Development of environmental literacy of student teachers on Green Living theme

I Farida¹* and Hadiansah²

¹Departement of Chemistry Education, UIN Sunan Gunung Djati Bandung, Bandung, Indonesia
²Departement of Biology Education, UIN Sunan Gunung Djati Bandung, Bandung, Indonesia

*farchemia65@uinsgd.ac.id

Abstract. This study aims to analyze the profile of environmental literacy of student teachers developed through project-based learning on the theme of green living. The research subjects involved 20 student teachers. The research instruments used were as follows: 1) Observation format, 2) Project-based worksheets, 3) Questionnaire for measuring environmental literacy. In this research has been applied Subtheme Save our water related to the concept of colloid. Project-based learning can help students have the creativity to think, solve problems, and interact with each other to solve real problems through inquiry activities. From analysis data, most students (85%) showed good environmental literacy. Most students have good knowledge (83%) and attitude (90%) towards the environment, and have the awareness to act (81%) to preserve the environment.

1. Introduction

Development of environmental literacy is essential for maintaining the quality of the environment[1]. The sustainability of environmental preservation needs to be developed continuously through environmental education[2]. Environmental literacy is knowledge of environmental issues and concepts, attitude disposition, motivation, cognitive abilities, skills, beliefs and behaviors in decision-making related to the environmental context[3]. Someone who has a literacy environment using critical thinking to solve problems and make decisions to solve environmental problems. [4]. He/she has a willingness to act on goals that improve the welfare of other individuals, society and the global environment, and be able to participate in public life [5].

Student teachers need to be equipped with environmental literacy skills, because one day they have to educate their students in order to have values and good character. Based on that thought, the environmental literacy ability of the student teachers needs to be developed in the relevant lecture program by using the appropriate learning approach. The environmental literacy preparation program for student teachers through project-based learning has been developed by Farida et al[6]. This paper presents the results of the application of project-based learning designs on the Green Living theme to develop the environmental literacy of student teachers.

2. Method

This paper reports the advanced stages of research and development carried out by Farida, et al [6]. The first and second stages of research have produced project-based learning models to develop environmental literacy. This paper describes the results of limited trials to evaluate the feasibility of the lecture program that has been prepared. The subjects of the study were 20 student teachers in the Department of Mathematics and Natural Sciences Education. The research instruments used were as...
follows: 1) Observation format, 2) Project-based worksheets, 3) Questionnaire for measuring environmental literacy. The total number of the statement is 52 statements with the choices of the answer are as follows: Strongly Agree (SA), Agree (A), Disagree (D) and Strongly Disagree (SD). For positive statement (favorable), the score for SA=4, A=3, D=2, and SD=1. In contrast, for the negative statement (unfavorable), the score for SA=1, A=2, D=3 and SD=4.

3. Result and Discussion

Project-based learning design to develop environmental literacy is packaged in one theme, namely the Green Living Theme [6]. This theme is outlined into four sub-themes, namely: 1) Save our water; 2) Save our Soil; 3) Use eco-friendly products; 4) Waste for life. The theme of ‘Green Living’ is a theme that is intended to provide awareness of the importance of managing the environment to prevent global warming [7]. Each sub-theme is a basic science content that does not have a hierarchy, so that it can be taught separately or inserted in the relevant course content. In the trial, this lecture program was carried out in Environmental Chemistry courses. In this research has been applied Subtheme Save our water related to the concept of colloid. Content that learned are: 1) The use of water and detergent wisely for washing and everyday purposes connected the water cycle in nature; 2) The process of cleaning stains on clothes using water and detergent; 3) The process of purifying dirty water. The content relates to the use of emulsifier and coagulant to colloidal separation process [8]. There are three main activities carried out by student teachers on sub-theme learning: 1) Analyze the relationship of water cycles in nature with actions to conserve water; 2) Designing experiments using detergent wisely; 3) Designing a water purification project.

