

The Effect of Chemistry Teaching Materials on Scientific Literacy and Critical Reasoning in SMA Negeri Langsa

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ABSTRACT: : Scientific literacy is the ability to understand the concepts and processes of science and to use science to solve problems of everyday life. The 21st century demands education to facilitate science literacy in students. However, early observations at SMA Negeri Langsa found that the literacy of students in science was still low, as well as critical. The school has provided complete facilities and has additional textbooks in addition to Chemistry. However, the chemistry materials used are still based on theory. So, this research was carried out to analyze the influence of chemistry teaching materials on science literacy and criticism of students. The method used was design with one-group type pretest-post-test, so there was only one group of samples in this study, the students of the 12th grade MIA-2 consisting of 32 people. The data collection techniques used are tests and observation sheets. Data analysis in this study is descriptive statistics and inferential statistics. The results show that (1) Chemistry teaching materials significantly influence scientific literacy with a percentage of influence of 89.90% and (2) Chemistry teachings also affect critical reasoning significantly with an influence rate of 87.90%. The chemistry learning materials used in this study are LKPD (Learners' Worksheet) designed using liveworksheet. Thus, the study recommends that teachers and other researchers use chemistries that support scientific literacy and are critical, such as worksheet.

Keywords: Chemistry teaching materials; critical reasoning abilities; scientific literacy; liveworksheet

INTRODUCTION

The results of the PISA study in 2015 followed by 72 countries showed that the literacy of Indonesian science students was classified as low because they received only a score of 403 or were below the OECD standard of 493 [1]. Meanwhile, science literacy is crucial in student life. Science literacy is the ability to understand the concepts and processes of science and to use science to solve problems of everyday life [2]. If the student has a high literacy in science, then the student will be able to identify the phenomena of science in everyday life [3]. The 21st century also demands education to prepare students for global competition, one of which is by facilitating science literacy in students [4]. Therefore, school learning should also be applied to improve science literacy, including the use of teaching materials.

Teaching materials are all forms of materials used to assist educators/instructors in carrying out Teaching-learning activities in the classroom and facilitate students understanding lessons [5]. Teaching material is also understood as any form of material that is systematically prepared by educators and following the applicable curriculum, thus enabling students to learn independently and the desired goals [6]. Therefore, teachers are expected to be able to develop teaching materials according to additional purposes to be achieved in addition to the main objectives, such as science literature-based teaching material [7], critical literacy-based learning material to improve science process skills [8], and so on.



Therefore, the learning of science or IPA requires the presence of teaching material that supports critical literacy and science literacy.

Based on initial observations at SMA Negeri 1 Langsa, found that students' literacy in science was still low, as well as their criticism. The critical reasoning is measured based on the elements of the student profile of Pancasila because in SMA Negeri 1 Langsa has been applied the Merdeka Curriculum. Early observations also revealed that the school has provided complete facilities and has additional teaching materials in addition to the Chemistry textbook. However, the chemistry teaching material used is still based on theory. The learning process of science requires the presence of teaching materials designed to the competence of science, such as scientific literacy. In addition to conforming to the purpose or competence, the teaching material should also be designed to develop the potential of students according to the needs of the community around them, is by applying critical reasoning. Merdeka's curriculum also gives every school the right to design learning based on critical reasoning. However, in SMA Negeri Langsa has not been analyzed in depth regarding the influence of chemistry teaching materials on scientific literacy and critical reasoning students.

Based on the above description, this study will analyze the influence of chemical materials in schools on scientific literacy of students at SMA Negeri Langsa. The teaching material according to Kemdikbud consists of three types, namely: (a) material references are devices designed to help in the explanation of material or topic specifically; (b) exercises/ assessments are devices that are designed to assist the evaluation of students, both diagnostic, formative, and summative assessments; and (c) reflective instruments are a tool for the reflection of teachers and students after learning [9]. The chemistry teaching material used in this study is in the form of a worksheet designed using a liveworksheet.

Based on the background description they found problems to be solved, are low scientific literacy and critical reasoning students in SMA Negeri Langsa. Thus put forward three formula problems studied, are (1) Is there an impact of chemistry teaching material on the literacy of students in SMA Negeri Langsa?; and (2) Is there an impact of chemistries teaching materials on the criticism teaching skills of students in SMA Negeri Langsa? This research is expected to provide various benefits or contributions, among others: (1) to be a reference for researchers who will research relevant topics such as: science literacy, critical reasoning, materials, as well as solvent cognitive properties; and 2) to provide experience for teachers and students about the use of chemists teaching equipment such as worksheet based liveworksheet, enhance science literacy, and improve critical reasoning.

