The Chemical Learning Effectiveness Based on Pelangiran Ethnoscience in Improving Students' Scientific Process Skills Through Electrolyte and Non-electrolyte Material Solution

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Abstract. The purpose of this study was to illustrate the effectiveness of the implementation of Pelangilla Ethnoscience Chemistry Learning in improving students' scientific process skills (SPS) through electrolyte and non-electrolyte solutions. The research method used is quasi-experimental with a pre-test and post-test control group design. The study population includes all her 10th graders from SMA Negeri 9 Bandarlampung. The study sample was drawn using a random sampling method and it was determined that her grade 1 at 4 IPA (science class) was the experimental class and her grade 5 at 5 IPA was the control class. An experimental class is a class that uses the Pelangira Ethnoscience-based learning model for the learning method, and a control class is a class that uses the traditional model-based learning method. The survey data were analyzed using a separate test of the two means by independent sample t-tests. Results showed that the mean N-gain SPS was higher in the experimental class than in the control class. These results demonstrate that learning chemistry based on Pelangilla ethnoscience is effective in improving scientific process skills, especially in electrolyte and non-electrolyte solutions.

Keywords: Pelangiran ethnoscience · Scientific Process Skills · Electrolyte and Non-elektrolyte

1 Introduction

The rapid development of science and technology is accompanied by the rapid movement of globalization, thus making a teacher no longer the only hub and source of information for the students. The teacher-centered learning is thus no longer appropriately applied in the realm of education. This is in line with what Gulo (2008) had to say that the teacher is not someone who knows everything and students are not the ones not knowing everything, so learning is therefore more focused on students-centered methods by emphasizing students to be directly involved [1] and active in every learning activity. The emergence of However, the Covid-19 pandemic seems to have changed the social

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order of life and has had a major impact on the current learning process [2]. In this context, physical limitations and large-scale social activities preclude face-to-face learning and have a significant impact on the activities of the learning process, especially those that need to be carried out face-to-face. in chemistry class. Student-centered learning should therefore be designed by teachers in online learning modes or limited face-to-face learning (limited PTM). Due to the limited in-person learning implementation in schools during the Covid-19 pandemic, it seems that the impact on such learning implementation, especially for practicum activities, is definitely impossible to carry out as it supposed to be. As a matter of fact, based on the essence of chemistry learning, it is a process, product, and attitude-based learning.

In connection with the essence of chemistry learning, although the learning is conducted in online platform or in limited PTM, the chemistry learning implementation should get priority place in contextual learning steps. The contextual learning can be implemented by utilizing the local wisdom [3]. The contextual chemistry learning is Such learning activities not only enhance students' conceptual and cognitive understanding, but also help broaden their knowledge as they can shape their scientific process skills in the form of observation/experience and data gathering. Considered to be effective, problem solving, teamwork, as well as students' scientific literacy [4]. One should put this in mind that one of the philosophical foundations for the 2013 curriculum development is that the education is rooted in the nation's culture. The chemistry learning that is based on a local wisdom (local culture) is one of the implementations of ethnoscience in the chemistry. The ethnoscience is an activity of transforming between original science consisting of all knowledge about social facts that come from ancestral beliefs and still contain myths (local wisdom), and the ethnoscience includes the fields of science, agriculture, ecology, medicine, even including flora and fauna [5]. Ethnoscience came into existence due to knowledge evolving through trial and error process and the people do not yet have the ability to translate the findings into scientific knowledge, this is thus, the starting point for the ethnoscience from the local to regional level as a form of knowledge resulting from the trial and error process [6], the implementation of ethnoscience-based chemistry learning, therefore, requires the ability of teachers to combine both original and scientific knowledge [7].

Several studies carried out both national and international scale have concluded that ethnoscience-based learning has proven effective in increasing the student involvement to think for the problem-solving [3, 6, 8–10], so as to improve students' reflective judgment and understanding of the material being studied [11, 12].

