Effect of Environmental Problem-based Learning on the Indonesian EFL Students' Environment-related Vocabulary Mastery and Writing Ability

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Abstract—This study aims at examining the effect of environmental problem-based learning (PBL) on the environment-related vocabulary mastery and writing ability of Indonesian EFL students. Previous studies showed that problem-based learning is a student-centered learning approach that affects students' learning positively and significantly. This study employed a quasi-experimental design by involving two classes of senior high school students, each consisted of 30 students. One class was assigned to be the experimental group and treated with environmental PBL, while the other class was assigned to be the control group and taught conventionally. A vocabulary test was used to measure the students' environment-related vocabulary mastery, while a hortatory writing test was used to examine the students' writing ability. The data were analyzed by using independent sample t-test. The results of the study showed that the students who were taught by using environmental PBL improved their environment-related vocabulary mastery and their writing ability significantly. The PBL approach is then recommended for future teaching and research. Nevertheless, before implementing this approach, other teachers and future researchers should consider the readiness of the curriculum, the students, and the school infrastructure.

Index Terms—environmental problem-based learning, environment-related vocabulary, writing ability

I. INTRODUCTION

Sustainable environmental education and language learning work simultaneously. This needs appropriate learning approaches so that the objectives of language learning as well as the purpose of encouraging students' awareness of the environment could be achieved effectively. In Indonesia, the government has set an environment-based school called *Adiwiyata*, in which compulsory subjects are integrated with environmental education. However, some teachers find it difficult to determine the appropriate learning approaches and the environment-related materials for the basic competencies they teach. More particularly, it is not easy to transform the issues into meaningful and joyful learning. The Indonesian 2013 Curriculum suggests three kinds of learning approaches: Project-based learning (PjBL), Problem-based learning (PBL), and discovery learning. Since this study deals with environmental issues that require high order thinking analysis, we believe that PBL is learning approach that is capable of carrying the mission.

Problem-based learning is a student-centered pedagogical approach in which students learn about a subject through the experience of solving an open-ended problem found in trigger material. It presents a contextual problem that stimulates the students to learn the topic with high order thinking skill. PBL classroom supports many of the components necessary for effective learning. For example, students would be deeply engaged, think critically, practice team-working, show confidence in problem solving situations, and make connections between the classroom and everyday life (Myers & Botti, 2000; Tan, 2004; Prince & Felder, 2006; Hung, Jonassen, & Liu, 2007). Another defining characteristic of PBLwas mentioned by Barrett (2005). They stated "in PBL tutorials, students define their own learning issues, what they need to research and learn to work on the problem and are responsible them selves for searching appropriate sources of information" (p. 13). Hence, incorporating the environment education to English-as-a-foreign-language (EFL) classes through PBL could enrich the students' vocabularies related to environment since learning to use the language and using the language to learn happen simultaneously. Thus, the students have the opportunity to learn language instructions, and at the same time experience real-life education.

It is essential for the students to venture out to explore their surroundings and to learn from their environment. Learning a language does not mean only learning its grammatical structure; it also means learning how to use it to communicate and deliver messages to other people. Thus, it is enriching to have students to use the language while they

explore life outside the classroom, learn from the world, improve their sensitivity of the environment, and participate in conserving it (Marsh, 2000; Cates, 2009). For example; students are asked to read an article about the danger of illegal logging, and at the end of the teaching and learning process students are guided to plant trees or to make poster with the aim of conserving the nature. It is obvious that the students would learn how to get information, concept and meaning from the reading texts, and experience how to plant trees at the school yard or at the yards of their home and show their awareness when they see many desolations to the nature. While learning the concept of the learning material they would explore more vocabularies.

A number of studies have been done in this field. Research studies conducted by Lin (2012; 2015) revealed that through PBL approach, students gained a significant advancement in the vocabulary test and higher proportion of vocabulary use. Another study which was conducted by Bicer, Boedeker, Capraro et al.(2015) found that PBL elicited a statistically significant (p <.05) improvement to students' mathematical and scientific vocabulary mastery. It was proved that PBL was able to bring the students to develop their vocabulary mastery. Through the process of PBL, the students independently explored the vocabularies and phrases related to the authentic topic they learnt.