RESEARCH METHODS

The research was carried out at SMAN 1 Langsa which is in Jalan Jenderal Ahmad Yani, Paya Bujok Seuleumak, Langsa Baro Prefecture, Langs City, Aceh Province. The survey was conducted from July 24th to August 31st, 2023. The method used in this research is quantitative research. This research uses Pre-Experimental Design with one-group type pretest-posttest using only one sample that applies treatment, as well as measuring pretest and posttest [10]. So, is study only use one sample by measuring the pretest and posttest of the research object. Thus, science literacy and critical literacy are bound variables, and chemistry is a free variable that affects bound variables. The data collection techniques used are tests and observation sheets that given to students. The test results to draw conclusions related to research objectives.

From the design of the research, then selected purposive sampling technique as a method of sampled in this research. Purposive Sampling is a technique of sampling based on the presence of certain considerations. The sample-taking considerations for this study are: (a) SMAN 1 Langsa hat implements the Merdeka Curriculum because it will measure critical student profile, (b) The science class chosen because it would measure student scientific literacy, and (c) research permission from both teachers and the head of school. Thus, it was chosen SMA Negeri 1 Langsa because it has implemented the Merdeka Curriculum. As for the sample in this study, there were 32 students in the 12th grade of MIA-2 in SMAN 1 Langsa.

Tests are used to measure literacy in science, while observation sheets are used for learning the responses of teachers and students to the use of chemical materials in learning at Langsa State High School. The test instruments are structured based on scientific literacy indicators, and the observation sheets are organized on the critical reasoning indicators.

The analysis of data in this study is: descriptive statistics and inferential statistics. Descriptive stats in this research are used to give a general overview of the data sets found. The inferential statistical test used to answer the hypothesis in this study is linear regression. The hypthesis in this study are:

1. Hypothesis for the first problem statement
 - Hypothesis null (H_0) : the use of chemical teaching materials has a no influence on the scientific literacy's students in SMAN 1 Langsa.
 - Hypothesis alternative (H_a) : the use of chemical teaching materials has a significant influence on the scientific literacy's students in SMAN 1 Langsa.
2. Hypothesis for the second problem statement
 - Hypothesis null (H_0) : the use of chemical teaching materials has no affect critical reasoning skills in SMAN 1 Langsa.
 - Hypothesis alternative (H_a) : the use of chemical teaching materials can significantly affect critical reasoning skills in SMAN 1 Langsa.

RESULT AND DISCUSSION

The Effect of Chemistry Teaching Materials on Students' Scientific Literacy

This research uses chemistry teaching materials in the form of worksheet based liveworksheet. The material discussed in the teaching materials is the colligative properties of solutions for class XII students. This research was conducted to measure the effect of chemistry teaching materials on scientific literacy and critical reasoning abilities of students at SMA Negeri 1 Langsa. The pretest is given before students use chemistry teaching materials, while the post-test is given after students use chemistry teaching materials.

The test has 10 questions contained colligative solution content-based science literacy indicators. There are four key indicators based on the PISA 2018 framework; (1) Identifying Scientific Issues; (2) Explaining Scientific Phenomena; (3) Using Scientific Evidence; (4) Reflecting on Science-Related Issues. Science literacy pretest and post-test data are presented in the Figure 1.

