Science teacher’s idea about environmental concepts in science learning as the first step of science teacher training

M C Tapilouw¹,²*, H Firman¹, S Redjeki¹ and D T Chandra¹

¹ Universitas Pendidikan Indonesia, Bandung, Indonesia
² Yayasan Salib Suci, Bandung, Indonesia

*Corresponding author’s e-mail: marisatapilouw@student.upi.edu

Abstract. To refresh natural environmental concepts in science, science teacher have to attend a teacher training. In teacher training, all participant can have a good sharing and discussion with other science teacher. This study is the first step of science teacher training program held by education foundation in Bandung and attended by 20 science teacher from 18 Junior High School. The major aim of this study is gathering science teacher’s idea of environmental concepts. The core of questions used in this study are basic competencies linked with environmental concepts, environmental concepts that difficult to explain, the action to overcome difficulties and references in teaching environmental concepts. There are four major findings in this study. First finding, most environmental concepts are taught in 7th grade. Second finding, most difficult environmental concepts are found in 7th grade. Third finding, there are five actions to overcome difficulties. Fourth finding, science teacher use at least four references in mastering environmental concepts. After all, teacher training can be a solution to reduce difficulties in teaching environmental concepts.

1. Introduction
Integrated science (Biology, Chemistry and Physics) which is taught in Junior High School help student think critically and holistically. Science learning in Junior High School itself (7th grade – 9th grade) must be contextual and based on phenomenon in daily life. Based on previous statement, natural environment is closest to student’s daily life. So, environmental concepts play important role in science education. Teachers and students each have different role in science learning. That’s why teachers must consider students’ cultural knowledge as their perspective to see the world and nature [1]. Science teacher must master subject matter in environmental concepts in order to enhance student’s understanding of environmental concepts.

As professional teachers, science teachers should improve their knowledge and skills regarding to the improvements in science and technology [2]. There are many ways to improve Science teacher’s knowledge and skills. Science teacher training is one possible way to help science teacher renew and complete their understanding in integrated science especially environmental concepts. As we know, science teacher must guide students in appreciating the nature of science’ as a form of scientific literacy [3]. In teacher training, all participant can have a good sharing and discussion with other science teacher. Good teacher training program have some goals, including enhance professional and pedagogical competencies.
Regarding to all the statements above, teacher training has to be done regularly. Teacher training program as a form of Professional development programs enable teachers to become highly qualified by improving, increasing and advancing their knowledge through a better understanding of effective instructional strategies [4]. This study is the first step of science teacher training. The major aim of this study is gathering participant’s idea of environmental concepts and many aspects of it. Discussion method is used to gather all these teacher’s idea.

2. Methods
This study is a descriptive study and as the first step of science teacher training program held by education foundation in Bandung and attended by 20 science teacher from 18 Junior High School. The procedure of this study is described in Figure 1.

| Science teacher training (participants: 20 science teachers) |
|---------------------------------------------------------------|
| Exploration of participants idea about environmental concepts |
| Four core questions:                                          |
| 1. Basic competencies linked with environmental concepts      |
| 2. Difficult environmental concepts                            |
| 3. Actions to overcome difficulties                            |
| 4. References in mastering environmental concepts              |

Another step of science teacher training

Conclusion

Analyzed

Collect the answer

Figure 1. Research procedure

As a first step of science teacher training, there are exploration of participant’s idea about environmental concept in integrated science (7th grade – 9th grade). This study use simple instrument consist of four open-ended questions. The core of these question is basic competencies linked with environmental concepts, difficult environmental concepts, actions to overcome difficulties and references in mastering environmental concepts.

3. Results and Discussion

3.1. Basic competencies that linked with environmental concepts
In this part, we will know participant’s idea about basic competencies (7th grade – 9th grade). From the result in 7th grade, there are nine basic competencies linked with environmental concepts. They are interaction between living things and environment, population dynamics (55%), environmental pollution (55%), Climate change (50%), energy, source of energy, energy transformation (45%), organization system of life (25%), natural disaster’s impact (5%), disaster’s mitigation efforts (5%), classification procedure of living and non-living things (5%) and predict density of the human population to natural environment (5%). Based on the result, environmental pollution, interaction between living things & environment take first place. There are many research about environmental pollution as side effects of human activities. Environment connected with other aspect in life, for example connected with health care practice waste’s [5]. As explained in other research, unconventional oil and gas (UOG) waste can affect environment and human health [6]. These previous research show that unhealthy environment can make a serious impact for environment.