The teachers must strive for the ethnoscience-based chemistry learning since it is very important. However, up to now the ethnoscience-based chemistry learning is still rarely implemented in schools. The study results state that the learning chemistry that does not respect both the cultural values and local potentiality will result in education that is not oriented to social development [13]. Thus, the ethnoscience-based chemistry learning is believed to be able to increase the students' scientific process skills.

The measurement of scientific process skills in this research will involve cognitive or intellectual, manual and social skills [14]. Collette & Chiappetta (1994) stated that the aspects that can be developed in the way of investigating commonly known as the Scientifical Process Skills (SPS) are as follows: (1) observing, (2) collecting data,

(3) developing a hypothesis, (4) experimenting, (5) concluding. Furthermore, Sunyono (2018) measured SPS by examining the following 7 aspects: (1) observing, (2) classifying/categorizing, (3) measuring, (4) probing questions, (5) formulating hypotheses, (6) planning investigations/trials and (7) interpreting/deciphering the information [15]. Thus, the aspects that are measured to see the student's SPS ability in this study will refer to the points described above.

Lampung is one area that has many ethno-science studies, including the whistle culture which is very thick with the chemical ethnoscience, such as the chemical content of tempoyak (from durian), the use of shrimp pastes for chili sauce, and so forth [16]. The carpentry culture in the making of Lampung traditional houses which can also be examined with the chemical ethnoscience, especially at the flower and lime sowing event, and this can be benefited in learning the material for acid-base solutions [17]. The pelangiran culture, likewise, is believed to cleanse both the body and the spirit. This tradition is usually carried out prior to the holy month of Ramadhan by adding lime juice to the bathing water or doing it in the sea [18]. This tradition is related to the ethnoscience of solutions including electrolyte and non-electrolyte material solution.

The above-mentioned problems shows that the research on efforts to improve the chemistry learning process by prioritizing local wisdom or ethnoscience to improve scientific literacy and students' science process skills is an up-to-date and urgent research to be immediately carried out. In addition to that, the learning design which is based on pelangiran ethnoscience is an innovative new research. This research is closely related to local culture as a reflection of people's lives with the original science of the community. This research will, thus contribute to preserving and studying the culture of the Lampung society as well as revealing the potential science contained in it. Through this research, it is hoped that it can reveal the ethnoscience and the local wisdom value of the Lampung people.

2 Method

A. *Design*

This research used a quasi-experimental method combined with a pre-test and post-test control group design, where the research was carried out in two classes with the object of research namely grade X IPA 5 and X IPA 6 students of SMA Negeri 9 Bandar Lampung. This study begins by observing the initial scientific process skills through a pre-test, and then a treatment is added to it, namely a discovery learning model based on pelangiran ethnochemistry in the experimental class and conventional learning in the control class which is then observed.

B. *Data Collection*

Data collection techniques in the form of Scientific Process Skills used a test instrument in the form of 5-item essay questions used for pre-test and post-test previously It has been tested for validity and reliability. Data can be drawn from student responses to pre- and post-tests. The student's level of N-gain for scientific process skills is then

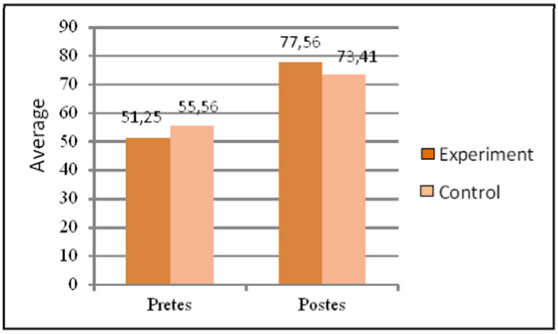

Fig. 1. Average Pre-test and Post-test value of SPS

calculated, and her N-gain criterion is calculated using the formula of Haake (2002) [19]. Learning model implementation data is observed through the Discovery Learning Model Implementation Observation Sheet. The Observation Sheet contains indicators developed to focus observation on the learning stage, with a checklist in one of the scoring columns with the following criteria:

Implemented, not implemented, not implemented. The means of measuring chemistry learning outcomes with discovery learning models refer to assessments made by previous researchers [20, 21], and the means of measuring students' competence in the scientific process refer to previous studies [21, 22, 25].

