Integrating Inquiry Based Learning and Ethnoscience To Enhance Students' Scientific Skills and Science Literacy

Integrating Inquiry Based Learning and Ethnoscience To Enhance Students' Scientific Skills and Science Literacy

P W Hastuti[1a], W Setianingsih[1], E Widodo[1]
[1]Department of Natural Science Education, Universitas Negeri Yogyakarta, Indonesia

Abstract. Since the indigenous knowledge of factual events in the scientific materials is often doubtful, it arises awareness for science investigation through integration of Inquiry Based Learning (IBL) and ethnoscience. This research is to reveal the effectiveness of Inquiry Based Learning (IBL)integrated with ethnoscience to enhance the students' scientific skills and science literacy. This study used quasi-experimental research with implementation of pretest and posttest. The research samples were 64 students of the first grade junior high school in Yogyakarta. They were divided into two groups, namely experimental group with integration of IBL and ethnoscience and control group with scientific approach. The instruments were observation sheets on scientific skills and science literacy as well as of students' cognitive test. The scientific skills and scientific literacy data were analyzed using N-Gain, while the testing data were using t-test at the level of significance of 0.05. The result of scientific skills and science literacy enhancement (N-Gain) were 0.73 and 0.69, respectively. On the other hand, the significant number of the given treatment was 0,000and the value was less than 0.05. It indicated that the integration of IBL and ethnoscience was more effective in enhancing the students' scientific skills and science literacy than the scientific approach.

Keywords: *Ethnoscience, Inquiry Based Learning, Scientific Skills, Science Literacy*

1. Introduction

Currently, globalization era has contributed to the shift of cultural values that end to be neglected. To anticipate the worse situation, education plays a crucial role to instill cultural values as preservation actions. Different thoughts appear in case of the urgency to integrate local wisdoms in the learning process. In fact, the science students should not only learn the content but also its relevance to the local culture. It is mentioned in the 2013 curriculum of Indonesia that the learning must be responsive to the development of science, culture, technology and art in order to build students' curiosity and their ability for appropriate implementation.

The diversity of Indonesian culture influences the society mindset and the world of education, especially the science learning. The culture values need to be integrated in science learning, because it is very potential as learning resources. Integrating indigenous points in the learning process will make it more meaningful. The indigenous science refers to the hereditary knowledge from generation to generation as well as the science knowledge of people who participates withincertain worldview and relativist interests of their home communities.[1]One way to promote local wisdom in the learning process is through ethnoscience integration. It is an approach which utilizes culture and local wisdom in science

learning [2] by creating a learning environment and designing learning experiences to integrate indigenous science as part of the learning process.

Integrating Ethnoscience in the learning process can be as contribution efforts to preserve and develop local wisdom and regional culture through the education process. The use of local wisdom in the learning process confirms the concept of science learning and strengthens the national identities [3]. Ethnoscience-based learning is indispensable for students, because it will grow a love towards culture and nation. This learning process can also introduce the students to the potential of their surrounding region so that they are more acquainted with it[4].

Integration of ethnoscience in Inquiry Based Learning (IBL)can help students to learn indigenous knowledge among society. It was followed by investigation to reveal the scientific truth, so the students can develop their own concepts[5]. Through inquiry-based learning, the students learn how to organize and conduct research independently to know the scientific truths of indigenous knowledge so that the obtained concepts can be long lasting. Therefore, it is important to teach science to use inquiry-based learning to integrate ethnoscience. IBL does not only equips students with scientific skills [6] but also develops scientific literacy, as revealed in the source research that IBL can effectively enhances science literacy [7]. Organisation for Economic Cooperation and Development (OEDC) stated that the science literacy is defined as knowledge and understanding of the concepts and processes of science for someone to identify problems, draw conclusions based on evidence, and finally make a right decision to participate in society, culture, and economic growth.

Based on previous preliminary research results, it was found that the process of science learning in Yogyakarta still struggling on the cognitive aspect without considering the studnents' scientific skills and literacy science. It makes the students are not able to identify phenomena, to conduct and to evaluate scientific investigations as well as to interpret the investigations results. Besides,the students are still lack of problems analysis and scientific investigation. The learning process with IBL by integrating Ethnoscience is expected to be able to develop the students' scientific skills and science literacy. IBL facilitate the students to use science as a tool to investigate and find answers the problems related to real phenomena. With this learning process, the students can compare the way they think, make discussion with others, and express what they get in verbal or written presentation to broaden their science knowledge to develop their scientific literacy skills.

