Environmental literacy of biology undergraduate students in Jakarta: Profile and comparative analysis

D V Sigit*, E P Azrai, D N Setyawati and I Z Ichsan

Biology Education Program, Faculty of Mathematics and Natural Science, Universitas Negeri Jakarta, Indonesia

*dianav@unj.ac.id

Abstract. Environmental Literacy (EL) was the ability to interpret and take appropriate action on environmental systems that purpose to conserve, restore and improve the environment. This study aimed to determine the EL level of biology undergraduate students. The method used the descriptive method. There were 6 indicators in EL. Data were obtained from 197 samples of the 4th semester of biology undergraduate students in the 2017-2018 from 5 universities in Jakarta which consists of Biology Science program and Biology Education program. The results were level EL of biology undergraduate student in the high category. Based on their majors, the EL of undergraduate students in biology science was higher than undergraduate students in biology education. Differences in EL levels based on gender, female was higher than Male. In conclusion, the Biology undergraduate student's EL varies from various aspects. The institution has an important role to enhance the student EL. Therefore, a student should increase the EL.

1. Introduction

Jakarta, as the National Capital of Indonesia, has become a center of activity so that it experiences rapid development in various sectors. As the center of government, Jakarta is an example for other regions in Indonesia. Development in the city of Jakarta besides being able to improve the welfare of the community through development and development of civilization can also add to the burden on the environment mainly due to the increase in solid, liquid and gas wastes resulting from business activities that have impacted on reducing land and environmental carrying capacity [1–3]. Environmental burden causes Jakarta to be vigilant on the Environmental Quality Index. This condition cannot be separated from the role of the people of Jakarta, one of which is influenced by Environmental Literacy (EL).

Environmental Literacy (EL) is the ability to interpret environmental health systems and take appropriate actions to maintain, restore, or improve the environmental system to be healthy. EL involves awareness and sensitivity to the environment, knowledge, and understanding of how humans interact with natural systems, problems and issues related to the environment on a local, national, international, and global scale [4,5]. EL involves more than just knowledge about the environment but also involves values, attitudes, skills, and behavior [6]. The results of this kind of understanding help arouse attention among individuals in creating a willingness to act to overcome environmental problems [5,7,8].

Another thing that is related to EL is environmental knowledge and ecological concepts, which are supported by attitudes and concerns for the environment that will motivate environmental caring behavior [9,10]. Environmental awareness is illustrated by the tendency to solve environmental
problems. EL is indicated by the ability to solve problems. Individual or group participation in solving environmental problems is the goal of EL [8,11].

Previous research related to EL measured a lot about EL undergraduate students but generally from various study programs [6,8,12]. In contrast to this study, which only focuses on EL undergraduate students majoring in Biology, which is divided into two study programs, namely Biology Science and Biology education. Based on this, the novelty offered in this study is a profile of EL undergraduate student majoring in biology from various aspects. Based on the description of the problem, it is necessary to conduct a study to look at EL undergraduate student profiles in the Biology and Biology Education study programs. So the purpose of this study is to measure the EL of Biology and Biology Education undergraduate students in Jakarta and presented in a descriptive profile.

2. Method

This study used descriptive methods with survey techniques. The research was conducted at five universities in Jakarta. The research sample consisted of 197 biology undergraduate students and 4th-semester biology education in the 2017-2018 academic year from 5 universities in Jakarta. Samples based on study programs; Biology Science study program (n = 117) and Biology Education study program (n = 80). Based on gender; male (n = 55) and female (n = 142). EL biology undergraduate students are measured using test instruments that have been developed based on Erdogan (2009). EL measured using 6 indicator [6,12,13]. The instruments used were 31 items that were valid and reliable.

