



Analysis of Teacher Needs for the Development of Higher Order Thinking Skill (HOTS) Based Class X High School Chemistry Material Assessment Instruments

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Abstract: Analysis of Teacher Needs for the Development of Higher Order Thinking Skill (HOTS) Based Class X High School Chemistry Material Assessment Instruments. This research aims to describe teachers' needs for HOTS-based assessment instruments that can be used in evaluating student learning outcomes in class X SMA. This research method is the first step in the ADDIE development process, namely (Analyst), namely initial analytical research to determine the needs of the product to be developed. The participants in this research were 5 chemistry teachers from 5 schools in Medan City. The research results were analyzed descriptively and obtained data that the assessment instruments often used by teachers were still at cognitive level C1 - C3 with a percentage of 90%, while HOTS-based chemistry learning assessment instruments with cognitive levels C4 - C6 were still very rarely used. The obstacle is that the creation, use and development of instruments are relatively difficult, so teachers feel less interested in creating HOTS-based assessment instruments and lack ideas or references for what assessment instruments are good for evaluating chemistry learning. So it has an impact on the level of critical and creative thinking abilities of students.

Keywords: *instrument, assesment, HOTS*

Abstrak: Analisis Kebutuhan Guru Terhadap Pengembangan Instrumen Penilaian Materi Kimia Kelas X SMA Berbasis Higher Order Thinking Skill (HOTS). Penelitian ini bertujuan untuk mendeskripsikan kebutuhan guru akan instrumen penilaian berbasis HOTS yang dapat digunakan dalam evaluasi hasil belajar siswa di kelas X SMA. Metode penelitian ini merupakan langkah pertama dalam proses pengembangan ADDIE yaitu (Analyst), yaitu penelitian analisis awal untuk mengetahui akan kebutuhan produk yang akan dikembangkan. Partisipan penelitian ini adalah 5 guru kimia dari 5 sekolah di Kota Medan. Hasil penelitian dianalisis secara deskriptif dan diperoleh data bahwa instrumen penilaian yang sering digunakan guru masih dalam tahap level kognitif C1 – C3 dengan persentase 90%, sedangkan instrumen penilaian belajar kimia berbasis HOTS dengan level kognitif C4 – C6 masih sangat jarang digunakan. Kendalanya adalah pembuatan, penggunaan dan pengembangan instrumen yang tergolong sulit sehingga guru merasa kurang tertarik untuk membuat instrumen penilaian berbasis HOTS dan kurangnya ide atau rujukan instrumen penilaian apa yang baik untuk evaluasi pembelajaran kimia. Sehingga berakibat pada tingkat kemampuan berpikir kritis dan kreatif pada peserta didik.

Kata kunci: *Instrumen, Penilaian, HOTS*

• INTRODUCTION

In the current era of globalization, science has developed according to the demands of the times, so it requires quality human resources (Sahalessy & Duparlira, 2023). Students are expected to have many skills that can be mastered in various ways. Skills that must be mastered by students in the 21st century include critical thinking, creative, collaboration and communication skills. This is known as the 4C (Fadliilah & Nasrudin, 2023). Abilities needed to face challenges and The era of global competition that is currently in the 21st century, apart from 4C, is the need for developing human resources to produce quality human resources. One of the factors that influences human resources is the quality of education improving the quality of learning (Risidiana et al., 2022).

Referring to the student ability survey released by the Program for International Student Assessment (PISA), in December 2019 in Paris, Indonesia was said to be ranked 72nd out of 77 countries (OECD, 2019). Data from the 2016 Trends International Mathematics and Science Study (TIMSS) shows that Indonesia's ability in science and mathematics is ranked 48th and 45th out of 50 participating countries respectively with an average score of both 39 points out of 500 points. Based on the PISA and TIMSS rankings, it can be concluded that literacy skills and HOTS achievements in Indonesia are still relatively low (Alviah et al., 2020).

