Representation of sustainability concept in prospective biology teacher learning

E Hartadiyati1,*, Wiyanto2, A Rusilowati2 and A Priyono2

1Biology Education Department, Universitas PGRI Semarang, Jl. Sidodadi Timur No. 24, Semarang 50125, Indonesia
2Science Education Department, Program Pasca Sarjana, Universitas Negeri Semarang, Petompon, Gajahmungkur, Semarang 50237, Indonesia

*Corresponding author: hartadiyatienny@gmail.com

Abstract. Fulfillment of sustainability skills competencies in the 21st century and industrial revolution 4.0, it gives important consequences to prepare teacher candidates who can implement the concept of sustainability in learning on the material they design. This study aims to describe the way prospective biology teacher students translate the understanding of sustainability in pedagogy which is shown in the representation of learning designs made. Ten prospective biology teacher students were recruited to participate in a workshop on learning that contained the concept of sustainability. Conception and awareness about sustainability are measured before and after the program takes place using a predetermined sustainability definition framework. Sustainability representation analysis is carried out qualitatively, seen from the learning plan made and observation real teaching using video. The results obtained show a variety of sustainability representation patterns from those that appear in the form of "mosaics" that are separated until connected and integrated, at the level of only information until the activities carried out by students. Sustainability charge quality that looks comparable to the increase in conception and sustainability awareness obtained by each candidate of biology teacher. The conclusion of this study is the representation of concept sustainability understanding in prospective biology teacher learning has shown suitable harmony among the three main perspectives on sustainability, seen to reach 80% of the workshop participants.

1. Introduction
The present and future generation that results from the teaching of science will be faced with a pragmatic human tendency in managing natural resources. The facts that exist today in our country show that the tendency of natural exploration in the framework of economic development has caused a negative impact not only on the people today but also on future generations. Many human activities in Indonesia in meeting their needs have an impact that often endangers the continuity of life and nature, for example (1) development in some areas before was forest, by clearing forests caused environmental destruction and also added geothermal, (2) wrong mining of natural resources leaves an unfavorable environment for the surrounding community, even makes future generations short of natural resources, (3) construction of several large buildings that do not respect the environmental feasibility of the coast, causing coastal flooding and damage and damage mangrove forest [1]. This has an impact on many lives and cultures will quickly become extinct, social institutions as the capital of shared life will be easily controlled by generations who do not have a pro-sustainability policy and love of life, advances in
science and technology are often treated unwise so as to eliminate local wisdom and have side effects on damage. In other words, the essential problems of the future related to sustainable life mean improvement in the economic field and inclusion in the social field but not damaging the environment for future generations [2].

Actually the government, concerning the Education Quality Assurance System (SPMP), in the third part emphasizes that quality assurance adheres to the education paradigm for sustainable development [3]. This is in line with the UNESCO program goals in education for sustainable (Education for Sustainable Development, ESD) which is aimed at maintaining environmental sustainability, economic sustainability and social welfare. In the 13 revision curriculum, it was also formulated that one of the contexts in learning content was the Sustainability Development Goals (SDGs). Few prospective teachers or teachers use the context of problems in the lives of students related to economics, environment, social - culture. This is indicated by the results of research related to the context of sustainability is still much limited to discourse [4-6], then it takes a futuristic concept of education and learning that is not only able to generate awareness and sense of responsibility but also provide knowledge and ability to someone to be able to improve conditions in a sustainable or sustainable manner. This is consistent with the current reality that students do not understand about sustainability, even though environmental concerns have been seen in students [7].

Prospective high school biology teachers must have a share in shaping young people who are pro-sustainability. Therefore, biology teacher candidates must have a number of competencies, namely pedagogical competence and professional competence to synergize (1) biological material; (2) the skills that students must possess include character, literacy, critical thinking, collaboration, creativity and communication; and (3) the context including environment, quality of life and SDGs (Sustainable Development Goals) [8]. This is needed in life in the 21st century, as the Industrial Revolution 4.0 has positive and negative impacts [9-10].

Based on an understanding of sustainability that has been trained, a number of prospective teacher students in the Biology Education Program of PGRI Semarang University strive to provide an understanding of sustainability to high school students through biology learning that includes a simultaneous sustainability perspective integrated in specific subjects of biology. In the meantime, prospective teachers measure cognitive learning outcomes, concept understanding, critical thinking, scientific literacy, environmental care, and care for the sustainability of their students. This is interesting to study how: (1) understanding the concept of sustainability, (2) the representation of the concept of sustainability in the learning of prospective biology teachers in specific topics.