3. Result and discussion

After measuring EL to undergraduate students, the overall data is obtained as below. The acquisition of EL values and for Biology Science and Biology Education undergraduate students in the fourth semester is presented in Table 1. Criteria and percentage of indicators EL presented in table 2 and 3.

| Table 1. Mean of EL Biology undergraduate students. |
|-----------------|----------------|----------------|----------------|--------------|---------------|--------------|
| n               | Min | Max | Sum       | Mean  | Std. Deviation (SD) | Variance |
| EL              | 197 | 58  | 90        | 14961 | 75,95            | 7,340     | 53,881     |

| Table 2. Criteria for EL Biology undergraduate students. |
|-----------------|-----------------|-----------------|-----------------|
| Range Score     | Criteria        | Undergraduate Students | Percentage (%) |
| 0 – 29          | low             | 0               | 0               |
| 30 – 61         | moderate        | 9               | 4.6             |
| 62 – 100        | High            | 188             | 95.4            |
| Total           | 197             | 100             |

| Table 3. Percentage of indicators and dimensions of EL in biology undergraduate students. |
|-----------------|-----------------|-----------------|
| Indicator        | Item            | Indicator (%) |
| Knowledge of natural and ecological history | 1,2,3,4 | 12.2 |
| Knowledge of environmental issues | 5,6,7,8 | 11.1 |
| Socio-political-economic knowledge | 9,10,11,12,13,14 | 15.9 |
| Skills for analyzing problems | 15,16,17 | 9.4 |
| Effects and determinants of behavior | 18,19,20,21,22,23,24,25,26 | 33.1 |
| Responsible for behavior towards the environment | 27,28,29,30,31 | 18.3 |

Based on the measurement results per item, item 13 gets the lowest average score. While for items with the highest score found in item 28. This shows that undergraduate students' economic, social, political knowledge about the environment is still quite low, seen in table 4.
### Table 4. Average scores on each item.

| No | Item                                                                 | Av Score |
|----|----------------------------------------------------------------------|----------|
| 1  | Mentioning environmental problems in an area                          | 0.57     |
| 2  | Describe effective ways to reduce the loss of biodiversity           | 0.68     |
| 3  | Able to read Environmental Quality Index Charts                      | 0.80     |
| 4  | Explain overcoming transportation problems                             | 0.81     |
| 5  | Explain the impact of an environmental phenomenon                    | 0.95     |
| 6  | Explain the impact of greenhouses in the atmosphere                  | 0.43     |
| 7  | Mentioning condition of the river upstream which caused a downstream area of the river flooded | 0.46     |
| 8  | Explain the impact of increasing population and infrastructure that covers land | 0.75     |
| 9  | Explain the causes of increased carbon dioxide                       | 0.79     |
| 10 | Explain about environmental protection and management in Indonesia   | 0.54     |
| 11 | Clarifying that human density in Jakarta reaches 15,000 / km²        | 0.81     |
| 12 | Explain that Jakarta has the smallest land area among the provinces in Indonesia | 0.51     |
| 13 | Clarifying the statement about Jakarta in National Environmental Quality Index 2016 | 0.15     |
| 14 | Clarifying statements about building permits                         | 0.93     |
| 15 | Identify environmental problems that occur in Jakarta based on a case | 0.93     |
| 16 | Explain the most plausible hypothesis to explain why species richness in the tropics is higher than in temperate regions | 0.67     |
| 17 | Explain the ecological level along with the correct explanation      | 0.61     |
| 18 | Explain the main causes of flooding based on a case                  | 0.93     |
| 19 | Clarifying statements about equality of rights between living things. | 0.78     |
| 20 | Clarifying the statement that environmental problems continue, welfare will increase. | 0.94     |
| 21 | Clarifying statements about community inequality can occur due to a factor in development equality. | 0.62     |
| 22 | Reviewing the statement that Ozone is a chemical compound consisting of three oxygen atoms that can be disrupted due to human behavior using CFC substances | 0.92     |
| 23 | Clarifying the statement that human behavior that feeds carelessly to wild animals does not affect animal behavior. | 0.84     |
| 24 | Clarifying statement that purchasing disposable products if not recycled will cause a buildup of garbage | 0.94     |
| 25 | Clarifying the statement that the behavior of waste burning is good because it can reduce the amount of waste and does not cause pollution | 0.81     |
| 26 | Reviewing the statement that planting trees can prevent erosion and landslides | 0.95     |
| 27 | Reviewing the statement that knowing the quality of the environment in Indonesia can use the Environmental Quality Index | 0.80     |
| 28 | Reviewing the statement that humans can utilize natural resources by paying attention to environmental factors so that the balance of nature is maintained. | 1.00     |
| 29 | Review statements that natural balance will be disrupted if there is massive exploitation. | 0.96     |
| 30 | Clarifying the causes of species extinction is a reduction in industrial, agricultural, forestry, fisheries and livestock development. | 0.69     |
| 31 | Reviewing the statement that environmental responsibility is imposed on the government as the organizer of the policy. | 0.84     |

