JPPIPA 9(8) (2023)

Jurnal Penelitian Pendidikan IPA

Journal of Research in Science Education

http://jppipa.unram.ac.id/index.php/jppipa/index

Chemistry Teacher's Perception About Higher Order Thinking Skills Assessment

Resi Febriyanti[1*], Endang Widjajanti[2]

[1] Master of Chemistry Education Study Program, Yogyakarta State University, Yogyakarta, Indonesia.
[2] Yogyakarta State University, Yogyakarta, Indonesia.

Received: January 31, 2023
Revised: May 12, 2023
Accepted: August 25, 2023
Published: August 31, 2023

Corresponding Author:
Resi Febriyanti
resi0002fmipa.2021@student.uny.ac.id

DOI: 10.29303/jppipa.v9i8.3040

© 2023 The Authors. This open access article is distributed under a (CC-BY License)

Abstract: Higher order thinking skills are an assessment that must be integrated into 2013 Curriculum learning process. The purpose of this study is to investigate the chemistry teacher's perception about higher order thinking skills assessment. Descriptive qualitative was used in this study. This study implicated 10 chemistry teacher from 10 senior high school in West Kalimantan. Data on chemistry teacher's perception about higher-order thinking skills assessment were obtained from questionnaire consist of 10 questions. The results showed that most of the chemistry teachers in West Kalimantan already know and implement higher order thinking skills assessment in learning, like final exam and daily test. The HOTS assessment has been implemented by most teachers, but the implementation was not optimal even though in terms of knowledge all teachers already know about the HOTS assessment.

Keywords: Assessment; Chemistry teacher; Higher order thinking skills; Perception

Introduction

The quality of a country's education affects the quality of its human resources. The quality of education is not only determined by educational plans and developments but also by the quality of its implementation (Retnawati et al., 2018). Improving the quality of education is a positive impact from the development of science and information technology, causing increasingly fierce globalization competition (Qamariyah et al., 2021). The demands faced by students in the 21st century include becoming students who have critical thinking, communication, collaboration, and creative skills to effectively solve real-world problems in the era of global competition (Sang et al., 2018; Toheri et al., 2020; Zhou, 2018). Therefore, education in Indonesia has an important role in pursuing quality processes and learning outcomes in accordance with the 2013 Curriculum. The 2017 revision of the 2013 Curriculum states that higher-order thinking skills are one of four things that must be integrated in the learning process (Pratama & Retnawati, 2018).

Chemistry is closely related to the problems of everyday life, so students are expected to be able to relate conceptual material to the problems around them (Qamariyah et al., 2021). Therefore, chemistry is one of the subjects that can contribute to training students' higher-order thinking skills. However, the chemistry material received by students was too much so that students had difficulty understanding the knowledge obtained because they did not find a link between chemical content in class and students' experiences in everyday life (Tsaparlis, 2020).

Higher order thinking skills are one of the concerns in the assessment of chemistry learning. The chemistry national exam instrument also contains questions based on higher-order thinking skills (Herunata et al., 2020). The 2018 PISA results, which were attended by 77 countries, show that Indonesia ranks 71st with an average score of 371 for reading ability, 70th place with an average score of 379 for math ability, and 69th place

How to Cite:
Febriyanti, R., & Widjajanti, E. (2023). Chemistry Teacher's Perception About Higher Order Thinking Skills Assessment. *Jurnal Penelitian Pendidikan IPA*, *9*(8), 5921–5926. https://doi.org/10.29303/jppipa.v9i8.3040

with an average score of 396 for math ability science (OECD, 2018; OECD, 2022). The assessment used in the PISA survey has used an assessment of higher order thinking skills. Based on the results of PISA, it can be concluded that the ability of students in Indonesia is still at a low level. Previous research conducted by Ichsan et al. (2019) also showed that students' high-order thinking skills were at a low level in all aspects. This is in line with the results of previous research by Anggraini et al. (2019) which stated that the high-level thinking skills of students in Indonesia have not reached the desired target. The low ability of students' higher-order thinking is caused by several things, such as a lack of motivation to learn, students only rely on material explanations from the teacher, students are not used to working on questions based on higher-order thinking skills (Retnawati et al., 2018; Syafryadin et al., 2022).

