24 (3), 2023, 545-555

Jurnal Pendidikan MIPA

e-ISSN: 2685-5488 | p-ISSN: 1411-2531

http://jurnal.fkip.unila.ac.id/index.php/jpmipa/

Students' Ability in Solving HOTS-Based Chemistry Problems: A Case of High School Students at Palembang City

Effendi Nawawi*, Andi Suharman, Budi Mulyono, & Eka Ad'hiya

Department of Chemical Education, Universitas Sriwijaya, Indonesia

Abstract: This research aims to analysis students ability in solving HOTS based chemistry problems. This research is qualitative research with a case study approach. Data collection was carried out through observation, tests and interviews. The research results show that high-level thinking skills which include the level of analytical skills have an average student achievement of 16.162%, the level of evaluation thinking skills reaches 8.937%, and the level of creative thinking skills reaches a maximum of 14.888%. score 100. Based on the interview results, it is known that students' high-level thinking abilities are relatively low because they are not used to working on HOTS questions. Therefore, it can be concluded that high-level thinking abilities need to continue to be improved, and one way to achieve this is through solving HOTS based chemistry problems.

Keywords: higher order thinking, chemistry problems, case study.

Abstrak: *Penelitian ini bertujuan untuk mengetahui tingkat kemampuan berpikir tingkat tinggi dalam menyelesaikan permasalahan Kimia HOTS (High-Order Thinking Skills). Penelitian ini merupakan penelitian kualitatif dengan pendekatan studi kasus. Pengumpulan data dilakukan melalui observasi, tes, dan wawancara. Hasil penelitian menunjukkan bahwa keterampilan berpikir tingkat tinggi yang meliputi tingkat keterampilan analisis mempunyai rata-rata pencapaian siswa sebesar 16,162%, tingkat keterampilan berpikir evaluasi mencapai 8,937%, dan tingkat keterampilan berpikir kreatif mencapai maksimal 14,888%. skor 100. Berdasarkan hasil wawancara diketahui bahwa kemampuan berpikir tingkat tinggi siswa tergolong rendah karena belum terbiasa mengerjakan soal HOTS. Oleh karena itu, dapat disimpulkan bahwa kemampuan berpikir tingkat tinggi perlu terus ditingkatkan, dan salah satu cara untuk mencapainya adalah melalui penyelesaian soal HOTS Kimia.*

Kata kunci: *kemampuan berpikir tingkat tinggi, soal kimia, studi kasus.*

▪ INTRODUCTION

In the era of the Industrial Revolution 4.0 and Society 5.0, Human Resources (HR) must have 21st century skills, including critical thinking, creative thinking, and the ability to solve problems (Rismawati, Rahmawati, & Rindiani, 2022). These three skills are collectively known as Higher-Order Thinking Skills (HOTS). As emphasized by Febrianti, Zulyusri, & Suryadi (2021), it is important to prepare the young generation who have the capacity for critical thinking, creativity, and decision-making skills to solve problems effectively. Likewise, Aryana (2019) also highlighted the need to adapt to the 21st century by fostering creativity and problem-solving skills.

Critical and creative thinking is very necessary to answer the challenges and complexities posed by the rapid development of science and technology in the era of the Fourth Industrial Revolution and Society 5.0, as observed by Fadli (2021). Despite the rapid progress of science and technology in the 21st century, Indonesia's ranking in international assessments such as PISA and TIMSS has not experienced significant

Effendi Nawawi
*Email: effendi@fkip.unsri.ac.id

DOI: http://dx.doi.org/10.23960/jpmipa/v24i3.pp545-555
Received: 05 September 2023
Accepted: 06 October 2023
Published: 27 November 2023

improvement. Specifically, in 2019, Indonesia was ranked 64th out of 72 PISA participating countries and 45th out of 48 TIMSS participating countries (Martin, 2019).

These low results underscore the importance of the Indonesian education system preparing itself to face rapid advances in science and technology in the 21st century. One approach is to provide students with HOTS during the learning process. It is true, in the field of education, implementing HOTS is feasible because students' high-level thinking abilities can be fostered and improved. As a result, many countries have included HOTS as an integral part of classroom learning (Beddu, 2019). Students' ability to absorb learning and take a problem-solving approach to various HOTS questions also contributes to the variety of high-level thinking abilities they have. Given the inherent uniqueness of each person, human abilities are essentially different from each other.

