Ecopreneurship-Oriented Project-Based Learning (PBL): An Approach to Enhance Students’ Problem-Solving Skill

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Abstract. This research aims to analyze the enhancement of students’ problem-solving skills by implementing ecopreneurship-oriented Project-Based Learning (PBL). The type of this research is descriptive quantitative with True Experimental Methods and Control Group Pre-Test and Post-Test Design, which is applied to 49 science-majored sophomore students in SMA Negeri 1 Mojosari, Mojokerto which are chosen by purposive sampling technique. The instruments of this research are problem-solving pre-test and post-test in which the result is analyzed using normalized gain test and the Mann-Whitney test. Based on the data analysis, the result obtained is that there is a significant difference between students’ problem-solving skills in the experimental class and the control class, where the experimental class’ n-gain score is 0.83 in high criteria whereas the control class’ is 0.53 in medium criteria. It can be concluded that ecopreneurship-oriented PBL model can enhance students’ problem-solving skill.

1. Introduction
The low quality of Indonesia’s education has caused its human resources to be uncompetitive during 21st Century [1]. That low quality in education can probably caused by Indonesia’s learning process that tends to be theoretical rather than applicable [2], so that the students can not relate the materials which has been taught at school to the real-life topics. Thus, in the learning year of 2013/2014 the governmen began to implement 2013 Curriculum which is expected to overcome the problem of human resources in Indonesia [3].

The 2013 Curriculum aims to enhance students’ soft skills and hard skills [4] to deal with global competition in 21st Century by implementing scientific approach. Scientific approach becomes more meaningful when students are able to apply and enhance their ability in creating products [5]. This ability in learning process can be done through project-based learning model, which is one out of three recommended learning models in the implementation of 2013 Curriculum.

Project-based learning is a learning model that involves students, within groups, to design, make, and display product based on the learning competencies and goals to overcome real life problems (social problems and environmental problems) [6,7]. In addition to apply and enhance students’ ability in creating products, project based learning, theoretically, can also be used to improve students’ problem solving-skill [8,9,10], which is considered to be one of the skills needed in order to be a competitive human resources in 21st Century [11].

Problem-solving skill is defined as students’ ability in thinking, based on the knowledge that owned by them, to give suitable solution to the problem that is being solved [12]. At school this skill can be trained through physics [13]. There are four base steps in problem-solving [14] that can be expanded to be problem-solving skill indicators in physics, namely (1) useful description: (2) physics
approach; (3) specific application; (4) mathematical procedures; and (5) logical progression [15]. Based on some research that have been conducted, Indonesia’s students’ problem-solving skill in physics are still considered to be low [16,17,18]. Those findings show that the learning that have been conducted until now can not facilitate students to practice and enhance their problem-solving skill. Students’ problem-solving skill in physics, by theory, can be improved by implementing project-based learning as described on the previous paragraph. Some research has also proven and concluded that this model can improve students’ problem-solving skill [19,20,21]. An innovation can also be undergone in implementing project-based learning to gain more maximal results. On this research, project-based learning is oriented to ecopreneurship concept. Ecopreneurship is a branch of entrepreneurship field that takes into account the environmental problems as the basis of innovation [22]. Ecopreneurship selected as the innovation in implementing project-based learning based on the consideration that environmental problems is one of the issues which affect the lives that must be faced by students in the future [23]. Therefore, students also have to be equipped with the skills to keep the environment as well as addressing environmental problems.

In implementing the ecopreneurship-oriented project-based learning model, dynamic fluid has been chosen as the material used on this research. The main consideration of the material chosen is the material’s basic competency in 2013 Curriculum, which requires students to be able to apply the concept and create simple project related to the dynamic fluid. In order for the dynamic fluid concepts to be capable of supporting ecopreneurship-oriented project-based learning, the assignments on the project-based learning model must be associated with environmental problems, such as the availability of water, flooding, availability of renewable energy, and the effects of tornado.

Based on the description in the previous paragraphs, the researchers is interested in knowing students’ enhancement in problem-solving skill after the implementation of ecopreneurship-oriented project-based learning. Thus, this research is held with the title: “Ecopreneurship-oriented Project-Based Learning: An Approach to Enhance Students’ Problem-Solving Skill” and aimed to analyze the enhancement of students’ problem-solving skills by implementing ecopreneurship-oriented project-based learning.

