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The Implementation of Student Worksheets with Scientific Approach on Reduction-Oxidation Reaction Matter toStudents' Cognitive Learning Outcome

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Abstract. Redox reaction matter which seems to be abstract makes students of X science grade difficult to understand the concept. Therefore, student-centered learning using teaching matter which has analyzed students' character or as known as scientific-based approach LKPD is necessary. This research aimed to identify the students' cognitive results after learning redox reaction matter using a scientific-based approach LKPD. The research was done at SMAN 1 Dukupuntang, Cirebon in the 2016-2017 school year using pre-experimental method with one-shot case study research design. The sample was students of X science 2 grade. The data collection was done via a questionnaire. The analysis technique was quantifying the result percentage before and after using LKPD. This research served LKPD data which involved learning activities such as (a) observing, (b) asking, (c) collecting the data, (d) associating, and (e) communicating whichstimulatedstudents to learn redox reaction matter actively. The pretest result showed that the students' completeness percentage was 66,67% while the protest result using LKPD showed that the percentage increased to be 86,67%. The conclusion was using a scientific-based approach LKPD on redox reaction matter was successful to enhance students' cognitive learning outcomes and fulfill the minimum completeness criteria (KKM).
Keywords: scientific approach, chemistry lesson, redox reaction, cognitive learning outcome

Introduction

One of the learning problem in Indonesia is that learning is generally student-centered.The teacher as a matter provider only transfers the knowledge with conventional methods and the learning matters are not adapted to the students' need, thus studentswill feel bored and not enjoy the learning. Itis strengthened by the statement of Kirana, et al. (2018) that classical learning system and monotonous teaching matter by memorizing without understanding the concept and breaking the scientific procedure has become a polemic of the learning system in Indonesia, thusit makesstudents' motivation in learning low. The lack of motivation makes students participating passively in learning. Erlidawati, et al. (2020) reveals that the students only become the listeners to the teacher's lecture that leads to the low students' learning outcomes.

The low student's learning outcomes occured at SMAN 1 Dukuntang, where the students' daily test resultson redox reaction matter in the 2016/2017 school year were less than 65. Teachers require more skills to teach chemistry course, because in learning the

redox reaction matter, students require the ability to reason through phenomena whichexists in daily life by using their surroundings as the part of learning matter. Graulich & Capsari (2019) reveals that students need various variables in reasoning about phenomena which exists in everyday life. This multivariate reasoning is the fundamentalto study the scientific literature in science class research. This statement is reinforced by Asnaini, et al. (2017) who reveals that learning chemistry requires high reasoning skills because students are encouraged to practice chemical reactions, calculations and many abstract concepts.

The chemistry concept which generally seems to be abstract is one of the obstacles in learning chemistry (Gurses, et al., 2015). Redox reactions are one of the chemistymatter with abstract characteristic, can befound in daily life, and alsoessential for our life (Meng, et al. 2017). One of the applications of redox reaction is the use of lithium battery.This battery is a promising energy storage media cause of its amazing compactivity of energy. The optimization was done through aprotic Li-S electrochemistry mechanism assisted by in-situ characterization and electrochemistry method. The optimization was summarized systematically by matter design, cathode configuration optimization, and electrolyte optimization so the comprehensive understanding of redox cathodic reaction was obtained and Li-S battery also got its high performance (Hu, et al. 2020). The research of Tao, et al. (2016) shows that the use of Nb_2O_5 nanocrystal as electrocatalyst accelerates the polisulphide redox reaction, so the polisulphide becomes reactive and reaches Li-S battery capacity which has high and durable specification.

Based on the explanation above, it is deeply regreted if teachers do not use proper teaching matterwhich can support students' reasoning skills.It is confirmed by Salwan, et al. (2017) who reveals that teaching matter must be able to build the knowledge of cognitive dimension through new experiences so that students' learning outcomes increase. One of the teaching matterwhich can attract students' interest in building reasoning skills through reading activities is LKPD (Prasetya, et al., 2019). Toman, et al. (2013) also says that the use of LKPD in learning chemistry on ethanol fermentation matteris proven to improve students' learning outcomes. LKPD will not automatically be successful in improving the students' learning outcomes if teachers do not use a learning approach which can make students interested and participateactively in the learning process, so that student-centered learning can be formed. The learning approach which can support this process is scientific approach. This approach allows students to learn how to find the knowledge from their experiences in developing scientific skills and attitudes (Wijayanti & Munandar, 2017). Through this approach, they are invited to explore the surroundings as the learning media, so that the learning does not only take place in the classroom but also can be done through direct observation with the matter being taught (Firman, et al. 2018).

The steps used in this approach are observing, asking, reasoning, practicing, and presenting (In'am and Hajar, 2017). Based on the explanation above, the aim of this research is to know the students' cognitive learning outcomes after using scientific based LKPD on redox reaction matter. This research aimed to identify the students' cognitive results after learning redox reaction matter using a scientific-based approach LKPD.

