THE EFFECT OF CHEMICAL EXPERIMENTS METHOD BASED ON NATURAL MATERIAL TO IMPROVING CHEMICAL LITERACY AND SCIENTIFIC ATTITUDE ON THE REACTION RATE TOPIC

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Abstract

This study aims to analyze: (1) the differences of chemical literacy ability and students' scientific attitude between students taught using chemical experiments method based on natural material and those taught using expository method; (2) the contribution of chemical experiments method based on natural material to chemical literacy ability and students' scientific attitude; (3) the difference of enhancement average value between pre-test and post-test students' scientific attitude after application chemical experiments method based on natural material. This research is a quasi-experiment using the pre-post design. The subjects are 105 students, consisting of 105 students in the experimental class and 82 students in the control class. The sampling technique is cluster random sampling. The research instruments are test of chemical literacy ability, scientific attitude questionnaire, and scientific attitude observation. The data analysis used the MANOVA test and paired sample t-test at the significance level of 5% and the ideal ranking categories. The results of study show that there was a difference in chemical literacy ability and students' scientific attitude between the students in experimental class and control class. The average score of students in the experimental class was better. The chemical experiments method based on natural material contributed to the chemical literacy ability and scientific attitude by 7.6%, the chemical literacy ability by 6.9% and scientific attitude by 6.9%. Although the chemical literacy ability was better using experiments method based on natural material, the students' chemical literacy level was still very low. The students' scientific attitude belonged to the very good category. There was enhancement of average value between pre-test and post-test students' scientific attitude after application chemical experiments method based on natural material in reaction rate topic.

Keywords: experiments method based on natural material, expository method, chemical literacy ability, scientific attitude.

1. INTRODUCTION

Chemical literacy is rooted in the definition of scientific literacy (Cigdemoglu et al., 2016). Chemical literacy is defined as the ability to use chemical knowledge to solve problems in everyday life (Wiyarsi et al., 2020a; Celik, 2014). The development of chemical literacy is an important 21st-century skill and the main goal of science education today (Sadhu et al., 2019; Kohen et al., 2020). Chemical literacy includes four components, namely chemical knowledge, using chemical knowledge to understand and innovate in everyday life, critical thinking skills and showing interest in chemical problems (Shwartz et al., 2006).

Many aspects of chemical literacy have direct applications in life, such as gasoline, diesel and lubricants which are used to deeply understand everyday vehicle cases (Wiyarsi et al., 2020a). In addition, many chemicals are closely related to human life and are very helpful in solving problems related to everyday life, such as food, drink, medicines, bleach, cleaners, air fresheners, vehicles, soil, air and equipment household

(Sumarni et al., 2017).

Students' interest and attitude towards chemistry are low. Students feel that chemistry is not meaningful for students' lives and professions in the future (Cigdemoglu et al., 2016; Cigdemoglu & Geban, 2015). In addition, students have difficulty connecting chemical concepts with everyday life (Wiyarsi et al., 2020a). Students are also constrained in making decisions about social problems related to chemistry (Cigdemoglu & Geban, 2015). This is caused by the conventional chemistry curriculum which does not connect theoretical knowledge with students' real-world lives so students' chemical literacy and scientific attitudes are low. Indonesian students have very low scientific literacy skills based on achievement data from the Program for International Student Assessment (PISA) (Rahayu, 2016). Indonesia was ranked 50th out of 57 countries in 2006; 57 out of 63 countries in 2009; 64 out of 65 countries in 2012; and 66 out of 74 countries in 2015 (Sumarni et al., 2017).

Various studies have been conducted to overcome this problem. Such as argumentation learning (Cigdemoglu et al., 2016), ethnoscience learning (Sumarni et al., 2017), STEAM learning integrated with dilemma stories (Rahmawati et al., 2020), reverse learning (Cigdemoglu, 2020), and based learning context (Cigdemoglu et al., 2015; Wiyarsi et al., 2020a). None of these studies have focused on underdeveloped areas where chemical literacy and scientific attitudes are low (Putri, 2021; Hanum, 2020) and educational facilities are still lacking. Research by Hanum (2020) and Putri (2021) found that scientific literacy in underdeveloped areas is classified as very low, namely 52.33% (Hanum, 2020) and 42.49% (Putri, 2021). According to the two studies, this is due to students' lack of interest in reading science, students' understanding of the content provided, teacher-centered learning methods, dense study time allocation, lack of parental guidance, lack of teaching materials, and reading sources that support scientific literacy as well as the absence of a science laboratory and adequate infrastructure.