Some studies reviewed the role of PBL to improve the students' writing ability. The process of PBL proved to be more powerful than the conventional lecture method in increasing students' English writing ability across texts from the secondary level students up to university students. In summary, the role of PBL is to assist the students in preparing good essays (Perry,2005; Dastgeer, 2015; Kusmawati & Purwati, 2015; Kumar & Refaei,2016). Anwar (2013) conducted his study on the effect of PBL on the students' ability in writing argumentative essays. The results of Anwar's studies showed that there was a significant difference when the students' scores of the pre-test and post-test were compared. However, so far there has been no study that specifically examines the environment related vocabulary. Therefore, we intended to know how PBL works for this purpose

The novelty of this research is the implementation of PBL integrated with environmental matters on the teaching of hortatory exposition which was used to examine the environment-related vocabulary acquisition and writing ability. Previous studies have shown that PBL could assist students' knowledge creation, deep understanding, achievement and motivation(Tee &Lee, 2013; Bank & Barlex, 2014); PBL is able to assist the students to bridge the gap between subjects and their prior experiences (Trekles, 2012); through PBL students will engage a better vocabulary recall and retention degree (Anderson, 2007). Thus, based on these results, it is known that PBL activities have capability of improving students' retention and critical thinking skills.

Azer (2001) stated that, "the primary goal of problem-based learning (PBL) is to foster clinical reasoning or problem-solving skills in students" (p. 299). That is why it is believed that this approach would be suitable to bring up the environmental matters to EFL writing class since it uses problems related to environment to drive the learning process. Therefore the problems would be employed as an exploratory-understanding activity, an example, and an integral part of the process. The learning stages of the PBL adopted from the Indonesian Education and Culture Ministry (*Kementrian Pendidikan dan Kebudayaan*, 2014) was used in this research, as illustrated in Fig. 1.
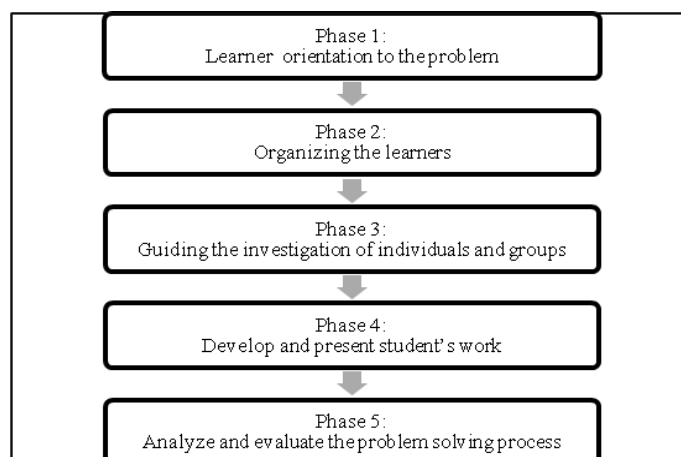

Figure 1. Problem-based Learning Stages (Kementrian Pendidikan dan Kebudayaan, 2014)

Based on the background outlined above, this research examined the effect of environmental problem-based learning on Indonesian EFL students' environment-related vocabulary mastery and their writing ability. Thus, the research problems can be formulated as follows:

1) Do the Indonesian EFL students involved in the environmental problem-based learning have better environment-related vocabulary mastery than those who are not involved in the environmental problem-based learning?

2) Do the Indonesian EFL students involved in the environmental problem-based learning have better writing ability than those who are not involved in the environmental problem-based learning?