The 2013 curriculum is an update of the previous curriculum, so this curriculum has the concept that students are required to explore information. This is of course directly related to changes in students' cognitive thinking. The cognitive domain of students is more emphasized on higher thinking ability processes, which are based on the vision and expectations of the 2013 curriculum (Hamidah & Wulandari, 2021). In the 2013 curriculum, students are required to work on high-level thinking chemistry questions (Nawawi et al., 2023). This is reinforced by the Learning Implementation Plan (RPP) created by the teacher based on the 2013 curriculum. In the learning implementation plan, teachers are required to create high-level thinking questions to hone students' high-level thinking skills, but preparing them is not an easy thing. The aim of national education is to improve abilities, one of the abilities being improved is the ability to think critically and creatively (Chairani & Nurfajriani, 2021). Therefore, one solution in developing critical and creative thinking skills is to develop a HOTS-based assessment instrument for high school chemistry material.

Chemistry is a science that studies matter and its changes, including elements and compounds, this makes chemistry abstract and complex (Sabila & Sukarmin, 2023). Chemical concepts are classified as complex because they require mastery of basic knowledge and its application in everyday life (Nurfajriani et al., 2021). There are many complex concepts in chemistry that cannot only be explained verbally and have complicated concepts for students to understand (Yudha et al., 2023). That way, chemical material requires high-level thinking abilities. Chemistry material requires a high conceptual understanding so that students are expected to be able to use structured, systematic thinking through appropriate stages of completion and be actively involved in understanding concepts. HOTS is a thinking skill that does not only require memory skills, however in practice it also requires critical and creative thinking skills (Saregar et al., 2016). So that the chemical assessment instruments used based on HOTS can measure the ability to solve problems, think critically and think creatively (Pulungan et al., 2022).

HOTS is different from higher order thinking (HOT). HOT refers to cognitive abilities in analyzing (C4), evaluating (C5) and creating (C6), while HOTS relates to the

ability to solve problems, think critically, think creatively and make decisions (Sani, 2019). There are three formats used to measure HOTS, namely: choosing answers such as multiple choice test instruments and matching, generating test instruments (test instruments with short answers, essays and performance, and explaining) (Weisdiyanti & Juliani, 2022).

Based on the results of previous research, it was found that students' HOTS abilities can be increased by utilizing activity assessment sheets (Ghani et al., 2017). Other research reports that students who were given HOTS and non-HOTS worksheets obtained different results, with the average of students who used HOTS worksheets being higher (Yennita et al., 2018). One of the other research into the development of HOTS (Higher Order Thinking Skills) questions on acid-base material was declared very valid by three material expert validators. The form of HOTS questions on acid base material is a description or essay consisting of 8 questions. This question is equipped with work instructions, answer key, and scoring guidelines. The characteristics of the HOTS question measuring instrument in this study are reliability and distinguishing power. The reliability of the test items is at very high criteria, as is the overall reliability value at very high criteria. The discriminating power of all questions is acceptable (Risidiana et al., 2022).

Interviews with 5 teachers at 5 schools in the city of Medan showed that 80% of teachers had limitations in finding sources for HOTS questions, 90% of the 200 questions used in the end of semester assessment were still at the C1-C3 level. Teachers use the questions in the textbook as a tool to measure students' abilities. This is proven by the results of the analysis of chemistry questions in the final semester assessment in class) 40%, analyzing (C4) 10%, evaluating (C5) 0%, and creating (C6) 0%. The cognitive evaluation and creating items are still 0%.

Based on the background that has been explained, it is necessary to develop a Higher Order Thinking Skill (HOTS) test instrument that can be used by teachers as a standard for assessment in learning and as a collection of quality questions so that it can be used in end-of-semester assessments in class X, even semester.

▪ **METHOD**

This research is a qualitative descriptive study. In this research, an analysis of teacher needs was carried out in developing HOTS-based assessment instruments. This research uses the ADDIE model. The ADDIE model is formed from the Analysis, Design, Development, Implementation and Evaluation stages. First, an analysis of performance and needs is carried out at the analysis stage. Second, create a design that is able to answer the problems found in the analysis stage. Third, product development in accordance with the results of the needs analysis. Fourth, apply the product by trial to see the capabilities of the product being developed. Fifth, the products developed are evaluated to determine their quality, practicality and effectiveness (Zulaiha et al, 2015).

This needs analysis is carried out based on the first stage of the ADDIE model, namely (analyst). The methods used in this research are survey and interview methods. The subjects in this research involved 5 class X chemistry teachers from 5 schools in Medan

City. The selection of schools was carried out using purposive sampling because these teachers were prepared to become facilitators in carrying out chemistry learning activities in class X from a predetermined population. Through interview techniques to

obtain data, then the questions that have been obtained will be analyzed for the affordability of the assessment instruments used by schools to measure HOTS.

