Profile of students critical thinking skills on redox concept in SMA Negeri 8 Semarang

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Abstract. The following study was carried out as a preliminary investigation of students' critical thinking skills after a learning process in redox reaction matter. The subject of this research was 36 students of science class grade XI school year 2018/2019 in SMA Negeri 8 Semarang. The data analysis technique in this research was done by calculation of the questionnaire results of students' responses to the questions on redox material. Methods of data collection were done by observation, documentation, teacher interview, and student interview. The instruments of this study consisted of observation sheets, questionnaires, and interview sheets. The results showed that students' critical thinking skills in redox concept material after learning process included in the category was low achievement. In advanced, we will develop efforts to improve students' critical thinking skills at SMA Negeri 8 Semarang that will be done by applying creative learning models and use of learning media.

1. Introduction

The purpose of chemistry learning was to develop an understanding of various natural phenomena, chemical concepts and principles which it was useful and could be applied in daily life. Students critical thinking skills were very necessary to apply chemistry learning concept. This could be achieved if the teacher was able to develop a learning process that demands active student involvement so that the students' thinking ability will develop with the problems and challenges they face [1]. The active participation of students in the learning process will be able to decrease boredom and give rise sense of pleasure in learning and in the end, it will impact with increasing students' critical thinking skills [2]. Schools and teachers as the main components of education needed to manage learning in accordance with the principles of teaching and learning activities, among others: student-centered activities, learning by doing, independent learning, and learning to work together so that learning will be expected to be unfocused on the teacher, but how to activate students in learning (student active learning) [3].

Students concepts must learn in the redox material include the development of the concept of reduction and oxidation reactions; the concept of oxidation numbers; reducing agents and oxidizing agents; autoredox reactions; and applying redox reactions in daily life. Redox has the material character of the relation between the concept, involves the calculation of mathematical, abstract nature, and deals with everyday life. The concept of oxidation number is both conceptually and mathematically, the concept of redox handover related electron, discharge, and oxygenation. Shehu (2015) stated that the redox materials is closely associated with daily life as many of the events happening around us which include redox reactions, such as respiration, photosynthesis, burning fuel, photography, and purification.
of metals [4]. The chemical characteristics of the particular material such as redox expressed to allow
the occurrence of difficulty students in study and demanding students to think critically [5].

One material that is still considered difficult and requires high order thinking skills by students of
class X in SMA Negeri 8 Semarang is redox material. The subject matter of chemistry contains many
concepts that are quite difficult to understand the students, because of concerns the chemical reaction,
mathematical calculations, as well as the concept that is both abstract and material considered students
is relatively new [6]. This is evident from the results of students' daily tests that are still below the KKM
(Minimum Completion Criteria). The results of the daily analysis of redox reaction material at the school
in the 2018/2019 school year show that less than 50% of students exceeded the KKM, and the remainder
was still below the KKM value. The low value of learning outcomes is one of the symptoms of student
learning difficulties.Completeness of the learning outcomes of class X students at SMA Negeri 8
Semarang on oxidation-reduction (redox) reaction material is still low and recurs from year to year. This
must be found a way of solving it by identifying students' critical thinking skills towards the concept of
redox reactions and their solutions.

This is reinforced by the results of interviews with some students class XI in SMA Negeri 8 Semarang
that the difficulties encountered when studying redox material were students have difficulty in
determining the reductant and oxidizing agent in a redox reaction because there were still few examples
of questions given by the teacher, students are still confused in determining the oxidation number of the
element because students' understanding was still limited to memorizing the rules for determining
oxidation numbers, and students still cannot understand well the material obtained at that time because
of the lack of supporting learning media.

Critical thinking skill in redox material needed to be developed to achieve optimal learning outcomes.
Critical thinking was a mental/intellectual process related to the skills in making an understanding or
concept, applying, analyzing, making a synthesis, and evaluating so that it could then be applied to solve
problems, make decisions, analyze assumptions, and conduct research. Critical thinking needs to be
developed to analyze arguments and bring insight and develop cohesive and logical reasoning patterns.
Critical thinking skills could develop if students were actively involved in active learning. Active
learning could be through learning models that were appropriate to students' interests and use of learning
media [7].

Based on the observations of the learning process carried out by chemistry’s students when studying
redox material, students were not accustomed to actively think critically. It was full thinking with the
skills in making understanding or concepts, applying, analyzing, synthesizing, and evaluating
observations, experiences, thoughts, considerations and communication, which will guide in
determining attitudes and actions. Teachers talk more, give exercises or written assignments, and
laboratory activities were only limited to doing activities according to the worksheet used but do not
provide opportunities for students to experiment according to their ideas and knowledge. It made the
learning process becomes less interesting and meaningful because the teacher's dominance was still very
prominent and consequently students were less motivated to learn. The purpose of this study was to
analyze the profile of students' critical thinking skills in redox reaction matter at SMA Negeri 8
Semarang.