Chemistry is a laboratory-based science (Kelley, 2021) that explicitly aims to form a high level of scientific and chemical literacy (Cigdemoglu et al., 2016). The learning method with practicum can be an alternative to increase chemical literacy and scientific attitude. However, not all schools have a complete chemistry laboratory. There are still many schools that do not have chemistry laboratories or the tools and materials are incomplete. Although many simulation experiences can be applied (Nguyen et al., 2020) (such as watching video experiments or using a virtual lab) they do not provide learning experiences comparable to direct experiments (Kelley, 2021). Therefore, it is important to develop experiments with tools and materials that are easy, cheap and safe if there are situations that do not allow practicum in school laboratories such as when Covid-19 hit the world (Orzolek et al., 2021; Radzikowski et al., 2021).

Laboratory experience is a popular and valuable approach. Carrying out laboratory experiments is very important in learning chemistry. In addition to producing skilled and competent graduates for industrial laboratories, it also imparts a foundation for understanding scientific thinking and practices to students. Laboratory experiments enable students to acquire manipulative skills, observational skills, the ability to interpret experimental data, and the ability to plan and carry out experiments, all of which are fundamental in scientific practice (Nguyen et al., 2020). In addition, experience in the laboratory can also instill students' scientific attitudes, because students will be accustomed to applying a scientific attitude while conducting experiments in the laboratory.

One of the chemistry topics that need to be understood with practical work in the laboratory is the reaction rate. The topic of reaction rates covers several concepts such as the concept of chemical reactions, collision theory, factors that affect reaction rates, reaction rate equations, and reaction orders. The factors that affect the reaction rate can be directly observed by experiment. Based on interviews and observations of students' interest in learning chemistry on the topic of reaction rates, students enjoy learning reaction rates. Student cognitive achievement data on reaction rate material is also quite good. However, when students were given chemical literacy questions, students had difficulties. Students are not able to use chemical knowledge to explain phenomena in everyday life. Students are unable to answer questions that require higher-order thinking skills.

In addition, students' scientific attitudes such as critical thinking, curiosity, discovery attitude, and creativity are less trained because the learning that has been going on so far is with the expository method. It is difficult to build a scientific attitude using the expository method because this method emphasizes only the knowledge aspect. Students are only instructed to understand and memorize scientific concepts which may not necessarily result in conceptual understanding. The expository method only reaches the second level of Bloom's Taxonomy, namely low-level thinking skills (Zulirfan et al., 2018).

Based on the description above, it is necessary to research to see the effect of applying chemical practicum methods made from natural materials on chemical literacy and the scientific attitude of students. The chemical literacy and scientific attitudes studied are on the topic of reaction rates. The concept of reaction rate is closely related to life and plays an important role in the chemical industry. The practicum applied is a practicum that is easy, inexpensive, safe and close to students' lives to encourage the meaningfulness of chemistry to students' daily lives. Students' chemical literacy is assessed with Chemistry Literacy Items (CLI) in an open-ended format. Chemical literacy items were built based on examples of PISA measurement questions about students' scientific literacy skills to reveal students' chemical literacy skills on cognitive aspects in the domains of content, context and high-level learning abilities. Scientific attitude is measured using questionnaires and observation sheets using the dimensions and indicators developed by Harlen (Sakliressy et al., 2021). Accordingly, this study aims to analyze the effect of chemical experiments method based on natural material to improve chemical literacy and scientific attitude on the reaction rate topic.

2. METHODS

2.1 Research Design

The type of research used was quasi-experimental research with pre- and post-test designs. The quasi-experimental design is an experimental design that has a control group and an experimental group, but the group is not determined randomly. This study consisted of an experimental class that used chemical practicum methods made from natural ingredients and a control class that used the expository method. The design of this study is shown in Table 1 (Cresswell, 2014).