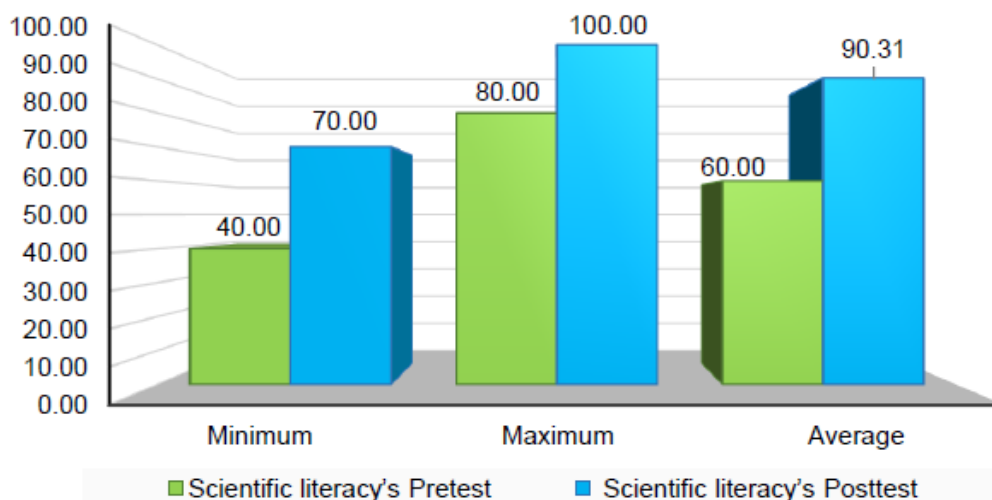


FIGURE 1. Scientific Literacy Pretest and Post-test Data

Figure 1 shows that there was an increase in scientific literacy scores after students used chemistry teaching materials. At the minimum score of students' scientific literacy in the class, it can be seen that the pretest got a score of 40, then the score increased to 70. At the maximum score for students' scientific literacy in the class, it was seen that the pretest got a score of 80, then the score increased to 100. On average, the students' scientific literacy was at class, it was seen that the pretest obtained a score of 60, then the score increased to 90.31. The increase in the minimum, maximum and average scores occurred in the post-test, namely after students used chemistry teaching materials.

TABLE 1. Inferential Statistics for Scientific Literacy Ability Data

Model	Unstandardized Coefficients		Standardized Coefficients	t-test	Sig.
	B	Std. Error	Beta		
1 (Constant)	44.66	4.147		10.770	0.000
Scientific Literacy's Pretest	0.761	0.068	0.899	11.227	0.000

The data above was analyzed using a linear regression formula to draw conclusions about whether the hypothesis was accepted or rejected. The results of the linear regression test can be seen in the Table 1.

The data in Table 1 show that there is an impact of chemistry teaching materials on scientific literacy of students in SMAN 1 Langsa. For more clarity can be seen from linear regression data analysis:

1. The t-test value (11,227) is greater than the t-table value (2,042), so h_0 is rejected and h_a is accepted. The calculations prove that there is an influence of chemical teaching materials on the scientific literacy in SMAN 1 Langsa.
2. The sig. value (0,000) is less than 0.05, so h_0 is rejected and h_a accepted. The calculations prove that the use of chemical teaching materials has a significant influence on the scientific literacy's students in SMAN 1 Langsa.
3. The percentage impact of chemical materials on scientific literacy of students SMA Negeri 1 Langsa can be seen from the Beta value (0,899) which is changed to the percentages that are 9.90%.

From the description above, it can be concluded that the use of chemistry teaching materials can significantly influence scientific literacy at SMA Negeri 1 Langsa. Several relevant studies also prove that in teaching chemistry it is recommended to use additional teaching materials other than textbooks in order to improve chemistry learning outcomes and also scientific literacy. Nisa et al developed the chemistry teaching material product "KAPRA" based on scientific literacy on reaction rate material, which was proven to be very feasible, but this teaching material was not tested on students so it was not significantly analyzed for its usefulness and influence on students' scientific literacy [11]. Likewise, research by Astuti et al which developed a chemical module based on scientific literacy in the study of colloids was also proven to be very suitable for use, but in their research they did not conduct trials on students so it is not known how significant the effect of using the chemistry module on students' scientific literacy is [12]. The description of two relevant studies proves that teaching chemistry requires supporting teaching materials other than textbooks, so that the relevant research develops teaching material products on different materials. However, there are differences that are the advantages of this research, namely: in this research, chemistry teaching materials in the form of worksheet based live worksheet were used by students when learning the colligative properties of solutions, and students' scientific literacy was also measured after the learning was carried out. The results of this research prove that the use of chemistry teaching materials has a significant influence on students' scientific literacy at SMA Negeri 1 Langsa, especially on the material on the colligative properties of solutions.

The Effect of Chemistry Teaching Materials on Students' Critical Reasoning in SMA Negeri 1 Langsa

Critical reasoning ability was measured using observation sheets twice, namely before and after using chemistry teaching materials. Data on students' critical reasoning abilities at SMA Negeri 1 Langsa is presented in Figure 2.

