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Analysis of Science Literacy Skills of Chemistry Education Students in Acid-Base Topics

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Abstract: **Analysis of Science Literacy Skills of Chemistry Education Students in Acid-Base Topics.** The purpose of this study was to determine the science literacy skills of chemistry education students in Acid-Base solution topics. The research method used is descriptive by using the purposive sampling technique. The sample in this study was 22 (out of 91) year 3 students of the chemistry education Department. Data collection techniques used in this study are the measurement techniques in the form of open questions and interview techniques. The results of data analysis show that chemistry education students in solving acid-base problems; science literacy content is in the medium category, the science process is still low, and the context of scientific literacy is also low. The conclusion is the average literacy skills of chemistry education students in acid-base material are in the medium group.

Keywords: analysis, science literacy skills, acid-base.

Abstrak: ***Analisis Keterampilan Literasi Sains Mahasiswa Pendidikan Kimia pada Topik Asam Basa****. Tujuan penelitian ini adalah untuk mengetahui kemampuan literasi sains peserta didik pendidikan kimia pada topik larutan asam basa. Metode penelitian yang digunakan adalah deskriptif dengan menggunakan teknik purposive sampling. Sampel dalam penelitian ini adalah 22 (dari 91) siswa tahun 3 Jurusan Pendidikan Kimia. Teknik pengumpulan data yang digunakan dalam penelitian ini adalah teknik pengukuran berupa pertanyaan terbuka dan teknik wawancara. Hasil analisis data menunjukkan bahwa siswa pendidikan kimia dalam memecahkan masalah asam basa; konten literasi sains berada pada kategori sedang, proses sains masih rendah, dan konteks literasi sains juga rendah. Kesimpulannya adalah rata-rata kemampuan literasi siswa pendidikan kimia materi asam basa berada pada kelompok sedang*.

Kata kunci: *analisis, keterampilan literasi sains, asam-basa.*

▪ INTRODUCTION

The scientific literacy skills of Indonesian students are still low. This is based on the results of the PISA study that the average score of science literacy skills of Indonesian students is still below the score of 500. The Indonesian scores in PISA from 2000-2015 are as follows:

Table 1. Indonesia's Score in PISA Year 2000-2015

Year	2000	2003	2006	2009	2012	2015
Score	393	395	393	383	382	403
Indonesia's Ranking	38/41	38/40	50/57	60/65	64/65	62/70

(OECD, 2015)

Based on the results of the PISA study, the low average literacy skills of science in Indonesia shows that the average scientific skills of Indonesian students is still at the stage of recognizing basic facts, and has not been able to communicate and associate various scientific topics.

Science literacy (scientific literacy) is now a demand to be mastered by every individual both in everyday life and in the world of work. Individuals who are literate in science can use the scientific information they have to solve problems in everyday life and produce useful scientific products (Suciati et al, 2011). According to Henriksen and Froyland (2000), the importance of scientific literacy ,in general, is to deal with everyday life in society, Indonesia is still at the stage of recognizing basic facts, and has not been able to communicate and associate various scientific topics. This resulted in them having difficulties in making a connection between the concept of subject matter and applications in everyday life in solving various problems that occur. The low average scientific literacy of Indonesian students can be one illustration that science learning in Indonesia still requires significant improvements.

One of the science lessons taught in high school is chemistry. Chemistry is one of science learning that is close to everyday life. In learning, students can solve various problems in their daily lives. Students' ability to solve problems is obtained if students have scientific literacy skills. In order for students to have better skills in solving problems, especially those related to basic chemical concepts, teachers and prospective teachers (Chemistry Education students) must also have adequate knowledge, especially regarding basic chemical concepts.

Considering the teacher's role in learning is very important, then a teacher must have more skill compared to the others, in improving the quality of education. Learning carried out by the teacher must also be able to generate interest in students to learn, so that learning becomes more meaningful. Not only teachers, the prospective teachers must also have better skill so that later on they carry out their duties as teachers can carry out learning as well as possible (Sujana *et al*, 2014). Therefore, it is very important for prospective teachers to have deep knowledge of chemistry. In other words, chemistry education students must have good chemical literacy.