II. METHOD

A quasi experimental research design was used to investigate whether or not the students who are engaged in environmental PBL obtain better environment-related vocabulary mastery and writing ability than those involved in conventional class. Two classes of EFL learners were selected from the eleventh graders of an *Adiwiyata* (environment-based) Senior High School at Papar, Kediri, which is located in the Province of East Java, Indonesia. The students were taught to write a hortatory text which requires them to express their opinions and arguments. The two classes of eleventh graders were divided as follows: The students in one class was assigned as the experimental group which was taught by using environmental PBL, while the students in the other class were taught conventionally without environmental PBL. In each of the two classes there were 30 students who became the subjects of the research.

The treatment in the experimental class was conducted as follows: First, the learning phases of environmental PBL were done in 5 meetings. This was to ensure that the students have time to analyze the occuring problems and to find out solutions to these problems. Second, the implementation of environmental PBL phases to environment-related vocabularies covered the steps adapted from Spence (2016) and "Cooperative Learning" (2017) as follows: exploring the isues, defining the problems, listing out possible solutions, carrying out actions to be taken with a timeline, presenting their ideas by involving the environment-related vocabularies. Third, a hundred environment-related vocabularies were determined as target vocabularies and set in the form of *Environment-Related Vocabulary List* (see Appendix 1). The vocabulary list consists of 55 nouns, 26 verbs, 17 adjectives, and 2 adverbs. The vocabularies were selected on the basis of the students' level of familiarity and divided into 5 meetings, 20 vocabularies for each meeting. The vocabularies were studied in a context through PBL. The students were taught to use the vocabularies in constructing sentences.

There are two kinds of instruments used in this research: vocabulary test based on the environment-related vocabulary list and writing test. The environment-related vocabulary test was constructed in the form of objective (i.e., multiple-choice, gap filing and matching) test by using the vocabulary in the Environment-Related Vocabulary List. To know the students' learning improvement, pre-test and post-test were conducted. The pre-test was used to find the students' vocabulary mastery level and their writing ability before the treatment. The post-test scores were used to as a means of comparison to know the students' progress after the treatment was given during the experiment. To measure the environment-related vocabulary mastery, the students were asked to write hortatory essays and then the use of the environment-related vocabularies were counted and compared to the *Environment-Related Vocabulary List* (see the Appendix).

Meanwhile, to examine the effect of PBL on students' writing ability, the hortatory essays were scored on four writing aspects: content, organization, vocabulary, mechanics. The content of the essay was analyzed on the relevance of the topic and how the students convincingly support the main idea either with appropriate example, reason, or evidence. The organization of the writing focuses on the main idea with well-organized supporting details; the essay should cover the thesis statement-arguments-recommendation. The scoring of the vocabulary was determined through the use of a well-chosen vocabulary, sentence variety and information. At last, the mechanics of the writing was judged from the effectiveness of the use of capitalization, punctuation, spelling and formatting.The ratings were carried out by two raters to avoid any subjectivity of the test results. The first rater was one of the English teachers in the school, while the second rater was the first author of this article.

III. RESULTS

There were two major results of this present research: the effect of environmental problem-based learning on the students' environment-related vocabulary mastery and the effect of environmental problem-based learning on the students' writing ability.

A. Effect of Environmental PBL on the Students' Environment-related Vocabulary Mastery

To determine the effect of environmental PBL, the students' environment-related vocabulary mastery was measured by using the environment-related vocabulary test. The scores of the experimental and control groups in the pre-test were compared by using independent sample *t*-Test. The results showed that there was no significant difference between the means of the scores of the two groups. Because of the similar mastery level of the experimental and control groups prior to the treatment, the scores of the post-test were also compared by using independent sample *t*-Test. The comparison of the scores of the experimental and control groups in the environment-related vocabulary post-test is depicted in Table 1.

