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The Effect of Ethnoscience Approach Through Problem Based Learning Model on Chemical Literacy Ability of Class XI Students on Reaction Rate Material at SMA Negeri 7 Gorontalo

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Abstract. *The research aims to determine the effect of the ethnoscience approach through the problem-based learning model on the chemical literacy skills of Grade XI students in the reaction rate material at SMA Negeri 7 Gorontalo. The research employs a quasi experimental method with a nonequivalent control group design. The sample consisted of Grade XI IPA (Natural Science) students from SMA Negeri 7 Gorontalo. The instrument used in this research was an essay test. Data processing and analysis were conducted using Microsoft Office Excel and SPSS version 16. The hypothesis test results on students' post-test data using the Mann-Whitney test at a significance level of $\alpha = 0.05$ showed that the Asymp. Sig. (2-tailed) value was less than 0.05 (0,002 < 0,05). Therefore, H_1 was confirmed, and H_0 was rejected. The N- Gain test results also indicated that the ethnoscience approach through the problem-based learning model was moderately effective in improving students' chemical literacy skills in reaction rate material, with the experimental class achieving an N-Gain score percentage of 57.13% (moderately effective category), while the control class achieved a percentage of 31.42% (ineffective category). In conclusion, the ethnoscience approach through the problem-based learning model significantly affects students' chemical literacy skills in reaction rate material.*

Keywords: *Ethnoscience, PBL (Problem-Based Learning), Chemical Literacy, Reaction Rate*

1. INTRODUCTION

Chemistry is a science that has a very broad application in everyday life (Sopandi, 2020).This is one of the subjects that must be studied in Senior High School. Chemistry is one of the subjects in Natural Sciences (IPA) that discusses micro concepts such as structure, properties or materials, reactions, and complex chemical processes (Sandabunga' *et al*., 2021)

Studying chemistry not only teaches the concept, but also how students are able to apply this knowledge in everyday life. If students truly understand Chemistry concepts and apply them in their daily lives, they will be more successful in the classroom. Gaining a comprehensive understanding of Chemistry concepts and applying them in everyday life can be achieved if students have skills that cover both aspects, namely Chemical literacy skills (Imansari *et al*., 2018).

The Science learning process can include holistic insights. This is done through the Ethnoscience method that connects Science knowledge with local context and culture empirically. By linking teaching materials with local wisdom in a particular region, students' understanding of local cultural wisdom can be influenced. Therefore, it is necessary for us to revive our enthusiasm for our local cultural background or heritage through media

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education. In this context, the Ethnoscience Learning method connects Learning with culture. This goal is achieved by familiarizing oneself with the viewpoints of the students' native culture. This is then translated into student knowledge (Sanova *et al*., 2021).

As part of school education, Pedagogical chemistry has also undergone changes. Chemical literacy becomes the main goal of pedagogical chemistry (Muntholib *et al*., 2020). Chemical literacy refers to students' ability to recognize, evaluate, and comprehend chemical ideas in order to address common issues and to convey and demonstrate them in a scientific manner (Mellyzar *et al*., 2022).

Based on the results of observations and interviews with chemistry teachers at SMA Negeri 7 Gorontalo, the teacher stated that the learning method used in learning is a conventional learning method. A learning model that is still valid and widely used by teachers. In learning with conventional methods, characterized by lectures accompanied by explanations and distribution of exercise tasks, but with the learning methods used, there are several weaknesses, students tend to just accept the material presented, students are less participatory in learning, and it is also known from the results of interviews with the chemistry teacher, many students still think that chemistry is a subject that is quite difficult to understand because chemical concepts are abstract and too many formulas. Such as on reaction rate material. Reaction rate material is one of the main materials of the chemistry lesson of grade XI. When studying on this material about reaction rate, most students do not understand the concepts given by the teacher because students do not clearly understand the formula or calculation, students only memorize without understanding the given material in advance. Students become disinterested and bored with the learning process (Iyabu *et al*., 2021)

To solve the previously mentioned problems or issues, Students will be more able to engage in the learning process if the learning model chosen is appropriate and student-centered because they gain a deep understanding of the subject matter. One such model is the Problem-Based Learning (PBL) model. The learning model known as “problem-based learning” is one of the learning models that focuses on students. Students can apply realistic or concrete thinking comprehensively because it includes elements of finding and solving problems simultaneously (Umar *et al*., 2022).