Data analysis of the findings was performed by descriptive and parametric statistical analyses, with the condition that samples were derived from normally and uniformly distributed populations. Although descriptive analysis was used for the data implementing the discovery learning model, the statistical analysis used was the difference between post-test and pre-test using two columns in a 2 × 3 factorial design, i.e. post-test and pre-test. It was a test of difference. Tests and pre-tests linked to the student's initial ability (high, medium, low).

3 Result and Discussion

A. *Result*

1) *Students' Scientific Process Skills*

The results of data collection on scientific process skills (SPS) of students in the control and experimental classes showed the mean scores before and after the test as follows in Fig. 1.

Figure 1 shows that the initial knowledge of the experimental class was lower than that of the control class, with a mean pretest value of 51.25 for the pre-experimental class and 55.56 for the control class. After performing different treatments for each of the two study classes and performing a post hoc test, both the experimental and control classes found an increase in SPS, while the increase in the experimental class was 26.31 and the difference in the control class was 17.85 and increased.

The pre-test and post-test mean values between the experimental and control classes were then used to determine the mean N-gain for each of the two classes. The average N-gains for students in the experimental and control classes are shown in Fig. 2.

The Fig. 2 shows the average N-gain values of the experimental class is higher than the control class with an average N-gain score of 0.25 for the experimental class and 0.17 for the control class with low improvement criteria of both classes.

After calculating the N-Gain, a hypothesis test was conducted to determine the effectiveness of the discovery learning model based on pelangiran ethnochemistry in improving scientific process skills on electrolyte and non-electrolyte material solution. Prior to testing the hypothesis test, a normality test was carried out on the pre-test and post-test SPS values of the experimental and control classes and a homogeneity test of the post-test values of the experimental and control classes. The results of the normality test are shown on Table 1.

The Table 1 shows the sig value > 0.05 indicating that the research sample obtained from a normally-distributed population.

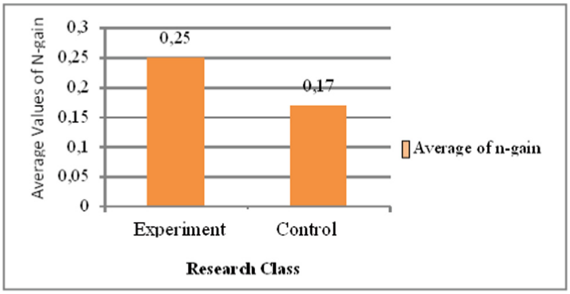

Fig. 2. Average N-Gain values of Experiment and Control Class

Table 1. THE RESULTS OF NORMALITY TEST ON PRE- AND POST TEST VALUES

Tests of Normality							
	Class	***Kolmogorov-Smirnova***			***Shapiro-Wilk***		
		Statistic	***df***	***Sig.***	***Statistic***	***Df***	***Sig.***
Results	Pre-test experiment	0,144	36	0,056	0,941	36	0,054
	Post- test experiment	0,131	36	0,122	0,964	36	0,292
	Pre-test Control	0,138	36	0,079	0,969	36	0,393
	Post-test control	0,120	36	0,200	0,960	36	0,220

Table 2. HOMOGENITY TEST RESULTS ON THE VALUE OF POST-TEST OF SPS

The Homogeneity test of Variance					
		Levene Statistic	***df1***	***df2***	***Sig.***
The results of students' SPS	Based on Mean	0,268	1	70	0,606
	Based on Median	0,294	1	70	0,589
	Based on Median and with adjusted df	0,294	1	69,746	0,589
	Based on trimmed mean	0,259	1	70	0,613

Table 3. TEST RESULT OF THE INDEPENDENT SAMPLES T- TEST

	Test Criteria	
0, 007	H_1 accepted, if *sig* (2-tailed) < 0,05	H1 Accepted
		H_0 Rejected

The second pre-requisite test, namely the homogeneity test is to determine whether the two sample groups have homogeneous variants or not. The results of the homogeneity test are shown on the Table 2.

