

THE APPLICATION OF PROJECT-BASED LEARNING USING MIND MAPS TO IMPROVE STUDENTS' ENVIRONMENTAL ATTITUDES TOWARDS WASTE MANAGEMENT IN JUNIOR HIGH SCHOOLS

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First draft received: 11 October 2016

Final proof received: 22 February 2017

Abstract

This research aims to determine the effectiveness of project-based learning method using mind maps in science learning for the topic of waste management and its solution to improve students' environmental attitudes. It adopted a quasi-experimental method with the pretest-posttest control group design. The subjects of the research consisted of the seventh grade students of two classes in one of the private junior high schools in Bandung Regency. The instrument used for data collection was a pretest and posttest on environmental attitudes for students, a questionnaire, and observations of environmental attitudes of the students from peer assessment, teacher's observations in the school, and parents' observations at home. The data were analyzed by considering the gain value with its normalization and counting the size effect. The results of the data analysis indicated that gain $\langle g \rangle = 0.61$ for the experimental class and $\langle g \rangle = 0.41$ for the control class, and effect size $d = 0.37$. These values mean that there were improvements in the students' environmental attitudes in the school and at home after the application of project-based learning with mind maps. It is concluded that PjBL (Project-Based Learning) method using mind maps for the theme of waste and its management works effectively since it has a small effect on improving students' environmental attitudes.

Keywords: Project-Based Learning model; mind maps; environmental attitudes

To cite this paper (in APA style):

Susilawati, A., Hernani, & Sinaga, P. The application of project-based learning using mind maps to improve students' environmental attitudes towards waste management in junior high schools. *International Journal of Education*, 9(2), 120-125 doi: dx.doi.org/10.17509/ije.v9i2.5466

INTRODUCTION

Natural Science is the learning process which is highly related to the environment and the regularity of the universe created by God the almighty. Thus, in the process of learning natural science, it is suggested to use a method which facilitates students not only in mastering knowledge, concept, and basic principles of science, but also emphasizes the awareness to maintain, to keep, and to conserve the environment, including its natural resources. In this regard, beneficial and applicable science principles could be obtained from daily life.

Based on the results of the preliminary study conducted by the researchers in one of the private junior high schools in Bandung district, there were problems related to environmental conservation, which were: 1) the average of achievement of the mastery of subject mastery has not met the minimum mastery criterion or the passing grade of 75; 2) based on the interview results with the teachers, the methods used in the science learning process are dominated by lecturing and discussion; and 3) based on the observation of the school's environment and the classes, there is much rubbish all over the place which has not been managed well. The rubbish clogs

the canal around the school, causing problems in the water flow. This condition shows that there is very little awareness and care towards the environment. The facts above raise the need of science contribution to the dynamics between human life and the environment. Thus, the roles of Science in enhancing society's knowledge about natural resources or the natural phenomena in daily life become absolute (The Indonesian Ministry of Education and Culture, 2014). The relation between Science and the environment in learning activity is expected to increase the awareness of keeping the environment. Waste is the consequence from all the activities done by humans and it affects greatly on one's quality life. It would bring problems if not well-managed. Therefore, particular ways or efforts to solve the problems related to waste management are necessary.

In order to solve waste issue, there have been many ways attempted by many people, including the government of Indonesia, who has created a particular rule about waste management in the national policy as is contained in the Law Number 18 Year 2008. Even in other countries such as America, Africa, European countries, China, Uganda, Nigeria,

Sweden, and others many strategies have been employed to resolve the waste issue. Some of these attempts are burying and collecting the trash to the final dump site (Fakere et al., 2012; Haaren et al., 2010; Sankoh et al., 2013), recycling (Douglas, 1986; Haaren et al., 2010; Sharon, 1993), processing it into compost (Haareen et al., 2010), burning or changing it into another form of energy (Felix et al., 2010; Haareen et al., 2010; Surono, 2013). Meanwhile, from the education department, what can be done to manage the rubbish is to spread the knowledge and understanding to all education institutions, including schools, about waste and its management to all students. The process of spreading that knowledge and understanding is conducted in learning activity such as science learning activity, when the learning topic is related closely to environmental issues.

