11(3), 2022, 48-55 DOI: 10.23960/jppk.v11.i3.2022.06
Jurnal Pendidikan dan Pembelajaran Kimia
e-ISSN: 2714-9595 | p-ISSN: 2302-1772
http://jurnal.fkip.unila.ac.id/index.php/JPK/index

Identification of The Learning Obstacles in Redox Reaction Concept of The Senior High School Students

Rizky Brehnaputrifajar Khaerudin[1], Herwantono[2]

[1,2]Universitas Nahdlatul Ulama, Jl. Sisingamangaraja No. 33 Cirebon, Indonesia
Correspondinge-mail: rizkybrehnaputri@unucirebon.ac.id

Received: September 12th, 2022 Accepted: December 16st, 2022 Online Published: December 23rd, 2022

Abstract: Identification of The Learning Obstacles in Redox Reaction Concept of The Senior High School Students. This study aims to obtain an overview of the characteristics of learning obstacles that can be identified in the redox reaction concept of high school students through the analysis of the Respondent Ability Test (TKR). This study used a descriptive method with research data obtained from TKR analysis results. The instruments used were respondents' ability tests, interviews and documentation of the concept of redox reactions. This research was conducted at the UPI Pilot High School with 30 students from Class XI IPA as subjects who had studied the concept of redox reactions. The findings show the characteristics of students' learning barriers in redox reactions ,namely students have not been able to analyze redox reaction material based on the involvement of oxygen and electron transfer as much as 80.64% , students are wrong in analyzing redox reaction material based on changes in oxidation numbers as much as 61.29%, students are wrong in determining the oxidation number of atoms in molecules as much as 61.29%, students are wrong in determining the oxidation number of atoms in ions as much as 35.48%, students have not been able to determine redox reactions based on oxidation numbers as much as 25.8%, and students are wrong in analyzing oxidizers and 38.7% reducing agent in redox reactions. Conclusion from study this is still there is obstacle study epistemological on material Reaction Redox , so need exists a effort more must proceed done to reduce obstacle study epistemological on material Reaction Redox .

Keywords: *Obstacle study, learning obstacles, reaction redox .*

Abstrak: ***Identifikasi Hambatan Belajar pada Konsep Reaksi Redoks Siswa SMA.*** *Penelitian ini bertujuan untuk untuk memperoleh gambaran tentang karakteristik learning obstacle (hambatan belajar) yang bisa diidentifikasi pada konsep reaksi redoks siswa SMA melalui analisis Tes Kemampuan Responden (TKR). Penelitian ini menggunakan metode deskriptif dengan data hasil penelitian diperoleh dari hasil analisis TKR. Instrumen yang digunakan yaitu tes kemampuan responden, wawancara dan dokumentasi tentang konsep reaksi redoks. Penelitian ini dilakukan di SMA Percontohan UPI dengan subjek sebanyak 30 orang siswa SMA Kelas XI IPA yang telah mempelajari konsep reaksi redoks. Hasil temuan menunjukkan karakteristik hambatan belajar siswa pada reaksi redoks yaitu siswa belum mampu menganalisis materi reaksi redoks berdasarkan keterlibatan oksigen dan serah terima elektron sebanyak 80,64%, siswa salah dalam menganalisis materi reaksi redoks berdasarkan perubahan bilangan oksidasi sebanyak 61,29%, siswa salah dalam menentukan bilangan oksidasi atom dalam molekul sebanyak 61,29%, siswa salah dalam menentukan bilangan oksidasi atom dalam ion sebanyak 35,48%, siswa belum mampu menentukan reaksi redoks berdasarkan bilangan oksidasi sebanyak 25,8%, dan siswa salah dalam menganalisis pengoksidasi dan pereduksi dalam reaksi redoks sebanyak 38,7%. Kesimpulan dari penelitian ini adalah masih terdapat hambatan belajar epistemologis pada materi Reaksi Redoks, sehingga perlu adanya sebuah upaya lebih lanjut yang harus dilakukan untuk*

mengurangi hambatan belajar epistemologis pada materi Reaksi Redoks.

