Effctiveness Of Socio-Sciences Issues In Chemistry Class To Improve Scientific Literacy In High School: Redox Reaction And Environmental Issues

by Sri Haryani

Submission date: 29-Jul-2020 04:09PM (UTC+0700)
Submission ID: 1363567571
File name: eracy_In_High_School_Redox_Reaction_And_Environmental_Issues.pdf (377.39K)
Word count: 2704
Character count: 15130

Man In India, 97 (17) : 249-256 © Serials Publications

EFFCTIVENESS OF SOCIO-SCIENCES ISSUES IN CHEMISTRY CLASS TO IMPROVE SCIENTIFIC LITERACY IN HIGH SCHOOL: REDOX REACTION AND ENVIRONMENTAL ISSUES

Anita Fibonacci[1], Sri Haryani[2] and Sudarmin Sudarmin[3]

The aim of this research is determine the ability of socio-sciences issues in improving the scientific literacy. One group pre-test post-test design applied to know the effectiveness of socio-sciences issues to promoting scientific literacy in high school. The data was collected by test and non-test methods, to measure the scientific literacy aspects of the students. Data of this study were analyzed using t-test with the SPSS 17.00 program at the 0.05 significance level. The findings indicated significant differences in overall scores of scientific literacy pretest and posttest. From the findings, it has been concluded that implementation of guided inquiry learning based on socio-sciences issues can be further developed through creative and innovative approach in the students' learning process.

Keywords: Chemistry Learning, Sscientific Literacy, Socio-Sciences issues

1. INTRODUCTION

The main problems of chemistry learning are the teacher does not provide an opportunity for students to apply chemical concepts opportunity for students to apply chemical concepts into real-life situations (Kurt&Ayas, 2012). It certainly must be addressed, because isolating knowledge in the school will cause two things that are not related to the system of their thinking (Wu, 2003). Teachers as educators should help the students to the knowledge from school to face the challenges of real-life students. Prodjosantoso (2008) said chemistry learning was irrelevant to students, didn't lead to greater cognitive skills. Linier with that Marks &Eilks (2009) that there is no link between the concept in the school with their real social situations. Brist (2012:1) states that students who studied chemistry tend to be bombarded with isolated facts and chemical formulas, so they tend to memorize, then easily throw it away without a trace. This is one of the important issues in teaching science.

The gap between science concepts in school with their real life situation is thought to be one of the factors that cause the level of scientific literacy of Indonesian students is very low when compared with students in other countries. The Average Indonesian students on the PISA test is still at level 1. At this level, students can only suggest a suitable source of information on the topic of science. Students can identify the quantity that occurs in an experiment. For a specific context, students

[1] Universitas Islam Negeri Walisongo Semarang Indonesia, *E-mail: anitafibonacci@walisongo.ac.id*
[2,3] Universitas Negeri Semarang, *E-mail: haryanimail@gmail.com, darsudarminl@gmail.com*

can only identify whether a variable can be measured or not (Bybee, McCree ,Lawrie, 2009). Scientific literacy emerged as a result of the challenges facing the greater global community related to the provision of adequate food and water, disease control, generating sufficient energy and adaptation to climate change (UNEP, 2012). That's why the use of the social issues in the learning of chemistry is important to do as a bridge to give the relation between chemistry concepts and student's real situations.

In this study, a research topic focused on redox in junior high school. The reason was a lot of teachers and students find it difficult to teach and learn redox (Haryani, 2012) in another hand reason was a lot of social issues related to the environment that can be explained by redox topic. Österlund & Ekborg (2009) discloses that redox reaction is fundamental to explain issues related to electrochemistry. Redox reactions is one of the difficult material taught and learned. De Jong (1995) reveals the difficulties for teachers to explain the concept of redox is how to explain the transfer of electrons in such a way that helped students to adopt a model of electron properly. There are a number of explanations regarding the difficulties in making the concept of redox reactions. Schmidt (1997) found many students revealed that oxygen always takes part in all the redox reaction and the oxygen which is a prerequisite for a redox reaction. His findings shows that this is due to a word *ox* in the redox reactions. A problem to be answered by researchers was: Is there a statistically significant difference between scores on the pre test and post test for scientific literacy after the implementation. The purpose of this study was find out the effects of learning based on socio-sciences issues in chemistry class.

2. MATERIALS ANDMETHODS

2.1. Measure Scientific Literacy Instrument

This instrument used for pre test and post test purpose of measuring the implementation of socio sciences issues in chemistry class. The instrument used to measure scientific literacy competency test is a question of the form of the description that integrates between science literacy competencies (PISA assessment framework refers to 2015) with the learning objective for subject matter competency redox. The validity test includes content, construct, and concurrent validity. The content validity test was done through the study of the instrument by the supervisor 1 as the evaluation expert and supervisor 2 and 3 as science matter expert, construct validity test performed with validation techniques by expert (judgment experts) through questionnaires validation, and then being calculated in Aikens V formula. The validity of concurrent was used to determine the correlation between matters developed with the question of the original PISA uses a technique product moment correlation (r_{xy}). Reliability testing was done by using *alpha cronbach formula*.