To address the issues mentioned above, there should be a learning model which can help students be more active in waste reduction in order to protect the environment. The implementation of project-based learning seems suitable to increase students' awareness towards the environment, which is related to concept mastery and managing the waste alongside in addition to helping students to enhance their knowledge about waste management. The implementation of project-based learning to address the issue of waste and waste management has been studied internationally. To mention but a few of them, there are Nargund-Joshi and Lee (2013) who implemented a cross-subject project-based module for the fifth and six grade students and Borhan and Ismail (2011) implemented project-based learning to promote students' environmental stewardship. Unfortunately, to this date, there have been no studies on project-based learning implementation, either in primary or secondary schools in Indonesia, as an attempt of improving students' attitudes towards the environment. Considering the lack of research on this topic and the urgent solutions needed to solve the problems related students' environmental attitudes, the present research

Literature Review

According to George Lucas Educational Foundation (2005), project-based learning method is a dynamic learning approach in which students are able to actively explore the real world's problem, get challenged, and get a deeper understanding about an issue. Furthermore, project-based learning is convenient for an interdisciplinary course because naturally it involves different academic skills such as reading, writing, and math. It is also appropriate to build the concept understanding through subject assimilation (Capraro et al, 2013). These arguments confirm that project-based learning model can be applied in teaching the theme of waste because the theme of waste and its management mixes different concepts such as physics, chemistry, and biology.

Besides the learning model, learning equipment is needed to help increase the education output, namely in the form of learning media. Media are learning sources or actual props which contain instructional materials in students' environment and able to stimulate students to study. Learning media are media carrying messages or information which has instructional purposes or contains the true meaning of learning (Hamdani, 2011).

The success of learning process needs proper media to create an interesting learning activity. It will be better if the media used are designed and created by students themselves. Such media might be suitable with the characteristics and thinking styles of the students. One of the media which can be created by students is mind maps. In learning process, mind mapping helps teachers lead students to focus on a particular aspect from the topic being discussed. Through mind maps created by students, teacher can find out if students understand the topic and how to manage and build a proper structure for the topic. Therefore, mind mapping is one of the tools to learn environmental issues, and also a strong device for students to build a working map in developing the knowledge (Keles, 2011).

A mind map is a creative, effective note which enables one to pour his or her ideas down. Mind map is also a route map which makes the memorizing activity easy and enables one to sort some facts and mind; thus, the natural brain activity is involved since the beginning. This means memorizing information could be easier and it is better to be relied on than writing down a note conventionally (Arifin, 1990).

The combination of project-based learning and mind map is expected to bring out students' independence and to motivate them to be more active in learning science for the topic of waste and its management; thus, there will be an effective and fun learning situation. The stages in the project-based learning activity are: 1) starting with essential questions; 2) designing a project; 3) creating schedule; 4) monitoring the students and the progress of project; 5) assessing the outcome; and 6) evaluating the experience. A study on the implementation of project-based learning in combination with mind maps and concept maps was conducted by Sembiring et al. (2015). However, the focus is on improving college students' conceptual mastery, not promoting their environmental awareness.

Based on the explanations above, this study aims to find out the improvement of students' concept mastery in waste and its management theme through the implementation of project based learning approach with mind map as an aid. This study also aims to find out the effectiveness of the project based learning with mind map implementation towards students' concept mastery of waste and its management.

METHOD

This study was conducted in a private junior high school in Bandung district. The method used was quasi experimental. The implementation of project-based learning with mind map was only given to one experimental class, while the control class was treated with project-based learning without using mind map, but the class used the ordinary note instead. The measurements of students' attitudes towards the environment were conducted at the beginning and end of the meeting. Therefore, the design of this study was pretest-posttest, control group design. The sample was drawn randomly (through cluster random sampling) to choose two classes that were designed as control class and experimental class. Based on the random sampling, D class with 32 students was chosen to be the

experimental class, and F class with 34 students as the control class, respectively. The projects related to waste and its management done by students in both classes were as follows: 1) The first group created biogas produced by organic matter; 2) the second group created recycled paper; 3) the third group and fourth group created a craft made from non-organic waste; and 4) the fourth group created fuel oil from bottle waste.

The data collection techniques of this study were: (1) pretest and post-test for students' environmental

attitudes; (2) observation method to find students' attitude toward the environment every week.

The instruments of this study were: questionnaire about caring attitude towards the environment; observation sheets for students' environmental attitudes given to three observers: parents, teacher, and peers; and a questionnaire for students' opinion. The effectiveness test with the calculation of effect size was obtained from the difference of the posttests between the control class and experimental class. Thus, the effect size formula used was:

$$d = \frac{(M_E - M_K)}{\sqrt{\frac{SD_E^2 + SD_C^2}{2}}} \quad (1)$$

Notes for formula (1): d score shows the effectiveness score of the attitude impact, which depends on the average score of the experimental class (M_E), the average gain of the control class (M_K), and the standard deviations of the experimental class (SD_E) and control class (SD_C).