In the first activity, students examine the problem: ‘How is the relationship of the water cycle in nature with water saving measures?’ Students conduct activities to identify, arrange sequences and provide explanations using concept cards about the water cycle and its relation to the action of saving water. Then the students collect data on water utilization activities for daily needs, including: recording the amount of water needed every day of the week by family members, creating tables and graphs to present data resulting from recording water needs for daily activities, identify activities that require a lot of water and provide suggestions for actions that can be taken to save water. The results of the discussion are written in the form of posters and presented by each group by visiting the works.

In the project to save water for washing clothes, the main activities carried out are as follows: 1) Read discourse about using detergents wisely; 2) Discuss in groups to answer the question: why is detergent needed to clean fat stains on clothes? Can grease and oil stains be cleaned only with water? How your habit of using detergent, according to a certain is amount or is it arbitrary? What is the impact of excessive use of detergent on the environment? 3) Design an experiment to determine the factors that affect the level of cleanliness, among others: detergent mass, the amount of water, the frequency and duration of mechanical motion and the duration of immersion. Each student group examines one of the factors according to their agreement with another group; 4) they formulate the problem and hypothesis. They determine which variable is the independent variable, the control variable and the dependent variable. 5) The results of the variable determination are used to construct the experimental design to obtain data. The project to use detergent wisely is important to be developed, because water pollution is mostly caused by the use of detergents that are mistaken in households [9]. Most people think that the more detergent used, the more clean clothes will be. This misunderstanding must be changed through education.

In the project designing and making a simple water purification prototype; first, students read and/or browse the literature about purifying dirty water. The steering questions submitted on the worksheet include: 1) How are the requirements of clean water in the physical, chemical and biological environment? 2) What should we do if the water used for daily needs does not meet the requirements of clean water? 3) What is an effective water purification prototype design? A referring question is asked to keep students focused on achieving the project objectives [10]. Then, students discuss water purification projects using tools and materials that are easily available in the environment, determine their own themes and objectives, design steps for making these tools, arrange a schedule of implementation activities, complete the design, compile group reports and then present, and assess the products produced by other groups using the assessment rubric. In these learning activities, lecturers and students collaboratively compile a schedule of activities in completing the project: (1) create a timeline to complete the project, (2) encourage students to plan new ways, (3) direct students when they
make ways that are not related to project, and (4) asking students to make an explanation about the selection of a method used in working on the project. Through project-based learning, student teachers can be empowered in order to acquire new knowledge and understanding based on his own experiences through exploration [11]. Project-based learning can help students have the creativity to think, solve problems, and interact with each other to solve real problems through inquiry activities[12][13]Assessment of the products is done by fellow students and by lecturers according to agreed assessment criteria. Assessment is done to measure the achievement of competency standards and get feedback on the achievement of student learning outcomes [14].

Table 1 describes the percentage of student responses (N=20) that show the profile of environmental literacy on aspects of knowledge, attitude and awareness to act.

