

Exploring Chemistry Teachers' Knowledge of Higher Order Thinking Skills (HOTs) Based Assessment

Hayuni Retno Widarti^{1*}, Herunata Herunata¹, Oktavia Sulistina¹, Habiddin Habiddin¹,
Yenin Nadhifah¹

¹ Chemistry Department, Faculty of Mathematics and Natural Science, Universitas Negeri Malang (UM), Jln. Semarang No. 5, Malang, Indonesia

*Corresponding author. Email: hayuni.retno.fmipa@um.ac.id

ABSTRACT

Informed by 2013 curriculum implementation, it is acknowledged that chemistry learning in schooling sector aims not only to discern students' competence but also to assess their higher-order thinking skills (HOTs). This notion of HOTs is demandable to help students compete in the millennial era. One visible practice of HOTs implementation in the classroom is the use of HOTs-typed questions to assess students' learning outcomes. Thereby, this present study seeks to explore the practice of HOTs in the schooling sector in Indonesia. A survey design was deployed in this study by recruiting chemistry teachers throughout East Java province in Indonesia. Data were collected through shared questionnaires to forty-one chemistry teachers in East Java province using Google form applications. The results of this study indicate that 97.5% of the surveyed teachers have included HOTs-typed questions in their daily and semester exams. It can also be concluded that these teachers have construed the HOTs assessment in their classrooms.

Keywords: assessment, chemistry, higher-order thinking skill

1. INTRODUCTION

Recent research has informed that Higher Order Thinking Skills (HOTs) is paramount importance for students to engage actively in the 21st century learning [1]. In addition, the assessment of HOTs is considered as an implementation of the 2013 Curriculum-based assessment improvement which corresponds to the international education standards. International standards refer to the Program of International Student Assessment (PISA) which measures the ability to think at a high level in the aspects of reading, mathematics, and other scientific literacies [2]. Characteristics of HOTs assessment are questions that measure the ability to think at a higher level, contextual assessment, and varied forms of questions [3]. Another perspective on HOTs is raised by Brookhard [4], stating that HOTs-based assessment instruments consist of six types; 1) transfer, 2) critical thinking, 3) creative thinking, 4) judgment, 5) logic and reasoning, 6) problems solving. Based on this fact, it is observed that the assessment of high-level thinking ability do not only include questions of C4

(analyze), C5 (evaluate), and C6 (create) presented in bloom's taxonomy framework, but also include a wider variation that includes PISA standard questions such as contextual assessment, transfer (analysis, evaluate, create), critical thinking, creative thinking, logic and reasoning, judgment, and problem solving.

The practice of the 2013 curriculum is a continuum of one of the curriculum principles such as change and continuity, besides, the 2013 curriculum is also a strategic policy to meet the demands of the 21st century skills [5]. This curriculum is implemented at every level of education such as in elementary school, junior high school, and senior or vocational school. The implementation was carried out in all subjects, particularly in high school chemistry subjects. As an actor in the teaching process, chemistry teachers should have the ability to include HOTs questions during the learning assessment [6]. Therefore, this present study explores the practice of HOTs-based assessment in the classroom daily and semester exam enacted by chemistry teachers in senior high schools throughout East Java.

This study focuses on how many chemistry teachers have applied HOTS assessments and how these teachers construe the HOTS-based assessment.

2. METHOD

To obtain a thorough picture of the teachers’ knowledge on HOTS-based assessment, a survey design was employed in this study. The design contained ten questions that were able to describe the teachers’ understanding on HOTS-based assessment and it’s implementation. Data were collected through shared questionnaires to forty-one chemistry teachers in East Java province. We spread the questionnaire online using Google form application to gain fast-tracking responses from the respondents. The questions in the survey consist of general and specific and detailed inquiries.

The collected data were then stored online in the application for further analysis. The analysis of the data was done through percentage formulation. It was carried out to understand the responses of the respondents effectively.