FINDINGS AND DISCUSSIONS

Generally, students' attitudes towards the environment experienced a quite significant improvement because the average score of students' pre-test was lower than their posttest, where the control class score had an increase from 81.00 to 90.00, meaning that the improvement was 9. Meanwhile, the experimental class's score increased for 11 points from the average score of 82.00 to 93.00. The normalized gain score of the control class and experimental class were both in the middle criteria, with a little gap, 0.47 and 0.61 for the control class and experimental class, respectively.

The interpretations of students' environmental attitudes were obtained from observation sheets of

three different sources: 1) parents who did a direct observation towards their children as the participants in their house; 2) subject teacher and homeroom teacher who observed the entire students' activity, where students as the research's participant were at school; and 3) fellow students who directly evaluated their own group members, in which one student evaluated two students. The sketch of students' attitudes towards the environment at home and at school could be seen in detail in the appendix. In addition, the final results could be seen in Table 2.

There was significant improvement in students' environmental attitudes based on the observation from parents, the average score from teachers (homeroom and subject teachers), and the average score from peers every week. The average observation scores from parents and peers were very good, while the average score from teacher was only 75.94% which is considered as good. Meanwhile, the scores of students' environmental attitude observation for the control class can be seen in Table 3.

Table 1. Average normalized gain scores of students' attitudes towards the environment on the theme of waste and its management

	Pretest	Posttest	<g>	Criteria
Control Class	81	90	0.47	Middle
Experimental Class	82	93	0.61	Middle

Table 2. Experimental class students' environmental attitude scores

Average score every week	Week 1	Week 2	Week 3	Average	Criteria
Parents	74.43%	80.57%	88.28%	81.09%	Very Good
Teacher	60.52%	81.56%	85.73%	75.94%	Good
Peers	81.09%	90.99%	91.67%	87.92%	Very Good

Table 3. Control class students' environmental attitude scores

Average Score every week	Week 1	Week 2	Week 3	Average	Criteria
Parents	68.52%	84.29%	86.71%	79.84%	Good
Teacher	67.38%	77.38%	74.25%	74.25%	Good
Peers	77.43%	77.67%	79.06%	78.06%	Good

An improvement could be found in the results obtained from the observations carried out by parents, teacher, and peers towards the control class students, in which the average score was at the category of good. The difference of students' environmental attitude improvement scores between the control class and experimental class is presented in the Figure 1.

Based on the observation scores from parents, teachers, and peers carried out on a weekly basis, it

can be concluded that: 1) The implementation of project-based learning model could enhance students' environmental attitude every week at home which was closely observed by parents, and at school with teacher and peers as the observers; 2) There was a difference between the students' environmental attitude scores for the class where project-based learning with mind map was implemented and the ones in the class that implemented project-based learning without mind map. The experimental class

obtained an average score of 81.62% which is higher than the average score of the control class, which was 77.39%.

The effectiveness of the implementation of project-based learning with mind map in improving students' environmental attitudes can be seen in Table 4.

The effect size score of 0.37 point, which is considered as small effect, means that there the

implementation of the project-based learning with mind map in science learning activity on the theme of waste and its management had some contribution towards students' environmental attitudes. Nevertheless, the real impacts in the students' real world cannot be formed in number. However, it is more important to have a better attitude with applicable actions, which were observed in this study.

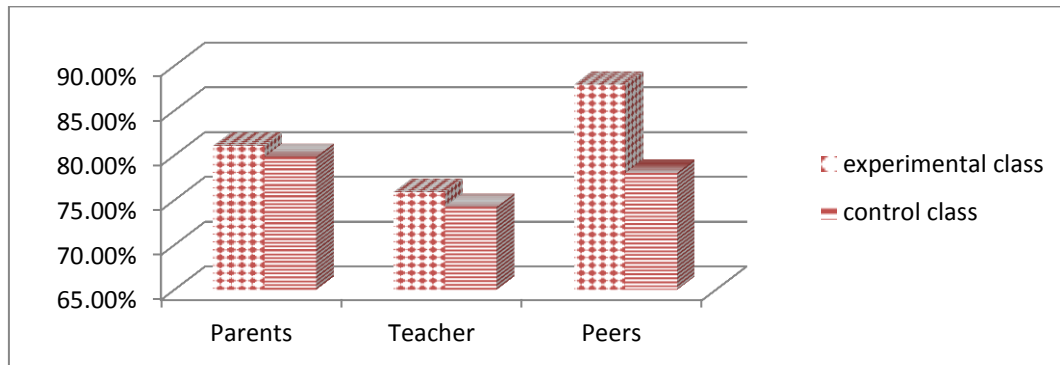


Figure 1. Difference in the average score of control class and experimental class students' environmental attitudes

