspects of material, construction, and language. The results of the feasibility assessment of Higher Order Thinking Skills (HOTS) e-questions by each expert on each aspect are shown in Figure 1.

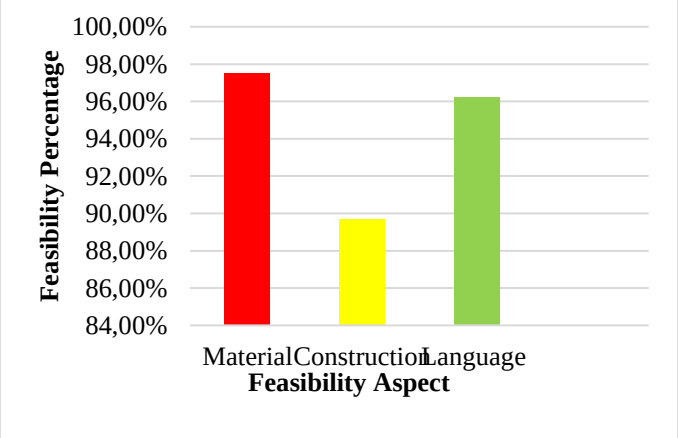


Figure 1. Graph of the results of the Feasibility Assessment of Higher Order Thinking Skill (HOTS) on Additive Materials

The feasibility results of the Higher Order Thinking Skills (HOTS) assessment instrument in the material aspect amounted to 97.5% with very feasible criteria. The results of the assessment in the construction aspect amounted to 89.68% with very feasible criteria. The results of the feasibility assessment in the language aspect amounted to 96.25% with very feasible criteria. The total percentage of Higher Order Thinking Skills (HOTS) e-questions from all aspects is 94.47% with very feasible criteria.

The development of Higher Order Thinking Skill (HOTS) e-questions has gone through various stages of feasibility assessment and improvement. This study passed a feasibility assessment covering 3 aspects, namely material aspects, construction aspects, and language aspects. Based on the validation results, the question indicators listed on the question grid are suitable for use. The question indicators can be seen in Table 1.

Table 1. Problem Indicators on the Problem Grid Problem Indicator

Multiple Choice	***Essay***
1. Investigate natural colors in beverages.	1. Identify natural and artificial sweeteners in beverage products.
2. Investigating artificial coloring in beverages.	
3. Identify various additives and their uses in beverages.	2. Assess the usefulness of additives in beverage products.
4. Deciding on a solution to replace artificial flavoring additives in a product	
5. Analyze the difference between natural and artificial sweeteners and artificial sweeteners in beverages .	3. Assess the impact of additives in a food product.
6. Find the appropriate use of additives in beverage products.	
7. Selecting additives that function as developers in food.	4. Design a sweet product using the ingredients and additives provided.
8. Determine additives that have negative effects of food products.	
9. Conclude the impact of consuming additives in food products on health based on a discourse.	5. Create a discourse on the negative impact of artificial additives.
10. Selecting additives that are safe to use in food manufacturing.	

The results of the feasibility assessment of *Higher Order Thinking Skill* (HOTS) e-questions on additives can be seen in Table 2. Based on the results of table 2, it can be seen that all questions developed are valid and feasible to use and test both multiple choice and essay.

The feasibility assessment by material experts shows that the additive material includes very feasible criteria. In the material aspect, there are micro revisions from experts related to the comparison object used in the question, so it is necessary to make improvements and obtain a comparison before and after the revision which can be seen in Table 3.

Table 2. Results of Feasibility Assessment by Experts

Proble Type	Number	Aspects observed												Average Expert Rating
		1	2	3	4	5	6	7	8	9	10	11	12	
Mu	1	4	4	4	4	4	4	4	4	4	4	4	4	100%
	2	3,5	3,5	3,5	3,5	3,5	4	4	4	4	4	4	4	94,79%
	3	4	4	4	4	4	4	4	4	4	3,5	3,5	3,5	96,88%
	4	4	4	4	4	4	4	4	4	4	4	4	4	100%
	5	4	4	4	4	4	3,5	3,5	3,5	3,5	4	4	4	95,83%
	6	4	4	4	4	4	3,5	3,5	3,5	3,5	4	4	4	95,83%
	7	4	4	4	4	4	4	4	4	4	4	4	4	100%
	8	4	4	4	4	4	3,5	3,5	3,5	3,5	3,5	3,5	3,5	92,71%
	9	3,5	3,5	3,5	3,5	3,5	4	4	4	4	3,5	3,5	3,5	91,67%
	10	4	4	4	4	4	4	4	4	3	4	4	4	97,92%
Es	1	4	4	4	4	4	3,5	4	3,5	4	3,5	4	4	96,88%
	2	4	4	4	4	4	3,5	3,5	3,5	3,5	3,5	4	4	94,79%
	3	4	4	4	4	4	3,5	3,5	3,5	3,5	3,5	4	4	94,79%
	4	4	4	4	4	4	4	4	4	4	3,5	4	4	98,96%
	5	4	4	4	4	4	4	4	4	4	3,5	4	4	98,96%