2. Methods

2.1 Design of Research

This research used the experimental method with the pre-post equivalent control group design. The sample is chosen with cluster random sampling technique while the criteria of the samples have normal and homogeneity data. There are sixty four students in the eight grade junior high school of Yogyakarta in the academic year of 2018/2019 who were involved in this research. They divided into two classes, one class was as the experimental class and the other was as a control class. The experimental group was taught with integration of Ethnoscience to Inquiry Based Learning. The steps were consisting of students' orientation of Ethnoscience, problems formulation, hypothesis formulation, hypothesis testing, data analysis and conclusion results to answer the determined questions. On the other hand, the control class was taught with the Scientific Approach of five steps including observation, question-answer, exploration, association and conclusion.

2. 2 Instrument

The data collection was done by the instruments observation sheets for students' science literacy and scientific skills, and the question items on pretest-posttest that had been tested empirically to clarify its validity and reliability. The questions had been declared valid with high reliability of $r_{11} = 0{,}74$

2.3 Data Analysis

The observation data of students' scientific skills and science literacy were analyzed using N-Gain by Hake, <g>, a value of obtained <g> was consulted with three categories, namely (1) high: <g> ≥ 0.7; (2)

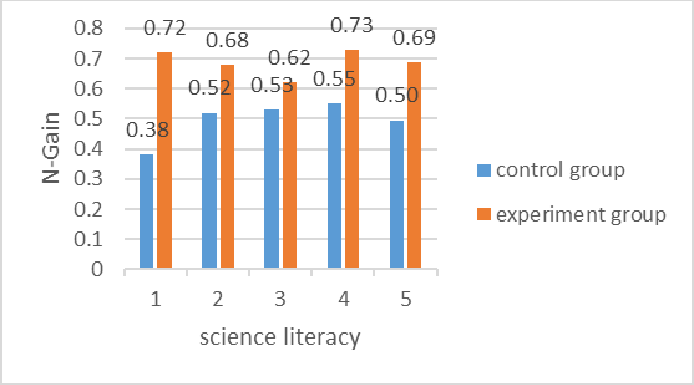
medium: 0.3 ≤ <g> <0.7; and (3) low: <g><0.3. While the test was using Independent t-test at 0.05 significant level to know the effectiveness of IBL which was integrating with Ethnoscience in science learning. The hypotheses proposed in this study are:
Ho : There is no difference of Integrating Ethnoscience in Inquiry based learning on scientific skills and literacy of the Junior High School students.
Ha: There is a difference of Integrating Ethnoscience in Inquiry based learning on scientific skills and literacy of the Junior High School students.

3. Results and Discussion

This research was conducted to know the effect of implementation of ethnoscience and inquiry based learning integration on the scientific skills and science literacy among the students of eighth grade high school junior students in Yogyakarta.

This research was based on the need for scientific investigation of ethnoscience in the community to develop the students' holistic knowledge about the indigenous knowledge within science learning. Ethnoscience was integrated by inquiry based learning models through six stages of ethnoscience orientation, problems formulation, hypotheses making, hypotheses testing, data analyzing and conclusion. Through inquiry based learning, the students were taught about the way to solve problems, discuss, conduct investigations and determine findings of which to develop their scientific skills and scientific literacy. During the learning process, the students' scientific skills and scientific literacy are observed. Based on the results of the observation before and after the implementation of learning using IBL and scientific approach on the additives theme, the researcher calculate and determine whether there is an increase in the students'science literacy. The improvement of students'science literacy was analyzed with N-gain.

Based on the N-gain calculation, the students' science literacy and scientific skills had improved as presented in Figure 1 and Figure 2. There were three categories of improvement in N-gain, i.e., low, medium, and high.

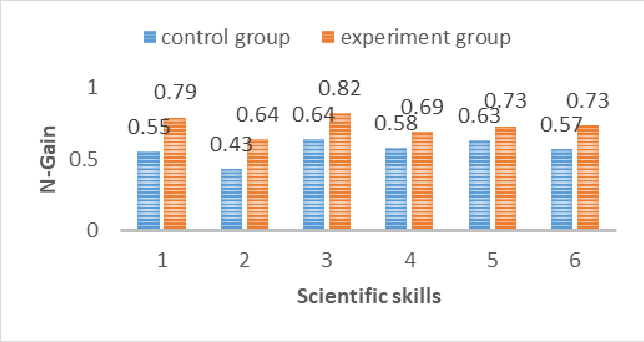


Note:
1. explaining the phenomenon scientifically
2. evaluating scientific investigations
3. interpreting the evidence scientifically
4. designing scientific investigations
5. average scientific literacy