Table 1. Research Design of the Study

Class	Pre-test	Intervention	Post-test
Experiment	X_1	Chemical experiment based on natural material	X_1, Y_1
Control	X_1	-	X_1, Y_1

Information:

X1: Scientific attitude questionnaire

Y1: Chemical literacy test

2.2 Sample of Research

The populations in this study were all students of class XI MIPA in South Aceh District who had the same characteristics as students in class XI MIPA at SMAN 1 Sawang, SMAN 1 Meukek, and SMAN Unggul Darussalam. The characteristics of the population used in this study are the curriculum used is the 2013 curriculum, the number of students is not much different in one class, does not have a complete chemical laboratory/chemical laboratory facility.

The samples in this study were students of class XI MIPA at SMAN 1 Sawang, SMAN 1 Meukek, and SMAN Unggul Darussalam which consisted of 7 classes with a total sample of 187 students. This study used a cluster random sampling technique by drawing lots to get class XI MIPA at SMAN 1 Sawang, SMAN 1 Meukek, and SMAN Unggul Darussalam as samples. The research sample used the XI MIPA class that was already available, namely XI MIPA 1, XI MIPA 2, XI MIPA 3 at SMAN 1 Sawang, and XI MIPA at SMAN Unggul Darussalam was an experimental class of 105 students and XI MIPA 1, XI MIPA 2, XI MIPA 3 at SMAN 1 Meukek is a control class of 82 students. This research was conducted in an odd semester of the 2022/2023 academic year. The research took place from October to November 2022.

2.3 Instrument of Research

Two types of data were obtained in this research, chemical literacy and students' scientific attitude. The data of chemical literacy was measured by chemical literacy test and scientific attitude was measured by questionnaire and observation.

2.3.1 Chemical Literacy Instrument

The chemical literacy instrument is a chemical literacy test concerning the framework of Shwartz et al. (2006) and adapted from Pakesa & Yusmaita (2019). The chemical literacy test consists of 19 questions.

Theoretical validity was tested by using expert opinion as a corrector on the material, construction, and language aspects. The instrument was revised based on input from experts, namely two lecturers in the Yogyakarta State University chemistry department and five chemistry teachers. Empirical validity was tested by giving tests to students who had studied the topic of reaction rates and had been trained in chemical literacy. The results of the empirical validity test were analyzed using the Quest program. Decision-making is based on the Infit MNSQ and Outfit MNSQ values with an accepted range of 0.77 ≤ MNSQ ≤ 1.33 (Hambleton & Swaminathan, 1985).

The chemical literacy ability test instrument was tested on 317 students who had studied the reaction rate material. Based on the results of the empirical validity test, of the 18 items tested, 17 items were valid and 1 item was invalid. The results of the reliability analysis of the chemical literacy test instrument were item reliability of 0.5. This shows that the quality of the items in the chemical literacy ability test instrument is in the fairly good category and the case reliability value is 0.78, which means that students' consistency in answering questions is good. The lattice of the chemical literacy test assessment instrument can be seen in Table 2.

Table 2. Distribution Indicators on the Chemical Literacy Test Assessment Instrument

Indicators	Amount
1) Knowledge content: definition of reaction rate. 2) Chemistry in context: firecrackers and rusted iron 3) High-level learning ability: explain phenomena scientifically and interpret data and facts scientifically	3
1) Knowledge content: collision theory and factors affecting reaction rates 2) Chemistry in context: • Use of firewood • Eggshell reaction experiment with vinegar • Hydrogen formation reaction experiment • N_2O decomposition reaction • The process of digestion of food • Corrosion 3) High level learning ability: explain phenomena scientifically, interpret data and facts scientifically, and evaluate scientific experiments	10
1) Knowledge content: reaction rates control 2) Chemistry in context: corrosion 3) High-level learning ability: evaluate and plan scientific inquiry	1
1) Knowledge content: reaction rates control 2) Chemistry in context: use of tomatoes 3) High-level learning ability: evaluate and plan scientific inquiry	1
1) Knowledge content: reaction rates law 2) Chemistry in context: nitrogen formation reaction experiment 3) High-level learning ability: interpret data and facts scientifically	4