3. RESULTS AND DISCUSSION

3.1 Question 1: Do you know HOTS assessment?

In this section, forty respondents responded that they know HOTS assessment while only one of them answered “No”. It, assuredly, portrays that 97.5% of the respondents apply the HOTS assessment on their learning assessment. One respondent who answered “No” might be due to lack of information or pedagogical trainings in making HOTS questions. This is in

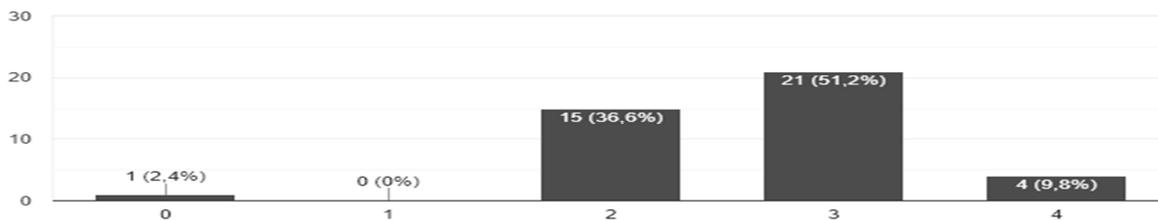


Figure 1. Chemistry teachers’ understanding on HOTS.

3.3 Question 3: Where did you obtain information with regard to HOTS assessment?

In this question, the responses are elaborated in the following details: 1) Training, 2) Subject teacher deliberations or MGMP, 3) Workshop, 4) Training or coaching, 5) Seminar, 6) Literacy of books or journals,

accordance with what was reported by Ahmad[7], contending that in the training of the implementation of the 2013 curriculum, oftentimes only one or two teachers are invited from each institution, it thus hinders shared knowledge among the teachers. This has an impact on teachers who encounter little opportunities, unless the teacher has his own desire to understand HOTS. It can be enacted through teacher self-learning. Furthermore, schools can also facilitate internal training or the teachers by inviting the participated teacher. The results of the questionnaire also showed that teachers and schools had implemented the 2013 curriculum and adapted to the demands of the 21st century learning.

3.2 Question 2: To what extent do you know HOTS assessments?

This section documents specific responses from the respondents asking their detailed knowledge on HOTS assessment. The answers are portrayed in Figure 1 below.

Based on the data above, it can be observed that one respondent does not have an understanding of HOTS assessment (scale 0), fifteen respondents have sufficient understanding of HOTS assessment (scale 2), twenty-one respondents have a good understanding of HOTS assessment (scale 3), and four respondents have a very good understanding of the assessment of HOTS (scale 4). In general, this figure portrays that the most of the respondents possess decent knowledge on HOTS assessment.

7) Lecture, 8) Information from supervisors and fellow teachers. This survey documents that the respondents obtain information from varied sources. They actively involved in teacher professional development discerning HOTS assessment.

3.4 Question 4: Have you applied the HOTS assessment in your semester exam questions?

Twenty-eight out of forty-one respondents responded “Yes”, while thirteen of them provided “doubtful” answers. Based on the questionnaire, there were 68.3% of respondents who believed that they had applied the HOTS assessment. On the contrary, this shows that there are still chemistry teachers who are still uncertain whether they have practiced HOTS assessment. Besides, several respondents are also still unsure whether they have included HOTS questions in their semester exams.

3.5 Question 5: Have you applied the HOTS assessment in your daily exam questions?

In this question, thirty-two respondents voiced their opinions. Among them, twenty-four responded “Yes”, while eight of them answered, “doubtful. Therefore, it can be concluded that there are 75% of respondents who believe they have applied HOTS assessment in their daily exam questions, and there are also 25% of them who are unsure of the HOTS questions they have made.

3.6 Question 6: How many HOTS questions do you employ in each semester exam?

In this question, The responses in this section vary in terms of number of questions used by the respondents. For instance, three of the respondents include one question. Fourteen of them include 14 questions. 12 employed three questions. Finally, twelve of the respondents utilized 4 questions. All questions are covered with HOTS items assessment. Based on the results of the questionnaire, most of the respondents included two HOTS questions in their semester exams. The difference in the number of HOTS questions may occur due to differences in school backgrounds, students’ abilities, and teachers’ ability to vary HOTS questions.

3.7 The seventh 7: Approximately, how many HOTS questions do you use in each daily exam?

This section documents thirty-two answers from the respondents. Ten of the respondents answered one question. Thirteen of them voiced two questions. Seven respondents answered three questions, and two of them contended four questions. Based on the results of the questionnaire, most of the respondents used two HOTS questions in their daily exam questions. There is a significant difference between the results of the sixth and seventh question in the questionnaires. The distinction

refers to the number of respondents who chose one to two HOTS questions exceeds more than three times. The difference in the number of HOTS questions may occur inasmuch the daily exam is scheduled nearer if compared to the semester exams, apart from possibility teachers’ lacking knowledge in HOTS assessment questions.