Higher-order thinking skills are complex thinking abilities to solve problems (Sasson et al., 2018). High-level thinking skills can improve students' critical thinking (Indriyana & Kuswandono, 2019). Higher-order thinking skills include the cognitive level of Bloom's Taxonomy, namely analyzing, evaluating, and creating (Brookhart, 2010). Analyzing is the ability to break material into its constituent parts and relate the parts to the whole, including differentiating, organizing, and attributing. Evaluating is the ability to make judgments based on criteria and standards, including checking and critiquing. Creating is the ability to combine elements to form a coherent functional whole; organizing elements into new patterns or structures, including generating, planning, and producing (Anderson et al., 2001).

Teachers have an important role in improving students' higher order thinking skills. Teachers are expected to be able to guide students to build on the knowledge and skills acquired to find new ways and means of solving problems and making the right decisions. Teachers not only have to understand higher-order thinking skills theoretically, but are required to practically train students' higher-order thinking skills (Driana et al., 2021). Therefore, it is important for teachers to have higher-order thinking skills so they can train students' higher-order thinking skills through classroom learning (Mitarlis et al., 2020). In fact, teachers only have basic knowledge of Bloom's cognitive taxonomy, but still have difficulty distinguishing high-level and low-order thinking levels, as well as low self-efficacy for teaching higher-order thinking skills (R. K. A. Singh et al., 2018). In addition, teachers also have difficulty applying higher-order thinking skills in assessments and the teacher's inability to determine appropriate learning techniques and strategies to bring out students' higher-order thinking skills (C. K. S. Singh et al., 2020). The instruments used to measure higher-order thinking skills are still dominated by items to measure lower-order thinking skills (Dahlan et al., 2020; Hamdi et al., 2018).

The teacher's knowledge of higher-order thinking skills plays a big role in developing students' higher-order thinking skills. Widarti et al. (2020) stated that most teachers in East Java Province had implemented HOTS assessments on daily test questions and final semester exams, however there are misunderstandings about HOTs assessments such as the belief that HOTS assessments are included in the C3 domain (application). In fact, it is included in C4 (analyze), C5 (evaluate) and C6 (create) domain based on bloom taxonomy. This shows that the teacher's knowledge of higher order thinking skills is still lacking.

Efforts that can be made to improve students' higher-order thinking skills are to develop learning media, methods, and assessment strategies used by teachers (Shanti et al., 2022). The importance of the teacher's knowledge and understanding of students' high-level thinking skills so that students' thinking skills can be improved and evaluated appropriately. Therefore, it is necessary to conduct research on chemistry teachers' perceptions of higher-order thinking skills in assessments so that the extent of knowledge, understanding, application, and constraints teachers face in implementing higher-order thinking skills in chemistry in the classroom can be identified. Based on the explanation above, the researcher is interested in conducting research on chemistry teachers' perceptions of higher order thinking skills assessment in senior high schools.

Method

This study uses a qualitative descriptive approach to describe chemistry teachers' perceptions of higher-order thinking skills in the assessment of chemistry learning. The research sample involved 10 high school chemistry teachers in West Kalimantan.

Data collection was carried out by distributing questionnaires to 10 chemistry teachers from 10 high schools in West Kalimantan Province online using the Google Form to get quick responses from respondents. This questionnaire consists of instructions for filling out the questionnaire, the identity of the teacher, the school where he teaches, and 10 questions regarding the chemistry teacher's perception of higher order thinking skills based on assessment. This questionnaire is used to identify the level of teachers applying higher order thinking skills in the assessment of chemistry learning in class. The instruments used in this study were adopted from research (Widarti et al., 2020).

Result and Discussion

Result

Question 1 and 2: Do you know HOTs assessment? To what extent do you know HOTs assessments?