2.3.2 Scientific Attitude Instrument

The scientific attitude of students in this study was measured using questionnaires and observation sheets. The scientific attitude assessment questionnaire consists of statements using 4 modified scales from the Likert scale. The dimensions and indicators of a scientific attitude use indicators developed by Harlen (Sakliressy et al., 2021). Theoretical validity was tested by using expert opinion as a corrector on the material, construction, and language aspects. The instrument was revised based on input from experts, namely two lecturers in the Yogyakarta State University chemistry department and five chemistry teachers. The scientific attitude questionnaire instrument was tested on 320 students. Based on the results of the empirical validity test, as many as 37 questionnaire items were tested, there were 36 valid items and 1 questionnaire item was invalid. The item reliability value for the scientific attitude questionnaire instrument was 0.41 which indicated that the quality of the statement items in the questionnaire was quite good. The case reliability value was 0.72 which indicated that the students' consistency in answering the questionnaire was good. It can be concluded that the chemical literacy test instruments and the scientific attitude questionnaire are reliable. The questionnaire sheet grid can be seen briefly in Table 3.

Table 3. Grid of Scientific Attitude Questionnaire

Aspect	Indicator	Number of Items
Curiosity	Read for information	2
	Pay attention to the observed object	2
	Ask each step of the activity	2
Honor facts/data	Not manipulating data	2
	Don't make bad assumptions	2
	Make decisions based on facts	2
Critical thinking	Ask questions that are appropriateto the topic/ problem being discussed	2
	Answer questions asked by the teacher or friends	2
	Explaining concepts based on observational data	2
Have an attitude of invention and creativity	Make conclusions based on facts	2
	Displays reports that are different from classmates	2
	Change opinion in response to data erroneous	2
	Suggest a new try	2
	Draw new conclusions from observations	2
Open and Cooperation	Respect the opinions/findings of other friends	2
	Work together to receive suggestions from friends	2
	It doesn't feel right all the time	2
	Participate in group actively	1
Persistent	Correcting errors/deficiencies in reports and LKPD that have beendone	2

The scientific attitude observation sheet is used as the supporting data for the questionnaire. The scientific attitude of students is seen based on the results of observations during learning activities and from the results of Student Activity Sheets (LKPD). The observation sheet lattice can be seen briefly in Table 4.

Table 4. Grid of Observation Scientific Attitudes

The Attitude Observed	Indicator	Number of Items
Curiosity	Read for information	1
Honor facts/data	Not manipulating data	1
Critical thinking	Give the question by the topic/problem discussed	1
Have an attitude of invention and creativity	Make conclusions based on facts	1
	Displays report that are different from classmates	1
Open and cooperation	Participate in the group actively	1
Persistent	Correcting errors/deficiencies in reports and LKPD that havebeen done	1

2.4 Data Analysis

To analyze whether or not there is a significant difference in chemical literacy and scientific attitude of students was a one-factor multivariate analysis (One-Way Manova). The result of this study has fulfilled Manova's assumptions. To analyze whether or not there is a difference in the increase in the average pre-test and post-test scores of students' scientific attitudes after the application of the chemical practicum method made from natural materials was a paired sample t-test. To determine the level of achievement of chemical literacy and the scientific attitude of each instrument, descriptive statistical analysis can be carried out. The values obtained are converted into five categories based on the ideal assessment category by determining the ideal average ($\overline{Xi}$) and ideal standard deviation (Sbi). This category refers to Table 5 as follows.

Table 5. Ideal Assessment Categories

Category	Score Range
Very Good	(Xi) + 1,8Sbi) < X
Good	(Xi) + 0,6 Sbi) < X ≤ (Xi) + 1,8 Sbi)
Sufficient	(Xi) - 0,6 Sbi) < X ≤ (Xi) + 0,6 Sbi)
Less	(Xi) – 1,8 Sbi) < X ≤ (Xi) - 0,6 Sbi)
Very Less	X ≤ (Xi) - 1,8Sbi)

Source: Widoyoko (2009)

Information:

(Xi) = ½ (highest ideal score + lowest ideal score)

Sbi = 1/6 (highest ideal score – lowest ideal score)

X = average score of the assessment results

3. RESULT AND DISCUSSION

3.1 Results

The achievement of students' chemical literacy skills in the experimental class and the control class can be compared by analyzing chemical literacy abilities descriptively using ideal assessment categories. The data used was the post-test data of students' chemical literacy abilities. The results of the analysis of the achievement of chemical literacy skills can be seen in Figure 1 as follows.