3.8 Question 8: According to you, how are the characteristics of chemical materials which can be used as HOTS questions?

Forty-one respondents provided answers from this question. Their vary in terms of deciding the characteristics of the materials are all chemicals can be made into a matter of type HOTS; material with basic competencies (KD) in the domains of C3(application), C4(analyze), C5(evaluation), and C6(create); contextual material that is related to the daily lives of students; questions that require more than one concept of completion; material in the form of concepts; material that covers the relationships or relationships of several topics; material that requires students to analyze first to solve the problem (reasoning); material acids, bases, colligative properties, electrochemistry, electron configurations, quantum numbers, periodic system of elements (SPU), chemical equilibrium, solutions; material in the form of procedural or experimental; questions that have a stimulus; material that requires a chemical calculation process; factual and contextual material; and material in the form of linkages from several.

Based on these data, there are several statements that are not in accordance with the concept of the Higher Order Thinking Skills (HOTS) assessment, including one tenet that HOTS do not cover the C3(application) domain in bloom taxonomy, but include the C4(analyze), C5(evaluation), and C6(create) domains. In addition, material in the form of chemical calculations is not necessarily included in the realm of high-level thinking. The material, on the other hand, only reaches the C3 domain based on bloom’s taxonomy. Research shows that the understanding of HOTS according to respondents is only in the scope of contextual transfers and assessment excluding a broader scope such as HOTS based on PISA and six types of HOTS based on Brookhard[4]. These findings are in line with the research of Senam and Iskandar[8] arguing that common chemistry teachers developed HOTS questions in their semester exams employ the realm of HOTS transfer C4(analyze) and C5(evaluation). Characteristics of HOTS by Brookhard[4] are divided into three categories, namely 1) the ability to transfer one concept to another connecting existing concepts to solve problems, 2)

critical thinking skills, namely the ability to understand or solve problems logically, think reflectively, as well as being able to determine decisions on the problems presented, 3) the ability to solve problems (problem solving), namely the skills in finding new solutions that are contemporary and creative.

3.9 Question 9: In what class do you use HOTS assessment?

In this question, there are forty-one respondents who responded to the question. Representation of the number of respondents in answering these questions can be seen in Figure 2. Figure 2 contains a representation of the number of respondents to the application of HOTS at each grade level (class X, XI, XII).

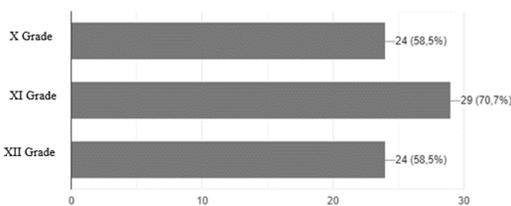


Figure 2. Class representation for the implementation of HOTS assessment.

Based on Figure 2 above, it is viewed that the application of HOTS assessment is mostly carried out in class 11. This might happen because enasmuch the students in this class are able to understand and answer HOTS questions. Some chemical theory on XI grade that includes HOTS are chemical equilibrium[9], acid-base pH[10], and thermochemistry[11].

3.10 Question 10: Since when did HOTS assessments take place in your school?

In this question there are forty-one respondents responded to the question. The responses can be seen from the chart below.

HOTS REPRESENTATION FROM 2013 UNTIL 2019

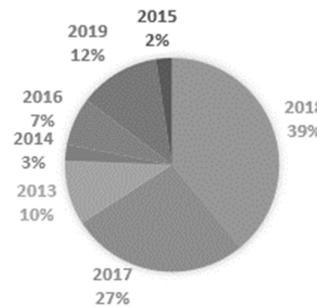


Figure 3. Chart showing the implementation of HOTS assessment.

Based on Figure 3, it can be seen that the application of HOTS assessment starts in 2018. Ahmad[7] stated that there are some problems in the implementation of the 2013 Curriculum in the form of criticism and suggestions. These problems deal with the readiness of teachers, the readiness of schools and the support of school principals who. These components can later lead to the implementation of 2013 curriculum and HOTS assessment. The revised curriculum has covered teachers to implement HOTS assessment in their classroom.