Methods

The method of this research was pre-experimental design with one-shot case study. The population were students of X science 2 grade SMAN 1 Dukupuntang, Cirebon who attended chemistry lesson of redox reactionin the even semester of 2016-2017 school year. They were students of one school in Cirebon district who were learning chemistrycourse of redox reaction. The criteria of the sample was:

1. Classified in the class whose most of the students had not passed the KKM yet
2. Most of the students disliked chemistry course
3. Most of the students were lack of scientific thinking ability

Based on those judgements, the samples that studied were 30 students of X science 2 class. The judgements were taken to see the increasing of students' learning outcome of the class that had limited potential that had to be explored. The analysis data was done through test percentage evaluation of before and after using LKPD.

Results and Discussion

The process of learning activities was carried out through the use of LKPD on the 1st, 2nd, and 3rd meetings. Scientific-approach based LKPD was developed by referring to aattachmentcopyofPermendiknas number 65 year 2013. The core activities of the learning steps refered to a scientific approach using the scientific learning method. The learning steps were carried out by following the syntax of the scientific approach which was carried out through several activities such as (a) observing, (b) asking, (c) collecting the data, (d) associating and (e) communicating. At the first meeting, the teacher presented the rules of oxidation numbers. The learning matter on LKPD presented questions which stimulated students' comprehension starting from the question of determining the oxidation state of simple compounds.

Learning Core Activities Using LKPD

Table 1. Learning Activities on The 1st Meeting

No.	Learning Steps	Activites
1	Observing	Students were asked to observethe oxidation number rules
2	Asking	Students were motivated to ask about oxidation number rules
3	Collecting The Data	Students discovered the information by answering the questions of oxidation number of an element in compound or ion based on oxidation number rules
4	Associating	Students associated by answering the same type questions with a litte more difficult
5	Communicating	Students presented the work result in front of the class

Table 1 presented data of learning activities which included data presentation of "Redox Reactions" learning presented at the first meeting.Students were asked to learn the initial rules of oxidation numbers before they learned redox reactions. The

understanding process about the rules of oxidation number of each element was fundamentalwhich must be understood by students to determine the reducing and oxidizing agent. The interview results with 5 students showed that they had difficulties when doing exercises on determining oxidation numbers because they did not understand the concept of determining oxidation numbers. Yuliana, et al. (2015) revealed that students who did not understand and master the concept thoroughly of oxidation number could not determine the reducing and oxidizing agent in redox reactions.

Table 2. Learning Activities on The 2nd Meeting

No.	Learning Steps	Activities
1	Observing	Teachers gave the chance and guidance to students to explore their ability observing redox reaction in daily life. Students distinguished the development concept of redox reaction.
2	Asking	Teachers gave the chance and motivated students to ask some questions. Students were able to ask some questions about: a. What are redox reaction examples based on the capture and release of oxygen? b. What are redox reaction examples based onthecaptureandrelease of electron? c. How to determine the oxidation number of a compound or an ion? d. How to distinguish between reductor and oxidizer of redox reaction? e. How to distinguish between disproportionation and consproportionation of autoredox reaction?
3	Collecting The Data	Students explored the information by doing: a. Designing an experiments of fruit change reaction, combustion reaction, and metal change reaction, and also representing the result to equilize the perception b. Doing experiment fruit change reaction, combustion reaction, and metal change reaction c. Observing and recording the result of fruit change reaction, combustion reaction, and metal change reaction
4	Associating	Students associated by doing: a. Formulating the difference of redox reaction based on the development concept of redox reaction b. Formulating the oxidation number and its rules followed by the examples
5	Communicating	Students represented their work result in front of the class on the redox reaction matter and the exercise of its applications

On the second meeting, after students had understood the rules of oxidation numbers,they continued to learn redox reaction matter, starting from the examples of everything whichwere often found in daily life through the experiments related to them. The interview results showed that the redox reaction experiments carried out by looking at the changes in fruit and metal and also the combustion made them to understand the concept of redox reactions better because what they learnedcorresponded to their

knowledge. Learning which started with something close to the mind and daily life would make students easier to understand the concept (Agustiar et al. 2020). It corresponded to the research conducted by Sogandi, et al (2019) that the implementation of redox concept learning in daily life made students easier to build the concept,thus they could solve the problems related to the environment.

Table 3. Learning Activities on The 3rd Meeting

No.	Learning Steps	Activities
1	Observing	Students were asked to observe: a. The characteristic of chemical transformation (chemical reaction) on fruit change (apple, pear, potato, or banana) that was cut then left outdoor and stored in the closed plastic b. The reaction of paper combusting c. The reaction of zinc change, rusty nail, and normal nail in the certain solution
2	Asking	Students were motivated to ask some questions about: a. Why does the color of apple, pear, potato, or banana change to brownish? b. Why does the reaction of zinc, rusty nail, and normal nail happen when they are dipped in acid solution? How are their chemical reactions? c. How do we determine the oxidation number of an element of compound or ion?
3	Collecting The Data	Students explored the information by doing: a. Designing the experiments of fruit change reaction, combustion reaction, and metal change reaction, and also representing the result to equilize the perception b. Doing the experiments of fruit change reaction, combustion reaction, and metal change reaction c. Observing and recording the experiment result of fruit change reaction, combustion reaction, and metal change reaction
4	Associating	Students associated by doing: a. Analyzing the data to conclude the experiments of fruit change reaction, combustion reaction, and metal change reaction b. Writing the combustion reaction based on the result experiment c. Equalizing the total element of the before and after reaction d. Practicing to write combustion reaction equation
5	Communicating	Students presented the work result in front of the class by presenting the experiment result of fruit change reaction, combustion reaction, and metal change reaction