Figure 1. The Improvement of student' science literacy

Figure 1 showed that the normalized gain for students' science literacy covered several aspects, namely explaining the phenomenon scientifically, evaluating scientific investigations, interpreting the evidence scientifically, designing scientific investigations and average scientific literacy. The highest value in the aspect of designing scientific investigations in both the control group and the experimental group was in the high category. Through inquiry, the students designed investigations to solve the

problems [8]. Learning in the control group was facilitated through ethnoscience orientation on additives, such as people's knowledge in the use of additives as dyes, preservatives, and flavorings, while control group discussed about issues of additives. On the other hand, the lowest gain was onthe aspect of interpretating the evidence scientifically in the experimental group and explaining the phenomenon scientifically for the control group. The students who were taught with Inquiry-based Learning integrated with Ethnoscience found it difficult to interpret evidences for indigenous supporting concepts among the community. Therefore, Ethnoscience had been emphasized as part of the phenomenon that certainty must be investigated to make sure the students finding the scientific concept [9].



Note:
1. Problem formulation
2. Hypothesis making
3. Investigation
4. dataanalysis
5. communicating data
6. average

Figure 2. The Improvement of student' scientific skills

The students conducted scientific activities to investigate the truth of indigenous knowledge found in the theme of additive substances. The students' scientific skills were observed during learning process in both classes. The aspects of scientific skills that can arise during the learning process involving problem formulation, hypothesis making, investigation, data analysis, and communicating data. Figure 2 described that the highest N-Gain of scientific skills aspect was on the investigation, while the lowest N-gain was on hypothesis makingfor both groups. In accordance with the nature of science learning, conducting investigation was the prominent elements[10]. Through investigation activities, the students can develop various skills needed in the 21st century including critical thinking, problem solving, and communication [11].

The results of observation sheet analysis showed that after integration of ethnoscience and Inquiry based learning was applied, the students' mastery on the scientific skills and science literacy in the experiment class was better than the control class. In addition, the researchers not only observing science literacy and scientific skills, but also measured improvements in the student learning outcomes through tests in the form of question items that integrated science literacy and scientific skills. The results of the pretest and posttest on additive substances are presented in Table 1

Table 1. The Data of Cognitive Test

Mean Score			StdDev	
Pre-test	Post-test	*N*	*Pre test*	*Post test*

Experiment class	62.83	75.50		5.07	4.14
Control class	62.67	67.50	24	6.32	6.28

As seen in Table 1, experiment class had high category in posttest score meaning that achievement of cognitive test was better than control class. The students could solve the problem by investigating as well as develop each aspect of scientific skills and science literacy. Inquiry learning was more effective in fostering students' learning outcame than the scientific approach.To know the significant improvement of students' learning outcome, the significance test with the t-test at = 5% was done.

Table 2. Significance Cognitive Test

Group	F	Sig	t	df	Stddev	Sig. (2 tailed)
Experiment	3.17	0.082	5.213	46	1.535	.000
Control			5.213	39.823	1.535	.000

In this research, the hypothesis test was done to know whether there was an effect of integration Ethnoscience on Inquiry based learning on the student' science literacy and scientific skills in the junior high school of Yogyakarta as the control class applied the scientific approach and experimental class adopted the inquiry-based learning by integrating Ethnoscience. During the learning process, the researchers observed the implementation in both classes. From the above analysis, it can be seen that the significant number of the cognitive test inintegrated scientific skills and science literacy was 0,000 where the value was less than 0.05 meaning that Ho was rejected. Thus, it can be concluded that there was a difference between scientific approach and the integrated model.

The integrated model emphasized the learning process that exposed the students to Ethnoscience with in additive topic and facilitated the students to solve problems through investigation. In this study, the orientation focused on Ethnoscience. Therefore, the first stage was the Ethnoscience orientation, problem formulation hypotheses making, evidence collection, hypotheses testing, and conclusion determination.

In the experimental class, the learning was conducted by assigning students to make observations related to existed habits in the community. It helps students to hone scientific skills because the students were required to interact directly with the community. In the experimental class, the students were given the task to make observations directly and compare them with the results found on the internet, while in the control class, the students searched for information through the internet. The students who gained knowledge with direct experience can practice scientific literacy[12]. By using Ehtnoscience in science learning, the students were more interested and enthusiastic during the learning process. This learning aimed to introduce to students about the existence of facts or phenomena in a society to be associated with the existing science materials. In ethnoscience learning, local wisdom-based science learning model was implemented through reconstruction of indigenous science within society[13].The students can grasp that learning was not only as the expression and communication of ideas and knowledge development but also the culture recognition as fundamental and important part of education [2].