▪ **RESULT AND DISCUSSION**

The needs analysis aims to find out problems in the test instruments used in the evaluation process at schools in Medan City. Based on the results of interviews with 5 teachers, information was obtained that 1) 80% of the teachers who had been interviewed had limitations in finding sources for HOTS questions, 2) 90% of the 200 questions used were still at levels C1 to C3. According to the teacher, HOTS questions in chemistry learning are good to apply in accordance with curriculum demands and also train students' high-level thinking skills. The teacher has already implemented it once in daily tests on stoichiometry material. Chemistry teachers in several schools actually already know about Higher Order Thinking Skills (HOTS)-based question instruments, but the teachers admit that they have never participated in training and created HOTS-based questions and also in class learning have only applied it once during daily tests. From the results of the interviews conducted, it can be concluded that the application of HOTS-based questions as a tool for evaluating student learning can be said to be still very lacking. To find out more about whether or not questions included in the HOTS category were used, the researchers conducted a cognitive level analysis of the class Based on the results of the analysis of cognitive levels in the final even semester exam questions in 5 schools in Medan City, they are as follows:

Table 1. Recapitulation of Cognitive Level Final Even Semester Exam Questions in 5 High Schools in Medan City

No.	Cognitive Level	Number of Questions
1.	C1 (Remembering)	50
2.	C2 (Understand)	50
3.	C3 (Applying)	80
4.	C4 (Analyzing)	20

The results of the analysis stated that 50 questions were at cognitive level C1 (Remembering), 50 questions were at cognitive level C2 (Understanding), 80 questions were at cognitive level C3 (Application) and 20 questions were at cognitive level C4 (Analyzing). From these results, if presented as a percentage, 10% of the questions included in the HOTS category are included. If presented, the results of the analysis of the final exam questions are as follows:

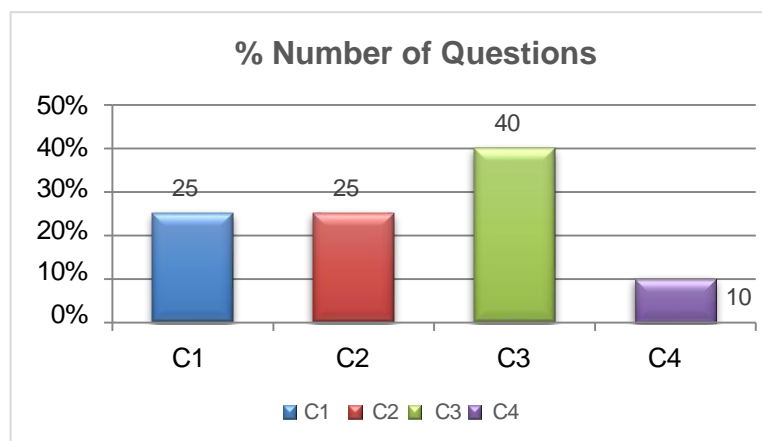


Figure 1. Percentage of Exam Question Analysis Results from 5 Schools in Medan City.

Based on Figure 1, it shows that 90% of the even semester final exam questions are cognitive level C1 – C3 or LOTS (Lower Order Thinking Skills) with the remaining 10% using C4 level questions. Table 1. Also explains the number of questions according to cognitive level C3 which has the largest number. From the analysis above, it can be concluded that questions with a cognitive level above C4 (Analyzing) or questions in the HOTS category as an evaluation tool in schools are still lacking. As for the percentage of instrument types in five schools in Medan City, all of them are multiple choice questions. So no one uses essay or short answer types of instruments. The percentage results of the types of assessment instruments can be seen in Figure 2.