Table 4. The effectiveness of the implementation of project-based learning with mind maps in improving students' environmental attitudes

	Result	Environmental Attitudes
Experimental Class	Average Gain	12
	Standard Deviation	7.48
Control Class	Average Gain	9
	Standard Deviation	8.77
<i>Effect Size (d)</i>		0.37
Interpretation		Small

After analyzing the findings of this study, the impact of implementing project based learning on the theme of waste and its management is that it improved students' environmental attitudes. The finding of this study is in accordance with the study conducted by Selçuk (2010) which concluded that learning based on daily life's issues could give a wider and more actual learning experience and could enhance one's caring attitude towards the environment. Furthermore, this finding is also in line with that of Wibowo (2009) who argued that project-based learning strategy has influenced students' attitudes in conserving the environment. Mahanal, et al. (2010) also put forward the same idea about life learning based on projects that could affect students' attitude development. Another study conducted by Pitipontapin & Pensang (2015) supports this argument as well, in which they argued that the best practice in learning process is implementing project based learning in order to develop students' attitude toward learning process. This explains that a direct experience in teaching is a key element in any learning process and can help prepare students to learn from daily life activities. This study has confirmed that project-based learning could motivate students to be interested in learning and could make students more confident. This fact is supported by the study conducted by Çakiki & Türkmen (2013), which concluded that project-based learning has significantly increased students' attitudes in learning.

Attitude is a predisposition or tendency learned by an individual to respond positively or

negatively with decent or adequate intensity toward an object, situation, concept, or other people [Fishbein & Ajzen, 1980]. This attitude navigates one's action, because attitude is a tendency to behave. Fishbein and Ajzen (1980) added that the attitude part includes cognitive abilities. Attitude is able to limit or to help someone to explain the skill and knowledge that have been mastered. Based on that statement, evaluating one's attitude is not sufficient using attitude scale only, as it involves cognitive aspects. In fact, the evaluation of attitudes leading to behavior is needed as well. Therefore, the attitude evaluation using observation sheet is needed, to get an accurate measurement. A proper and accurate measurement tool to evaluate the change in one's attitude is also argued by Brossard et al. (2005). That is why the present research also employed observations to measure students' attitudes towards the environment.

More particularly, the observations in this research were conducted by parents, teachers, and peers to get a thorough and great attention concerning students' environmental attitudes. The design of observations by three different parties is in accordance with Arnold et al. (2009) who suggested that forming students' caring attitude towards the environment positively needs great attention and influence from parents, experience, peers, and teacher.

The data from observations also indicated that there is improvement in the students' environmental attitudes as shown by the attitude scores given by the

peers, teachers, and parents. This finding is also claimed by Sarkar (2011) who concluded that there is relation between environmental caring attitude with behavior or action that drives a teenager to care for their peers and the environment in Bangladesh. This proves that tracking attitude evaluation is not sufficient by doing a test only, but the reality of attitude evaluation should be evaluating fully the attitude and behavior of students in daily life; thus, the evaluation needs an additional instrument in the form of observation sheet completed with a journal to get valid data. This is in line with Darmansyah's statement (2014, p.10) that there are four types of evaluation that can be applied by teachers to evaluate students' attitudes: 1) independent evaluation; 2) teacher observation; 3) peer assessment; and 4) daily journal.

Moreover, Table 4.6 shows the effectiveness of implementing project-based learning model with mind maps which influences students' environmental attitudes because it shows 0.37 point, labeled into a small category. This means there is a contribution in implementing project-based learning model with mind maps in science learning on the theme of waste and its management toward students' improved environmental attitudes. Albeit in the actual implementation the improvement of attitudes cannot be only measured by number, the most important thing of all is the real action. The effectiveness of implementing-project based learning toward students' environmental attitudes is in accordance with the study conducted by Mahanal (2010) who stated that to enhance students' attitude towards the environment, teachers who design the learning activity should enable students to interact with members within the same group and with other groups in solving the environmental issues such as a project-based learning. In fact, it is in line with Vygotsky (1978) who stated that in project-based learning, there is cooperative value which enables student to interact with other students.

CONCLUSION

Based on the findings elaborated above, it can be concluded that the implementation of project-based learning model with mind maps on the theme of waste and its management was able to enhance students' environmental attitudes, which was better than the learning activity without mind map. Furthermore, that implementation is effective in elevating students' environmental caring attitudes toward waste and its management. The findings give some implications for the teachers of science to employ the learning model in order not only to increase students' knowledge but also awareness of the environmental problems.

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