Table 2 shows the values of sig. > 0.05, which indicates that the samples used in this study were evenly spread. Based on normality and uniformity tests of pre-test and post-test values, i.e. different hypothesis tests of two means, using parametric statistics using independent samples T-tests for student's her N-gain values, SPSS was executed with 25.0 for Windows. The results of the hypothesis tests are shown in Table 3.

Table 3 shows the values of sig. (both sides) < 0.05. This indicates that Ho was rejected and H1 was accepted. That is, we show that there is a significant difference between the mean N-reinforcement values of the students in the experimental and control classes for scientific processing skills and her mean N-reinforcement values for scientific processes. The skill of students in the experimental class that is higher than the average N-gain value of the scientific process skill of the students in the control class.

2) *The implementation of the Pelangiran Ethnochemistry-based Discovery Learning Model*

The effectiveness of the Pelangiran Ethnochemistry-based Discovery Learning Model can also be supported by the implementation of the RPP which contains the stages of the model used. The percentage of implementation of the Pelangiran Ethnochemistry-based Discovery Learning Model is shown on the Fig. 3.

The Fig. 3 shows that the implementation of the pelangiran ethnochemical-based discovery learning model has been carried out with a very high implementation criteria. This shows that at each stage, the students can follow the lessons according to the stages

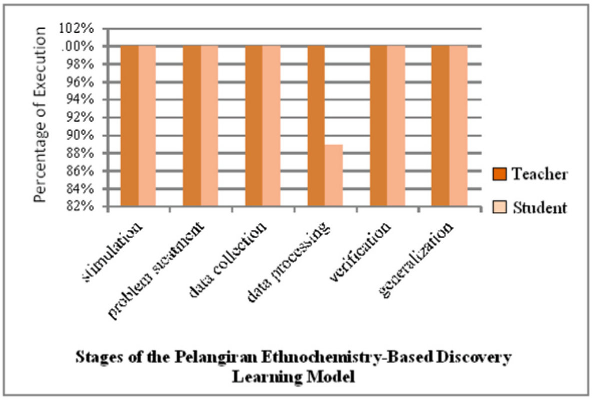

Fig. 3. The percentage of implementation of the Pelangiran Ethnochemistry-based Discovery Learning Model

in the RPP, where at each stage of this model, the basic scientific process skills are put into practice.

B. *Discussion*

The effectiveness of the discovery learning model based on pelangiran ethnochemistry in improving students' SPS on electrolyte and non-electrolyte solution material is indicated by a significant difference between the average N-gain SPS value of experimental and control class students, compared with the average N-gain SPS value of the experimental class students which is higher than the control class. Damayanti, Rusilowati, & Linuwih (2017) put it that the effectiveness of the ethnoscience-integrated science learning model is indicated by the differences in improvement of the student learning outcomes in the experimental and control classes, where this difference is analyzed using N-gain [26]. The hypothesis testing shows that the discovery learning model based on pelangiran ethnochemistry is effective in improving students' SPS with the average N-gain SPS value of experimental class students which is higher than the control class with the same N-gain criteria in both classes, which is moderate criteria. The increase in SPS in the experimental class is, however, higher than the control class.