Kata kunci: *Hambatan belajar, learning obstacle, reaksi redoks..*

- **INTRODUCTION**

In the Ministry of Education and Culture (2014) it was stated that one of the (rational) reasons for changing the curriculum was the low achievement of Indonesian students in international assessments, such as TIMSS (*Trends in Mathematics and Science Study*) and PISA (*Program for International Student Assessment*). Indonesian students' participation in TIMSS and PISA showed unsatisfactory results. Indonesia has participated in TIMSS since 1999. Indonesia was ranked 40th out of 42 countries in the field of scientific literacy in 2011. Meanwhile, PISA was held for the first time in 2000. Indonesia ranked 64th out of 65 countries in 2012. Indonesia has always been ranked low compared to other countries. In recent years, Indonesia has no longer involved its students in implementing PISA because Indonesian students are considered unable to compete with other countries in terms of literacy skills.

The low achievement of students in international assessments indicates that students' understanding of scientific literacy is still low. This can be an indication that the current learning is not effective. This was reinforced based on the results of observations at a private high school in the city of Bandung, students only listened to how the teacher explained problem solving or explained material on the blackboard and then students recorded what the teacher had written. Such a learning process causes students to be unenthusiastic and tends not to pay attention to what the teacher explains so that it is difficult for students to explore their abilities. These problems can lead to learning barriers.

Barriers to learning is a situation where students' knowledge is still limited so that something that is actually wrong is something that is right (Kiranti, Rusnayanti, Wijaya, & Siahaan, 2018). Brousseau (2002) reveals that there are three factors that cause *learning obstacles*, namely ontogeny (mental learning readiness), didactic (due to teacher teaching) and epistemological (knowledge of students who have limited application contexts). In this case students will experience *learning obstacles* due to epistemological barriers, because students do not understand the basic concepts of the material and only remember the material presented by the teacher in an informative manner.

To find out the epistemological learning barriers that occur can be done through an analysis of the historical approach by using questions to see how students a) explain the knowledge learned and understand its use, b) explain the benefits of using the knowledge that has been learned, c) see the relationship of a concept with the concept other related or possibly related, d) identifying problems and giving reasons for the solution given, e) repeating the wrong response to the exact same or similar problems, as well as how students understand each of these problems (Brousseau, 2002).

Chemistry is a subject that has a fairly high complexity, where there are lots of abstract concepts that students must and will learn (Yuniarti, Bahar, Elvinawati, 2020). Redox material is one of the chemical materials that is considered difficult for high school students to learn. This material is easy to find in real life because its products are close to everyday life (photosynthesis reactions, fossil fuel burning reactions and metal rusting). As expressed by Kusumawati (2014) that students have some difficulties in understanding the meaning of redox reactions. Lack of students' understanding of the meaning of redox reactions results in students having difficulty identifying substances that experience reduction or oxidation in an equation. Students also have difficulty understanding the meaning and determining oxidation numbers, and identifying reactants that are oxidizing or reducing agents. Therefore, to find out the characteristics of students' *learning obstacles* in redox

reaction material, a test is needed. The purpose of this study was to obtain an overview of the characteristics of *learning obstacles* that can be identified in the redox reaction concept of high school students through the analysis of the Respondent Ability Test (TKR).