Responding to this aspect, Pratiwi (2019) explained that developing good HOTS-based questions for students requires the highest quality teachers. Teachers must have a good understanding of the cognitive processes involved in Lower Order Thinking Skills (LOTS) and Higher Order Thinking Skills (HOTS). Moreover, according to Widana (2019), teachers play an important role in optimizing HOTS assessments, both in daily tests, end-of-semester evaluations and school exams. This approach is intended to train and identify categories of students' higher-order thinking abilities.

However, in research conducted by Schulz & FitzPatrick (2016), it was found that teachers showed uncertainty about the HOTS concept, and they were not prepared to teach or assess HOTS. Further research conducted by Retnawati (2018) revealed that teachers' knowledge about HOTS, their ability to increase student HOTS, create HOTS-based problem solving activities, and measure student HOTS is still low. Similar findings were also obtained by Siti Rahmah, Lia Yuliati, Edy Bambang Irawan (2011) who found that elementary school science teachers who participated in their research lacked a comprehensive understanding of HOTS. As a result, there is a lack of training activities and measurement of students' higher-order thinking abilities. The main problems were also discovered during research observations. At SMA Negeri 5 Palembang, the Deputy Principal for Curriculum stated that the school is aware of the importance of developing students' high-level thinking skills for competitiveness. Teachers at these schools have attended workshops or seminars on developing HOTS questions and assessments, but their implementation has not been fully optimal. Observation results also show that the daily quiz questions and grade promotion assessment questions are only at cognitive level C1 to C3, with limited C4 questions. Based on these observations, it can be interpreted that the categorization of each student's high-level thinking abilities is not yet known. On a broader scale, this has an impact on students' readiness to face more complex problems in the 21st century. The lack of training activities and ability measurement causes students' low cognitive abilities in the areas of analysis, evaluation and creation as shown by research conducted by Angraini and Sriyati (2019).

To ensure students' HOTS develop well, it is important to get them used to taking measurements through HOTS assessments. Failure to do this will hamper the potential for the growth of HOTS in students, as highlighted by Arifin and Retnawati (2017). According to Budiarta (2018), HOTS can be defined as the ability to engage in complex thinking processes that involve analyzing material, criticizing, and creating solutions for problem solving. Likewise, Thomas and Thorne (2009) describe HOTS as the ability to think by connecting existing facts and problems. Problem solving requires more than just

memorizing; This requires establishing relationships and drawing conclusions from existing problems. In line with that, Annuuru et al. Annuru, Johan & Ali (2017) explained that HOTS involves the ability to integrate facts and ideas in the process of analyzing, evaluating, and ultimately making judgments about the information learned or generating new insights from the knowledge gained. In short, HOTS encompasses a range of advanced thinking skills that go beyond simply remembering and memorizing. It involves the skills of analysis, evaluation, and creativity, which enable individuals to connect information, make judgments, and design innovative solutions to a variety of problems.

The processes of analyzing, evaluating, and creating are part of the cognitive taxonomy developed by Benjamin S. Bloom in 1956. Later revised by Anderson and Krathwohl (2001) into six levels: C1-remembering, C2-understanding, C3-applying, C4 analysis , evaluation of C5, and creation of C6. Tanujaya, Mumu & Margono (2017) explained that levels one to three represent Lower Order Thinking Skills (LOTS), while levels four to six represent Higher Order Thinking Skills (HOTS). So, from a cognitive domain perspective, HOTS includes the ability to analyze, evaluate, and create. Based on this, Sulianto, Joko & Cintang (2018) presented a revised cognitive level diagram of Bloom's taxonomy in Figure 1.