Test of characteristics by determining the level of difficulty and discrimination power.

2.2. Participant

This study was conducted in the Nahdatul Ulama Vocational School in Semarang Indonesia. Total 40 subjects participated. Ages ranged from 14 to 16 years with the mean age of participants being 15 years old.

2.3. Design

This study used one group pre-test post-test design. Researcher obtained the permission to conduct this study from Nahdatul Ulama Vocational School. Researcher obtained the consent to use the data for this study from each participant, so that students' awareness of being studied would not interfere with their normal responses and academic performances. The pre test was given at the beginning of of the first meeting before implemented learning using socio-sciences isues. Post test was given to the participants after finishing the implementaion of learning redox reaction using socio-sciences issues. The pre test and post test of each sample was scored and review by reseacrher. Reseacher also evaluate the improvement of science literacy competencies using *N-gain score.*

2.4. Data Analysis

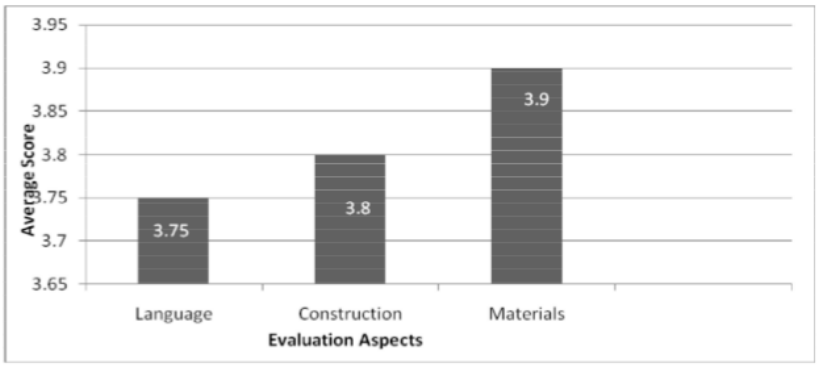
Inferential statistics including t test were used to test the difference between two independent group means (Sugiyono, 2006: 196).

3. RESULTS

3.1. Scientific Literacy Instrument

The content validity test was done before the evaluation instrument based scientific literacy tested in the first trial to obtain suggestions for improvements. Based on the review experts, the developed instrument that was categorized valid with recommendation. The result of construct validity test which obtained by calculating a score of expert validation in the questionnaire can be seen in Graph 1.The result of *product moment* technique has a linier result. After doing the data analysis, the result obtained as shown on r_{xy} calculation is 0.73 with valid category. Reliability of this instrument result 0.78 that fulfill the criteria reliable.

The result show that the significancy for pre test was 0.084 with average score was 31 and minimum and maximum score was 10 and 57. Significancy of post test was 0.097 with maximum score was 90 and minimum score was 78. Participants had scored considerably higher science literacy post test than on the pre test. T-test was computed to determined significant differences between the pretest and posttest.



Graph 1: Result Average Score from Experts

Results showed significant for the pretest and pos ttest was $t_{(39)}$ = -40,824, $p < 0.005$. As expected, a statistically significant is seen in the scores.

TABEL 1: ACHIEVEMENT N-GAIN PROFILE FOR FIRST COMPETENCY OF SCIENTIFIC LITERACY

No	*Category*	*N-Gain Average Score*	*Criteria*
1.	High-rank academic achievment	0,68	Moderate
2.	Moderate-rankacademic achievment	0,70	High
3.	Low-rankacademic achievment	0,66	Moderate

TABEL 2: ACHIEVEMENT *N-GAIN* PROFILE FOR SECOND COMPETENCY OF SCIENTIFIC LITERACY

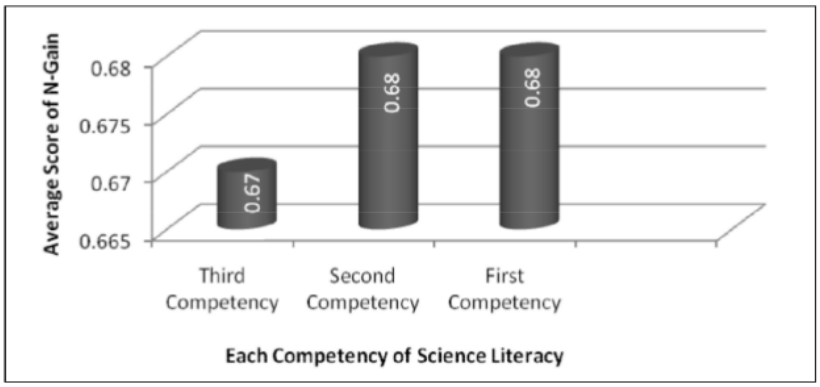
No	*Category*	*N-GainAverage Score*	*Criteria*
1.	High-rank academic achievment	0,64	Moderate
2.	Moderate-rankacademic achievement	0,70	High
3.	Low-rankacademic achievement	0,68	Moderate