2. Method
This research used True Experimental methods and Control Group Pre-test and Post-test design, which is applied to 49 science-majored sophomore students in SMA Negeri 1 Mojosari, Mojokerto which are chosen by purposive sampling technique. The samples was actually came from two classes, where one of them would be the control class and the other would be the experimental class. In the control class, physics learning was conducted by implementing a traditional model (using lecture method) that is oriented towards the concept of ecopreneurship and used understanding worksheet, whereas, in the experimental class, physics learning was carried out using ecopreneurship-oriented project-based learning model and also used understanding worksheets. The understanding worksheet was used to practice students to apply problem-solving steps in solving the chosen environmental issue. The instruments of this research are problem-solving pre-test and post-test that have been adjusted to problem-solving skill indicators by Doktor et al. [15], in which the result was analyzed using normalized gain test and the Mann-Whitney test. Before the understanding worksheet and problem-solving skill pre-test and post-test were applied to the sample classes, they had been validated to two physics lecturers in Universitas Negeri Surabaya. The problem-solving skill pre-test and post-test itself, after the validation process by the lecturers, was applied to non-sample class in order to analyze the validaty, reliability, difficulty level, and differentiating ability.

3. Results and Discussion
3.1 Results
The items of problem-solving skill pre-test and post-test which stated to be valid, reliable, have average difficulty level, and good ability to differentiate non-sample class skill were applied to sample classes. After the sample classes did the learning and the tests, the first thing to do with the results of problem-solving pre-test and post-test is to analyze it using normalized gain test. Normalized gain test will give global description on control class and experimental class students’ problem-solving skill
before and after the learning. Normalized gain test starts by calculating normalized gain score (n-gain score) using the control class’ and experimental class’ problem-solving skill pre-test and post-test data results, categorising them based on n-gain score interpretation [24], then ends by comparing the n-gain score of both classes. Here is a table showing the mean result of problem-solving skill pre-test and post-test n-gain score of each sample class on each indicator of problem-solving skill.

### Table 1. Control Class’ and Experimental Class’ Mean N-Gain Score on Each Indicator of Problem-Solving Skill.

| Problem-Solving Indicators | Sample     | Control Class | Experimental Class |
|----------------------------|------------|---------------|-------------------|
|                            | N-Gain Score | Category | N-Gain Score | Category |
| Useful Description         | 0,05       | Low         | 0,67         | Moderate |
| Physical Approach          | 0,74       | High        | 0,97         | High     |
| Specific Application       | 0,59       | Moderate    | 0,87         | High     |
| Mathematical Procedures    | 0,61       | Moderate    | 0,98         | High     |
| Logical Progression        | 0,22       | Low         | 0,51         | Moderate |

Here is a table showing the mean result of problem-solving skill pre-test and post-test n-gain score of each sample class.

### Table 2. Control Class’ and Experimental Class’ Mean N-Gain Score of Problem-Solving Skill.

| Sample       | N-gain Score | Category |
|--------------|--------------|----------|
| Control Class| 0,53         | Moderate |
| Experimental Class | 0,83 | High     |

Based on the table 1 and table 2, it is clearly known that experimental class gains higher enhancement on each aspect of problem-solving skill than control class, but it does not say whether the n-gain score difference between both classes is significant or not. In order to know the significance of n-gain score difference between both classes, the Mann-Whitney test was used. Here is a table showing the result of Mann-Whitney test.

### Table 3. The Result of Mann-Whitney Test.

| Sample       | U         | μU       | ΣT   | δcombined | Z_{counted} | Z_{table} |
|--------------|-----------|----------|------|------------|-------------|------------|
| Control Class| 523       | 24,5     | 51,5 | 49,61      | -0,50       | 0,0385     |
| Experimental Class | 106 | 24,5     | 51,5 | 49,61      | -0,50       | 0,0385     |

Table 3 shows that the Z_{counted} is not located between Z_{table} and -Z_{table}. According to this result, it is known that there is significance difference between control class’ and experimental class’ n-gain score of problem-solving skill.

### 3.2 Discussion

According to Table 1, vary enhancement on problem-solving skill indicators is gained by the control class and experimental class. Both sample classes gained higher enhancement on physics approach aspect, specific application aspect, and mathematical procedures aspect than the other two indicators. This finding could happen due to the students of both sample classes get used to practice physics by using problems that required physics application and mathematical procedures only, which are basic physic problem form. Those kind of physics problems are less accommodating to students to identify useful and important statements to be considered and draw relevant conclusions and decisions based on the result they get from doing the mathematical procedures. Then, Table 2 shows that the experimental class’s enhancement on problem-solving skill is higher than the control class and based on Table 3 there is significance difference between both sample classes’ n-gain score of problem-
solving skill. Some researches have also gained the same results to what is shown on Table 2 and Table 3 [19,20,21].