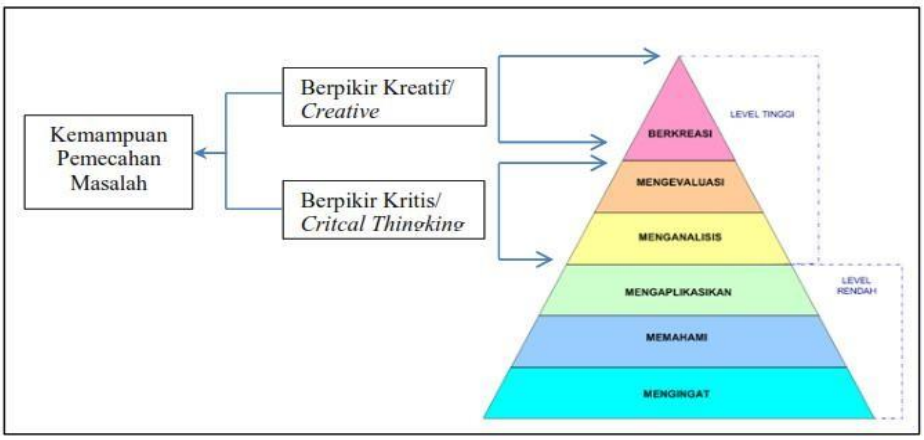

Figure 1 . Cognitive taxonomy of higher order thinking skills (hots)

Figure 1 includes processes C4 and C5 as critical thinking, while C6 is part of creative thinking. The ability to engage in critical and creative thinking processes is utilized to solve problems or create solutions, leading to decision making. These three cognitive processes are activated when facing new challenges, and the success of higher order thinking skills lies in a person's proficiency in using these thinking processes (Saido, 2015). Adapted from the views of Anderson & Krathwohl (2001), Wahyuni (2018), and Anggraini (2019), the meaning and indicators of the three HOTS cognitive levels can be summarized in Table 1.

Table 1. Cognitive level and indicators of higher order thinking skills

Aspect	Level and Cognitive Indicators	Definition
Critical thinking	**C4- Analyzing**	The process of deconstructing material and then seeking its overall relevance.

	Differentiating	Able to sort information into relevant and irrelevant parts.
	Organizing	Able to identify information in an organized structure.
	Atributing	Able to determine the relationship pattern between each part of the information structure.
	C5- Evaluating	Decision making activities are based on predetermined criteria and standards.
	Inspecting	Able to examine and identify incorrect parts in a process or statement.
	Criticizing	Able to accept and reject information based on predetermined criteria.
Berpikir kreatif	**C6- Creating**	Creating a solution or something new by combining various elements.
	Formulating	Able to provide perspective on a problem.

▪ METHOD

Participants

The research subjects were 63 class XI students from various state high schools in Palembang City. These students have varying levels of ability, including high, medium and low level analytical abilities.

Research Design and Procedures

The type of research carried out is mixed methods research. The research approach used is a case study. The case study is intended so that researchers can directly understand the extent of students' higher order thinking abilities in solving Chemistry HOTs (Higher Order Thinking Skills) questions. In this mixed methods research, researchers used qualitative and quantitative data collection & analysis techniques. The qualitative aspect of the research allows for an in-depth understanding of students' perspectives and experiences, while the quantitative aspect provides numerical data to measure and compare the level of higher order thinking skills among students.

The case study approach allows researchers to focus on a specific context or group (in this case student performance in solving Chemistry HOTs questions) and gain insight into students' thinking processes and problem-solving abilities. Using a mixed methods approach and case study design, this research aims to provide a comprehensive and nuanced understanding of students' higher order thinking skills in the context of Chemistry.

Instruments

The instrument of this research is a test instrument. The test instrument used consists of 20 essay Higher Order Thinking Skills (HOTS) questions to assess students' higher order thinking levels. The HOTS questions were adapted from Sukaryawan et al. (2021), with details which can be seen in Table 2. Before using essay questions to assess higher order thinking skills, each question has been tested for validity and declared valid. The results of the reliability of the questions also show that the questions used are reliable.

Table 2. Question details

Question No	Topics	Cognitive level	Total
1-2	Hydrocarbon	C4 (Analyzing)	7
3-7	Chemical equilibrium		
8-10	Hydrolysis	C5 (Evaluating)	7
11-13	Acid base		
14	Crude oil		
15-17	Crude oil	C6 (Creating)	6
18-20	Thermochemistry		

This research is also equipped with an interview guide to understand how HOTS-based learning is implemented in schools. This research instrument uses quantitative and qualitative data collection methods, utilizing essay questions for quantitative analysis and conducting interviews to gain qualitative insights. The mixed methods design enabled the researcher to gain a comprehensive understanding of students' higher-order thinking abilities and the application of HOTS-based learning in the school environment.

Data analysis

Data obtained from student responses were analyzed. Data analysis will use SPSS version 26 software to carry out descriptive tests. In this test, the mean value of each aspect of high-level thinking skills (Analysis, Evaluation and Creation) is measured.