- **METHOD**

This Study using qualitative descriptive method. Qualitative research focuses on general issues. Descriptive research describes questions about the existence of a variable by not comparing it with other variables (Lestari & Yudhanegara, 2015). Researcher describe obstacles learning experienced by students based on the results of an analysis of the historical approach using the respondent's ability test (TKR). Respondent Ability Test (TKR) is a test instrument used to explore students' epistemological learning barriers which in this study was carried out on Redox Reaction material. The Respondents' Ability Test used was in the form of a written test containing description questions covering the essential concepts of the Redox Reaction material and given to students who had studied the Redox Reaction material. This instrument was made by the researchers themselves and before TKR was implemented, the instrument was validated in a good category. Based on the results answer student could is known is student could understand material or justguess the answers to the questions required to provide reasons so that you can known characteristics obstacle learning on the concept reaction redox . Deep subject study this student class XI IPA as much 3 1 people which has learn material reaction redox on 2014/2015 academic year. Data collection was carried out by written tests, interviews, and documentation. This interview was conducted to dig up more in-depth information from students on their understanding of oxidation-reduction reactions, factors which cause obstacle student learning and knowing the learning process that has been done by the teacher in teaching reaction material redox. The interviews were conducted with the help of a *recorder*. Documentation came from the lesson plan, the teacher's teaching resource about reaction material redox. Analysis of the data used for TKR by calculating the percentage of student learning barriers in each type using the formula:

$$\% \text{ initial TKR} = \frac{the\ number\ of\ respondents\ in\ each\ type}{all\ responden}\ x\ 100\%$$

(Hartanto, 2019)

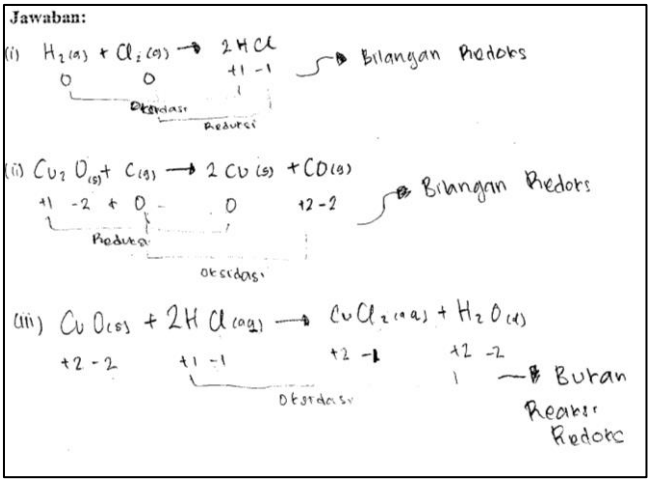
- **RESULT AND DISCUSSION**

Based on the results of this study obtained characteristics obstacle learn on draft reaction redox. In identifying *learning obstacles*, researchers used an instrument in the form of a description test instrument known as the Respondent Ability Test (TKR). The essential concept of a redox reaction includes the development of the concept of a redox reaction based on the involvement of oxygen, the transfer of electrons and oxidation number (chain), the determination of oxidation states, the identification of redox reactions, and the determination of oxidizing and reducing agents. Description about characteristics obstacle study which experienced student explained in below.

Characteristics Learning Obstacle on Development Reaction Redox Concept

In the concept questions regarding the meaning of redox reactions, students are asked to analyze redox reactions based on explanations of the involvement of oxygen and the handing over of electrons. For finish about student required have ability for formulate problem, analyze about and determine solution (Sulthoniyah, 2017). Based on the analysis of the answers as many as 80.64 % of students wrong in analyzing redox reactions based on the explanation of the involvement of oxygen and electron transfer. That error done by students

can be seen in the picture 1.



Picture 1. Error In Analyzing Concepts Redox Reaction Development

Based on answer the, show that student wrong in give reasons. Almost all of them answer the meaning of redox reactions based on an understanding of oxidation numbers. Some errors in students' answers occurred because students did not understand the development of the concept of redox reactions which began with the involvement of oxygen and then the handover of electrons. Their understanding of redox reactions is only seen based on the ups and downs of oxidation numbers.

The second question is given to find out students' learning barriers regarding the concept of redox reactions based on changes in oxidation numbers. Students are asked to explain an equation for the reaction that occurs in the formation of black spots whether it is a redox reaction or not and explain why this is so. A total of 61.29 % students wrong in Write down the oxidation number of the element in the reaction in the problem. Error that conducted by students can be seen in the picture 2 following.