In the first question, all respondents stated that they knew about the HOTS assessment. The second question shows specific responses from respondents asking for their detailed knowledge of HOTS assessments. The results of the answers indicated that the respondents' knowledge of the HOTS assessment varied, including the characteristics of the questions, cognitive level, and the application of higher order thinking skills in the assessment.

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

Through this question, the responses of respondents were obtained that information regarding the HOTS assessment was obtained when studying lectures, technology guidance, books, articles, internet, worksheets, *in house training* (IHT). Respondents' answers indicated that respondents obtained information regarding HOTS assessments from various sources.

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

Nine respondents stated that they had implemented the HOTS assessment in semester exam questions and one respondent stated that they had not. Based on the results of the questionnaire, 90% of the respondents believed they had applied the HOTS assessment in the semester exams, while there were respondents who were still unsure whether they had implemented the HOTS questions in the semester exam assessments.

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

Nine respondents had implemented the HOTS assessment in daily test questions and one respondent stated that they had not. Based on the results of the questionnaire, 90% of respondents had implemented HOTS assessments in daily tests, while there were respondents who had not implemented HOTS questions in daily tests.

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

The answers to these questions differ regarding the number of HOTS questions applied by respondents in the semester exams. Four respondents used 10 questions, three respondents used 5 questions, one respondent used 4 questions, 1 respondent used 3 questions, and 1 respondent did not apply HOTS questions. Based on the answers to the questionnaire, most of the respondents entered 5-10 HOTs questions in the semester exam.

Question 7: Approximately, how many HOTs questions do you use in each daily exam?

The answers to these questions differ regarding the number of HOTS questions applied by respondents in the semester exams. One respondent applied 5 questions, four respondents applied 2 questions, four respondents applied 1 question, and 1 respondent did not apply HOTS questions. Based on the answers to the questionnaire, most of the respondents included one to two HOTs questions in the daily test.

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

The answers to this question vary. The characteristics of chemical material that can be used as HOTS questions include questions that require high-level thinking skills for students with cognitive domain levels C4 (analyze), C5 (evaluate), and C6 (create); contextual material related to students' daily lives; questions that require more than one concept of completion; material that requires students to analyze beforehand in solving problems (reasoning); questions that have a stimulus; materials that require a chemical calculation process.

Question 9: In what class do you use HOTs assessment?

This question was answered by 9 respondents and several respondents taught not only one class. The application of the HOTS assessment in class X, XI, and XII was 7 respondents, 4 respondents and 5 respondents respectively.

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

This question was answered by 9 respondents. Respondents' answers can be seen in the Figure 1.

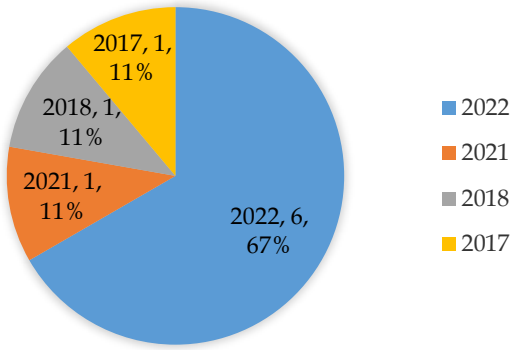

Figure 1. The year the HOTS assessment was implemented

Discussion

The teachers who participated in this study knew about the HOTS assessment in chemistry lessons. This is in line with the curriculum that applies in Indonesia, namely the 2013 Curriculum where higher-order thinking skills are an important concern in chemistry subjects so that the need for teacher knowledge about higher-order thinking skills. In addition, the national exams held contain questions based on HOTS because the concept of HOTS is an important part of the 2013 Curriculum in Indonesia (Harta et al., 2020). The teacher's knowledge of higher-order thinking skills in assessment includes assessments that measure students' knowledge at cognitive levels C4-C6 and include critical thinking skills. HOTS includes the ability to problems solving, creative thinking, critical thinking, reason, and make decisions (Utama et al., 2020).

Government support in the implementation of the 2013 Curriculum by holding training is a source of information for teachers to know about the implementation of the 2013 Curriculum including the assessment of higher order thinking skills (Nursyifa et al., 2019) In addition, the teacher's high curiosity also plays a role in obtaining HOTS assessment information through articles and journals and the internet.