TABLE 1
COMPARISON OF SCORES IN THE ENVIRONMENT-RELATED VOCABULARY POST-TEST BETWEEN THE EXPERIMENTAL AND CONTROL GROUPS

Group	t-test for Equality of Means					
	t	df	Sig. (2-tailed)	Mean	Mean Difference	Std. Error Difference
Experimental	8.116	58	.000	68.933	19.90	2.45203
Control	8.116	41.037	.000	49.033	19.90	2.45203

Table 1 shows that the mean obtained by the experimental group was 68.933, while the mean obtained by the control group was 49.033. The comparison of means showed a significant difference in the results of the environment-related

vocabulary post-test. The significance value was .000 (p <.05) or the *t*-count (8.116) >*t*-table (2.001717). This result suggests that learning by implementing environmental PBL has a positive effect on students' environment-related vocabulary mastery. Meanwhile, the changes of the students' results of environment-related vocabulary tests can be seen in Table 2.

TABLE 2
THE CHANGES OF STUDENTS' RESULTS OF ENVIRONMENT-RELATED VOCABULARY TESTS

	Before Treatment		After Treatment	
	Experimental	Control	Experimental	Control
Highest score	82	74	84	83
Lowest score	28	26	60	37
Vocabulary interval	18	16	8	15
Lower group	7 students	11 students	6 students	14 students
Medium group	21 students	12 students	20 students	10 students
Higher group	2 students	7 students	4 students	6 students

Table 2 shows that the environmental PBL treatment is able to affect positively on the mastery of environment-related vocabulary from the aspects of the highest score improvement, lowest score improvement, environment-related vocabulary interval (meaning that the vocabulary is more densely-filled), the decreasing number of the lower students, and the increasing number of the higher students.

B. Effect of Environmental PBL on Students' Writing Ability

To ascertain the equality of the students' writing ability between the experimental group and the control group on the writing pre-test, a *t*-test was used to examine it. The results of the writing pre-test showed that there was no significant difference between the experimental and control groups. The statistical result pointed out that the students' hortatory writing ability were equal from one group to another.

Since the pre-test showed no significant difference, then the post-test result was analyzed through *t*-test. The mean obtained by the experimental group was 69.53, while the mean obtained by the control group was 52.00. The two means were then compared and the result is shown inn Table 3.

TABLE 3
COMPARISON OF POST-TEST WRITING SCORES BETWEEN THE EXPERIMENTAL AND CONTROL GROUPS

Group	t-test for Equality of Means					
	t	df	Sig. (2-tailed)	Mean	Mean Difference	Std. Error Difference
Experimental	5.118	58	.000	17.53333	3.42564	10.67617
Control	5.118	44.119	.000	17.53333	3.42564	10.62993

Table 3 depics that there was a significant difference between two groups. It could be interpreted from the significance value, which was .000 (p <.05) or the *t*-count (5.118) > *t*-table (2.001717). The scores indicated that after the treatment of PBL, the students performed better in writing hortatory essay.

When the calculation was focused on the writing components, it was found that not all the components could be affected significantly by the implementation of PBL, even though in the end the overall test results mentioned that there was significant influence between PBL and the students writing abilities. This can be seen in Table 4.

TABLE 4
RESULTS OF t-TEST FOR THE WRITING COMPONENTS BETWEEN THE EXPERIMENTAL AND CONTROL GROUPS

Components	Mean		t-count	Sig.	Analysis
	experimental	Control			
Content	5.833	1.500	3.750	0.000	Significant
Organization	3.000	1.333	1.764	0.083	not
Vocabulary	7.200	1.200	4.573	0.000	Significant
Mechanics	1.867	0.867	1.176	0.244	not

Table 4 shows that the influence of PBL significantly indicated the important components of content and vocabulary. Meanwhile the component of organization and mechanics were not affected significantly although the results showed that there were increases in the score.

In addition to the examination of the overall ability in writing, the environment-related vocabulary test carried out in the form of objective environment-related vocabulary of the students in the two groups were compared, The result is shown in Table 5.