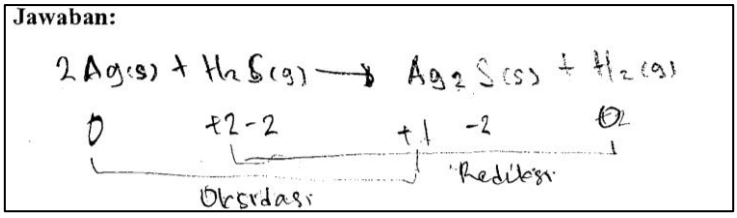


Figure 2. Errors in Writing Biloks

Based on answer student, student wrong write oxidation state of the elements in the reaction. (The H oxidation state in H_2S should be +1, but students write +2 because there are 2 H atoms). The students' understanding of concepts is still very low. This is because still a lot error student whereas Theory about determine biloks already studied in class X SENIOR HIGH SCHOOL.

Characteristics Learning Obstacle on Rule Determination Biloks Concept

The concept of determining the oxidation number is tested with two questions which are follow-up questions from the previous material. The third and fourth problems determine the oxidation number of atoms in a molecule or ion. In the third question, students were asked to determine the oxidation number of Cl atoms in OCl^- and Cl in Cl^-. Meanwhile, in the fourth question, students were asked to determine the oxidation state of Cr in the compound

$(NH_4)_2 Cr_2 O_7$. Results study show as much 61.29 % error student in determine number atomic oxidation in ionic compounds while only 35.48 % of students' errors in determine number atomic oxidation in molecule. Error student for determination number atomic oxidation in molecule or ion can be seen on picture 3 following.

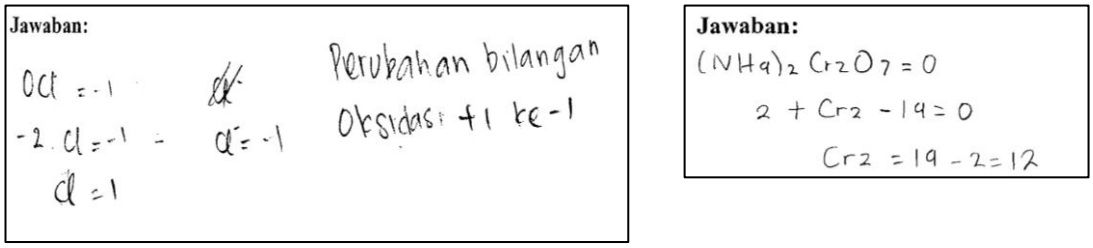
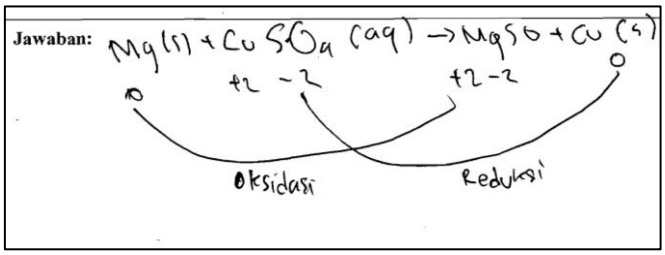


Figure 3. Error in determining the atomic oxidation state in Molecule or Ion

Based on answer students in the third and fourth questions, identified many barriers to student learning. Most of the students still do not know the rules for determining the oxidation number, so it is difficult to determine the oxidation number.

Characteristics Learning Obstacle on Identification Reaction Redox

The fifth question is given to determine student learning barriers regarding redox reactions based on changes in oxidation numbers. Students are asked to determine the oxidation reaction and reduction reaction in the reaction equation between magnesium metal and copper sulfate solution based on changes in oxidation numbers. The results of the analysis of student answers percentage of 25.48%. The percentage gain illustrates the students' ability to work on the fifth problem regarding redox reactions based on changes in oxidation state quite well. Student error in determine reaction redox based on change biloks can be seen on picture 4 following.



Picture 4. Error Student In Determining Redox Reactions Based on Oxidation Numbers

Based on students' answers, it shows that the error in determining reaction redox. Students incorrectly show an increase/decrease in the oxidation number of the elements in the reaction.