Most of the respondents had applied the HOTS assessment in semester exams and daily tests, but one of the respondents had not applied it in the exam because the teacher thought that his students were not ready to solve complex questions (Driana et al., 2021). The preparation of HOTS questions by the teacher is not optimal because of limited time and the teacher's lack of ability to make quality questions and the ability of students is still low (Afriyanti et al., 2021; Driana et al., 2021). The number of questions used by respondents varied. Differences in the number of HOTS questions used can be caused by differences in school backgrounds, students' abilities, and teachers' abilities to vary HOTS questions (Widarti et al., 2020).

Based on the data, the characteristics of chemical material that can be used as HOTS questions according to respondents include the C4 domain (analysis), C5 (evaluation), and C6 (making) domain. However, chemical materials that contain chemical calculations are not necessarily included in the realm of higher-order thinking. Chemical material for chemical calculations only reaches the C3 domain (application) based on Bloom taxonomy (Widarti et al., 2020). Research showed that the meaning of HOTs according to respondents is only within the scope of cognitive levels C4-C6. Ningsih et al. (2023) stated that generally chemistry teachers develop HOTs questions in semester exams using cognitive levels C4 (analysis), C5 (evaluation), and C6 (create). HOTS characteristics are divided into three categories, namely 1) higher-order thinking as transfer to link one knowledge to other knowledge to solve problems, 2) higher-order thinking as critical thinking to understand or solve problems logically, think reflectively, and be able to determine decisions on existing problems, and 3) higher-order thinking as problem solving for solving abilities, namely skills in finding new contemporary and creative solutions (Brookhart, 2010).

Respondents stated that the HOTS questions contained a stimulus. The HOTS test questions are given through a stimulus (Hamdi et al., 2018). Stimulus can come from current global issues such as technology, information, science, education, health, and infrastructure. Stimulus can also arise from the environment such as culture.

The HOTS assessment began in 2017. Based on Figure 1 it can be seen that the implementation of the HOTS assessment began in 2017. Several obstacles in implementing the 2013 Curriculum included teacher readiness, school readiness and support from the school principal (Warman et al., 2021).

Conclusion

The HOTS assessment has been implemented by most teachers but it is not optimal even though in terms of knowledge all teachers already know about the HOTS assessment. Information on the HOTS assessment is obtained by teachers through various sources, such as lecture materials during undergraduate education, training, as well as articles and journals. The teacher interprets HOTS assessments as limited to assessments at cognitive levels C4-C6. The HOTS assessment began in 2017 until now. The teacher has implemented the HOTS assessment in class, such as end-of-semester exams and daily tests, but their application was not optimal. This shows that the teacher has implemented the HOTS assessment in class.

Acknowledgments

The author would like to thanks teachers who contributed in this research. Then, the author also thanks my supervisor and the lecturers at the Yogyakarta State University who have guided me in compiling this article. I hope that the results of this study can be additional information for the future chemistry education research.

Author Contributions

The authors were involved in the overall writing this article.

Funding

This research received no external funding.

Conflicts of Interest

The authors declare that there is no conflict of interest regarding the publication of this article.

References

Afriyanti, M., Suyatna, A., & Viyanti. (2021). Design of e-modules to stimulate HOTS on static fluid materials with the STEM approach. *Journal of Physics: Conference Series*, *1788*(1), 1–7. https://doi.org/10.1088/1742-6596/1788/1/012032

Anderson, L. W., Krathwohl Peter W Airasian, D. R., Cruikshank, K. A., Mayer, R. E., Pintrich, P. R., Raths, J., & Wittrock, M. C. (2001). *A taxonomy for learning, teaching, and assessing*. Retrieved from https://www.uky.edu/~rsand1/china2018/texts/Anderson-Krathwohl - A taxonomy for learning teaching and assessing.pdf

Anggraini, N. P., Budiyono, & Pratiwi, H. (2019). Analysis of higher order thinking skills students at junior high school in Surakarta. *Journal of Physics: Conference Series*, *1211*(1), 1–9. https://doi.org/10.1088/1742-6596/1211/1/012077