Description:
Aspect 1: Suitability of questions with indicators (requires written tests for multiple choice and essay forms.
Aspect 2: The suitability of the question using a clear stimulus.
Aspect 3: The suitability of the questions using contextual stimulus (pictures, text, visualization, description in accordance with daily life).
Aspect 4: The suitability of the question measures the cognitive level of reasoning (Analyzing/Evaluating/Creating). Aspect 5: The suitability of the answer is not found in the stimulus.
Aspect 6: The suitability of the formulation of the question sentence or question using verbs that measure the desired cognitive level.
Aspect 7: The suitability of the scoring guidelines or rubric provides an answer key with the concept, theory or law of the problem.
Aspect 8: The suitability of the scoring guide or rubric provides an answer key with the procedure or steps of the desired level of thinking.
Aspect 9: The appropriateness of pictures, tables, diagrams, or discourses to illustrate the overall answer.
Aspect 10: Language conformity with Indonesian Language Rules.
Aspect 11: The question does not use taboo or ambiguous language.
Aspect 12: The suitability of the question uses communicative sentences.

Table 3. Beverage Type Correction Problem Number 1 Multiple Choice

Before Revision	After Revision
1. ….Investigate which glasses has natural coloring!  	1. ….Investigate which glasses has natural coloring!  

The assessment of the feasibility of Higher Order Thinking Skills (HOTS) e-questions by construction experts shows that the construction includes very feasible criteria. The results of the feasibility assessment of Higher Order Thinking Skills (HOTS) e-questions in the construction aspect can be seen in Figure 1. In the construction aspect, there are micro (minor) revisions, namely the formulation of question sentences for both multiple choice and essay questions, improvement of scoring guidelines by marking keywords, and improvement of operational verbs for question number 7 multiple choice indicators without changing the cognitive level. Improvements to the indicators of multiple choice questions can be seen in Table 4 below.

Table 4. Problem Indicator Improvement

Before Revision	After Revision
7. Assess the discovery of additives in food.	7. Selecting additives that function as developers in food.

One of the improvements to the formulation of multiple-choice question sentences assessed by construction experts can be seen in Table 5 below.

Table 5. Improvement of Multiple Choice Question Sentence Formulation

Before Revision	After Revision
5. He bought two types of ice, namely iced tea and iced orange juice. The iced tea contains sugar while the iced orange contains aspartame. Analyze the differences in the additives in the two ices!	5. .... She bought two types of ice: sweet iced tea and iced tea bags. Sweet iced tea contains a composition consisting of tea water, sugar, and ice. While iced tea packets contain a composition consisting of tea extract, food coloring (tartrazine Cl, diamond blue FCF Cl, and carmoisin Cl), citric acid, and aspartame. Analyze the difference in additives in the form of sweeteners in the two iced teas!

On essay questions, there are improvements to the formulation of question sentences by construction experts which can be seen in Table 6 below.

Tabel 6. Improvement of Essay Question Sentence Formulation

Before Revision	After Revision
3. With the development of the times, most people always choose ready-made food seasonings without thinking about the side effects caused. ...Give your opinion on whether the ready-made seasoning is safe for consumption and an explanation of the negative impact of additives in the ready-made seasoning!	3. Along with the development of the times, most people always choose ready-made food seasonings because of their practicality without thinking about the side effects caused. ....Give your opinion on the negative impact of additives contained in ready-made seasonings on the body!

Improvements by construction experts for scoring guidelines on one of the keywords given a mark can be seen in Table 7. Assessment of the feasibility of Higher Order Thinking Skills (HOTS) e-questions by linguists shows that the language used includes very feasible criteria. In the language aspect, there are micro revisions so that improvements need to be made to multiple choice questions by changing the location of the table.

Table 7. Keyword Improvements in Scoring Guidelines

Before Revision	After Revision
1. The additives contained in sweetened condensed milk are natural sweeteners in the form of sugar and artificial sweeteners in the form of lactose.	1. The additives contained in sweetened condensed milk are natural sweeteners in the form of sugar and artificial sweeteners in the form of lactose.

The writing looks neat on questions number 3 and 8 and question number 9, and the use of correct phrases and clauses. One of the improvements to the essay questions can be seen in Table 8 below.