Characteristics Learning Obstacle on Determination of Oxidizing and Reducing Concept

The sixth question aims to find out the students' obstacles in the ability to analyze oxidizing and reducing agents in redox reactions, students are asked to determine reducing and oxidizing from a known reaction equation. The percentage of 38.7% of students cannot analyze oxidizing and reducer in reaction redox. Student error could show in the picture 5 following.

Picture 5. Student Error in Analyze Oxidizing and Reducing in Reaction Redox

Based on the results of the identification *of* students' learning obstacleson Theory reaction redox this show that most of the students have been able to determine the oxidizing and reducing agents in a redox reaction. However, there are still some students who are confused about the meaning of oxidizing and reducing. This is caused by students' associative thinking, where the terms oxidizing and reducing are associated differently by students. Some students assume that if a substance is reduced, then that substance acts as a reducing agent, as well as an oxidizer as a substance that is oxidized. According to Kusumawati (2014), another cause that results in errors in this material is wrong intuition, where students believe the reducing agent is a substance resulting from an oxidation reaction and the oxidizing agent is a substance resulting from a reduction reaction.

Chemistry Teacher and Student Interview Results

Based on the results of student interviews, several factors caused students to have difficulty in understanding redox material, namely students have difficulty recalling material about this material. Oxidation is a reaction where oxygen gains and loses electrons. While the reduction reaction is a reaction of the release of oxygen and the acceptance of electrons. Students memorize more often when learning the concept of redox reactions so that students' understanding is easier to forget when compared to understanding and interpreting the concept of redox reactions. According to Kusumawati (2014), another cause that results in errors in this material is wrong intuition, where students believe the reducing agent is a substance resulting from an oxidation reaction and the oxidizing agent is a substance resulting from a reduction reaction.

Based on the results of the teacher's lesson plans documentation, it shows the method used still giving lectures and practice questions in student learning resources. This matter reinforced by the results of teacher interviews on how to provide redox material, the teacher said that learning redox reactions and determination of oxidation states includes abstract material so that it is difficult to understand if visualization is not given. This abstract learning can make students lazy to learn, as a result students cannot fully understand the material in redox reactions and oxidation state determination. Based on results Interview the, could concluded Teacher learning is not meaningful, because it is only limited to providing an explanationand practice questions, so that students' understanding of the concept of redox material still low.

Based on the difficulties experienced by students, what can be done so that understanding draft student Becomes more good that is *first* , teacher in teachshould use a number of method teach so that learning no boring and increase students' interest in studying chemistry such as activitiesconduct experiments either by demonstration or directly involving students directly do the practicum. *Second*, the provision of various practice questions. In The provision of varied questions will make students trained in solving problems various problems on acid base titration material. *Third*, deepening the concept of prerequisites and emphasis on important concepts in redox material.

- **CONCLUSION**

The product developed in this research is a textbook containing HOTS Based on the results and discussion, it can be concluded that the low understanding of students' concepts on redox reaction material. *Learning obstacles* experienced by students are students have not been able to analyze the concept of redox reactions based on the involvement of oxygen, students have not been able to analyze the concept of redox reactions based on electron transfer, students are wrong in analyzing the concept of redox reactions based on changes in oxidation numbers, students are wrong in determining oxidation number of atoms in molecules, students are wrong in determining the oxidation numbers of atoms in ions, students have not been able to determine redox reactions based on oxidation numbers, students are wrong in analyzing oxidizing and reducing agents in redox reactions. Teacher and student that aloneis factor which cause many barriers to learning student. CreateLearning strategies that are meaningful and not boring can be a solution for studentsteacher to improve students' understanding to be better

- **REFERENCES**

Brousseau. G. (2002). *Theory of Didactical Situations in Mathematics*. Dordrecht: Kluwer Academic Publishers.

Chang, R. (2011). *General Chemistry : The Essential Concepts*. Sixth Edition. United States : McGraw Hill.