Learning material, process skills, problem solving, and studying real-world issues are the goals of this problem-based learning approach. The goal of putting this strategy into practice is to inspire pupils to become analytical, creative, and researchers. Therefore, rather

than focusing solely on memorization and storytelling, the PBL paradigm can help pupils think (Uliyandari *et al.*, 2021).

Therefore, problem-based learning (PBL) with an ethnoscience approach has the suitability of encouraging students to think through a problem-solving process that focuses on real-life problems. This approach integrates students' knowledge of their environment, local wisdom values, and their culture. This approach can optimize students' learning potential to find their own concepts. Because students do more work than just listen, they have a greater role in the learning process (Temuningsih *et al.*, 2017).

According to the aforementioned description, the purpose of this study is to ascertain how the Ethnoscience Approach, using a problem-based learning model, affects the chemical literacy skills of class XI students at SMA Negeri 7 Gorontalo with regard to reaction rate material.

2. THEORETICAL STUDY

Chemical literacy is an important component of education that must be developed. Chemical knowledge is relevant to people of all ages and educational levels, both scientific and non-scientific. Chemical literacy is essential for teachers and students to gain a better understanding of broad and abstract chemical concepts. Teachers must certainly make students think and have the ability to integrate and predict chemical concepts in everyday life. The students will be helped in terms of how they will learn chemistry by seeing chemistry from what they feel and experience everyday (Fahmina *et al.*, 2019).

The problem-based learning (PBL) model is a student-centered learning model that is faced with problems in everyday life. Problems are the main focus of the problem-based learning model. At this stage, students are expected to be able to develop their own insights, hone their research skills, and be able to think at a higher level. Students must formulate hypotheses about the problem which of course requires them to think rationally, provide solutions, which of course relate to everyday life (Nurhaedah *et al*., 2022).

The ethnoscience approach is a process of reconstructing primitive knowledge that develops in society and transforming it into scientific knowledge. The ethnoscience approach is a strategy for creating learning environments and designing culturally integrated learning experiences as part of the science learning process. Culture is the result of human creativity and spontaneity, which develops in the form of unique knowledge (independent knowledge) and turns into scientific knowledge. Some terms used for local wisdom:

traditional ecological knowledge, traditional knowledge, and indigenous knowledge (Khoiri & Sunarno, 2018).

3. METHOD

This type of research is quantitative research with quasi-experimental research methods. A research method used to study the effect of an object that is given treatment on other objects under conditions that can be controlled. The research design used in this study used a nonequivalent control group design. In this design, neither the experimental group nor the control group is randomly selected. Both groups will receive a pretest (initial test) before treatment, followed by treatment and posttest (final test) after treatment (Kosanke,2019)**.** The subjects of this study were XI science class students at SMA Negeri 7 Gorontalo consisting of 2 groups, namely XI merdeka 2 class consisting of 35 students as the experimental class using ethnoscience approach through PBL model and XI merdeka 1 class consisting of 34 students as the control class using conventional learning model. Which is determined by using purposive sampling technique which is a data source retrieval technique by determining the sample with certain considerations. Purposive sampling is included in non-random sampling techniques (Amin *et al*., 2023)**.**

Data collection techniques in this study were collected through tests. The test instrument used is an essay test consisting of 5 questions to determine students' chemical literacy skills before and after applying the ethnoscience approach through the Problem-Based Learning model. The instruments used have been tested for validity and reliability. Based on the results of the validity and reliability tests, the instruments used were declared valid and reliable. Data processing and analysis were conducted using Microsoft Office Excel and SPSS version 16.

4. RESULT AND DISCUSSION

This type of research is quantitative research with quasi-experimental research methods. This research was conducted at SMA Negeri 7 Gorontalo located at Jalan Budi Utomo No.70, Limba U, Kota Selatan, Gorontalo City, in the even semester of the 2023/2024 school year. This research was conducted with the aim of knowing the influence of the ethnoscience approach through learning models problem- based learning on students' chemical literacy skills in the material on reaction rates. During the learning process, some local wisdom that will be used as ethnoscience materials on reaction rate material in the

form of traditional Gorontalo foods such as such as: apang colo (apangi) cake, wapili cake, binte biluhuta (milu siram), tiliaya. Based on the learning conducted as many as 3 meetings in the experimental class and control class with different treatments. The experimental class was given treatment with an ethnoscience approach through the model problem- based learning and the control class was given treatment with a conventional learning model. There was an increase in student abilities before and after being given treatment. The research results obtained using an essay test instrument consisting of 5 questions, obtained data from the pretest and posttest results of the experimental class and control class experienced an increase with a difference in average values. The difference in the mean scores of the pretest and posttest of the experimental and control classes can be seen in Figure 1.