EL achievement based on study programs and based on gender is shown in Table 5. Biology Science undergraduate students have a significantly higher average than undergraduate students of biology education study programs. Based on these data, a female has a higher EL than male.
Table 5. Average EL based on the study program

| Program          | n  | Mean  | Std. Deviation | Std. Error Mean |
|------------------|----|-------|----------------|-----------------|
| Biology Education| 80 | 74.40 | 7.722          | .863            |
| Biology Science  | 117| 77.14 | 7.006          | .648            |
| Gender           |    |       |                |                 |
| Male             | 55 | 74.18 | 8.564          | 1.155           |
| Female           | 142| 76.82 | 6.783          | .569            |

Based on the results of the study, the three highest indicators were obtained by (1) Effects and determinants of behavior (2) Responsible for behavior towards the environment (3) Socio-political-economic knowledge. The three indicators received a high percentage score because at the student level, many students had accepted the basic concepts of elementary school. This has an impact on the behavior and responsible that began to form when they became students. Also, undergraduate students are also young intellectuals, and they often follow the development of socio-political-economic developments in the community. This makes the indicator high because they have implemented it in their daily lives [14,15].

The lowest indicator is obtained by the Skills for analyzing problems indicator. This is because environmental learning at universities often does not train students' analytical skills in solving environmental problems. This certainly will have a bad impact, because at the level of students should have the ability to analyze problems to create a solution to environmental problems. Students who do not have these abilities will only memorize various concepts but find it difficult to provide solutions to the environmental problems [16–18].

The item with the highest score is obtained with a maximum score of 1.00, which is regarding the utilization of natural resources in item 28. This item gets the highest score because this discussion of natural resources has been discussed for a long time and is a simple concept that is easy to understand. This is reasonable if students get the highest score on this item. While the lowest score is found in item 13 with a score of 0.15, which is about data on environmental quality in Jakarta, this can happen because students often only read information about the environment without paying attention to the data in more detail. This is related to the lowest indicator, where students have low ability to analyze data and problems. Based on these points, learning should be directed towards problem-based learning [19–23].

EL is currently needed to improve environmental quality. This effort was accompanied by an increase in the quality of environmental education that took place in educational institutions. The quality of environmental education needs to be supported by EL attainment information on various elements of society, one of them is undergraduate students. Knowledge about the environment is needed to solve environmental pollution problems [7,24,25]. Achievement of EL improvement cannot be separated from involvement in the learning process in the classroom. In studies of the sustainable development of higher education, studies need to be conducted to determine the level of EL and the effectiveness of the university with regard to environmental education and sustainable development [26–28].

The level of EL of biology undergraduate students is obtained on average with a high category. Biology undergraduate students have high EL regarding the environment. Students' thinking about the environment comes from the direct influence of social life and society, which is the main reason for the development of environmental education and values related to environmental issues in higher education institutions [29–32]. Students who learn about living things and their environment experience an increase in significant environmental awareness with the EL requirements [33–35].

Biological science study program students do not differ significantly from students in the biological science study program. This is because the students take the same learning, so the output produced in EL is not much different [32,36,37]. Biology study program students have a higher EL level compared to biology education study program students. EL levels relate to student majors and the level of self-exposure to environmental content [35,38].

Based on gender there is a significant difference in average between male and female biology undergraduate students with female biology students. In the female, the average EL value is higher compared to male. Gender is one of the distinguishing factors in EL. Female more concerned and behave
positively towards the environment and can be explained in the role of individuals in everyday life, the level of sensitivity and feeling of responsibility towards the environment, and being aware of the effects of behavior that is not environmentally responsible [33,34,39,40].

4. Conclusion
Based on the results of the study obtained EL profile undergraduate students of Biology Science and Biology Education have a high score. Besides being based on study programs, they are also distinguished by gender. Female EL scores are higher than male scores. In the future, there must be an increase in the quality of environmental learning at the university level to improve EL undergraduate students.