| No | Statement                                                                                                                                   | % Response to each score |
|----|-----------------------------------------------------------------------------------------------------------------------------------------------|--------------------------|
| A  | Knowledge about environment                                                                                                                   |                          |
| 1  | Trees in plantations cause less water to flow into the river. (+)                                                                        | 30 58 12 0              |
| 2  | Oceans play an important role in absorbing carbon dioxide which results in a decrease in sea water temperature and affect global warming. (-)   | 2 19 60 4               |
| 3  | Excessive use of natural resources can cause environmental problems such as habitat destruction of living organisms (+)                 | 63 37 0 0               |
| 4  | Energy from the sun is passed to animals through food chains and webs (+)                                                                  | 19 68 12 0              |
| 5  | The loss of wildlife habitat contributes to the threat of extinction of wildlife species. (+)                                               | 53 46 2 0               |
| 6  | Coal combustion releases gas into the atmosphere which affects the endurance of living organisms. (+)                                      | 19 68 12 0              |
| 7  | Carbon dioxide produced by burning coal causes global warming. (+)                                                                         | 4 49 30 18              |
| 8  | Coal is an inexhaustible natural resource (-)                                                                                        | 37 39 21 4              |
| 9  | The individual actions such as collecting cans for recycling have no effect on environmental sustainability, (-)                           | 51 30 14 5              |
| 10 | High concentration of waste in an area will result in reduced oxygen dissolved in water. (+)                                              | 37 61 0 2               |
| 11 | Plant waste can be discharged into the river, because little effect on biological life on the river. (-)                                     | 67 18 14 2              |
| 12 | Harmful gases in the atmosphere can be reduced if people do not use aerosol.(+)                                                               | 7 72 18 4               |
| 13 | If the ozone hole gets worse, excessive ultraviolet sunlight will reach the earth.(+)                                                      | 49 44 7 0               |
| 14 | It is very important to make compost from biodegradable home waste. (+)                                                                     | 44 56 0 0               |
| 15 | Misuse of natural resources will not affect humans. (-)                                                                                  | 72 14 11 4              |
| 16 | The amount of water on earth is constant and can be used repeatedly. (-)                                                                    | 12 42 33 12             |
| 17 | Consumers should be able to evaluate the benefits and disadvantages of a product on the environment when bought. (+)                          | 39 60 0 2               |
| 18 | Recycling of paper will reduce the felling of trees for commercial purposes. (+)                                                              | 44 47 4 1               |
| 19 | The advantage of using modern products is more important than the pollution due to the use of these products. (-)                             | 39 37 19 5              |
| 20 | Solving environmental problems solely the responsibility of the government. (-)                                                             | 65 19 14 2              |
| 21 | Sustainable mechanisms for recycling waste have not been developed by the community (+)                                                   | 21 60 18 1              |
| 22 | Society tends to choose a short gain rather than considering the long-term effects on the environment. (+)                                    | 42 46 9 2               |
| 23 | Turn on the lights during the day is a behavior that does not support the environmental equilibrium. (+)                                      | 46 51 3 0               |
| 24 | Green open spaces in urban areas only adds to the government's budget, better make new commercial buildings so that the city increasingly advanced (-) | 63 23 12 2              |
| 25 | Mean                                                                                                                                    | 39 44 14 3              |

| B  | Attitudes toward environment                                                                                                                    |                          |
| 1  | I do not care about the land that is used as a place for shepherds, because it is not harmful to the environment.(-)                                    | 7 51 37 5              |
| 2  | I'm not worried about the massive killing of wild animals, because the balance of nature can recover in the future. (-)                            | 58 37 2 3              |
Based on table 1, most students (85%) showed good environmental literacy. In the aspect of knowledge, the percentage of students who reach score 4 is 39% and score 3 is 44%. This shows that most students (83%) have an understanding of a good environment. In the aspect of attitude, 30% of students get a score of 4 and 60% of students get a score of 3. In this score range, most students (90%) have an attitude (83%) have an understanding of a good environment. In the aspect of awareness to actively participate in maintaining the environment, most students (85%) showed good environmental literacy. In the aspect of knowledge, most students (83%) have an understanding of a good environment. In the aspect of attitude, most students (90%) have an attitude towards a good environment. In the aspect of awareness to act for the environment, most students (81%) have the awareness to actively participate in maintaining the environment. Further analysis is needed to determine the significance of the influence of the learning process carried out on students' environmental literacy changes.

4. Conclusion
In this research has been applied Subtheme Save our water related to the concept of colloid. Content that learned are: 1) The use of water and detergent wisely for washing and everyday purposes connected the water cycle in nature; 2) The process of cleaning stains on clothes using water and detergent; 3) The process of purifying dirty water. Project-based learning can help students have the creativity to think, solve problems, and interact with each other to solve real problems through inquiry activities. Most students (85%) showed good environmental literacy. In the aspect of knowledge, most students (83%) have an understanding of a good environment. In the aspect of attitude, most students (90%) have an attitude towards a good environment. In the aspect of awareness to act for the environment, most students (81%) have the awareness to actively participate in maintaining the environment. Further
analysis is needed to determine the significance of the influence of the learning process carried out on students' environmental literacy changes.