▪ RESULT AND DISSCUSSION

The first step taken in conducting research was conducting interviews to understand how HOTS-based learning is implemented in schools. The statement by the Deputy Principal for Curriculum (Wednesday, June 21 2023) is as follows: "*To implement the 2013 Curriculum and the Independent Learning Curriculum, the school has carried out teacher quality improvement activities in the form of workshops or in-house training (IHT) at the beginning of each school year, including the 2023 school year in June 2023*."

Based on the statement from the Deputy Principal for Curriculum, it can be concluded that the implementation of HOTS-based learning has been implemented by teachers at the school. Teachers have incorporated 21st century skills (4C) into the lesson plan in the 2013 Curriculum or Teaching Module in the Merdeka Belajar Curriculum. The development of lesson plans or modules continues through subject study group (MGMP) activities for each subject.

Based on an interview with the subject coordinator (Chemistry teacher), the following data was obtained (interview conducted on Wednesday, 21 June 2023): "*Development of Lesson plan in the 2013 Curriculum or Teaching Modules in the Independent Learning Curriculum is carried out by teachers during Workshop activities orIn-house Training (IHT) at school and continued through Subject Study Groups (MGMP Activities) for each subject. "Apart from that, for subject coordinators there are quality improvement activities in the form of seminars or workshops organized by the ministry*."

From the interview data, it can be seen that the Chemistry teacher who is also the subject coordinator actively participated in the development of Lesson plans in the 2013 Curriculum or Teaching Modules in the Independent Learning Curriculum during Workshop or IHT activities at school. Continuous development and refinement of Lesson plans or Teaching Modules continues through Subject Study Group (MGMP) activities, where teachers collaborate and exchange ideas to improve teaching practices.

In addition, subject coordinators also benefit from quality improvement activities, such as seminars or workshops organized by the ministry, to further improve their skills and knowledge in delivering HOTS-based learning in Chemistry subjects. This initiative shows the commitment of schools and subject coordinators to continue to improve the implementation of HOTS-based learning in the educational environment.

Based on information from the Deputy Principal for Curriculum and the Chemistry teacher, it can be concluded that HOTS-based learning has been implemented at the school. Development of Lesson plan (lesson plan) or Teaching Modules implementing new paradigm learning models, including Problem Based Learning (PBL) or Project Based Learning (PjBL). This signals the school's commitment to incorporating a HOTS-based approach in their teaching practices.

Furthermore, HOTS-based learning planning (lesson plan and Teaching Modules) developed in schools is integrated into Teacher Professional Development (MBKM) activities for subject teachers. Teaching and learning activities in the 2013 Curriculum lesson plan or modul ajar *Kurikulum Merdeka Belajar* are in line with the learning model adopted. This is in line with the views of Rahmat Setiawan et al. (2022) that the syntax of the learning model developed by the teacher should be reflected in the teaching and learning activities in the teaching module. However, it should be noted that some teachers may still face challenges in developing Teaching Modules in the Merdeka Belajar Curriculum, as mentioned by Rindawati et al. (2022). Despite these challenges, the school's efforts to integrate HOTS-based learning through various learning models and professional development activities demonstrate a commitment to improving the quality of education and fostering higher-order thinking skills among students.

Based on the results of interviews with students, it is known that they gave positive responses and expressed enthusiasm in solving HOTS-based problems. However, there are still many students who complain because the questions given are quite challenging. As a result, some students had difficulty solving the HOTS-based questions provided. Another cause identified is that students are not used to working on HOTS-based test questions given in every lesson at school. This sentiment is in line with Yuniharto's (2011) statement that students must have high motivation, desire & enthusiasm to solve mathematical problems that involve high-level thinking & may not have a straightforward solution process.

Feedback from students indicated that although they found HOTS-based problems interesting and interesting, they needed more support and practice to feel comfortable dealing with such complex questions. This shows the importance of introducing students to HOTS-based learning gradually and providing them with ample opportunities to practice and build higher-order thinking skills. In addition, fostering a positive learning environment that encourages students to face challenges and develop problem-solving abilities is very important to help them overcome difficulties in solving HOTS-based questions. Schools and teachers should consider implementing various strategies to

support students in developing higher-order thinking skills and improving problem-solving abilities in HOTS-based learning contexts.