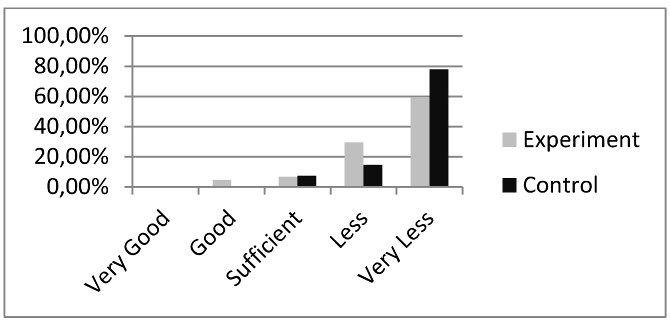

Figure 1. Comparison of Achievement of Chemical Literacy Ability

The achievement of the scientific attitudes of students in the experimental and control classes can be compared by analyzing scientific attitudes descriptively using ideal assessment categories based on questionnaire scores and observations. The results of the analysis of the attainment of a scientific attitude can be seen in Figures 2 and 3 as follows.

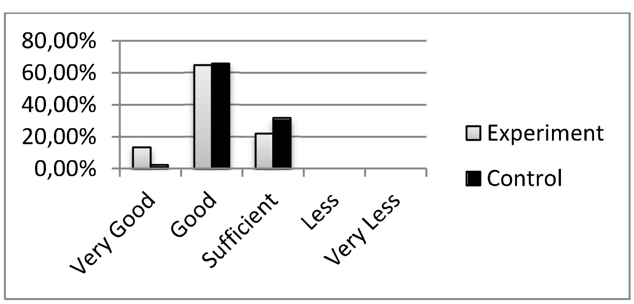

Figure 2. Comparison of Achievement of Scientific Attitudes Based on Questionnaires

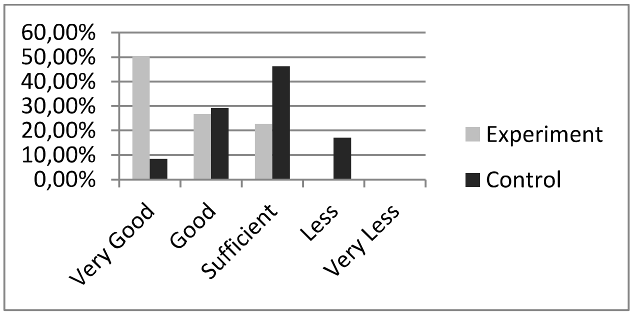

Figure 3. Comparison of Achievement of Scientific Attitudes Based on Observation Scores

The results of the Manova test showed that there were differences in chemical literacy and scientific attitudes between students who took lessons in the experimental and control classes. Based on the results of the multivariate significance test, a significance value of <0.05 was obtained, which was 0.001. These results indicate that there is a significant difference in chemical literacy and scientific attitude of students between students in the experimental and control classes. Based on the partial eta squared value, it is known that chemical practicum methods made from natural materials contribute 7.6% to chemical literacy and students' scientific attitudes.

Based on the results of the univariate significance test, it is known that the significance value for chemical literacy was 0.01 < 0.05. This shows that there are differences in chemical literacy abilities between students in the experimental and control classes. In addition, a significance value for scientific attitude was 0.00. This shows that there is a difference in scientific attitude between students in the experimental and control classes. Practical methods made from natural materials contribute 3.5% to students' chemical literacy abilities and contribute 6.9% to students' scientific attitudes.

The results of paired sample t-test showed that there was a difference in the increase in the average score between the pre-test and post-test of students' scientific attitudes after the application of the chemical practicum method made from natural. Significant differences between students' scientific attitudes before and after the application of the natural materials practicum method is shown through the Sig value. (2-tailed) which is smaller than 0.05, namely 0.000.