The highest improvement results were caused by the application of culture based learning models to explore students' ideas and beliefs through anwer questions session. In the aspects of explaining scientific phenomena, designing scientific investigations, conducting investigations, and communicating data, the ability of the experimental class with the level of achievement of N-gain can be catagorized as high, while the control class was moderate. The high level of achievement in the experimental class wasinfluenced by (1) learning models that considered the cultural and ecological environment along with moral values among society to produce literate generations who have innovative thinking skills and scientific attitudes [9]. (2) The students had made direct observations in the community so that they can guaranteeits reliable source. (3) thestudents can draw conclusions based on the results of their

observations. (4) the students arranged the strategies to determine the actions during and after observation [4]. (5) the students conducted some investigation to transform indigenous knowledge into scientific knowledge through ethnoscience intervals in inquiry-based learning.

Inquiry based learning can improve the students'scientific skills through the problems or issues investigation[14].The students collected evidence and use it to explain the studied phenomena. Through investigation of Ethnoscience in the theme of additives, the students can also construct scientific knowledge. Moreover, the students applied the original knowledge from the community to the concepts in the school society to improve their literacy skills.

4. Conclusion

In the science learning process, the students need to learn the content and the relevance of its content to the local culture. Integration of ethnoscience and inquiry based learning can help students to learn and obtain indigenous knowledge among society through scientific investigation to reveal the scientific truth. By doing so, the students can develop their own concepts. Through inquiry based learning, the students learn how to organize and conduct research independently to investigate scientific truths about indigenous knowledge so that the obtained long-lasting concepts and improve their science literacy.

5. Acknowledgement

Our thanks go to 1) Universitas Negeri Yogyakarta, which has provided funding for this research and 2) students who contribute to the completion of this research.

6. References

[1] Snively G and Williams W L 2011"Creating Change : Instructional Strategies , Teacher Education Teaching Science in Rural Aboriginal and Urban Multicultural Schools," pp. 60–62.
[2] Sudarmin, R. Rebu, M. Nuswowati, and W. Sumarni 2017 *J. Phys. Conf. Ser.* **824** 012024.
[3] Parmin, Sajidan, Ashadi, and Sutikno 2015 *J. Pendidik. IPA Indones* **4** (2) 120–126.
[4] Parrish P and Linder vanberschot J A 2010 *Int. Rev. Res. Open Distance Lear* **11 (2)**
[5] Hastuti P W, Tiarani V A, Nurita T 2018 *J. Pendidik. IPA Indones.* **7** 232–238.
[6] P. W. Hastuti, S. Nurohman, and W. Setianingsih 2018 *J. Phys. Conf. Ser.* **1097** (012004)
[7] Gormally G, Brickman P, Hallar H, and Armstrong N 2009 *Int. J. Scholarsh. Teach. Learn.* **3 (2)**
[8] Maxwell D O and Lambeth D T 2015 *Asia-Pacific Forum Sci. Learn. Teach.***16 (1)** 1–31
[9] Sudarmin, Pujiastuti, and Endang S 2015 *Int. J. Sci. Res.* **4 (9)** 598–604.
[10] Lederman N G, Lederman J S, Antink A 2013 *Int. J. Educ. Math. , Sci. Technol. (IJEMST)* **1 (3)** 138–147.
[11] Dwyer C P, Hogan M J, and Stewart I 2014 *Think. Ski. Creat.* **12** 43–52.
[12] Murat Genç, 2015 *Ondokuz Mayıs Üniversitesi Eğitim Fakültesi Derg. Eff. Sci. Stud. Students ' Sci. Lit. Attitude* **34 (1)** 141–152.
[13] Khusniati M, Parmin, and Sudarmin 2017 *J. Turkish Sci. Educ.***14 (3)** 16–23.
[14] Duran M 2016 *Eurasia J. Math. Sci. Technol. Educ.*, **12 (12)** 2887–2908.

INTERNATIONAL CONFERENCE ON EDUCATION, SCIENCE, AND TECHNOLOGY (ICESTech)

KONASPI IX 2019 Konvensi Nasional Pendidikan Indonesia & International Conference

NO:435/ICESTech/III/2019

CERTIFICATE

This is to certify that

Purwanti Widhy Hastuti

has actively participated in "International Conference on Education, Science and Technology" (ICESTech)
with the theme "Education, Social Science, and Humanity in Industrial Revolution 4.0"
held by Universitas Negeri Padang on March 15, 2019 in Padang, Indonesia

as

PRESENTER

Padang, March 15, 2019

Rector,

Prof. Ganefri, Ph.D

Chair,

Prof. Dr. M. Zaim, M.Hum