By taking one aspect to be discussed, useful description aspect of the experimental class’ students is categorized as moderate, which is better than the control class’ students that is in low category. This finding happened due to the students of experimental class train to understand the problem by describing it first [19]. On this research, it is practiced when students work on project and understanding worksheets during the physics learning through ecopreneurship-oriented project-based learning. Relatedly to that reasoning, the researcher infer that the enhancement of the other four problem-solving skill aspects, which is better in the experimental class, caused by the similar reason. The enhancement of physics approach aspect, specific application aspect, and mathematical procedures aspect in the experimental class is supported by project making activity where the students actively apply physics concept into the chosen environmental issue. These statements imply that through meaningful experience, such as every step of project-based learning that required students to design and make a project to give suitable solution to the chosen problem, students are asked to use their problem-solving skill and creativity in understanding a concept so that they can apply the concept to solve a problem [21,25].

4. Conclusion
Based on the results obtained can be concluded that learning physics using ecopreneurship-oriented project-based learning can enhance students’ problem-solving skill, especially related to environmental issues. Ecopreneurship-oriented PBL model not only let students to learn physics concept on their own in a different way by doing a project, but also practice and enhance skills which are important to be owned in 21st Century, such as problem-solving skill and project-making skill. Based on the findings, the researchers believe that ecopreneurship-oriented PBL model should be applied more, either in physics or other variety of subjects that are taught in schools in order to give students an interesting and valuable learning experience. By doing this kind of learning, it is expected that learning process will tends to be applicable rather than theoretical.

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References
[1] Widodo H 2015 Cendekia: J. Kependidikan Kemasyarakatan. 13 293
[2] Widiaworo E 2017 Inovasi Pembelajaran Berbasis Life Skill & Entrepreneurship (Yogyakarta : Ar-Ruzz Media)
[3] Patimah 2016 Al Ibtida 3 147
[4] Shafa S 2014 Dinamika Ilmu 14 81
[5] Yamin Y, Permanasari A, Redjeki S, and Sopandi W 2017 J. Phys.: Conf. Ser. 895 012153
[6] Goldstein O 2016 Cogent Educ. 3 1
[7] Isro’katun and Rosmala A 2018 Model-Model Pembelajaran Matematika (Jakarta : Bumi Aksara)
[8] Sumarni W 2013 Int. J. Sci. Res. 4 478
[9] Gonzales J 2016 Project Based Learning : Start Here (www.cultofpedagogy.com)
[10] Krish N 2017 Project-Based Learning : Taking Students to a Deeper Level (www.gettingsmart.com)
[11] Zubaidah S 2016 Keterampilan Abad Ke-21: Keterampilan Yang Diajarkan Melalui Pembelajaran Seminar Nasional Pendidikan Program Pendidikan Biologi STKIP Persada Katulistiwa Sintang - Kalimantan Barat (Sintang: STKIP Persada Khatulistiwa).
[12] Yusuf M and Prabowo 2016 Deskripsi Problem Solving Skill Peserta Didik pada Pembelajaran Fisika Prosiding Pertemuan Ilmiah XXX HFI Jateng (Salatiga: Universitas Kristen Satya Wacana)

[13] Departemen Pendidikan Nasional 2013 Definisi Ilmu Pengetahuan Alam (IPA) (Jakarta: Departemen Pendidikan Nasional)

[14] Gok T 2010 Eurasian J. Phys. Chem. Educ. 2 110

[15] Docktor J L, J Dornfeld, E Frodermann, K Heller and L Hsu 2016 Phys. Rev. Phys. Educ. Res. 12 010130

[16] Mustofa M H and D Rusdiana 2016 J. Penelit. Pengemb. Pendidik. Fis. 2 15

[17] Pradugawati D, M Diantoro and Sutopo 2016 Pros. Semin. Nas. Pendidik. IPA Pascasarjana UM 1 146

[18] Susiana N, Lyuliati, and E Latifah 2017 Analisis Pembelajaran Berdasarkan Profil Kemampuan Pemecahan Masalah Fisika Siswa Kelas X SMA Prosiding Seminar Nasional III Tahun 2017 (Malang: Universitas Muhammadiyah Malang) 240

[19] Dewi B M M, N Khoiri, and U Kultsum 2017 J. Penelit. Pembelajaran Fis. 8 8

[20] Tamba P, Motlan, and Turnip B M 2017 IOSR J. Res. Method Educ. 7 67

[21] Makrufi A, Hidayat A, Muhardjit and SRIWATI E 2018 J Pendidik. : Teori Penelit. Pengembangan 3 878

[22] Isaak R 2002 The Making of the Ecopreneur (USA : Greenhalf Publishing)

[23] Zulfa V, Max M, Hukum I and Ilyas I 2016 J. Green Growth Manaj. Lingkung. 5 30

[24] Sundayana R 2016 Statistika Penelitian Pendidikan (Bandung : CV. Alfabeta)

[25] Rahmazatullaili, Zubainur C M and Munzir S Beta: J. Tadris Matematika 10 166