3.2 Discussion

3.2.1 Differences in Chemical Literacy Ability and Scientific Attitude of Experiment Class and Control Class Students

Based on the results of the Manova and ideal assessment category experimental class were better than the control class. In learning activities using the chemical practicum method made from natural ingredients, students are given a stimulus beforehand to stimulate motivation and curiosity of students to take part in learning. The stimulus also stimulates high-level learning skills in determining problem formulation and hypotheses related to the experiments to be carried out. From this stimulus, students collect data in groups by doing chemical practicums made from natural materials. During the practicum students are trained to work together, be open, active, honest, and skilled in conducting experiments according to procedures. After collecting data from the experimental results, students process the data by answering the questions in the LKPD. After that, students presented the results of their discussion in front of the class.

Research conducted by Sapitri et al. (2020) found that practicum methods made from natural materials can improve students' scientific literacy skills. This is because the practicum method can increase student activity in discovering principles or knowledge through experiments and connecting them with student life. According to the research, practical methods made from natural materials enable students to master aspects of scientific literacy because the use of natural materials that students usually use in everyday life makes learning more real, impressive, meaningful, and increases student motivation.

Learning with practicum methods can train students' scientific attitudes such as being active in discussions, being honest in writing experimental data, thinking critically and always being curious. During practicum, students have many opportunities to communicate because students work in groups to complete their experimental assignments. Discussion in learning is very important because it challenges students to form understanding and create new knowledge. Activities such as planning, data processing, and analysis of results require students to be more active and explore student knowledge (Anderson & Enghag, 2017).

Meanwhile, learning with the expository method, is teacher-centered learning. First of all the teacher introduces the topic being studied and reviews the initial understanding. Then the teacher presents, explains, and describes the material complete with examples. After that, the teacher divides students into groups and distributes LKPD. Students practice under the guidance of the teacher. After that students carry out independent exercises and finally, the teacher gives reinforcement to the conclusions of learning. A scientific attitude is difficult to build with a verbalistic approach or lecture method (Zulirfan, 2018). Students who take part in learning using the practicum method are more active than students who take part in learning using the expository method (Anderson & Enghag, 2017).

The initial abilities of students in the experimental class and the control class were not too much different. The average scores of the cognitive aspects of the experimental and control class students in the midterm assessment were 77.3 and 77.32 respectively. The average values of the affective aspects (attitudes) of students in the experimental class and the control class were 78.5 respectively and 80.5. There are differences in chemical literacy skills and students' scientific attitudes due to the learning methods used. Low chemical literacy is influenced by the curriculum and education system, selection of learning methods and models, learning facilities and infrastructure, learning resources, and others (Celik, 2014).

3.2.2 Differences in Chemical Literacy Ability of Experiment Class and Control Class Students

Students' chemical literacy skills in the experimental class were better than in control class. Chemistry practicum is a scientific research process that involves observing, proposing hypotheses, designing research procedures, analyzing data, drawing conclusions, and communicating these findings in class discussions. This process can improve science process skills related to higher-order thinking, critical thinking, and reasoning power (Adlim et al., 2018). By doing practicum, students can discover concepts while exploring the observed phenomena (Gericke et al., 2022). Practicum methods can improve understanding of chemical concepts (Hakim et al., 2016).

The practicum method made from natural ingredients is a green chemistry practicum method. The results of research by Redhana & Merta (2017), green chemistry practicum methods are more effective in improving student learning outcomes than conventional chemistry practicum methods on the topic of reaction rates. This is caused by the first, students feel safer working with natural materials that students often use in everyday life compared to chemical materials. However, the principle of the chemical reaction and the symptoms observed during the reaction are no different from conventional chemistry practicum methods. Second, the use of natural materials can increase students' curiosity and motivation because they do not find reactions that occur from natural materials in school textbooks. Third, the natural materials used are abundant, easy to obtain, and cheap so chemistry practicum activities can be carried out in almost all schools, even though schools do not have chemical laboratory equipment and materials. Students can also repeat the practicum several times at home to make more careful observations. Fourth, the green chemistry practicum method can be carried out with used glass/plastic so that it can reduce the disposal of plastic waste into the environment.