Based on participant’s opinion, energy also play an important role in environment. A research shows that demand of water and energy is increasing as the increase population of the world [7]. This phenomenon gives effect to environment. Learning environment concepts is integrated with ecosystem. A recent study shows some researchers were doing research about modeling river in United Kingdom that already polluted and affect the ecosystem [8]. As a science teacher, every participant should realize about the importance of keeping environment healthy and also teach about environment concepts based on many environmental problem and research.
From the result in 8th grade, there are five basic competencies, which are earth layer, volcano, earthquake and minimize after risk (55%), respiratory system in human body (45%), pressure substance and its application in daily life, transport network in plants (45%), structure of plant tissue and technology that inspired by plant structure (45%), Addictive and additive substances in foods, drinks and its impact to health (40%). Plants, human health and earth integrated with environment. A recent research shows that acid rain affected plants (*Fagus sylvatica*) over three decades [9]. As we know, pollution’s concept already given in 7th grade. There is a research about how benzene affect human health [10] especially respiratory health. Through this relation, participant should concern more about the effect of environmental pollution in human body.

| No | Basic Competencies                                                                 | Frequency (%) |
|----|-------------------------------------------------------------------------------------|--------------|
| 1  | Energy, source of energy, energy transformation (include photosynthesis)           | 45           |
| 2  | Environmental pollution                                                            | 55           |
| 3  | Climate change                                                                      | 50           |
| 4  | Natural disaster's impact                                                           | 5            |
| 5  | Interaction between living things and environment, population dynamics             | 55           |
| 6  | Disaster mitigation efforts                                                         | 5            |
| 7  | Organization system of life (from cell to organism and cell constituents)           | 25           |
| 8  | Classification procedure of living and non-living things                            | 5            |
| 9  | Predict density of the human population to natural environment                     | 5            |

| No | Basic Competencies                                                                 | Frequency (%) |
|----|-------------------------------------------------------------------------------------|--------------|
| 1  | Structure of plant tissue and technology that inspired by plant structure           | 45           |
| 2  | Addictive and additive substances in foods, drinks and its impact to health        | 40           |
| 3  | Pressure substance and its application in daily life, transport network in plants   | 45           |
| 4  | Respiratory system in human body (interference and efforts to maintain health)     | 45           |
| 5  | Earth layer, volcano, earthquake and minimize after risk                            | 55           |

| No | Basic Competencies                                                                 | Frequency (%) |
|----|-------------------------------------------------------------------------------------|--------------|
| 1  | Plant and animal reproduction and technology implementation on reproduction system  | 50           |
| 2  | Breeding and survival of living things                                              | 10           |
| 3  | Biotechnology and its role in human life                                            | 50           |
| 4  | Importance of soil in life, living things in soil for life sustainability           | 15           |
| 5  | Environmental friendly technology                                                   | 5            |
| 6  | Dynamic electricity and its utilization                                             | 25           |
| 7  | Physical and Chemistry properties of soil                                           | 40           |
| 8  | Life sustainability in living things                                               | 25           |
| 9  | Technology's process and product                                                   | 25           |

There are nine basic competencies in 9th grade based on science teacher’s idea, which are Plant and animal reproduction and technology implementation on reproduction system (50%), Biotechnology and its role in human life (50%), physical and chemistry properties of soil (40%), dynamic electricity and its utilization (25%), life sustainability in living things (25%), technology’s process and product (25%), importance of soil in life, living things in soil for life sustainability (15%), breeding and survival of living things (10%) and environmental friendly & technology (5%). As we know technology is develop from time to time and surely affecting environment. Development of Science and technology must consider environment. For example, the invention of plastic change the world. Plastic is useful in human daily life, on the other hand it affects natural environment. Many research shows how plastics take a long time to degrade in environment (soil, water) and because of that many invention about biodegradable plastic that take more short time to degrade in environment [11]. Living things in soil (earthworms) also take attention to some researchers. A research shows how polluted soil affected
earthworms, as a bio-indicator of polluted soil [12]. In 9th grade, participant should bring student’s thinking about technology and natural environment. Technology is good for everyday life, in addition, it’s harmful for natural environment.

3.2. Difficult Environmental Concepts

In science learning, there are some concepts that difficult to teach. However, the difficult environmental concepts need to be mastered by science teachers themselves. In table 2, we can see how many participant give their idea about difficult environmental concept (in percentage/ %). In part of 7th grade, six concepts that difficult to explain, they are climate change (15%), relation between classification and environment (15%), living organisation system (15%), energy (10%), diversity of living things (5%), temperature and heat (5%).