Acknowledgment
Acknowledgments and awards were presented to the Research and Publication Center - Institute for Research and Community Service UIN Sunan Gunung Djati Bandung which has helped facilitate research funds and publications.

References
[1] M. Kubiatko, “The Environmental Literacy of Lower Secondary School Pupils, High School and College Students,” J. Environ. Sci. Eng. Technol., vol. 2, pp. 2–8, 2014.
[2] A. Blessing, “Environmental Literacy Assessment: Exploring the Potential for the Assessment of Environmental Education / Programs in Ontario Schools,” Int. J. Cross Discip. Subj. Educ., vol. 3, no. 1, pp. 648–656, 2012.
[3] K. S. Hollweg, J. R. Taylor, R. W. Bybee, T. J. Marcinkowski, W. C. McBeth, and P. Zoido, Developing a framework for assessing environmental literacy. 2011.
[4] M. Morrone, K. Mancl, and K. Carr, “Development of a Metric to Test Group Differences in Ecological Knowledge as One Component of Environmental Literacy,” J. Environ. Educ., vol. 32, no. 4, pp. 33–42, 2001.
[5] R. St. Clair, “Words for the world: Creating critical environmental literacy for adults,” New Dir. Adult Cont. Educ., vol. 2003, no. 99, pp. 69–78, 2003.
[6] I. Farida, H. Hadiansyah, M. Mahmud, and A. Munandar, “Project-Based Learning Design for Internalization of Environmental Literacy with Islamic Values,” J. Pendidik. IPA Indones., vol. 6, no. 2, pp. 277–284, 2017.
[7] V. Castán Broto and H. Bulkeley, “A survey of urban climate change experiments in 100 cities,” Glob. Environ. Chang., vol. 23, no. 1, pp. 92–102, Feb. 2013.
[8] I. Farida, “Profil Keterampilan Argumentasi Siswa Pada Konsep Koloid Yang Dikembangkan Melalui Pembelajaran Inkuiri Argumentatif,” Edusains, vol. 6, no. 1, pp. 31–40, 2014.
[9] S. E. Hobbie et al., “Contrasting nitrogen and phosphorus budgets in urban watersheds and implications for managing urban water pollution,” Proc. Natl. Acad. Sci., vol. 114, no. 20, pp. 1–6, 2017.
[10] I. Farida, I. Helsy, and M. Nurmelati, “Pengembangan Prototype Reaktor Dan Prosedur Eksperimen Pembuatan Biogas Skala Rumah Tangga Dari Sampah Organik Untuk Pembelajaran Kimia,” in Seminar Nasional Sains dan Teknologi, 2015, no. DOI: 10.13140/RG.2.1.1309.192.
[11] J. S. Krajcik and P. C. Blumenfeld, “Project-Based Learning,” in The Cambridge Handbook of the Learning Sciences, R. K. Sawyer, Ed. St. Louis: Cambridge University Press, 2006, pp. 317–334.
[12] S. Sari, R. Ratnasari, and I. Farida, “Pengembangan Sikap Kreatif Siswa Pada Praktikum Penjernihan Air,” EduChemia (Jurnal Kim. dan Pendidikan), vol. 1, no. 2, pp. 124–136, 2016.
[13] E. S. Bahriah, S. Suryaningih, and D. Yuniati, “Pembelajaran Berbasis Proyek Pada Konsep Koloid Untuk Pengembangan Keterampilan Proses Sains Siswa,” J. Tadris Kim., vol. 2, no. 2, pp. 145–152, 2017.
[14] I. Farida, Evaluasi Pembelajaran Berdasarkan Kurikulum Nasional. Bandung: PT Remaja Rosda Karya, 2017.