Table 8. Improvement of Phrase or Clause Writing

<table>
<tr><th>Before Revision</th><th>After Revision</th></tr>
<tr><td>Do you think these drinks are good for consumption?</td><td>Do you think these drinks are good for consumption?</td></tr>
<tr><td>2. Abi bought a bottle of tea drink at the stall, knowing the composition contained in tea as follows
<table><tr><th>No.</th><th>Tea Composition</th></tr><tr><td>1.</td><td>Water</td></tr><tr><td>2.</td><td>Glukose</td></tr><tr><td>3.</td><td>Tea Exctract (0,1%)</td></tr><tr><td>4.</td><td>Lactose</td></tr><tr><td>5.</td><td>Tea synthetic flavor</td></tr><tr><td>6.</td><td>Vitamin C</td></tr><tr><td>7.</td><td>Citric acid</td></tr></table></td><td>2. Abi bought a bottle of tea drink at the stall. Knowing the composition contained in tea as follows
<table><tr><th>No.</th><th>Composition of Packaged Tea</th></tr><tr><td>1.</td><td>Water</td></tr><tr><td>2.</td><td>Glukose</td></tr><tr><td>3.</td><td>Tea Exctract (0,1%)</td></tr><tr><td>4.</td><td>Lactose</td></tr><tr><td>5.</td><td>Tea synthetic flavor</td></tr><tr><td>6.</td><td>Vitamin C</td></tr><tr><td>7.</td><td>Citric acid</td></tr></table></td></tr>
</table>

Discussion

The development of HOTS questions is carried out through several stages including analysis, design, and development. At the analysis stage including analyzing the curriculum, core competencies, basic competencies, subject matter, and indicators. At the design stage, make a draft question indicator.

In the development stage, based on the indicators, the questions are developed into HOTS questions. One of the fundamental things that is very important in making HOTS questions is indicators (Hidayati, et.al., 2022). In line with research conducted by Widhiyani, et.al., (2019) which states that in making HOTS questions, there needs to be characteristics that meet the category of HOTS questions, one of which is the question indicator.

Based on the results of the validation of material, construction, and language experts, the Higher Order Thinking Skills (HOTS) questions developed have met the criteria for good learning outcomes assessment instruments because they meet the requirements of material,

construction, and language validity. This is as stated by Widarto (2014) that learning outcomes assessment instruments must meet the requirements: (a) substance, representing the competencies being assessed; (b) construction, meeting technical requirements in accordance with the form of instrument used; (c) language, using good and correct and communicative language in accordance with the level of development of students; (d) have evidence of empirical validity.

The question is in accordance with the indicator, meaning that the question will measure the ability of students based on the cognitive level desired by the educator. Images, tables, diagrams, or discourse provide an overview of the answer as a whole, meaning that it must be clear, legible, and easy for students to understand. If learners can answer the question without paying attention to the pictures, tables, diagrams, and discourse contained in the question then the pictures and so on do not work.

Questions are made using a clear stimulus, meaning that the ability to be measured must be clear so as not to cause different interpretations with the desired cognitive level. Kemendibud (2017) states that the stimulus must be clear so that students can transfer the information obtained from the stimulus then process, apply, relate to other information and solve a problem. The stimulus in the problem uses parables or examples from everyday life or is contextual in nature. In line with Astuti's research, et. al. (2019) which states that habituation of questions based on everyday life is needed to hone students' critical thinking skills. Fanani (2018) in his research wrote that a contextual stimulus requires students to connect, interpret, apply, and integrate knowledge in classroom learning to solve problems in a real context. The stimulus does not contain an answer, meaning that the question should not provide words or sentences that indicate the correct answer.

Questions use language in accordance with Indonesian language rules, meaning that questions do not use taboo or ambiguous language so that students do not misinterpret the intended questions. Questions use communicative sentences so that they are easily understood by students.

Fanani (2018) wrote that the questions measure the cognitive level of reasoning so that students are able to remember, understand, and apply factual, conceptual, and procedural knowledge and have high logic and reasoning to solve contextual problems. The cognitive level of reasoning includes analyzing (C4), evaluating (C5), and creating (C6). The formulation of question sentences or questions uses verbs that measure the desired cognitive level, meaning that the questions made can make students reach a cognitive level that includes analyzing (C4), evaluating (C5), and creating (C6). In line with Winarti's research, et. al., (2021) which states that the aspects of making HOTS questions include the ability to analyze (C4), evaluate (C5), and create (C6). Scoring guidelines or rubrics provide answer keys with concepts, theories, or laws from the questions made, meaning that the answers must be in accordance with the material asked, the writing is equivalent, and the answers can be used or function properly. Scoring guidelines or rubrics provide answer keys with procedures or steps of the desired level of thinking, meaning that the answer key is in accordance with the thinking procedures of each cognitive level of analyzing (C4), evaluating (C5), and creating (C6).

CONCLUSION

Based on the results of research and development of Higher Order Thinking Skills (HOTS) e-questions on additive materials that have been carried out with a total of 10 multiple choice questions and 5 essay questions, it can be concluded that the feasibility level of Higher Order Thinking Skills (HOTS) e-questions on additive materials from all aspects, namely material

aspects, construction aspects, and language aspects of 94.47% with very feasible criteria to be used in learning activities and tested.

RECOMMENDATIONS

This study recommends the application of e-HOTS questions on additives as an alternative learning strategy for the digital era. Teachers can utilize these e-questions to improve students' higher order thinking skills and enrich the learning experience. Further research can be conducted by measuring the effectiveness and long-term impact of using HOTS e-questions in learning.

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