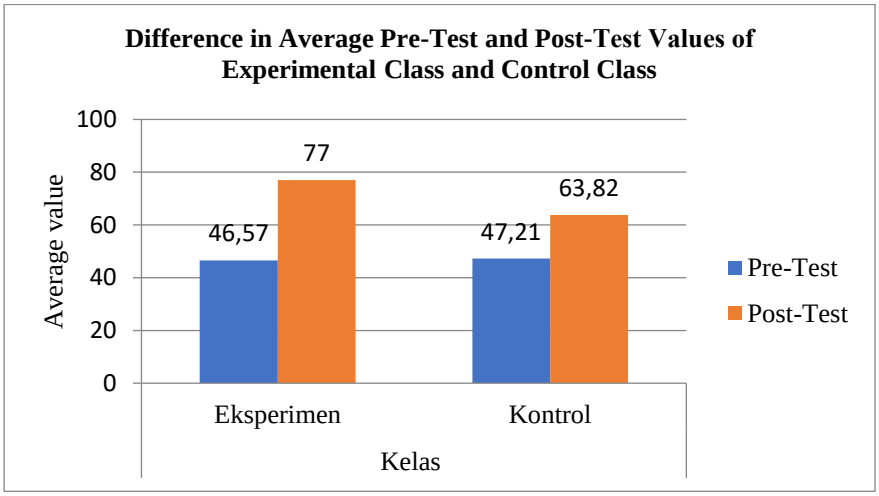

Figure 1. Difference in mean scores of pretest and posttest of experimental and control classes

Based on figure 1. The difference in the average pretest and posttest scores of the experimental and control classes shows that the pretest results in the experimental class obtained an average score of 46.57 with 35 students. Meanwhile, the control class obtained an average pretest score of 47.21 with 34 students. When compared between the experimental and control classes, these two classes only have a slight difference in the average pretest score. The mean score of the control class pretest was higher than the experimental class. While the average value of the experimental class posttest is 77.00. Meanwhile, the control class obtained an average posttest score of 63.82. Based on the average value obtained from the posttest results, the experimental class is higher than the control class. The results show that treatment with an ethnoscience approach through the problem based learning model provides influence in improving students' chemical literacy skills.

Chemical Literacy Ability Category Result Data

Table 1. Percentage Data of Chemical Literacy Ability Result Categories

Category of Chemical Literacy Result	Percentage Number of Students			
	Pre-Test Experi ment	**Post-Test Experi ment**	**Pre-Test Control**	***Post-Test* Control**
Low	77,1%	8,6%	70,6%	29,4%
Medium	22,9%	40,0%	29,4%	64,7%
High	0%	51,4%	0%	5,9%
Total	100%	100%	100%	100%

Based on the percentage data of the results of the chemical literacy category as shown in Table 1. It can be seen that the average percentage of chemical literacy scores of experimental class students and the chemical literacy scores of control class students has increased after treatment. Where the average percentage of experimental class students' scores on the posttest with the treatment of using the ethnoscience approach through the PBL model which is included in the low category becomes as much as 8.6%. This indicates that students after receiving learning about ethnoscience have understood and can apply it in everyday life. While on the other hand, 29.4% of students on average scored in the low category on the posttest of the control group, which used a conventional learning model.

Pretest and Posttest Result Data Based on Chemical Literacy Ability Indicators

In accordance with table 2, which presents data on the results of chemical literacy indicators in the pre-test. Experimental and control class students gave the most accurate answers on the chemical knowledge content (CK) indicator, with an average percentage of 67.14% for the experimental class and 73.53% for the control class. This shows that students in both classes are able to conduct scientific investigations and generalize findings and can explain the idea of reaction rate and connect its definition in everyday life. While the least percentage answered correctly from the pre-test results of the two classes was on the chemistry in context (CC) indicator, namely in the experimental class as much as 38.21% and the control class as much as 37.50%. This shows that students in both classes have not been able to explain everyday situations based on chemical knowledge such as analyzing one example of typical Gorontalo food related to collision theory.