References
[1] Lazaridou D, Michailidis A, Trigkas M 2018 Socio-economic factors influencing farmers’ willingness to undertake environmental responsibility *Environ Sci Pollut Res.* 1–10
[2] Chander P, Muthukrishnan S 2015 Green consumerism and pollution control. *J Econ Behav Organ [Internet].* 114 27–35
[3] Olsson M, Kjällstrand J 2006 Low emissions from wood burning in an eco labelled residential boiler. *Atmos Environ.* 40(6) 1148–58
[4] Erdogan M 2015 The Effect of Summer Environmental Education Program (SEEP) on Elementary School Students’ Environmental Literacy. *Int J Environ Sci Educ.* 10(2) 165–81
[5] Bissinger K, Bogner FX 2018 Environmental literacy in practice: education on tropical rainforests and climate change. *Environ Dev Sustain.* 20(5) 2079–94
[6] Arnon S, Orion N, Carmi N 2015 Environmental literacy components and their promotion by institutions of higher education: an Israeli case study. *Environ Educ. Res.* 21(7) 1029–55
[7] Uyar Y, Ensar F 2016 Does mother tongue education support development of environmental literacy in turkey? An analysis of turkish course books. *Int J Environ Sci Educ.* 11(1) 1–8
[8] Tuncer Teksoz G, Boone JW, Tuzun OY, Oztekin C 2014 An evaluation of the environmental literacy of preservice teachers in Turkey through Rasch analysis. *Environ Educ Res.* 2014 20(2) 202–27
[9] Janmaimool P, Khajohnmanee S 2018 Enhancing university students’ global citizenship, public mindedness, and moral quotient for promoting sense of environmental responsibility and pro-environmental behaviours. *Environ Dev Sustain [Internet]* (123456789)
[10] El Ghoul S, Guedhami O, Kim H, Park K 2018 Corporate Environmental Responsibility and the Cost of Capital: International Evidence. *J Bus Ethics.* 149(2) 335–61
[11] Dani D 2011 Sustainability as a Framework for Analyzing Socioscientific Issues. *Int Electron J Environ Educ. 1(2) 113–28
[12] Alkaher I, Goldman D 2018 Characterizing the motives and environmental literacy of undergraduate and graduate students who elect environmental programs—a comparison between teaching-oriented and other students. *Environ Educ Res.* 24(7) 969–99
[13] Erdogan M 2009 Fifth grade student’ environmental literacy and the factors affecting students’ environmentally responsible behavior. (Middle East Technical University, Turkey)
[14] Juhanda A, Maryanto Y 2018 The emergence of biological problems in electronic school books (bse) class x reviewed from the scientific knowledge domain of scientific literacy. *Biosfer: Jurnal Pendidikan Biologi.* 11(2) 121–125
[15] Lemus JD, Seraphin KD, Coopersmith A, Correa CK V 2014 Infusing Traditional Knowledge and Ways of Knowing Into Science Communication Courses at the University of Hawai’i. *J Geosci Educ [Internet].* 62(1) 5–10
[16] Jewpanich C, Piriyasurawong P 2015 Project-Based Learning Using Discussion and Lesson-Learned Methods via Social Media Model for Enhancing Problem Solving Skills. *Int Educ Stud. 8(6) 24–31
[17] Winarno S, Muthu KS, Ling LS 2017 Direct Problem-Based Learning (DPBL): A Framework for
Integrating Direct Instruction and Problem-Based Learning Approach. *Int Educ Stud* [Internet]. **11**(1) 119–26

[18] Esa N 2010 Environmental knowledge, attitude and practices of student teachers. *Int Res Geogr Environ Educ*. **19**(1) 39–50

[19] Sung HY, Hwang GJ, Chen SF 2019 Effects of embedding a problem-posing-based learning guiding strategy into interactive e-books on students’ learning performance and higher order thinking tendency. *Interact Learn Environ* [Internet] **27**(3) 389–401

[20] Barber W, King S, Buchanan S 2015 Problem based learning and authentic assessment in digital pedagogy: Embracing the role of collaborative communities. *Electron J e-Learning*. **13**(2) 59–67