The increase of moderate criteria in these two classes was caused by several factors, among others; when the learning process was carried out, most of the students in both the experimental and control classes already had learning readiness, especially in the electrolyte and non-electrolyte material solution. A significant increase in experiential education is due to learning processes that utilize Pelangira's ethnochemistry-based discovery learning model, supported by teaching materials in the form of the e-LKPD that integrates ethnochemistry. Ethnochemistry of perangilan using electrolyte and non-electrolyte material solutions. This allows students in the lab class to become accustomed to answering the ethnochemistry questions incorporated in No.8. This is consistent with the formulation of Damayanti, Rusilowati and Linuwih (2017). Differences in N gains between the experimental and control classes were caused by different treatments, the classroom learning controlled class used a traditional model with a scientific approach and the experimental class a scientific learning model integrated with ethnoscience using, teaching materials in the form of ethnoscience integrated e-LKPD [26].

In the experimental class have increased the basic SPS indicators, but in the control class, the improvement given has low criteria. Meanwhile, in the experimental class the increase in SPS is in the moderate to high criteria. This is because the experimental class during the learning process used a discovery learning model based on pelangiran ethnochemistry, where at the beginning of learning, the information related to pelangiran ethnochemistry was given to the students and at the end of learning, the students are asked to relate the tradition to electrolyte and non-electrolyte material solution, it is lime juice that can cleanse dirt by focusing on the role of the ions produced by the juice solution in binding dirt with water.

In order that the students can answer these problems, the students need to use relevant facts, namely the material used is in the form of an electrolyte solution (weak), meaning that the students' skills of observing and classifying are trained, then the students find a pattern of similarities between fatty acid ions in soap and citric acid ions in limes juice in binding dirt with water, then make predictions that the lime juice is added to the pelangiran tradition in order to cleanse the body because that material is in the form of an electrolyte solution (weak), in order that the SPS indicators could train the skills of the interpreting/measuring and predicting. After the students had found the relationship pattern between pelangiran ethnochemistry with electrolyte and non-electrolyte solution (especially the ions produced), the students could make written conclusions, in order that SPS indicators could train the skill of concluding and communicating. Based on that description, the students who can explain the ethnochemical relationship of pelangiran with the concept of electrolyte and non-electrolyte solution (especially the ions produced) are the students who have good SPS. This is also in accordance with what Indrawati and Qosyim (2017) has put it that the ethnochemistry integrated worksheet used in the ethnochemistry-based learning model can practice SPS through activities such as observation to be able to explain scientific knowledge to the community [27]. Besides, according to Rustaman (2005), SPS is needed to develop, acquire and apply science learning theory both mentally, physically and socially [28].

The effectiveness of the pelangiran ethnochemical-based discovery learning model in improving SPS is also supported by data of the students' scientific, including curiosity, thoroughness, and responsibility have experienced an increase in each meeting. This increase is indicated with the increase on the average percentage of scientific attitudes for each aspects (except the responsible aspect) from the medium category (for the meticulous aspect) and high (for the curiosity aspect) to the very high category.

The high scientific attitude of the students is also indicated with the results of implementation observations of the discovery learning model based on pelangiran ethnochemistry, this is because the students' scientific attitude is formed from various learning activities. Where the learning with the pelangiran ethnochemistry-based discovery learning model used the pelangiran tradition as a learning resource, so that with this approach, the students feel motivated and have curiosity regarding the relationship between electrolyte and non-electrolyte material solution with the pelangiran tradition. At the data processing stage, the students were discussing the questions on the pelangiran ethnochemistry integrated e-LKPD, so that through this process, the students can cultivate a meticulous attitude in processing data in the form of animated videos. This is in line with what Sutrisno, Wahyudiati, & Louise (2020) put it that cultural manifestations can be used as a natural laboratory linked to a concept that can have a Widyaningrum influencing the success of the learning process with its positive impact in improving students' understanding of the concepts, attitudes, scientific skills, morals, and spiritual values necessary to compete in the era of Industrial Revolution 4.0 (2018) Learning is affected by students' cultural backgrounds. or the community where the school is located, where the quality of learning is the intensity of the relationship between teachers, students, materials, learning climate and media [29, 30].

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