3.2.3 Differences in Scientific Attitudes of Experiment Class Students and Control Classes

The scientific attitude of students in the experimental class was better than the control class. Scientific attitude is a determinant of students' motivation and interest in conducting scientific research and exploring natural phenomena. An effective way to cultivate students' scientific attitudes is the practicum method (Zulirfan et al., 2018). Practicum is an activity in which students manipulate and observe real objects to experience and investigate the physical world. Practicum can generate students' motivation and interest in learning (Gericke et al., 2022). High learning motivation makes students ask about chemical problems they face and improves student learning outcomes (Redhana & Merta, 2017).

3.2.4 Differences in Scientific Attitudes of Students Before and After the Application of Natural Material Chemical Practicum Methods

The application of the practicum method made from natural materials gives better results to improve students' scientific attitudes compared to the expository method. By Zulirfan et al. (2018) show that scientific attitude can be improved by practicum methods. This is because this method involves students' direct participation in experimental activities to discover scientific concepts. In the practicum method, students are familiarized with scientific activities to broaden their scientific attitude. Whereas in the expository method, students do not get enough time to familiarize themselves with scientific activities because they get more explanations from the teacher.

3.2.5 Profile of Students' Chemical Literacy Ability in Experimental Class

Based on the results of the ideal assessment category, more than half of all students were included in the very poor category and none of the students were included in the very good category. This shows that the achievement of students' chemical literacy skills on the topic of reaction rates is still very low after the application of natural chemical practicum methods. Stasevic's research (2023), which tested the chemical literacy level of 379 high school students, also obtained the same results. The results obtained indicate that students' chemical literacy is still low. Students do not know the basic concepts of chemistry and do not have enough knowledge to relate the knowledge gained to real-life situations so they cannot apply chemical concepts in everyday life. The score on the chemical literacy ability test showed that the level of students' chemistry knowledge was unsatisfactory and none of the questions reached a high level rating scale.

Indonesian students' chemical literacy index is low. There is still a lot of content, context and process in chemistry learning that has not been achieved as a learning resource for developing the realm of chemical literacy in four main areas, namely content, competence, context and attitude (Dewi et al., 2019). Research by Wiyarsi et al. (2020b) showed that a large proportion of students reach a nominal and conceptual level, as well as a nearly equal percentage of illiteracy. The lowest achievement is for the functional and multidimensional levels.

The results of the analysis showed that the indicators that were mastered by students were indicators of contributing thoughts as a form of environmental concern through the issue of the dangers of playing fireworks on the environment and health. The following is the result of the description of student answers which can be seen in Figure 4 as follows.

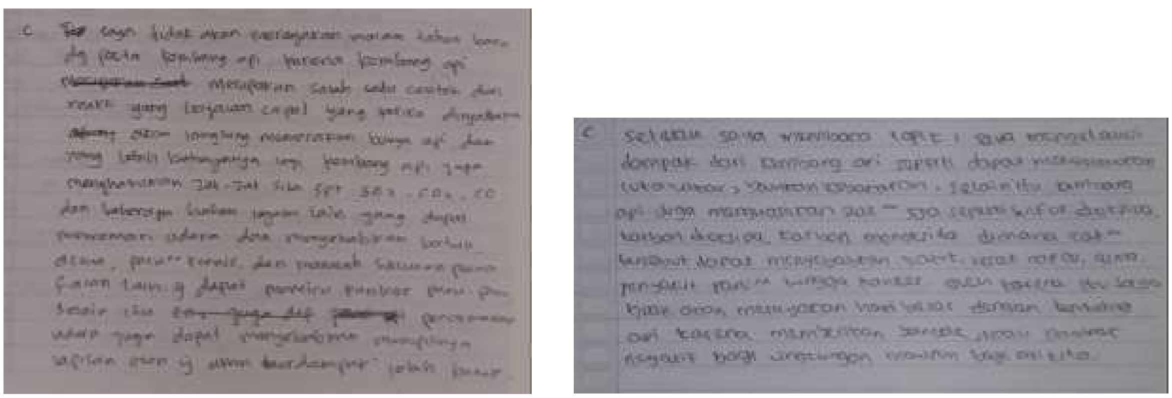

Figure 4. Chemical Literacy Ability based on Number 1.c

Based on Figure 4, shows that students can contribute ideas to activities that are harmful to the environment and health. In the learning process using the chemical practicum method made from natural materials, students are trained to express opinions in class discussions. Argumentation practice contributes to chemical literacy skills (Cigdemoglu et al., 2016)