Meanwhile, on the third meeting, students did a redox reaction practice using materials whichwere easy to find in daily life. The use of the surrounding environment as the teaching material of scientific approach made students really enjoy every learning process without feeling lazy and bored (Abadi, et al.,2015). Students got the new experience of learning process so that they were enthusiastic on participating in the learning process. In

addition, practice using materials found in daily life gavethe positive influence on students' scientificskills.It corresponded to the research of Astuti et al. (2018) because students find their own practice matters in daily life whichcorresponded to the practice they carried out.

Table 4. Recapitulation of Students' Questionnaire Results in Doing LKPD 1,2 and 3

No.	**Percentage of Questionnaire Result**				**Total**
	SA	A	DA	SD	
1.	The course matter taught had an attractive appearance				
	33,33	50	16,67		100
2.	The matter presented made me easier to understand the concept of redox reaction matter				
	36,67	46,67	16,67		100
3.	The steps of learning in LKPD helped me to learn independently				
	13,33	73,33	13,37		100
4.	The exercises of redox reaction made me easier to understand the matter				
	33,33	53,33	13,37		100

Description: SA = Strongly Agree
A = Agree
DA= Do Not Agree
SD = Strongly Disagree

The recapitulation of students'questionnaireresults in doing LKPD showed the positive result where scientific-based LKPD helped them to understand independently the redox reaction matter based on the relevant informations, thus their scientific skill developed.As stated by Wielman & Gilbert (2015), many of what we know as scientific concepts were the way scientists gathered a lot of information in one category to enable them to decide quickly where the information was relevant. The scientific approach allowed students to explore relevant information in one category, thus they would do a lot of observing, asking questions, collecting the data, associating and concluding. Therefore, they wouldget the matter based on their own discovery process, and the absorption of knowledge would be more profound when compared to listening to the teacher's lectures and practicing only. Based on that,the student-centered learning would be formed. Avsec, et al. (2014) stated that student-centered learning allows students to carry out high-level active learning, where they could develop problem-solving and decision-making skills.

Students' Cognitive Learning Outcome

Table 4. Students' learning outcome through the application of scientific-based approach LKPD to The

No.	During The Treatment		After Doing The Test	
1	Percentage of students that passed the KKM	66,67%	Percentage of students that passed the KKM	86,67%
2	Percentage of students that did not pass the KKM	33,33%	Percentage of students that did not pass the KKM	13,33%

Notes:

During The Treatment:

Completeness percentage = $\frac{Total\ of\ students\ that\ passed\ the\ KKM}{Total\ of\ students}$ x100%

$= \frac{20}{30}$ x 100% = 66,67%

After Doing The Test

Completeness percentage = $\frac{Total\ of\ students\ that\ passed\ the\ KKM}{Total\ of\ students}$ x100%

$=\frac{26}{30}$ x 100% = 86,67%

Based on data of that table, it resulted that the learning outcome had passed the target, which the students' completeness percentage reached 86,67%. It showed that the scientific approach was successful to make the difficult chemistry learning to be easy and meaningful to the students, therefore they were motivated to learn chemistry. Because how important chemistry course is, teachers are expected to choose the right method and approach in optimizing the role of students in the class to make the learning process more meaningful (Syafii & Yasin, 2013). In another word, no matter how great the teacher is, if the teacher does not choose the right method and approach, the meaningful learning process will not happen. Scientific approach forced the students to do inquiry activity and investigation, which students were given the stimulus to think highly in analyzing the problem, behave honestly, creatively, disciplinely, and independently. Kusmaningsih (2013) stated that learning as inquiry process was doing science such as observing, makinghypothesis, doing the experiment, collecting and analyzing the data and presenting the report. Therefore, inquiry process was scientific work that led students to be always involved directly in learning process, which students as the learning center and teacher as the facilitator only. Students' creative behavior would appear when they presented a creative work, appreciated the achievements that have existed, was responsible and brought up the communication skills well, so the character of making teamwork with the others would show. Then, on the last step, students were on the analyzing and evaluating level, where they reflect to the process that they had done (Machin, 2014).

Conclusion

Based on the research, it can be concluded thatLKPD with scientific approach gave the positive influence to students' cognitive. It was shown by the amount of student who

had passed KKM. Using LKPD with scientific approach by implementing practice learning based on daily life created a meaningful learning to students. They also got the conclusive evidence to bridge the theory and its application in daily life.

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