2. Methods
The research used a descriptive qualitative research method. This method analyzed the results of
observations and questionnaire responses of students with explanatory explanations qualitatively. The
populations of this research were all students of class XI Science at SMA Negeri 8 Semarang. The
samples of this research were one of the XI IPA classes at SMA Negeri 8 Semarang, which called XI-
IPA 2 class. The research instruments were observation sheets, documentation, students' critical thinking
questionnaires, teacher interview sheets, and student interview sheets. The research instrument was
validated by the supervisor. In conducting research, researchers were directly involved in data collection
through questionnaires, interviews and documentation. The questionnaire instrument developed in this
study was arranged in table form with four Likert scales namely SA = Strongly Agree, A = Agree, D =
Disagree, and SD = Strongly Disagree, with scores of SA = 5, A = 4, D = 3, SD = 2. The criteria in the questionnaire consisted of Very Good, Good, Poor and Bad. This questionnaire consists of 20 statements regarding students’ critical thinking skills.

3. Results and Discussion

The results of observations at SMA Negeri 8 Semarang during the learning process were the critical thinking skills and students’ learning motivation was lacking because they did not pay attention when the teacher was teaching. Students tend to be less active so teacher and student interactions were not going well. The chemical laboratory at was used as class XI due to lack of space. This caused a lack of chemical practicum activities at school. The arrangement and maintenance of chemical laboratories were not considered so that many SMA Negeri 8 Semarang laboratory equipment were seen which have been damaged and left alone. Based on the results of the interview, students understand and understand the material taught through direct practice in the laboratory rather than the theory.

Student interview results obtained input students feel difficulties when they have to apply the concepts they know to different problems with the teacher's explanation. The concept of redox filled with interesting natural phenomena, experimental activities, and useful knowledge to understand the nature and process of the occurrence of the universe [8]. Redox was a chemical concept that has many applications in everyday life, for example: whitening, photosynthesis, combustion, metal rusting, batteries, batteries and so on [9]. The redox concept needs to be explored by students through active knowledge construction and taught directly by the teacher [10].

Based on the results of interviews with one of the chemistry teachers at SMA Negeri 8 Semarang, student learning outcomes on the redox concept were still low, students were less active and feel burdened to memorize terms in the redox concept. Students have difficulty in making the redox reaction equation. Even though they had been given the task of reading concepts and practice questions, students had not been able to answer the questions given properly. This condition was allegedly due to the tendency of the learning process was still teacher-centred and students did not give the opportunity to move to construct their own knowledge. This was in line with what was stated by Hendel and ER Young (2016) in general, most teachers in the learning process did not try to invite thinking to students [11]. The teacher considers, for students to master the material was more important than developing the ability to think. This causes the ability to think students become less trained. The role of the teacher and high student learning motivation in a learning process will greatly assist students in achieving optimal learning outcomes [12]. Students' critical thinking skills could be seen based on student responses to the learning process that demands critical thinking. The analysis of students' critical thinking could be seen in Table 1 and Figure 1.

The aspects of students' critical thinking skills in redox material could be developed through learning activities assessed in the questionnaire. In the first aspect of critical thinking skills namely giving a simple explanation. This group consists of three indicators which include: focusing questions, analyzing arguments, and asking and answering questions. It was in line with the statement from Smith (2013) that learning that asks students to understand or formulate problems, goals and hypotheses, and analyze to answer the problems which have been formulated could develop critical thinking skills [13]. Seranica (2018) states that through drawing conclusions by students will be better able to improve their critical thinking skills [14]. The results of questionnaire critical thinking of students in the first aspect obtained a total score of 776 with a percentage of 71.85% in the good category.

The second critical thinking ability group was building basic skills. There were two indicators, consider whether the source could be trusted or not and observe and consider the observation report. Through practicum activities, students were trained to record observations, report observations, use correct evidence, account for observation results, ability to give reasons, consider the use of appropriate procedures and consider the suitability of sources. The results of questionnaire critical thinking of students in the second aspect obtained a total score of 249 with a percentage of 69.16% in the low category. The third critical thinking ability group was concluded. There were three indicators which include: reducing and considering the results of deduction, inducing and considering the results of
induction and making and determining the results of consideration. Students' critical thinking skills in this group could be improved by the activities of formulating problems, analyzing, asking questions and answering questions from learning activities. The results of questionnaire critical thinking of students in the third aspect obtained a total score of 509 with a percentage of 70.69% in the good category.