One of the subject matter of chemistry subject which is related to scientific literacy is the material of acid base solution which is very widely used in daily life such as vinegar, fruits, and others. Acid-base solutions have a relevant concept in the future because they are still needed in life. Besides that, this acid-base solution is experimental in that it involves process competencies in studying it, so students are expected to have high

scientific literacy skills. Therefore it is also necessary to describe the scientific literacy skills of students as prospective teachers.

Scientific literacy is a person's ability or skill to understand science, communicate science, and apply science knowledge to solve problems so that they have a high attitude and sensitivity to themselves and their environment in making decisions based on scientific considerations.

Scientific literacy is defined in the OECD Program for International Student Assessment as the ability or skill to engage with issues related to science, and with the ideas of science as reflective citizens (OECD, 2015). A scientifically literate person is willing to engage in reasoned discourse about science and technology, which requires competence to identify scientific questions, explain scientific phenomena, and interpret data and use scientific evidence.

PISA divides scientific literacy into 3 dimensions: "First, scientific concepts, which are needed to understand certain phenomena of the natural world and the changes made to it through human activity. The main content of the assessment is selected from within three broad areas of application: science in life and health; science of the earth and the environment and science in technology. Second, scientific processes, which are centred on the ability to acquire, interpret and act upon evidence. Third, scientific situations, selected mainly from people's everyday lives rather than from the practice of science in a school classroom or laboratory, or the work of professional scientists. As with mathematics, science figures in people's lives in contexts ranging from personal or private situations to wider public, sometimes global issues (Jack, 2009).

In general, the passage above provides an explanation that scientific literacy is divided into 3 dimensions, namely scientific concepts, scientific situations and scientific processes. The dimensions of scientific concepts are needed to understand natural phenomena and natural changes due to human activities. The assessment of scientific concepts is chosen from three application fields, namely science in life and health, earth science and the environment and technology science. Then scientific processes, centred on the ability to obtain, interpret and act on evidence. Whereas scientific situations emphasize the daily life of the community and not from the practice of science in school classrooms or laboratories, or the work of professional scientists.

Scientific Literacy Skills Assessment

In order to transform the definition of scientific literacy into scientific literacy assessments, PISA identifies three major dimensions of scientific literacy.

Scientific Literacy Content

In the dimensions of scientific concepts (scientific concept), students need to capture a number of key or essential concepts to be able to understand certain natural phenomena and changes that occur due to human activities.

Scientific Literacy Process

The process of scientific literacy in PISA examines the ability of students to use scientific knowledge and understanding, such as the ability of students to search for, interpret and treat evidence.

PISA defines three aspects of the following scientific processes in scientific literacy assessment, namely identifying scientific issues, explaining phenomena scientifically, and using scientific evidence.

Scientific Literacy Context

The modern definition of scientific literacy emphasizes the importance of recognizing and understanding the context of science applications, and being able to apply science in solving real problems it faces, both those related to the child's self (for example food), local communities where children are located (for example water supply), and life on earth more globally (for example global warming). PISA divides the field of application of science into the following three groups:

1) Life and health
2) Earth and environment
3) Technology

Mastery of science literacy skills is influenced by several factors including the approach or method of science learning used by teachers in developing learning concepts (Wulandari & Solihin, 2016).