Table 2. Data on the percentage of achievement of Pretest and Posttest Values of Experimental Class and Control Class Students on Each Indicator of Chemical Literacy Ability

Chemical Literacy Ability Indicator	Percentage Number of Students			
	Pre-Test Experiment	Post-Test Experiment	Pre-Test Control	Post-Test Control
Chemistry Knowledge Content (CK)	67,14%	95%	73,53%	91,18%
Chemistry In Context (CC)	38,21%	68,21 %	37,50%	60,66%
High Learning Level Ability	50,71%	80%	46,32%	63,97%
Attitude Aspect	38,57%	73,57%	41,18%	42,65%

For the results of the experimental and control class post-test data, the experimental class had the most correct answer average of 95% for the chemical knowledge content indicator. While the control class was 91.18%. This shows that almost all experimental and control class students can conduct scientific investigations because they answer correctly on these indicators. While in the experimental class the least percentage answered correctly was on the chemistry in context (CC) indicator, which was 68.21%. This shows that students have not been able to explain everyday situations based on chemical knowledge to solve problems on the question of analyzing one example of typical Gorontalo food related to collision theory and explaining 2 factors of effective collisions. While in the control class the least was in the attitude aspect indicator, namely 42.65% in solving the problem of whether the reaction rate of each chemical process is the same based on chemical changes in the environment around them and mentioning the factors that affect the reaction rate, this shows that students in the control class do not yet have a fair and rational perspective on chemistry and its application in problem solving.

Prerequisite Analysis Test Results

a. Normality Test Results

Prerequisite test analysis, the results of the pretest and posttest tests were tested. In this study, the normality test used the Kolmogorov- Smirnov test assisted by the SPSS version 16 application can be seen in table 3. The results of the Experimental Class and Control Class Pretest Normality Test, obtained the experimental class pretest significance value of 0.000 and the control class of 0.016. These results show that the significance value in the experimental class (0.000) < 0.05 and the significance value in the control class (0.016) < 0.05, it can be concluded that both data are not normally distributed. In the posttest, the experimental class posttest significance value was 0.008

and the control class was 0.001. These results show that the significance value in the experimental class (0.008) < 0.05 and the significance value in the control class (0.001) < 0.05, it can be concluded that both data are not normally distributed.

Table 3. Normality Test Results

Test Type	Class	Kolmogorov-Smirnov			
		Statistik	df	Sig.	Description
Pretest	Experiment	0,219	35	0,000	Not Normal
	Control	0,168	34	0,016	Not Normal
Posttest	Experiment	0,175	35	0,008	Not Normal
	Control	0,206	34	0,001	Not Normal

b. Homogeneity Test Results

Table 4. Homogeneity Test Results

Test Type	Statistik				Signifi-cance Level(α)	Description
	Levene Statistic	df1	df2	Sig.		
Pretest	0,104	1	67	0,748	0,05	Homogen
Posttest	9,761	1	67	0,003	0,05	Not Homo-gen

The next analysis prerequisite test, homogeneity test using the Levene Statistic test can be seen in table 4. The results of the Experiment Class and Control Class Pretest homogeneity test, showed that the pretest significance value was 0.748. This shows that the significance value of the data is > 0.05. Thus, it can be concluded that the pretest data of the experimental and control classes have a homogeneous variance. In the Posttest of the Experimental Class and Control Class, it shows that the significance value of the posttest is 0.003. This shows that the significance value of the data is less than the significance level of 0.05. Thus, it can be concluded that the experimental class and control class posttest data have inhomogeneous variances.