Table 3. The level of students' higher order thinking skills

Descriptive				
Factors		**Analyzing**	**Evaluating**	**Creating**
Means		16.16	8.94	14.89
95% Confidence interval for means	Lower bound	14.67	7.79	11.93
	Upper bound	17.66	10.07	17.84
5% Average trimmed		15.98	8.77	13.72
Median		15.97	9.09	9.09
Difference		35.320	20.420	137.668
Std. Deviation		5.94308	4.51884	11.73322
Minimum		5.72	2.68	5.34
Maximum		31.54	19.95	51.59

The results of the analysis of the level of high-level thinking abilities of 63 students are presented in Table 3. Based on Table 3, it can be seen that the students' high-level thinking abilities in each indicator are still not optimal. In detail the mean value for each question can be seen in Figure 2.

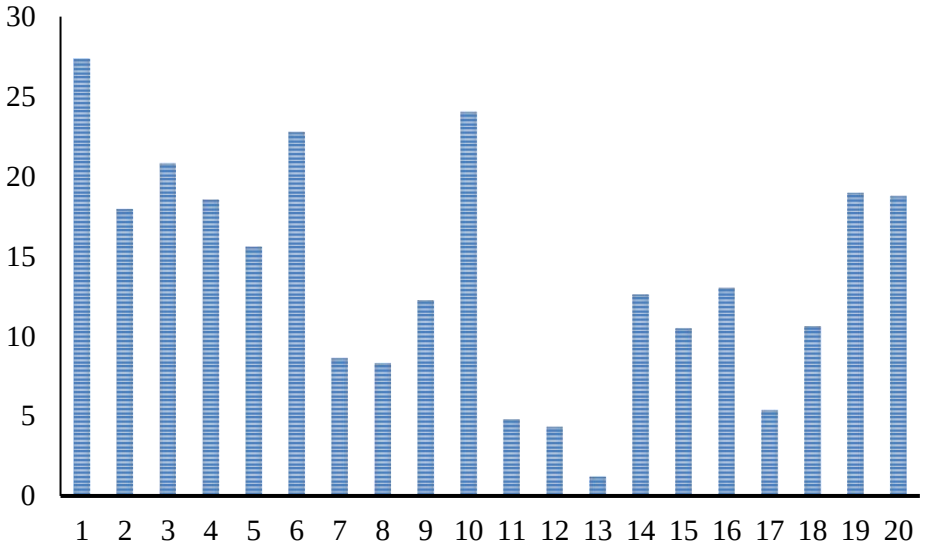

Figure 2. Mean score for each question

Based on Figure 2, it shows that students' high-level thinking abilities are still low. Therefore, it is still necessary to carry out learning programs to improve students' high-level thinking abilities. This is supported by Khafida (2023) who states that high-level thinking abilities can be developed and optimized through HOTS problem solving. This means that by solving problem-based HOTS questions, students identify problems &

analyze patterns or relationships, which then determines their subsequent thinking abilities.

Apart from that, Amalia (2020) stated that in solving high-level HOTS questions, students go through stages of manipulating data, information, and analyzing ideas to break down meaning and implications, synthesize, generalize, explain, make temporary conclusions, and finally draw conclusions. Thus, students' higher-level thinking abilities are interrelated.

▪ CONCLUSION

In conclusion, based on the results of the research and discussion, it can be concluded that high-level thinking skills consist of three levels, namely analysis, evaluation and creation. Test result data is analyzed to determine the average final score for each thinking skills indicator. The results of the analysis show that the average score for students' analytical thinking is 16.1627%, evaluative thinking is 9.9368%, and creative thinking is 14.8883% of the maximum score of 100. The overall level of high-level thinking skills is very low.

Based on interviews with students, this may be due to their lack of understanding in solving HOTs-based questions in regular classroom learning, even though the school claims to implement HOTS-based learning. Additionally, it is observed that higher order thinking skills are interconnected. If basic high-level thinking abilities, namely analytical thinking, are low, this can affect the next high-level thinking abilities, namely evaluation and creation.

These findings highlight the importance of providing more exposure to and practice with HOTS-based questions to help students develop their higher-order thinking skills. Schools should consider implementing effective strategies and approaches to foster a culture of critical and creative thinking among students. Improving higher-order thinking skills is essential to prepare students to face the challenges of the 21st century and to improve their problem-solving abilities in a variety of contexts.