The role of Scientific Literacy in Education

A number of developed countries in the world have built scientific literacy for a long time and it is integrated into the learning process. Science literacy in developed countries is a top priority in science education. People who have scientific literacy will be able to contribute to welfare both from a social and economic perspective, this is because scientific literacy is one of the impacts of a country's economic progress. The five components of the science process in the scientific literacy assessment established by PISA (2003), namely:

a. Get to know scientific questions, namely questions that can be investigated and answered scientifically
b. Identify the evidence required for scientific investigation. This process also involves the procedures required to obtain evidence that will be identified to answer questions in a scientific investigation.
c. Draw and evaluate conclusions, namely connecting the conclusions with the evidence that underlies the conclusion.
d. Communicating valid conclusions. This process reveals a conclusion precisely derived from the evidence.
e. Demonstrating an understanding of scientific concepts, which is the process of being able to use scientific concepts in situations or circumstances that are different from those that have been studied. (OECD, 2013)

▪ METHOD

The method used in this research is descriptive method. Descriptive research aims to describe the scientific literacy skills of chemistry education students.

Population and Samples

The population in this study was the 2014 chemistry education students, which consist of 3 classes, A1, A2 and A3. All students already learned the acid-base topic. Total students for each class can be seen on Table 2. The sampling in this study used a purposive sampling technique. This sampling is based on academic considerations, that is the average score of the final exam of High School Chemistry Course (Mata kuliah

Kimia SMA). Based on Table 2, students from A1 class, have the highest average score, therefore they were chosen to the sample of this study.

Table 2. The average score of the final exam of Highschool Chemistry course

Kelas	Jumlah Mahasiswa	Rata-rata Nilai
A1	22	71.4
A2	34	49.2
A3	35	58.6

Data Collection Techniques

Data collection techniques used in this study are measurement techniques, and direct communication.

To achieve the aim of this study, the test and interview guide were used to collect data. The test was used to gather students' literacy skills. Meanwhile, the interview guide was used to complement the main data from the test, also to confirm students' answer.

Validity and Reliability

A test is said to be objective if it gives a quantitative value to the answer, the element of the subjectivity of the researcher does not influence (Nawawi, 2012). Furthermore, the test questions made by the researcher were conducted validation and reliability first to assess the feasibility of their use in the field.

Validity

The validity used in this study is content validity. According to Jihad & Haris (2013) content validity is used to measure the congruence between the questions, the topics and the objectives that need to measure, which is science literacy skills. The validity technique used in this study is the validity of Gregory's content. In this study 2 validators were from chemistry education lecturers. From the results of validation it is necessary to revise the sentence number 1, so that it does not cause the ambiguity. The validity obtained is 1 in the very high category, which mean that the test is valid.

Reliability

In this study the reliability was measured using Alpha Cronbach. Based on the calculation result, the coefficient was 0.73 which is in the high category. This result means that the test is feasible to be used to measure students' science literacy skills.

Data Analysis Techniques

Test Result Analysis

Determining the students' science literacy skills category with the following criteria.

Table 3. Classification of Literacy Category

Criteria	Category
Score > $\bar{x}$ + SD	High
$\bar{x}$ - *SD* ≤ Score ≥ $\bar{x}$ + SD	Medium
Score < $\bar{x}$ - *SD*	Low

Arikunto (2012)

Data Analysis of Interview Results

Data analysis of interview results is based on a review of the answers expressed by respondents from the questions raised by the researcher. Respondents' answers are used to find out the causes of students' inability to solve the questions given.

▪ RESULT AND DISCUSSION

This study involved Chemistry Education students in VII semester. Students who were participants in this study were 19 people. Data obtained from the test essay questions consisting of 4 items. Each question has an indicator of the problem and aspects of scientific literacy to be achieved. Based on the recapitulation of the results of student answers, the average value of students is 29.55. The highest score achieved was only 46.15 and the lowest value was 9.61. This meant that students' scientific literacy in Acid-Base material was on average still low. Based on the calculation of the average value and standard deviation, the 2014 scientific literacy skills of Chemistry Education students have criteria that can be seen in table 3.