[21] Suhendar S, Wahyuni A 2018 Achievement and response of students at favorite junior high schools in sukabumi on trends in international mathematics and science study (timss) questions. *Biosfer: Jurnal Pendidikan Biologi* **11**(2) 126–133

[22] Istiana R, Awaludin MT 2018 Enhancing biology education students ability to solve problems in environmental science material through inquiri model-based lesson study. *Biosfer: Jurnal Pendidikan Biologi*. **11**(1) 57–66

[23] Fauzi A, Fariantika A 2018 Courses perceived difficult by undergraduate students majoring in biology. *Biosfer: Jurnal Pendidikan Biologi*. 2018 **11**(2) 78–89

[24] Markaki V 2014 Environmental Education through Inquiry and Technology. *Sci Educ Int*. **25**(1) 86–92

[25] Braun T, Cottrell R, Dierkes P 2018 Fostering changes in attitude, knowledge and behavior: demographic variation in environmental education effects. *Environ Educ Res* [Internet]. **24**(6) 899–920

[26] Yedla S, Park HS 2017 Eco-industrial networking for sustainable development: review of issues and development strategies. *Clean Technol Environ Policy*. **19**(2) 391–402

[27] Ilma S, Wijarini F 2017 Developing of Environmental Education Textbook Based on Local Potencies. *Indones J Biol Educ J Pendidik Biol Indones*. 3**(33)** 194–201

[28] Innes S, Shephard M, Furnari M, Harraway J, Jowett T, Lovelock B, et al. 2018 Greening the Curriculum to Foster Environmental Literacy in Tertiary Students Studying Human Nutrition. *J Hunger Environ Nutr* [Internet] **13**(2) 192–204

[29] McCollough C, Jeffery T, Moore K, Champion J 2016 Improving Middle Grades STEM Teacher Content Knowledge and Pedagogical Practices through a School-University Partnership. Sch Partnerships [Internet] **9**(2):50–9

[30] Choudri BS, Bauwain M, Al-Sidairi A, Al-Nadabi H, Al-Zeidi K 2016 Perception, knowledge and attitude towards environmental issues and management among residents of Al-Suwaiq Wilayat, Sultanate of Oman. *Int J Sustain Dev World Ecol*. **23**(5) 433–40

[31] Kinslow AT, Sadler TD, Nguyen HT 2018 Socio-scientific reasoning and environmental literacy in a field-based ecology class. *Environ Educ Res*. **4622** 1–23

[32] Shamuganathan S, Karpudewan M 2015 Modeling environmental literacy of malaysian pre-university students. *Int J Environ Sci Educ*. **10**(5) 757–71

[33] Öztürk N, Teksoz G 2016 The Impact of Affective Constraints on Shaping Environmental Literacy: Model Testing Using Mediator and Moderator Variables. *Int Electron J Environ Educ*. **6**(2) 54–75

[34] Digby CLB 2013 The Influences of Socio-demographic Factors, and Non-formal and Informal Learning Participation on Adult Environmental Behaviors. Int Electron J Environ Educ [Internet] **3**(1) 37–55

[35] Goldman D, Pe’er S, Yavetz B 2017 Environmental literacy of youth movement members—is environmentalism a component of their social activism? *Environ Educ Res*. **23**(4) 486–514

[36] Ugulu I, Sahin M, Baslar S 2017 High School Students’ Environmental Attitude: Scale Development and Validation. *Int J Educ Sci*. **5**(4):415–24

[37] Imamura M 2017 Beyond the Limitations of Environmental Education in Japan. *Educ Stud Japan*
[38] Fidan N K, Ay T S 2016 Acquisition of operational environmental literacy in social studies course. *Int J Environ Sci Educ.* *11*(13) 5951–68

[39] Köse S, Savran Gencer A, Gezer K, Erol GH, Bilen K 2011 Investigation of Undergraduate Students’ Environmental Attitudes. *Int Electron J Environ Educ.* *1*(2) 85–96

[40] Fitriani U, Adisyahputra A, Komala R 2018 Eco-friendly website development in biology learning based on project activities on environmental pollution *Biosfer: Jurnal Pendidikan Biologi* *11*(1) 32–46