Hypothesis Test Results

Table 5. Hypothesis Test Results

Data	Significance Level (α)	Asymp.Sig. (2-Tailed)	Conclusion
Posttest	0,05	0,002	There is an influence

Tabel 6. Test Statistics[a]

	Post Test Kemampuan Literasi Kimia
Mann-Whitney U	339.000
Wilcoxon W	934.000
Z	-3.096
Asymp. Sig. (2-tailed)	.002

a. Grouping Variable: Kelas

The results of the data obtained are not normally distributed and not homogeneous, so the hypothesis test used is the Mann-Whitney test with the hypothesis test criteria H0 is rejected and H1 is accepted if the Asymp. Sig (2-tailed) is smaller than 0.05. The data in table 5 of the Mann Whitney Posttest Test Results shows that the Asymp. Sig (2-tailed) value of 0.002. This shows that the Asymp. Sig data <0.05. It can be concluded that H0 is rejected and H1 is accepted. This can be interpreted that there are differences in the results of chemical literacy skills between the experimental class and the control class. So it can be concluded that the use of an ethnoscience approach through a problem-based learning model has a significant (large enough) effect on the chemical literacy skills of the experimental class students' reaction rate material compared to the control class using conventional learning.

N-Gain Test Result Data

To compare or measure the extent to which students' chemical literacy skills or abilities increase after treatment using the ethnoscience approach through issue-based learning demonstrations (problems) and conventional learning demonstrations, the Normalized Gain (N-Gain) test is used. Table 6 displays the results of the N-Gain test.

Table 6. N- Gain Test Results

Class	N-Gain Score	N-Gain Score %	Category
Experiment	0,5713	57,13%	Effective enough
Control	0,3142	31,42%	Not effective

The percentage of the N-Gain Score value of the experimental class treated with an ethnoscientific approach through problem-based learning demonstrations is 57.13% or included in the moderately effective category, based on Table 6 Experimental Class and Control Class N-Gain Test Results. In contrast, the N-Gain Score value of the control class treated with conventional learning demonstrations of 31.42% is included in the ineffective category. It can be concluded that the ethnoscience approach through problem-based learning is quite effective in developing and improving the Chemical Literacy Ability of Class XI Students on reaction rate material at SMA Negeri 7 Gorontalo.

Based on the results of research and data analysis by conducting various tests, the results of this study show that the influence of using an ethnoscience approach through the problem-based learning model has an influence on students' chemical literacy skills in the reaction rate material in the experimental class compared to students who use conventional learning models in the control class. In line with the findings of Aiman *et al*., (2019) which states that PBL supports students to learn independently by giving responsibility for their learning, which ultimately strengthens independence and intrinsic motivation. The application of problem-based learning shows in chemistry learning can have a positive impact on improving science literacy.

By applying an ethnoscience approach through a problem-based learning model on the topic of reaction rate, students are actively involved in collaborative problem solving during their learning process. In addition, they gain an understanding of local wisdom or ethnoscience in the environment where they live and can relate it to the material scientifically. This is in accordance with the research of Putri *et al*., (2014). In local potential-based PBL learning, students work in groups. Working in groups allows students to get better results than working individually. The results of information analysis show that PBL based on local potential has an influence on students' science literacy skills. The learning stage shows that PBL can train students' science literacy skills based on local potential. Likewise, research conducted by Desni *et al*., (2019) found that the Problem Based Learning learning model provides students with more opportunities to seek information from various sources and has a positive influence on the learning process.

5. CONCLUSION AND SUGGESTIONS

Based on the results of the research and the results of the data analysis that has been carried out, it can be concluded that there is a significant effect on the use of the ethnoscience approach through a problem-based learning model on chemical literacy skills on reaction rate material between experimental class students and control class students who use conventional learning models. This is based on the results of hypothesis testing of student posttest data using the Mann Whitney test with a significance level of $\alpha = 0.05$ which shows that the Asymp. Sig (2-tailed) is smaller than 0.05 ($0.002 < 0.05$). Thus, H1 is accepted and H0 is rejected. Which means there is a significant difference in the results of chemical literacy skills of experimental and control class students. Thus, there is an effect of ethnoscience approach through Problem Based Learning model on students' chemical literacy skills on reaction rate material. The N-Gain test results also show that the effect of using the ethnoscience approach through the Problem Based Learning model is quite effective in improving the chemical literacy skills of grade XI students on reaction rate material at SMA Negeri 7 Gorontalo.

Based on the results of the research that has been conducted, the researcher provides suggestions, It is hoped that future researchers will be able to study this in more depth by looking for more reference sources in order to obtain a link between ethnoscience and material that is more varied and closely related to everyday life.

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