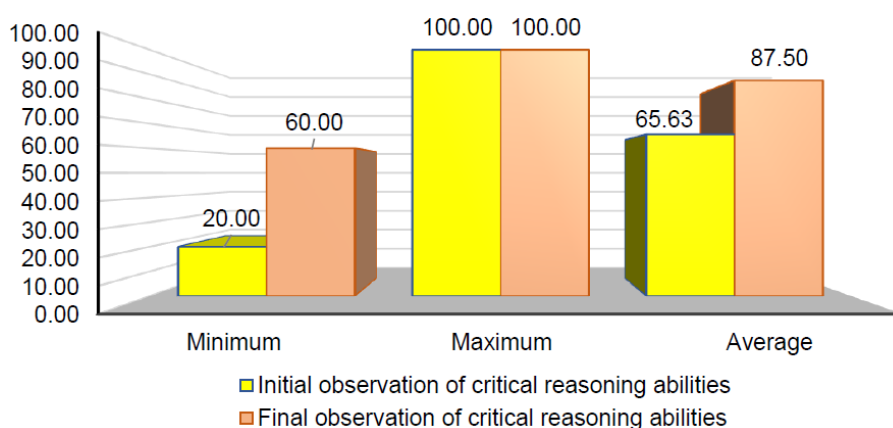


FIGURE 2. Critical Reasoning Ability Data

Figure 2 shows that there was an increase in critical reasoning ability scores after students used chemistry teaching materials. At the minimum score for critical reasoning ability, it can be seen that students got a score of 20 during the initial observation, then their score increased to 60 at the final observation. At the maximum score, students' critical reasoning abilities did not increase because there

were already students who got the highest score of 100 during the initial observation, even though only 2 out of 23 people got the maximum score. On the average critical reasoning ability in class, it can be seen that students obtained a score of 65.63 during the initial observation, then their score increased to 87.50 at the final observation. The increase in minimum and average scores occurred at the final observation, namely after students used chemistry teaching materials.

The data above is analyzed using the linear regression formula to draw conclusions about whether the hypothesis is accepted or rejected. The results of the linear regression test can be seen in Table 2.

TABLE 2. Inferential Statistics for Critical Reasoning Ability Data

Model	Unstandardized Coefficients		Standardized Coefficients	t-test	Sig.
	B	Std. Error	Beta		
1 (Constant)	46.281	4.226		10.952	0.000
initial observation of critical reasoning abilities	0.628	0.062	0.879	10.122	0.000

Data in Table 2 shows that there is an influence of chemical teaching materials on critical behavior of students in SMAN 1 Langsa. For more clarity can be seen from linear regression data analysis as follows:

1. The t-test value (10.122) is greater than the t-table value (2.042), so h_0 is rejected and h_a is accepted. The calculations prove that there is an influence of chemistry teaching materials on students' critical reasoning abilities at SMA Negeri 1 Langsa.
2. Sig value. (0.000) is smaller than 0.05, so h_0 is rejected and h_a is accepted. Calculations prove that the use of chemistry teaching materials has a significant influence on students' critical reasoning abilities at SMA Negeri 1 Langsa.
3. The percentage of influence of chemistry teaching materials on the critical reasoning abilities of SMA Negeri 1 Langsa students can be seen from Beta (0.879) which is converted into a percentage, namely: 87.90%.

Based on that description, it can be concluded that the use of chemical teaching materials can significantly affect critical reasoning skills in SMAN 1 Langsa. Several relevant studies also prove that additional teaching material besides textbooks can critically reading skills of students. Zakaria et al developing problem-based chemistry teaching materials and a Brain Based Learning approach which has proven to be very feasible and successful in improving students' critical thinking skills and scientific literacy [13]. Critical thinking skills in Zakaria's research are not included in the Pancasila Student Profile because they have different indicators from critical reasoning elements, while the Merdeka Curriculum has one specific goal, namely strengthening the Pancasila Student Profile. Zakaria's research is declared relevant because it uses chemistry teaching materials to influence critical thinking and scientific literacy, although there is a slight difference in indicators between critical thinking and critical reasoning. Naibaho and Suryani's research proves that the PBL-based chemistry module on salt hydrolysis material used for driving schools has been proven to be very feasible and practical for students to use, but it has not been measured in more depth regarding its influence on students' achievement of the Pancasila student profile [14]. It is known that programs at driving schools include the implementation of the Independent Curriculum in the learning process and a project to strengthen the profile of Pancasila students. Thus, it is appropriate that teaching materials are used to support strengthening the profile of Pancasila students as in this research which proves that chemistry teaching materials can significantly influence critical reasoning abilities. Critical reasoning is one of the character elements in the Pancasila student profile.

CONCLUSION

Based on the results of the study can be concluded are the use of chemistry teaching materials can significantly influence scientific literacy at SMA Negeri 1 Langsa. Chemistry teaching materials significantly influence scientific literacy with a percentage of influence of 89.90%. In addition, this study proves that the use of chemical teaching materials can significantly affect critical reasoning skills in

SMAN 1 Langsa. Chemistry teachings affect critical reasoning significantly with an influence rate of 87.90%.

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