Brookhart, S. M. (2010). How to assess higher-order thinking skills in your classroom. In *ASCD*. ASCD. https://doi.org/10.1177/002205741808801819

Dahlan, D., Permana, L., & Oktariani, M. (2020). Teacher's competence and difficulties in constructing hots instruments in economics subject. *Cakrawala Pendidikan*, *39*(1), 111–119. https://doi.org/10.21831/cp.v39i1.28869

Driana, E., Susilowati, A., Ernawati, E., & Ghani, A. R. A. (2021). Assessing students' higher-order thinking skills: knowledge and practices of chemistry teachers in vocational senior secondary schools. *Jurnal Pendidikan Teknologi Dan Kejuruan*, *27*(1), 37–47. https://doi.org/10.21831/jptk.v27i1.32882

Hamdi, S., Suganda, I. A., & Hayati, N. (2018). Developing higher-order thinking skill (HOTS) test instrument using Lombok local cultures as contexts for junior secondary school mathematics. *Research and Evaluation in Education*, *4*(2), 126–135. https://doi.org/10.21831/reid.v4i2.22089

Harta, J., Rasuh, N. T., & Seriang, A. (2020). Using HOTS-based chemistry national exam questions to map the analytical abilities of senior high school students. *Journal of Science Learning*, *3*(3), 143–148. https://doi.org/10.17509/jsl.v3i3.22387

Herunata, H., Widarti, H. R., Amalia, R., Sulistina, O., Habiddin, H., & Rosli, M. S. Bin. (2020). An analysis of higher order thinking skill (HOTs) in chemistry national examination for senior high school. *AIP Conference Proceedings*, *2215*(April), 1–8. https://doi.org/10.1063/5.0000639

Ichsan, I. Z., Sigit, D. V., Miarsyah, M., Ali, A., Arif, W. P., & Prayitno, T. A. (2019). HOTS-AEP: Higher order thinking skills from elementary to master students in environmental learning. *European Journal of Educational Research*, *8*(4), 935–942. https://doi.org/10.12973/eu-jer.8.4.935

Indriyana, B. S., & Kuswandono, P. (2019). Developing students' higher order thinking skills (HOTS) in reading: english teachers' strategies in selected junior high schools. *JET (Journal of English Teaching)*, *5*(3), 204–216. https://doi.org/10.33541/jet.v5i3.1313

Mitarlis, Ibnu, S., Rahayu, S., & Sutrisno. (2020). The effectiveness of new inquiry-based learning (NIBL) for improving multiple higher-order thinking skills (M-HOTS) of prospective chemistry teachers. *European Journal of Educational Research*, *9*(3), 1309–1325. https://doi.org/10.12973/eu-jer.9.3.1309

Ningsih, N. R., & Kamaludin, A. (2023). Development of higher order thinking skills-based assessment instrument on acid-base materials in high school. *Jurnal Penelitian Pendidikan IPA*, *9*(1), 13–19. https://doi.org/10.29303/jppipa.v9i1.1457

Nursyifa, A., Nurzaman, E., & Alinurdin, A. (2019). Learning assessment training based on curriculum 2013 by using Vocational High School E-Report in South Tangerang. *ASEAN Journal of Community Engagement*, *3*(2), 286–306. https://doi.org/10.7454/ajce.v3i2.1065

OECD. (2018). What 15-year-old students in Indonesia know and can do. In *Programme for International Student Assessment (PISA) Result from PISA 2018*. Retrieved from https://www.oecd.org/pisa/publications/PISA2018_CN_IDN.pdf

OECD. (2022). *Education GPS*. Retrieved from https://gpseducation.oecd.org/CountryProfile?primaryCountry=IDN&treshold=10&topic=PI

Pratama, G. S., & Retnawati, H. (2018). Urgency of higher order thinking skills (HOTS) content analysis in mathematics textbook. *Journal of Physics: Conference Series*, *1097*(1), 1–8. https://doi.org/10.1088/1742-6596/1097/1/012147