4. CONCLUSION

Based on the research results, the following conclusions can be drawn 97.5% of respondents already apply the HOTS assessment. This indicates that the assessment of HOTS is new among the teachers, particularly in East Java province. Information from question two we know that more than 50% of the respondents believe that they have a good understanding of HOTS assessment. Information about the assessment of HOTS is obtained from various sources. This shows that many sources of information are able to provide knowledge of HOTS assessment. The application of HOTS questions in the daily exam is lowering the semester exam.

There are some misconceptions about the assessment of HOTS such as a belief that the assessment of HOTS is included in C3(application) domain, while the fact it is included in the C4(analyze), C5(evaluation) and C6(create) domains based on bloom taxonomy. This study documents that the respondents' knowledge on HOTS is still lacking. The application of HOTS is mostly implemented in class 11. It is carried out since the students are able to understand and answer HOTS questions well. The application of HOTS has been carried out starting in 2013 and continues to increase until 2018. The application of HOTS mostly is started in 2018, in addition there are five respondents who have just started implementing the HOTS assessment in 2019.

REFERENCES

- [1] M. Ramli, Implementation of research in developing Higher Order Thinking Skills in Sains Education, 5th National Science Education Seminar Held by Master of Science Education and Doctoral Education at IPAS FKIP UNS, 2019.
- [2] OECD PISA, PISA for Development Assessment and Analytical Framework, OECD, 2017.
- [3] M. Z. Fanani, Higher Order Thinking Skills (HOTS) Development Strategy in the 2013 Curriculum, *Edudeena*, 2 (1) (2018) 57-76, DOI: <https://doi.org/10.30762/ed.v2i1.582>
- [4] S. M. Brookhard, How to Assess Higher-Order Thinking Skills in Your Classroom, ASCD, Virginia USA, Alexandria, 2010.
- [5] I. Machali, 2013 Curriculum Change Policy and Welcome Indonesia Gold Generation 2045, *Jurnal Pendidikan Islam*, 3(1) (2014) 71-94, DOI: <https://doi.org/10.14421/jpi.2014.31.71-94>
- [6] Ismono, S. Poedijastoeti, and S. Suyoto, Implementation of Learning Model Map Concept with Inquiry Strategy in an Effort to Train High-Order Thinking Skills of Chemistry Education Student. *International Conference on Science and Tecnology*, 1 (2018) 209-2014, DOI : <https://doi.org/10.2991/icst-18.2018.45>
- [7] S. Ahmad, 2013 Curriculum Problems and the principal's Instructional Leadership, *Jurnal Pencerahan*, 8 (2) (2014) 98-108, ISSN : 1693-1775
- [8] Senam and D. Iskandar, Study the Ability of High School Chemistry Teachers Graduated From UNY in Developing HOTS-based Questions, *Jurnal Inovasi Pendidikan IPA*, 1 (1) (215) 65-72,
- DOI: <https://doi.org/10.21831/jipi.v1i1.4533>
- [9] Rr. R. Y. Rahayu and H. Sutrisno, The Effect of Chemistry Learning Based on Analogy on Higher Order Thinking Skills of Senior High Schools Student in Equilibrium Concept, *European Journal of Education Studies*, 5 (12) (2019) 255-267, DOI: 10.5281/zenodo.2619248
- [10] R. B Rudibyani and R. Perdana, Enhancing Higher-Order Thinking Skills Using Discovery Learning Model's On Acid-Base pH material, *AIP Conference Proceedings 2014*, DOI: 10.1063/1.5054512
- [11] R. Verdina, A. Gani, and Sulastri, Improving Students' Higher Order Thinking Skills in Thermochemistry Concept Using Worksheet Based on 2013 Curriculum, *IOP Conf. Series: Journal of Physics: Conf. Series 1088* (2018) 012105, DOI: 10.1088/1742-6596/1088/1/012105
- [12] S. Arikunto, *Research Procedure: a Practical Approach*, Aneka Cipta, Jakarta, 2014.
- [13] S. Elo and H. Kyngas, The Qualitative Content Analysis Process. *Journal of Advanced Nursing*, 62 (1) (2008) 107-115, DOI: 10.1111/j.1365-2648.2007.04569.x
- [14] P. Lietz, Research into questionnaire design: A summary of the literature. *International Journal of Market Research*, 2 (22) (2010) 249-273, DOI: 10.2501/S147078530920120X