2. Method
Ten candidates for Upper High School Biology teachers were recruited to participate in an integrated sustainability learning workshop. They are students of Biology Education at PGRI Semarang University in the seventh semester consisting of 4 men and 6 girls. In the workshop prospective teachers received material by lecturers on the notion of sustainability, Sustainable Development Goals formulated by UNESCO, Education for Sustainable Development and integration of sustainability perspectives namely economic, socio-cultural and environmental learning in biology in high schools. Furthermore, they made sustainability-based lesson plans with assistance from lecturers. Before and after the workshop a test was conducted to measure understanding of sustainability containing conception and awareness about sustainability using the form of multiple choice tests. Then the test results were analyzed using t-test dependent and normalized gain (N gain) use catagorized low, medium and high [11]. The data retrieval of the representation of the concept of sustainability uses a modified Systematic Review method from [12]. Data is taken from lesson plans produced by prospective biology teachers and observations of real teaching using video. Data were analyzed qualitatively descriptive using the reference of the general model of integration of sustainability perspectives in learning [13-15].
3. **Result And Discussion**

Representation of the concept of sustainability can be seen from the pattern of integration of the sustainability perspective on specific topics of biology in high school, can be seen in Table 1.

**Table 1.** Representation of perspective sustainability in prospective biology teachers learning in high school

| Perspective Biology Teacher | Specific Topic of Biology | Perspective Sustainability | Perspective Sustainability in Lesson Plan | Suitable Harmony Among The Three Main Dimensions Perspective Sustainability |
|-----------------------------|---------------------------|-----------------------------|------------------------------------------|--------------------------------------------------------------------------|
|                            |                           | Ec | S  | E | Instructional Media | Teaching materials | context ||
| A                           | Environment change       | ✓  | ✓  | ✓ | Problem based learning | E-Magazine | Greenhouse effect | ✓, but has not involved students in concrete actions in learning |
| B                           | Women Reproduction system| ✓  | ✓  | ✓ | Discovery learning | Article in worksheet | Disposable Bandages | ✓, but has not involved students in concrete actions in learning |
| C                           | Respiratory system       | ✓  | ✓  | ✓ | Video | Problem based learning | Problem sheet | Fish Frying | ✓, already involving students in concrete actions in learning |
| D                           | Human kidney             | ✓  | ✓  | ✓ | Filtering analogy in the kidneys from plastic waste | Problem based learning | Problem sheet | Kidney health issues | ✓, already involving students in concrete actions in learning |
| E                           | Skeletal system          | ✓  | ✓  | ✓ | Discovery learning | Worksheet | - | Just connect isn't integrated yet |
| F                           | Environment change       | ✓  | ✓  | ✓ | Video | Project based learning | Project sheet | Lokal Wisdom | ✓, already involving students in concrete actions in learning |
Table 1 shows that the representation of the concept of sustainability not all prospective biology teachers produce Suitable Harmony Among The Three Main Dimensions Perspective Sustainability (Economy, social-cultural and environment), it appears in the prospective teachers E and G. As for C, D, F, H , J has been able to represent the concept of sustainability to the maximum, not only limited to information through learning media, teaching materials or syntax of learning models; but has involved students in concrete actions in their environment. As an example for prospective teacher, the learning and teaching tools that were carried out were seen suitable harmony among the three main dimensions perspective sustainability : First, students are reminded of traditional food in their area, namely Sego Megono, the prospective teacher by bringing Sego Megono, allows some students to taste Sego Megono, and then asks whether it is good or not, the students answer it pleasantly. The prospective teacher then said that sego megono could be made at home using various kinds of plants that were around the students, and could even be sold either in the stalls or in large restaurants so that it could be used as a source of income. Then the prospective teacher shows a video on how to make sego megono. From the video show students with guided worksheets identified plant species as ingredients for making sego megono to study spermatophyta including spermatophyta characteristics, classification, phenetics and roles. The role of spermatophyta, among others, is as a food ingredient such as in the manufacture of sego megono, as well as medicinal plants, because in these plants many compounds for health such as kencur, greetings, and so on. For this purpose, medicinal plants should be planted in school grounds. In addition to being beneficial for health, it can also green the school environment, so that more attention
is given to environmental sustainability. Planting is done using plastic bottle waste and so the environment becomes more beautiful. Planting is done by using vertical garden techniques from phenetic analysis.

Data on understanding of sustainability for prospective biology teachers before and after the workshop is shown in Table 2 and Table 3.

Table 2. Pretest and posttest results of sustainability understanding

| Mean score | N gain | Categori | p  |
|------------|--------|----------|----|
| Pretest    | 9.32   |          |    |
| Posttest   | 19.67  | 0.81     | high | 0.023 |

Table 2 shows that an increase in understanding of the sustainability of prospective teachers after a biology learning workshop integrated with a sustainability perspective in a high category and evidenced by a dependent t test showed a significant difference (p <0.05).

When analyzed based on aspects of understanding sustainability, there are differences in the improvement of each aspect, presented in Table 3.