Qamariyah, S. N., Rahayu, S., Fajaroh, F., & Alsulami, N. M. (2021). The effect of implementation of inquiry-based learning with socio- scientific issues on students ' higher-order thinking skills. *Journal of Science Learning*, *4*(3), 210–218. https://doi.org/10.17509/jsl.v4i3.30863

Retnawati, H., Djidu, H., Kartianom, Apino, E., & Anazifa, R. D. (2018). Teachers' knowledge about higher-order thinking skills and its learning strategy. *Problems of Education in the 21st Century*, *76*(2), 215–230. https://doi.org/10.33225/pec/18.76.215

Sang, G., Liang, J. C., Chai, C. S., Dong, Y., & Tsai, C. C. (2018). Teachers' actual and preferred perceptions of twenty-first century learning competencies: a Chinese perspective. *Asia Pacific Education Review*, *19*(3), 307–317. https://doi.org/10.1007/s12564-018-9522-0

Sasson, I., Yehuda, I., & Malkinson, N. (2018). Fostering the skills of critical thinking and question-posing in a project-based learning environment. *Thinking Skills and Creativity*, *29*, 203–212. https://doi.org/10.1016/j.tsc.2018.08.001

Shanti, M. R. S., Istiyono, E., & Munadi, S. (2022). The effectiveness of learning to improve students' higher-order thinking skills. *Cypriot Journal of Educational Sciences*, *17*(5), 1576–1587. https://doi.org/10.18844/cjes.v17i5.7220

Singh, C. K. S., Singh, T. S. M., Ja'afar, H., Tek, O. E., Kaur, H., Mostafa, N. A., & Yunus, M. M. (2020). Teaching strategies to develop higher order thinking skills in english literature. *International Journal of Innovation, Creativity and Change*, *11*(8), 211–231. Retrieved from www.ijicc.net

Singh, R. K. A., Singh, C. K. S., M. T. M., T., Mostafa, N. A., & Singh, T. S. M. (2018). A review of research on the use of higher order thinking skills to teach writing. *International Journal of English Linguistics*, *8*(1), 86. https://doi.org/10.5539/ijel.v8n1p86

Syafryadin, Wardhana, D. E. C., Noermanzah, Rofi'i, A., & Awalludin. (2022). Students' perspective and problems in implementing higher order thinking skill (HOTS) in speaking for presentation class. *Journal of Language and Linguistic Studies*, *18*(1), 477–487. https://doi.org/10.52462/jlls.196

Toheri, Winarso, W., & Haqq, A. A. (2020). Where exactly for enhance critical and creative thinking: The use of problem posing or contextual learning. *European Journal of Educational Research*, *9*(2), 877–887. https://doi.org/10.12973/eu-jer.9.2.877

Tsaparlis, G. (2020). Higher and lower-order thinking skills: The case of chemistry revisited. *Journal of Baltic Science Education*, *19*(3), 467–483. https://doi.org/10.33225/jbse/20.19.467

Utama, C., Sajidan, Nurkamto, J., & Wiranto. (2020). The instrument development to measure higher-order thinking skills for pre-service biology teacher. *International Journal of Instruction*, *13*(4), 833–848. https://doi.org/10.29333/iji.2020.13451a

Warman, Suryaningsi, & Mulawarman, W. G. (2021). Overcoming obstacles in implementing 2013 curriculum policy. *Cypriot Journal of Educational Sciences*, *16*(3), 967–980. https://doi.org/10.18844/CJES.V16I3.5770

Widarti, H. R., Herunata, H., Sulistina, O., Habiddin, H., & Nadhifah, Y. (2020). Exploring Chemistry Teachers' Knowledge of Higher Order Thinking Skills (HOTs) Based Assessment. *Proceedings of the International Conference on Learning Innovation 2019*, *446*, 21–25. https://doi.org/10.2991/assehr.k.200711.005

Zhou, Z. (2018). An empirical study on the influence of PBL teaching model on college students' critical thinking ability. *English Language Teaching*, *11*(4), 15–20. https://doi.org/10.5539/elt.v11n4p15