Table 2. Difficult Environmental concepts

| No | Difficult Environmental Concepts                                      | Frequency (%) |
|----|------------------------------------------------------------------------|---------------|
| 1  | Diversity of living things                                             | 5             |
| 2  | Climate change                                                         | 15            |
| 3  | Relation between classification and environment                        | 15            |
| 4  | Temperature and heat                                                   | 5             |
| 5  | Energy (source, concept, transformation)                               | 10            |
| 6  | Living organisation system                                             | 15            |

| 7th Grade |
|-----------|
| 1 Motion and style | 5 |
| 2 Plant structure and technology | 15 |
| 3 Substance tension and environment | 5 |
| 4 Static electricity concept | 5 |

| 8th Grade |
|-----------|
| 1 Animal and plant reproduction | 5 |
| 2 Soil and life | 5 |
| 3 Biotechnology | 5 |
| 4 Electricity concept | 5 |
| 5 Inheritance | 5 |

| 9th Grade |
|-----------|
| 1 Inheritance | 5 |

There are four difficult concepts in 8th grade based on participant’s idea. They are plant structure and technology (15%), motion and style (5%), substance tension and environment (5%), static electricity concept (5%). Still in Table 2, there are five difficult concepts in 9th grade, which are animal and plant reproduction (5%), soil and life (5%), biotechnology (5%), electricity concept (5%), inheritance (5%). Difficult environmental concepts can motivate science teacher to learn more and more in order to improve their professional competencies. Teachers themselves must have special skill to do research that can help them know which part of difficult concepts exactly [13]. Good relation between student and teacher can motivate teacher to be confidence and minimize the difficult concept by right approach in science learning [14]. Difficult concepts can be a good challenge for participants to improve their knowledge. Science teacher training program can be a good solution where participants can do many discussion between colleagues about the difficult concepts.

3.3. Action to overcome difficulties

As a professional science teacher, some action have to be done to overcome difficulties in mastering environmental concepts. Based on teacher’s idea in this study, there are five actions to overcome difficulties. These actions are opening internet sources such as scientific web (40%), doing discussion with colleagues or other science teacher/ other discipline (35%), reading scientific books beside
textbooks (30%), sharing difficulties with senior teacher who have more experiences in science learning (10%) and reading scientific journals (10%).

Table 3. Actions to overcome difficulties

| No | Actions                  | Frequency (%) |
|----|--------------------------|---------------|
| 1  | Scientific books         | 30            |
| 2  | Internet sources         | 40            |
| 3  | Discussion with colleagues | 35          |
| 4  | Scientific journal       | 10            |
| 5  | Sharing with seniors     | 10            |

Discussion is a right action, because professional group discussion can produce good solution for problems and by term that dialogue means conversation/talking/brainstorming together [15]. So, positive actions can help other understanding some difficult concepts. In the other hand, sharing with senior can enhance understanding of some difficult concepts. A research shows that teacher from different career phase come together to learn from each other and learn together [16]. A meeting group that consist of experienced and newly science teachers will enrich knowledge because sharing process happen. Reading scientific books and scientific journal is recommended for knowledge improvement.

3.4. Reference for mastering environmental concepts

The fourth question of gathering science teacher’s idea about environmental concepts is what references are used in mastering environmental concepts. There are nine answers, they are text book class 7, 8, 9 (25%), Science books (10%), Science journal (10%), textbook class 7, 9 (5%), Government website (5%), Teacher’s handy book (5%), Student’s handy book (5%), study about environmental problem (5%) and Biology and Physics website (5%).

Table 4. Reference for mastering environmental concepts

| No | Actions                           | Frequency (%) |
|----|-----------------------------------|---------------|
| 1  | Science books                     | 10            |
| 2  | Text book Class 7 and Class 9     | 5             |
| 3  | Government website                | 5             |
| 4  | Textbook Class 7, 8, 9            | 25            |
| 5  | Teacher’s handy book              | 5             |
| 6  | Student’s handy book              | 5             |
| 7  | Science Journal                   | 10            |
| 8  | Study about environmental problem | 5             |
| 9  | Biology & Physics website         | 5             |

Ideal science teacher must master all science concepts including environmental concepts through many references, but not all science teacher have this capability. However, science teacher need to be refreshed. Science teacher train can be a good solution because of it is one form of professional development. In teacher training, there should be a session of strengthening knowledge and skill [17]. A good teacher training program can be developed according teacher’s need and support teacher’s development in content specific, pedagogy competencies and reducing difficulties in teaching science or other specific concepts.