The results of the analysis showed that the indicators that were less mastered were the indicators that determine the reaction rate equation and calculate the reaction rate. The following is the result of the description of student answers which can be seen in Figure 5 as follows.

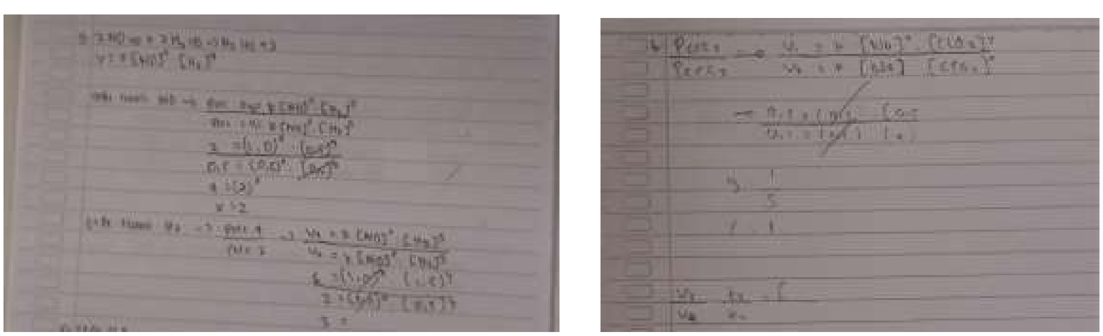

Figure 5. Chemical Literacy Ability based on Number 9.b

Based on Figure 5, it shows that students cannot interpret data and facts scientifically. Dominant students are at the nominal level of scientific literacy and functional scientific literacy. Research by Priliyanti et al., (2021) found that low math ability is one of the causes of students' difficulty learning chemistry. Most of the students had difficulty with materials related to chemical calculations such as stoichiometry, determining the pH of salt solutions, and buffer solutions.

3.2.6 Profile of Scientific Attitudes of Students in Experimental Class

The profile of students' scientific attitudes can be seen from the results of the data analysis of the average observation score of the experimental class. Based on the results of the analysis of the achievement of scientific attitudes of students on the topic of reaction rate, it showed that more dominant students are included in the very good category. This result was supported by the dominant questionnaire score which was included in the good category.

The results of the analysis showed that the aspect with the highest average was the aspect of respecting facts and data. Chemical practicum methods made from natural materials and conventional chemical practicum methods can both develop a character which includes, among others, discipline, responsibility, honesty, order, and thoroughness. This is possible because the green chemistry practicum method and the conventional chemistry practicum method require students to carry out practicums that are bound by time, are responsible in carrying out practicums, are honest in reporting practicum results, and are thorough in making observations. (Hakim et al., 2016).

The results of the analysis showed that the aspects with the lowest average were aspects of openness and cooperation. This is caused by students who are familiar with the expository method. Even though the demands of the 2013 curriculum are student-centered learning, the expository or lecture method is preferred by teachers because it is easy and fast. Zulirfan et al. (2018). The lecture method affects learning discipline and student responses during learning (Rikawati, K., & Sitinjak, D., 2020).

4. CONCLUSION

The results of the study show that there is a difference in chemical literacy ability and students' scientific attitude between the students in the experimental class and the control class. The average score of students in the experimental class is better. The chemical experiments method based on natural material contributes to the chemical literacy ability and scientific attitude by 7.6%, the chemical literacy ability by 6.9%, and the scientific attitude by 6.9%. Although the chemical literacy ability is better using experiments methods based on natural material, the students' chemical literacy level is still very low. The students' scientific attitude belongs to the very good category. There is the enhancement of average value between the pre-test and post-test students' scientific attitude after the application of chemical experiments method based on natural material in the reaction rate topic.

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