TABLE 4
ENVIRONMENT-RELATED VOCABULARIES USE BEFORE AND AFTER THE TREATMENT

Groups	Before the treatment	After the treatment
Experimental group	11-12 words	16-17 words
Control group	8-9	11-12 words

Based on the result of the post-test by using the two instruments, it was revealed that problem-based learning affected the students' environment-related vocabulary achievement. The students who were taught by using problem-based learning achieved better than the students who were taught by using conventional learning.

IV. DISCUSSION

In this section, the results of the study are discussed in reference to the theories and previous research studies. One of the results of this study is that students who were taught through environmental PBL performed better in the environment-related vocabulary test. They used more environment-related vocabulary in writing hortatory essay than the students who studied in a conventional classroom. These findings are in line with the findings of the impact of PBL on Chinese-speaking elementary school students' English vocabulary learning and use reported by Lin (2015). Her research revealed that the PBL group performed better in using the Off-List level of vocabulary in the writing task. They used a higher proportion of vocabulary beyond the 2000-word level, and wrote significantly longer compositions than their counterparts. The student-centered learning process in PBL as described by Utecht (2003) and Dole, Bloom, and Kowalske (2015) was able to improve students' environment-related vocabulary mastery. It was proven from the scores gained by students who were involved in PBL treatment. The result of the present study showed that before the treatment the students utilized 11-12 words and after the treatment the students perform 16-17 words.

This research is in line with the result of research done by Bicer et al. (2015:69) in that PBL approach could be used effectively in the teaching and learning process. They stated that "the model of STEM (Science, Technology, Engineering, and Mathematics) PBL instruction elicited a statistically significant ($p < 0.05$) improvement in the mathematical and scientific vocabulary knowledge of students." It was proved that PBL was also able to bring the students to develop their vocabulary achievement in environmental matters. By analyzing the surrounding environment, students were able to identify, understand, and evaluate the problems related to the environment. The students were able to give solution or recommendation to the emerging issues and then put it in the form of hortatory essay in which the uses of environment-related vocabularies were properly recorded in their memories. PBL provides the way for the teachers assisting their students in achieving the 21st century skill, through collaboration, discussion, and self-accessing knowledge (AACTE, 2010; Center, 2010).

The implementation of PBL fosters students to be engaged and learn the skills of interpretation, analysis, self-regulation, inference, explanation, and evaluation (Facione, 1990). The students were expected to: identify and examine ideas and arguments, draw conclusions, clarify meaning through categorization and translation, do self-assessment and reflection, and to justify arguments. Therefore, the activities of student-centered learning in PBL promoted students creativity, and independency as documented on Appendix 1.

The results of this study also show that the students who were taught through environmental PBL achieved a better writing ability than those who were not involved in the environmental PBL. To elaborate ideas in the form of hortatory writing, students need to present supporting evidences, claims, and reasons. To do this they should have the skill of presenting arguments and defending their arguments in front of the class. In relation to the environmental matters, Problem Based Learning able to promote the students writing ability especially in expressing ideas about how to overcome the issues around environment.

The finding on the effect of problem-based learning on students' writing ability showed that there was a significant effect of PBL to the students' writing ability. This finding supports Dharma, Marhaeni, and Budasi (2014) research. Their research discovered the significant effect of PBL which occurs simultaneously and separately on students' reading and writing competencies.

The teaching and learning steps of PBL are found to be more compelling rather than the teacher-based lecture method in enhancing learners writing skill. The implementation of PBL may support the students to produce a well-prepared composition (Perry,2005; Dastgeer, 2015; Kusmawati & Purwati, 2015; Kumar & Refaei,2016). Through discussion students were able to interchange their knowledge on how to construct a hortatory essay, develop the generic structure, and build some reasoning. By working on teams the students are able to shape their own understanding about the content knowledge and language use. PBL supports the weak learners to be more confident, so that he or she may learn how to write independently.

The finding of the present research also supported Anwar's (2013) finding that the ability of writing argumentative paragraph could be enhanced through PBL. It can be seen through the results of studies showing the significant increase in the score in the pre-test and post-test. The main learning material was hortatory text which evolved arguments, claim, and reasoning.