4. Conclusion

Based on exploration and analysis above, there are three major conclusions. First, basic competencies that linked with environmental concepts can be grouped to make integrated science with environmental theme. Second, difficult environmental concepts can be overcome with discussion with other teacher,
sharing with seniors, reading scientific books/journal. Third, science teacher training can be a solution to reduce difficulties in teaching environmental concepts.

5. References
[1] Geilsa B and Graça C 2012 Working Conditions of School and Teacher Training in Science: A Study with Teachers of Biology of Bahia Brazil Procedia-Social and Behavioral Sciences 55 57-61
[2] Güneúa T, Demira E S, Hoplana M, Çelikolu Ą and Güneúa O 2011 Procedia Social and Behavioral Sciences 15 1102–1109
[3] Mugalolu E Z and Bayram H 2009 How are prospective science teachers’ values and their attitudes toward science associated?: Implications for teacher training programs Procedia-Social and Behavioral Sciences 11 749-752
[4] Bozkurt E, Kavak N, Yamak H, Bilici S C, Darici O and Ozkaya Y 2012 Secondary school teachers’ opinions about in-service teacher training: a focus group interview study Procedia-Social and Behavioral Sciences 46 3502-3506
[5] Daughton C G and Ruhoy I S 2013 Lower-dose prescribing: minimizing “side effects” of pharmaceuticals on society and the environment Science of the Total Environment 443 324-337
[6] Cozzarelli I M, Skalak K J, Kent D B, Engle M A, Benthem A, Mumford A C, Haase K, Farag A, Harper D, Nagel S C and Iwanowicz L R 2017 Environmental signatures and effects of an oil and gas wastewater spill in the Williston Basin North Dakota Science of The Total Environment 579 1781-1793
[7] Matos C, Briga-Śá A, Bentes I, Faria D and Pereira S 2017 In situ evaluation of water and energy consumptions at the end use level: The influence of flow reducers and temperature in baths Science of The Total Environment 586 536-541
[8] Sharps K, Masante D, Thomas A, Jackson B, Redhead J, May L, Prosser H, Cosby B, Emmett B and Jones L 2017 Comparing strengths and weaknesses of three ecosystem services modelling tools in a diverse UK river catchment Science of The Total Environment 584 118-130
[9] Berger T W, Türtscber S, Berger P and Lindebner L 2016 A slight recovery of soils from Acid Rain over the last three decades is not reflected in the macro nutrition of beech (Fagus sylvatica) at 97 forest stands of the Vienna Woods Environmental pollution 216 624-635
[10] Ferrero A, Esplugues A, Estarlich M, Llop S, Cases A, Mantilla E, Ballester F and Iñiguez, C 2017 Infants' indoor and outdoor residential exposure to benzene and respiratory health in a Spanish cohort Environmental pollution 222 486-494
[11] da Costa J P, Santos P S, Duarte A C and Rocha-Santos T 2016 (Nano) plastics in the environment–sources, fates and effects. Science of The Total Environment 566 15-26
[12] Carter I J, Ryan J J and Boxall A B 2016 Effects of soil properties on the uptake of pharmaceuticals into earthworms Environmental pollution 213 922-931
[13] Taylor L A 2017 How teachers become teacher researchers: Narrative as a tool for teacher identity construction Teaching and Teacher Education 61 16-25
[14] Pennings H J, van Tartwijk J, Wubbels T, Claessens L C, van der Want A C and Brekelmans M 2014 Real-time teacher–student interactions: A dynamic systems approach Teaching and Teacher Education 37 183-193
[15] Vrikk M, Warwick P, Vermunt J D, Mercer N and Van Halem N 2017 Teacher learning in the context of Lesson Study: A video-based analysis of teacher discussions. Teaching and Teacher Education 61 211-224
[16] Korhonen H, Heikkinen H L, Kiviniemi U and Tynjälä P 2017 Student teachers' experiences of participating in mixed peer mentoring groups of in-service and pre-service teachers in Finland Teaching and Teacher Education 61 153-163
[17] Blömeke S, Busse A, Kaiser G., König J and Suhl U 2016 The relation between content-specific and general teacher knowledge and skills Teaching and Teacher Education 56 35-46