TABLE 3: ACHIEVEMENT *N-GAIN* PROFILE FOR THIRD COMPETENCY OF SCIENTIFIC LITERACY

No	*Category*	*N-Gain Average Score*	*Criteria*
1.	High-rank academic achievement	0,76	High
2.	Moderate-rankacademic achievement	0,67	Moderate
3.	Low-rankacademic achievement	0,58	Moderate

4. DISCUSSION

Graph 1 showed that all the criteria was valid from the expert validity. Suggestion that was given by experts are: a) the picture that has been used in question must be able to explain the question and has a meaning, not only for decoration; b) avoid



Graph 2: Average Score of *N-Gain* for Each Competency in Science Literacy

TABLE 4: MEAN SCORES PRE-TEST, POST-TEST AND N-GAIN LITERACY ASPECTS OF COMPETENCE IN STUDENT ABILITY GROUP HIGH, MEDIUM AND LOW

Category	*N of Students*	$\bar{X}$ *Pre-Test*	$\bar{X}$ *Post-Test*	$\bar{X}$ *N-Gain*	*Criteria*
High-rank academic achievment	11	43	82	0,69	moderate
Moderate-rankacademic achievment	18	30	79	0,70	higher
Low-rankacademic achievment	11	20	72	0,65	moderate

the ambiguity of the sentences; c) print the question in a colourfull paper because there was specific purposes from that colour (not only decoration) especially in question that consist of practical activity.

Post-test results showed that 35 students achieved the score more than 70, with the average score in the classical 78 which means that the implementation of socio-sciences issues effective in improving science literacy competence. Use of social issues in the learning appears effective in enhancing aspects of science literacy competence. Similar findings were also obtained from the results of research Barab, Sadler, Heiselt, Hickey & Zuiker (2010), namely the use of socio-scientific issues can helped the students construct arguments by connecting evidence to claim. Socio-sciences issues also has been proven to improve the comprehension in understanding the interrelation of sciences (Castano, 2008).

PISA definition of scientific literacy by 2015 is the capacity to use scientific knowledge, procedural knowledge, and epistemic knowledge to identify questions, reflect an evidence based conclusions in order to understand and help make decisions about the nature and changes thereto through human activity. Competence scientific literacy is seen in this study include: a) explain the phenomenon scientifically; b) evaluate and design a scientific investigation; c) interpret the data and scientific evidence (OECD, 2013). Profile achievement of each competence

on the subject of the study was presented in table 2, 3, and 4 while the overall data shown in Graph 3.

First competency is explain the phenomenon scientifically. Table 1 showed that the highest improvement was achieve by moderate-rank academic achievement category. Second competency is evaluate and design a scientific investigation. Table 2 showed that the highest improvement was achieve by moderate-rank academic achievement category. Third competency is interpret the data and scientific evidence. Table 3 showed that the highest improvement was achieve by high-rank academic achievement category.

Graph 2 showed that the third competency (interpret the data and scientific evidence) was the lowest of the N-gain score. This happens because students has difficulties to transform the data from one representation to another representation to achieve that competency, as a result of the lack of experience proper practice, so that students are not accustomed to interpret the macroscopic level into another form of representation such as charts, graphs and diagrams. Gilbert & Treagust (2009: 6) said one of the problems faced by students is the lack of experience on the macroscopic level and also unavailability of appropriate practical experience.

One of the example of socio sciences issues that has been used by researcher is the color changes of liberty statue as a result of acid rain, and students are invited to analyze the article about acid rain. With the discussion of issues concerning acid rain, students trying to learn on the macroscopic level, and then determine the cause of why the presence of acid rain can make color changes on the statue of libert. Students must have to learn on a microscopic level. The next step, the students were asked to name the the compounds that involved in acid rain according to the standards set by the IUPAC naming, eg SO2(g) is the sulfur dioxide gas. From the naming, the students learn at the level of symbolic language. Johnstone (2006) said there was a triplet concepts in chemistry, the macroscopic level, submikroskopis and symbolic language.

Another example socio issues in the learning of chemistry was the case of rusting iron Howrah bridge in India as the result from a bad habit of spitting in the Indian people to that bridge. This is because the Indian people love to chew guthka (a mixture of tobacco and citrus) and paan (betel leaf mixed orange) so their saliva become more acidic. From these cases, students are asked to explain the phenomena scientifically (one of the competency in science literacy).

Results of classroom observations indicate that students with category low rank academic acjhievement category tend to be difficult to set up. It was thought to be the reason why the increase in N-Gain in that group is small criteria. In the group are experiencing an increase in N-Gain the most, this is presumably because the group was happy and tend to show a high interest for learning, by actively asking.

Acknowledment

Author would like to thanks to Universitas Islam Negeri Walisongo Semarang for providing support for this study.

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