Table 3. Increased perception of sustainability understanding based on aspects

| Section | Sustainability Concept aspect | N gain | Level |
|---------|--------------------------------|--------|-------|
| A       | Understanding of the concept sustainability | 0.76   | High  |
| B       | Sustainability knowledge awareness | 0.82   | High  |
| C       | Attitude awareness | 0.83   | High  |
| D       | Practice awareness | 0.72   | High  |

Table 3 shows that the improvement of each aspect is all in the high category. However, if we see the difference, the normalized average gain <g> aspect of practice awareness shows the lowest number.

The representation data in Table 1, understanding the sustainability concepts shown in Table 2 and Table 3 shows that the Workshop that was followed by the candidates gave an understanding of sustainability, namely the conception and concern about sustainability. This is very important because this understanding will have an impact on the resulting lesson plan and peer teaching that is carried out. Likewise after designing in the lesson plan and transforming students in teaching, there is an increased understanding of sustainability. It can be said that there is simultaneous alternating between the understanding of the concept of sustainability and the ability of prospective teachers to prepare learning plans. This is consistent with research that the workshop has an effect on the results to integrate concepts in thematic learning [16].

Actual activities of integrating sustainability perspectives, namely socio-cultural, economic and environmental aspects of learning in accordance with the material chosen, have succeeded in encouraging prospective biology teachers to be more active in assimilating, accommodating, organizing and constructing concepts in mind. Various factors such as the nature of stimulus, background of individual experience, motivation and so on play a role in determining a person's reaction to environmental and social stimuli [17]. The activity of knowing and understanding the concept of sustainability well, will lead to a caring attitude which will then be able to take appropriate action. the knowledge about sustainability plays an important role in developing a positive attitude towards sustainability [18]. This is consistent with the opinion that the experience possessed will play a role in shaping the cognition of one's feelings towards certain objects and attitudes that can be used to determine the tendency of one's behavior [19]. It was emphasized that one of the factors that influence behavior is attitude [20].

However, there are still some that have not been maximized to produce suitable harmony among the three main dimensions of sustainability perspective, according to the teacher E and G because they feel
that they have not been maximized in participating in the workshop so that they cannot produce suitable harmony among the three main dimensions of sustainability perspective in the lesson plan or in real teaching. This is like the result of identification [21] that barriers to the implementation of sustainability include knowledge and education on the topic, training and collaboration and integration in teaching.

Overall the results obtained show a variety of sustainability representation patterns from those that appear in the form of "mosaics" that are separated until connected and integrated, at the level of only information until the activities carried out by students. Sustainability charge quality that looks comparable to the increase in conception and sustainability awareness obtained by each candidate of biology teacher.

4. Conclusion

Representation of concept sustainability understanding in the learning of biology teacher candidates has shown suitable harmony among the three main perspectives on sustainability, seen reaching 80%.

References
[1] OECD 2017 Green Growth Policy Review Indonesia 2017-19
[2] Birdsall S 2011 The Pedagogical Realisation of Education for Sustainability- Thesis (Auckland: The University of Auckland)
[3] Prabawani B, Hanika I M, Pradanawati A, Budiatmo A, 2017 Int J Env Sci Ed 12 4
[4] Nomura K 2009 Int. J. Educ. Dev. 29
[5] Segara N B 2015 Sosio Diklatika: Sci. Educ. J. 2 22
[6] UNESCO Education Sector 2017 Education for Sustainable Development (Paris: United Nations Educational)
[7] Malik R S 2018 J. Sustain. Dev. Educ. Res. 2 1
[8] Kim M, Diong CH Biology 2012 Educations for Social and Sustainable Development (Rotherdam: Sense Publisher)
[9] Bonekamp L and Sure M 2015 J. Bus. Media Psychol. 6 33
[10] Bussing A, Schleper M, Menzel S 2018 Environ. Educ. Res. p 1
[11] Hake, R.R. 1998 Am. J. Phys. 66 66
[12] Kitchenham B 2004 Procedures for Performing Systematic Reviews (Eversleigh: Keele University)
[13] Hartadiyati E, Rizqiyah K, Rusilowati A, Prasetia APB 2017 Journal Physics: Conf.Series 895 012051
[14] Ciegis R, Ramanuskiene J, Martinkus B 2009 Engineering Economic 2 28
[15] Herremans I M and Reid R E 2002 J. Environ. Educ. 34 20
[16] John Y 2015 Int. J. High. Educ. 4 172
[17] Bozoglu M, Bilgic A, Topuz BK, Ardali Y 2016 Fresenius Environmental Bulletin 25 4
[18] Watling, Alice. 2011 Attitudes Towards Sustainability: A Quantitative Study Of Sustainable Alidhem (UMEA School Business.)
[19] Ishii K, Shibata A, Oka K 2010 Int. J. Behav. Phys. Activity 7 61
[20] Ajzen I 1991 Organizational Behavior and Human Decision Processes 50 179
[21] Filho WL, Wu YJ, Brandli LL, Avila LV, Azeiteiro UM, Caerio S, Mandruga LRRG 2017 J. Integr. Environ. Sci. 14 93