▪ ACKNOWLEDGEMENT

Thanks to the Rector of Sriwijaya University for funding the research and publication of this article from the DIPA BLU 2023 fund with number SP DIPA-023.17.2.677515/202.

▪ REFERENCES

Amalia, A., & Pujiastuti, H. (2020). *Analisis kemampuan berpikir tingkat tinggi pada siswa smp ypwks cilegon dalam menyelesaikan soal hots* [analysis of higher level thinking abilities in ypwks cilegon middle school students in solving hots questions]. *Wahana Didaktika: Jurnal Ilmu Pendidikan*,18(3), 247-254

Anderson, L. W., Krathwohl M. C. (2001). *A taxonomy for learning, teaching and assesing*. New York: Longman.

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*, *12*(1), 1–9. https://doi.org/10.1088/1742-6596/1211/1/012077

Angraini, G., Sriyati, S. (2019). *Analisis kemampuan berpikir tingkat tinggi siswa kelas x sman di kota solok konten biologi* [analysis of high level thinking abilities of class

x sman students in solok city biology content]. *Journal of Education Informatic Technology and Science (JeITS), 1(10.*

Annuuru, T. A., Johan, R. C., & Ali, M. (2017). *Peningkatan kemampuan berpikir tingkat tinggi dalam pelajaran ilmu pengetahuan alam peserta didik sekolah dasar melalui model pembelajaran treffinger* [improving higher level thinking abilities in natural science lessons for elementary school students through the treffinger learning model]. *Eduthecnologica, 3*(2), 136–144.

Arifin Z., & Retnawati, H. (2017). *Pengembangan instrumen pengukur higher order thinking skills matematika siswa sma kelas x* [development of instruments for measuring higher order thinking skills in mathematics for class x high school students]. *PYTHAGORAS: Jurnal Pendidikan Matematika*, *12*(1), 98-108.

Arnyana, I. B. T. (2019). *Pembelajaran untuk meningkatkan kompetensi 4c (communication, collaboration, critical thinking, and creative thinking) untuk mrnyongsong era abad 21* [learning to improve 4c competencies (communication, collaboration, critical thinking, and creative thinking) to welcome the 21st century era]. 1(1). *Prosiding : Konferensi Nasional Matematika dan IPA Universitas PGRI Banyuwangi*. http://ejournal.unibabwi.ac.id/index.php/knmipa/article/view/829

Beddu, S. (2019). *Implementasi pembelajaran higher order thinking skills (hots)* [implementation of higher order thinking skills (hots) learning]. *Jurnal Pemikiran dan Pengembangan Pembelajaran (JP-3),* 1(3), 71-84. http://ejournal-jp3.com/index.php/Pendidikan/article/view/78

Budiarta, K., Harahap, M. H., Faisal, & Mailani, E. (2018*). Potret implementasi pembelajaran berbasis high order thinking skills (hots) di sekolah dasar kota medan* [portrait of the implementation of high order thinking skills (hots) based learning in medan city elementary schools]. *Jurnal Pembangunan Perkotaan*, *6*(2), 102-111.

Febrianti, W., Zulyusri & LufriSuryadi, S. (2021). *Meta analisis: pengembang soal hots untuk meningkatkan kemampuan berpikir kritis peserta didik* [meta analysis: hots question developer to improve students' critical thinking abilities]. *Bioilmi: Jurnal Pendidikan,* VII(1).

Fadli, M. R. (2021). *Hubungan filsafat dengan ilmu pengetahuan dan relevansinya di era revolusi industry 4.0 (society 5.0)* [the relationship between philosophy and science and its relevance in the era of industrial revolution 4.0 (Society 5.0)]. *Jurnal Filsafat,* 31(1), 130-161.

Lewy, Z., & Aisyah, N. (2009). *Pengembangan soal untuk mengukur kemampuan berpikir tingkat tinggi pokok bahasan barisan dan deret bilangan di kelas IX akselerasi SMP* [Development of questions to measure high-level thinking abilities on the subject of sequences and series of numbers in class IX accelerated middle school]. *Jurnal Gammath*, 03(02).

Khafida, I.L., & Ismono (2023). *Pengembangan lkpd inkuiri berbasis hands-on & minds-on activity untuk meningkatan hots pada materi laju reaksi* [development of inquiry worksheet based on hands-on & minds-on activity to increase hots in reaction rate material]. *Unesa Journal of Chemical Education,* 12(2), 38-47.