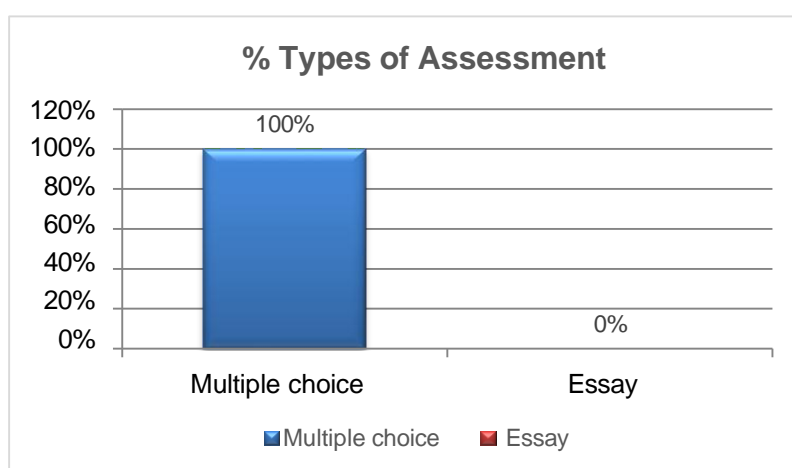


Figure 2. Percentage of types of assessment instruments

Critical thinking tests can be made in the form of multiple choices related to databases and standards (Sani, 2019). Data-driven questions are based on the data provided in the question. This data can be in the form of maps, tables, stories, cartoons, line graphs, bar graphs, writing, conversations and others. Survey activities and

interviews that have been carried out with chemistry teachers state that students can solve problems in class with a HOTS thinking level of 20% and most of them still solve problems with a HOTS level of 80%. This can be seen in figure 3.

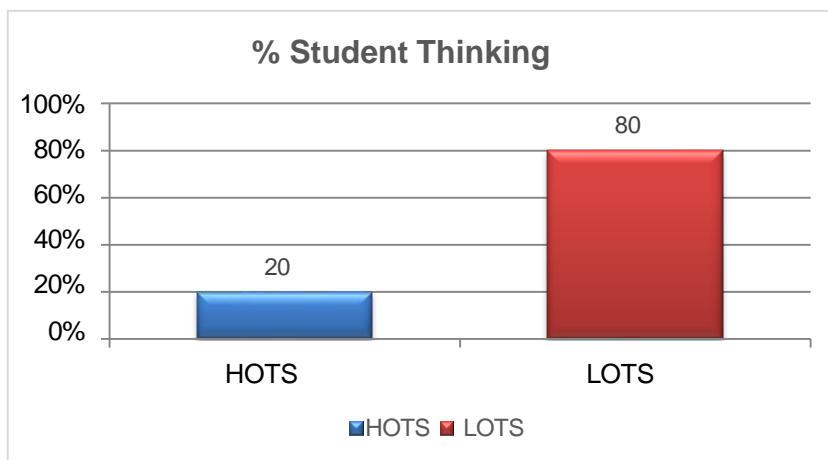


Figure 3. Students' levels of thinking in solving chemistry problems in class.

HOTS questions can encourage students to think more deeply about the subject matter, can increase learning motivation, and can increase love and concern for their region (Khaldun et al., 2019). HOTS-based test questions in chemistry learning influence students' skills in solving various complex problems (Harta, 20117). The interview results also showed that 100% of the schools observed required the HOTS instrument to be used in the final semester exams. These results can be seen from Figure 4.

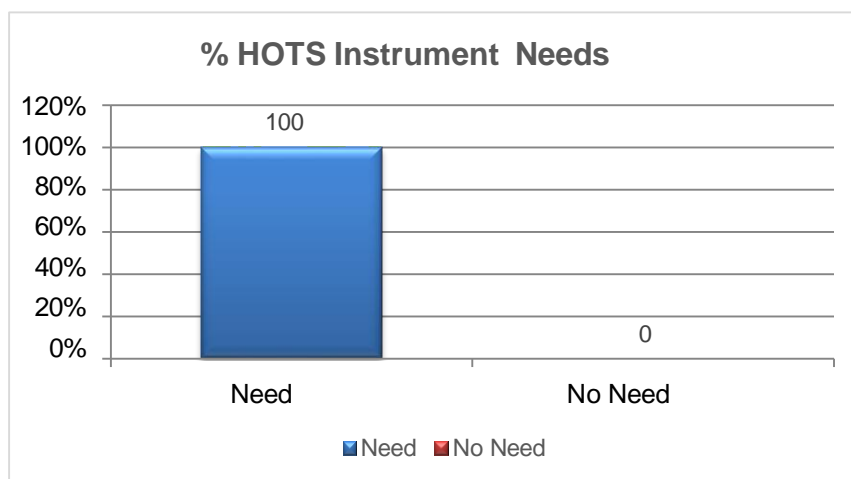


Figure 4. Percentage of HOTS Instrument Needs

Analysis of the affordability of assessment instruments was carried out to see the affordability of the instruments used in schools in measuring student HOTS. The results of this analysis will show the deficiencies in the assessment instruments used in schools. The deficiencies obtained from the analysis results will be used as a reference in developing the assessment instrument. Data was obtained by analyzing the question

instruments used by the school in the previous semester using a questionnaire. The results of quantitative analysis of the instruments used in schools are in Table 2.