| No | Critical Thinking Indicators Ennis                  | Sub-Indicators Critical Thinking According to Ennis                                      | Total Score | % Critical Thinking | Category |
|----|-----------------------------------------------------|-----------------------------------------------------------------------------------------|-------------|---------------------|----------|
| 1. | Provide a simple explanation                        | a. Focus questions                                                                     | 776         | 71.85               | Good     |
|    |                                                     | b. Analyze the                                                                         |             |                     |          |
|    |                                                     | c. Question and answer questions                                                       |             |                     |          |
| 2. | Build basic skills                                  | d. Consider whether the source was trustworthy or not                                  | 249         | 69.16               | Low      |
|    |                                                     | e. Observing and considering observation reports                                       |             |                     |          |
| 3. | Summing up                                          | f. Reducing and considering deductions                                                 | 509         | 70.69               | Good     |
|    |                                                     | g. Inducing and considering the results of induction                                   |             |                     |          |
|    |                                                     | h. Making and determining the results of consideration                                 |             |                     |          |
| 4. | Providing further explanations                      | i. Defining terms and considering a definition                                          | 614         | 68.22               | Low      |
|    | Managing strategies and tactics                     | j. Identifying assumptions                                                              |             |                     |          |
|    |                                                     | k. Strategies for defining with terms as provides further explanation                 | 371         | 68.70               | Low      |
|    |                                                     | l. Determines an action                                                                 |             |                     |          |
|    |                                                     | Total                                                                                  | 2519        | 69.97               | Low      |

Figure 1. Questionnaire Student

Table 1. Analysis of Student Critical Thinking Questionnaire
The fourth critical thinking ability group was giving further explanation. This group consists of two indicators which include: defining terms then considering a definition and identifying assumptions. Students' critical thinking ability in this group could be increased through discussion and analysis activities, students were also required to be able to identify assumptions and state whether there was a relationship or not from these assumptions. The results of questionnaire critical thinking of students in the fourth aspect obtained a total score of 614 with a percentage of 68.22% in the low category. The fifth critical thinking ability group was managing strategy and tactics. There were two indicators, namely: the strategy to make definitions by acting to provide further explanation and determine an action. In this sub-indicators study developed only on the ability to determine an action. Students' critical thinking ability on the indicator of the ability to determine an action could be developed through a learning design that uses problem submission first to find a concept. The results of questionnaire critical thinking of students in the fifth aspect obtained a total score of 371 with a percentage of 68.70% in the low category. The total of all aspects of students' critical thinking in chemistry was 2519 with a percentage of 69.97% and in the low category.

The active role of students was more fun for teachers and students, and most importantly the active role of students could cause students to be able to think critically. The critical thinking ability that was developed and tried to be improved in this study was the ability to think critically according to Ennis. Critical thinking ability according to Ennis was divided into 5 groups, namely giving simple explanations; building basic abilities (basic abilities); concluding; making further explanations (advanced clarification); managing strategies and tactics. It was described into twelve critical thinking skills, which include, focusing questions; analyzing arguments; asking and answering questions; assessing the credibility of information sources; observing and considering observations; making deductions and evaluating deductions; making induction and evaluating the results of induction; making and determining the results of consideration; defining and assessing definitions); identifying assumptions; determine an action; and interact with other people [15].

Factors that caused student difficulties in the concept of oxidation-reduction reactions include internal and external factors. Internal factors were students easily forget the material, students were less careful, students pay less attention during the learning process, students were not regular in learning, students did not have complete notes, and students have difficulty explored redox material. External factors that cause student difficulties in redox material were the teacher is less clear in delivering learning material. The solution to overcoming the difficulties of students in learning redox material at SMA Negeri 8 Semarang was that students should learn more actively in learning, teachers applied creative learning methods and models, teachers provide remedial teaching, and if seen from technological advances can be made an application of redox reactions. The teacher was expected to provide the material about redox reactions in a creative way so that students easily remember the material and could improve students' critical thinking skills in SMA Negeri 8 Semarang.

4. Conclusion
Based on the results of the study it could be concluded that the ability to think critically of students in class XI in SMA Negeri 8 Semarang was still in the low category with a total score of 2506 percentage of 69.97%. This shows a lack of activity and high-level thinking skills in students, especially critical thinking in answering questions contained in the questionnaire. One of the efforts was to improve students 'critical thinking skills in SMA Negeri 8 Semarang by applying the learning model with accompanying learning media that were appropriate to students' interests. The learning model could make students more active in learning, so students could think critically, logically, and systematically in solving chemical problems, especially redox material. Further research was needed to determine the effect of the learning model assisted by learning media on students' critical thinking skills in redox material at SMA Negeri 8 Semarang.
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