Martin, M. M. O. (2019). *TIMSS 2019 assessment frameworks*. publishers: timss & pirls international study center, lynch school of education, boston college and international association for the evaluation of educational achievement (IEA).

Pratiwi, N. P. W., Dewi, N. L. P. E. S., & Paramartha, A. A. G. Y. (2019). The reflection of hots in efl teachers ' summative assessment. *Journal of Educational Research and Evaluation*, *3*(3), 127–133.

Rahmah,S., Yuliati, L., Irawan, E.B. *Penguasaan konsep ipa pada siswa sekolah dasar* [mastery of science concepts in elementary school students]. *Prosiding Seminar Nasional PS2DMP Universitas Lambung Mangkurat*, 3(1).

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.

Rindayati, E., Putri, C. A. D., & Damariswara, R. (2022). *Kesulitan calon pendidik dalam mengembangkan perangkat pembelajaran pada kurikulum merdeka* [difficulties of prospective educators in developing learning tools in the independent curriculum]. *PTK Jurnal Tindakan Kelas,* 3 (1), 18-27

Rismawati, M., Rahmawati, P., & Rindiani, A.B (2022). *Analisis kemampuan berpikir tingkat tinggi dalam pemecahan masalah matematika berbasis higher order thinking skill (hots)* [analysis of higher order thinking skills in mathematical problem solving based on higher order thinking skill (hots)]. *Jurnal Cendekia: Jurnal Pendidikan Matematika,* 06(02), 2134-2143.

Schulz, H., & Fitz Patrick, B. (2016). Teachers' understandings of critical and higher order thinking and what this means for their teaching and assessments. *Alberta Journal of Educational Research*, *62*(1), 61–86.

Saido, G. M., Siraj, S., Bakar, A., Nordin, B., Saadallah, O., Nhwhudpsl, X. P., & Orrp, G. E. (2015). Higher order thinking skills among secondary school students in science learning. *Malaysian Online Journal of Educational Sciences*, *3*(3), 13–20.

Setiawan**, S.,** Syahria, N., Andanty, F., & Naban, S. (2022). *Pengembangan modul ajar kurikulum merdeka mata pelajaran bahasa inggris smka kota surabaya* [development of independent curriculum teaching modules for english language subjects at smka surabaya city]. *Jurnal Gramaswara: Jurnal Pengebdian Pada Masyarakat*, 2(2), 49-62

Sukaryawan, M., Hartono, Effendi Nawawi (2021). *Instrumen soal higher order thinking skills (hots): instrumen pengukuran kemampuan berpikir kritis [*higher order thinking skills (hots) question instrument: instrument for measuring critical thinking abilities*]*. Palembang: Bening media Publishing.

Sulianto, Joko., Cintang., A. (2018). *Higher order thinking skills (hots) siswa pada mata pelajaran matematika di sekolah dasar pilot project kurikulum 2013 di kota semarang* [higher order thinking skills (hots) of students in mathematics subjects in elementary schools pilot project curriculum 2013 in semarang city]. *Journal of Chemical Information and Modeling*, *53*(9), 1689–1699. https://doi.org/10.1017/CBO9781107415324.004

Tanujaya, B., Mumu, J., & Margono, G. (2017). The relationship between higher order thinking skills and academic performance of student in mathematics instruction. *International Education Studies*, *10*(11), 78–85. https://doi.org/10.5539/ies.v10n11p78

Thomas, G., & Thorne, A. (2009). How To Increase Higher Level Thinking. *Metarie, LA:* Center for Development and Learning, *2009*, 1–17.

Widana, I Wayan., Adi., H. A. (2019). *Modul penyusun soal hots matematika [*hots mathematics question preparation module*]*. Direktorat Jendral Pendidikan Dasar dan Menengah.

Wahyuni, & Yusri., F. (2018). Higher order thinking skill instrument design of student based on bloom ' s taxonomy. *American Journal of Engineering Research*, *7*(8), 84–87.

Yuniharto, B. S., & Nisa, A. F. (2022). *Implementasi pembelajaran berorientasi hots dan kreativitas pada muatan pelajaran ipa siswa sd negeri sariharjo* [implementation of hots and creativity oriented learning in science lesson content for sariharjo state elementary school students]. *E-Jurnal STKIP Modern Ngawi*, 7(3), 115-122