Table 2. Results of Affordability Analysis of Question Instruments for Measuring HOTS

Rated aspect	Average				
	School 1	School 2	School 3	School 4	School 5
Material Aspects	2,602,55	2,8	2,86	2,8	2,8
Construction Aspects	2,782,48	2,6	2,78	2,8	2,8
Language Aspects	2,502,50	2,37	3,50	2,87	2,87
Total average	2,622,51	2,59	3,04	2,82	2,82

Based on Table 2, the total average result for schools 1 to 5 is 2.62; 2.51; 2.59; 3.04 and 2.82. These results indicate that the test questions used by the two schools are still not valid and some need to be revised. Next, a qualitative analysis was carried out. The results of the qualitative analysis and test instrument development plans are seen in Table 3.

The results of the analysis in Table 3 generally inform that the assessment instruments used in schools are still not included in the HOTS question items. The instruments used by schools are still at the C3 cognitive level, namely applications. There are several questions that fall into the HOTS category, but the number is still limited. Then, from the analysis results, it was found that there were still typing errors in words and chemical formulas. The shortcomings of the instruments used in schools are used as a basis for developing HOTS questions so that instruments are produced that suit the needs in the field.

Table 3. Results of Needs Analysis of the HOTS Assessment Instrument

Analysis of Question Items Used by Schools	Expansion plan
Material Aspects	
There are only a few questions that have contextual stimuli.	Add stimulus that can train students' HOTS abilities.
The questions still measure the ability to apply (C3) which is still in the LOTS category.	Select questions that are able to measure HOTS and repair/replace question items that still measure LOTS.
The technical terms are appropriate, but there are still typing errors in several questions.	Correction of incorrect writing of chemical formulas.
There are several stimuli that display answers to other questions.	Change question items and answer options.
Construction Aspects	
There are still stimuli that are not yet efficient and effective.	Improved stimulus that is not yet efficient and effective.
The quality of the images used in the questions is still poor.	Use images that are clear and of good quality.

Analysis of Question Items Used by Schools	Expansion plan
There is already a distractor and it is estimated that it will function well.	Distractors that are predicted to be good will be tested for quality.

There are still pictures and chemical formulas that are not good.	Corrected writing errors and low quality images changed to high quality.
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Language Aspects

There are still sentences that are less communicative and do not stimulate students to think at a higher level.	Correct sentences that are less communicative and less stimulating.
Not yet able to stimulate students to question something further and look for answers independently.	Improve the language used in the questions by adding several contextual events.

The solution to this problem is that teachers want a tutorial in creating and developing HOTS-based assessment instruments. This is related to the fact that there are still many teachers who have not been able to create HOTS-based assessment instruments that will be used as assessments. Apart from that, there are several factors that hinder the development of instruments in learning assessment, such as teachers feeling burdened because they are required to be more creative, require thorough preparation and also require high-level thinking abilities. Learning assessment using HOTS-based instruments will have a significant influence on the thinking process and ability to solve complex problems for students (Harta, 2017). This is also supported by research results which state that teachers can use the HOTS instrument as a reference or study material related to the preparation of the HOTS assessment instrument so that it can add to high-level reasoning for students (Hamidah & Wulandari, 2021).

▪ **CONCLUSION**

Based on the results of the analysis of teacher needs as a basis for developing HOTS-based final even semester assessment instruments, it can be concluded that the instruments most frequently used are those with cognitive levels C1-C3 (LOTS), while instruments with cognitive levels C4-C6 (HOTS) are very rarely used as assessment instrument. Barriers for teachers in using media are a lack of understanding in producing and developing HOTS-based assessment instruments. The solution to this problem is that teachers want a tutorial in creating and developing HOTS-based assessment instruments. So that it has a good impact in training students' critical and creative thinking skills.

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