Table 3. Classification of the Student Science Literacy Category

Results	Category
Score > **39,71**	High
19,39 ≤ Score ≥ 39,71	Medium
Score < **19,39**	Low

Ket:

$\bar{x}$ = 29,55

SD = 10,16

The science literacy skills of Chemistry Education students in 2014 can be seen in Figure 1 below:

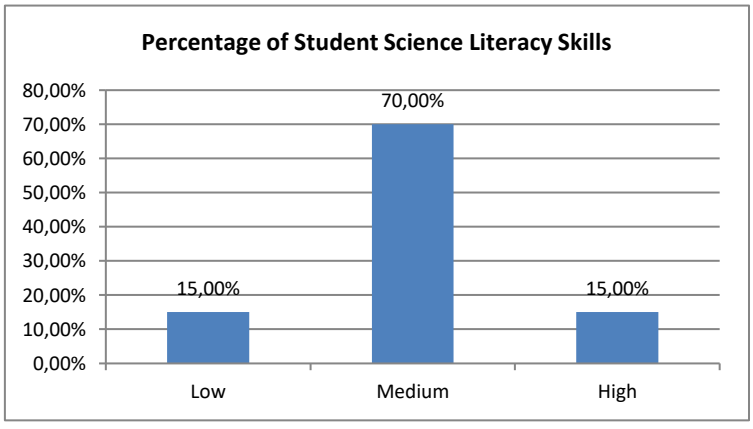

Figure 1. Percentage of Student Science Literacy Skills

Based on graph 4.1, it can be seen that the percentage of scientific literacy skills of Chemistry Education students is 70% in the medium category. Based on Table 4.1, it can be seen that students have excellent science content skills in applying the acid-base

concept to solve actual problems. But they are less able to explain the science process in applying the concept in the field of health and the environment.

The scientific literacy skills observed in this study consisted of 3 aspects, namely, aspects of science content, aspects of the science process, and aspects of the science context. Science literacy skills of students based on scientific literacy aspects on each indicator can be seen in Table 4.

Table 4. Percentage of Student Literacy Skills Based on Science Literacy Aspects

Question Indicator	Science Literacy Aspects (%)		
	Science Content	Science Process	Science Context
Applying the concept of calculating acid base to neutralizing reactions	42%	42 %	42 %
Implementing the concept of acid base to solve the problem of acidic peat soils	100 %	32%	32%
Implementing the concept of acid base to solve the problem of the impact of acid rain	100%	26%	26%
Applying the concept of dilution to vinegar acid solution	52%	21%	21%
Mean	73,50%	30,25%	30,25%

Based on Table 4, it can be seen that the science literacy aspects of Chemistry Education students in 2014 were the largest in the aspect of science content. While the aspects of the process and the context of science were still very low.

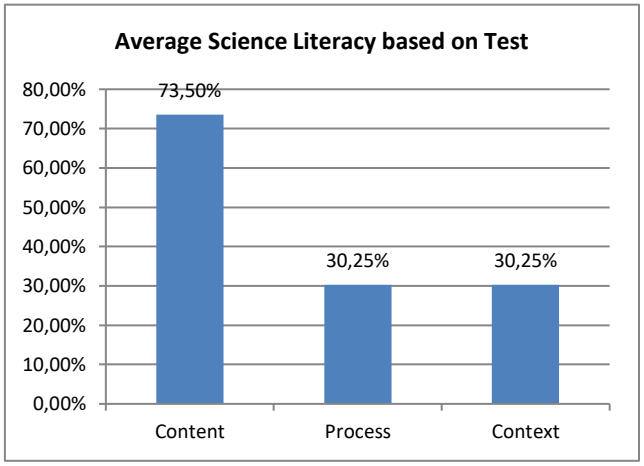

Figure 2. Average Science Literacy based on Test

▪ CONCLUSION

Overall, the science literacy skills of chemistry education students are in the medium category (70%), only 15% are in the moderate category and 15% are in the upper category. The highest literacy aspect is in the content section, while the ones that are still low are in the process and context section. To improve chemical literacy skills, high school students or college students should use problem-solving strategies as suggested by

Schmidt, Cohen-Schotanus, & Arends (2009) and Levin (2011). In addition, Rahayu (2016) and Khery, et al. (2018) state that the Nature of Science-based (NOS) learning can also improve students' scientific literacy skills.

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