In the present study, the biggest influence on the implementation of PBL in hortatory writing lies in the aspects of content and vocabulary. The subjects of this research were the students who were at the pre-intermediate level. They were in the stage of learning basic grammar, while this study focused on the hortatory text that collaborate simple present tense with the expressions of delivering arguments. These students may be more concentrated on matters relating to the content or material. This is because they study in groups and determine their own learning needs.

From the analysis we can see that the biggest effect of the PBL treatment to the students writing ability was on the component of vocabularies then followed by the component of content. Even there were increases in the result of organization and mechanics; they could not be said as a significant difference. Perhaps this is because the low level of

the participants in their English proficiency. Therefore, it would take more time to improve the writing ability especially on the aspects of organization and mechanics.

V. Conclusion

The importance of sustainable environmental education has led the Indonesian government issued a policy regarding green school for secondary school. In order to improve the awareness of the students of environment that has been damaged by human activity and to prevent further damage, students need to be educated from an early age to have a sense of responsibility towards the natural resources for future generations. The role of English language learning is able to bring this content knowledge to the realm of language learning, for both language and content knowledge will work simultaneously. One of the suggested learning approaches in the Indonesian 2013 Curriculum is Problem Based Learning. Through this model, the students were directed to work collaboratively to find solutions of the real problems in their lives in the English learning in the classroom. This study tried to see whether PBL would affect the students' environment-related vocabulary mastery and their writing ability. Based on the research, it was proved that the teaching conducted through environmental PBL involving the eleventh grade Indonesian EFL students showed a significant effect on the achievement of environment-related vocabulary and writing ability.

APPENDIX. ENVIRONMENT-RELATED VOCABULARY LIST

No	Word/Phrase	Part of Speech	No	Phrase	Part of Speech
1	acid rain	N	51	habitat	N
2	aerosol, spray	N	52	harm	V
3	atmosphere	N	53	harmful	Adj
4	aware	Adj	54	human	N
5	awareness	N	55	hygienic	Adj
6	balance	V	56	ignore	V
7	biodegradable	Adj	57	illegal logging	V
8	biotic	V	58	improperly	Adj
9	carbon dioxide	N	59	industrial waste	N
10	chemical	N	60	insulation	N
11	chop down	V	61	jungle	N
12	clean	Adj	62	landslide	N
13	cleanliness	N	63	leak	V
14	conservation	N	64	litter	V
15	conserve	V	65	mangrove	N
16	damage	V	66	manufacture	V
17	deforestation	N	67	mineral	N
18	deplete	V	68	natural disaster	N
19	destruction	N	69	natural resources	N
20	detergent	N	70	nature	N
21	dirty	Adj	71	noise	N
22	dispose	V	72	non-renewable resources	N
23	drought	N	73	nuclear	N
24	dumping ground	N	74	overpopulated	Adj
25	dustbin	N	75	ozone layer	N
26	ecology	N	76	paperless	Adj
27	ecosystem	N	77	plant	V
28	emission	N	78	plastic	N
29	endangered	Adj	79	poisonous	Adj
30	energy-efficient	Adj	80	pollute	V
31	environment	N	81	pollution	N
32	environmental	Adj	82	preserve	V
33	erosion	N	83	prevent	V
34	extinct	Adj	84	properly	Adv
35	extremely	Adv	85	protect	V
36	factory	N	86	quality	N
37	fertilizer	N	87	radiation	N
38	fire	N	88	rainforest	N
39	flood	N	89	recycle	V
40	forest	N	90	reduce	V
41	fossil fuel	N	91	reforestation	N
42	friendly	Adj	92	renewable	Adj
43	fume	N	93	reuse	V
44	garbage	N	94	rubbish	N
45	gas	N	95	save	V
46	global warming	N	96	smoke	V
47	green	V	97	sustainable	Adj
48	greenhouse effect	N	98	throw	V
49	grow	V	99	waste	N
50	growth	N	100	water	N

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