Hartanto. (2019). Barriers to Learning Epistemology in the Matter of Liquid Pressure through Analysis of Respondent Ability Tests. *Journal of Physics Innovation and Learning,* 6(2): 191 – 199.

Hendayana, S & Hidayat, A. (2013). Developing tools for classroom interaction: does it student-centered or teacher-centered lesson?. Disajikan pada *international seminar on mathematics, science, and computer science education*, Bandung.

Kiranti, GA, Rusnayanti, H., Wijaya, AF, & Siahaan, P. (2018). Profile of students' epistemological barriers to static fluid material for class XI SMA based on the analysis of the respondent's ability test. *Journal of the Physics Education Forum* , 3(2): 19 – 24.

Kuno, H. (2014). *Transcript-based lesson analysis: A way for deeply understanding of lessons*. Disajikan pada WALS 2014 *International Conference*, Bandung.

Kusumawati. (2014). Misconceptions of Class XII Students of SMA Negeri 1 Sambas on Oxidation Reduction Reaction Material. Pontianak: Tanjungpura University.

Lestari, KE, & Yudhanegara, MR (2015). Mathematics Education Research (Anna(ed.)). PT Refika Aditama.

Mardiana, H. (2013). *Pengembangan Desain Pembelajaran IPA Berbasis Konstruktivisme Tentang Gaya Magnet di Sekolah Dasar*. Bandung: Universitas Pendidikan Indonesia.

Masaaki, S. (2012). *Dialog dan kolaborasi di Sekolah Menengah Pertama*: praktek "*learning community*". Jakarta: PELITA.

Matsubara, K. (2012). *Lesson Study and Curriculum Development -from Japanese Experience-*. Jepang : Curriculum Development Center National Institute for Educational Policy Research.

Ministry of Education and Culture of the Republic of Indonesia. (2014). Emergency Education in Indonesia by Anies R. Basweda, PhD. Available at: http://www.kemdiknas.go.id/kemdikbud/sites/default/files/Paparan%20Menteri%20-%20Kadisdik%20141201%20-%20Low%20v.0.pdf. Accessed March 4, 2015.

Nindisari, Hepsi. (2011). *Pengembangan Bahan Ajar dan Instrumen untuk meningkatkan Berpikir reflektif Matematis Berbasis Pendekatan Metakognitif pada siswa SMA*. Banten: Universitas Sultan Ageng Tirtayasa.

Roeroe, M.B. (2011). *Didactical Design Research (DDR) dalam Pengembangan Pembelajaran Kependidikan*. Jurnal Pendidikan Teknologi dan Kejuruan. Manado : Jurusan Pendidikan Kesejahteraan Keluarga Fakultas Teknik Universis Negeri Manado.

Sanjaya, W. (2012). *Perencanaan dan Desain Sistem Pembelajaran*. Jakarta: Kencana.

Sato, M. (2012). *Mereformasi Sekolah : konsep dan praktek komunitas Belajar*. Tokyo : The Internasional Development center of Japan inc.

Sudarmo, U. (2013). *Kimia untuk SMA/MA kelas X*. Jakarta : Erlangga

Sunarya, Y. (2012). *Kimia Dasar 2* : Berdasarkan Prinsip-Prinsip Kimia Terkini. Bandung : Yrama Widya

Sulthoniyah, A. (2017). Analysis of critical thinking skills in solving word problems on social arithmetic material. Essay. Purworejo: Mathematics Education Study Program, University of Muhammadiyah Purworejo.

Sunarya, Y. (2012). *Kimia Dasar 2* : Berdasarkan Prinsip-Prinsip Kimia Terkini. Bandung : Yrama Widya

Yuniarti, E., Bahar, A., Elvinawati. (2020). Analysis of Students' Misconceptions on Redox Concept Material Using the *Certainty of Response Index* (CRI) at SMA Negeri 9 Bengkulu City. *Journal of Education and Chemistry* , 4(1):69 – 82.