Field trip method as an effort to reveal student environmental literacy on biodiversity issue and context

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Abstract. Field trip method through investigation of local biodiversity cases can give educational experiences for students. This learning activity was efforts to reveal students environmental literacy on biodiversity. The aim of study were (1) to describe the activities of students get information about the biodiversity issue and its context through field trip, (2) to describe the students findings during field trip, and (3) to reveal students environmental literacy based on pre test and post test. The research method used weak-experiment and involved 34 participants at senior high school students in Bandung-Indonesia. The research instruments for collecting data were environmental literacy test, observation sheets and questionnaire sheets for students. The analysis of data was quantitative descriptive. The results show that more than 79% of the students gave positive view for each field trip activity, i.e students activity during work (97%-100%); students activity during gather information (79%-100%); students activity during exchange information with friend (82%-100%); and students interested to Biodiversity after field trip activity (85%-100%). Students gain knowledge about the diversity of animal vertebrate and its characteristics, the status and condition of animals, and the source of animal with the cases of animal diversity. The students environmental literacy tends to be moderate level based on test. Meanwhile, the average of the attitudes and action greater than the components of knowledge and cognitive skills.

1. Introduction

Environmental education is the foundation for every person to understand the important sustainable development. Education for Sustainable Development (ESD) is practise to keep biodiversity [1]. Five aims of environmental education is to improve awareness, knowledge, attitudes, skills, and participation of issues related to the environment [2]. Re-orientation of education by UNESCO to develop the knowledge, skills, values and behaviors required for sustainable development [1]. These efforts include incorporating climate change and biodiversity issues in teaching and learning. So it is possible to increase the potential of human resources through ESD and the five aims of environmental education.

Indonesia is the third largest mega-biodiversity country in the world, a convenient habit for plants, animals, and microorganisms. They live in seven bio-regions in Indonesia such as Sumatra, Java and Bali, Kalimantan, Sulawesi, Lesser Sunda Islands, Maluku and Papua [3]. The percentage of...
the world’s animal and plant species living in Indonesia, such as birds (16.2%); amphibians (4.6%); mammals (12.2%); reptiles (7.1%); fishes (14.1%); vascular plants (10.9%) [4]. However, all of that diversity cannot be separated from the threat posed by human activities that cause environmental problems, including the issues of biodiversity loss.

The growth of human populations with their needs for biological resources will have an impact on nature that is environmental degradation and biodiversity loss. The continued exploitation of biological resources has resulted in increased extinction rates of endemic and exotic species. Meanwhile, environmental issues related to biodiversity such as habitat destruction, land conversion, habitat fragmentation, hunting and trade in protected wildlife [4,5].

Literacy towards biodiversity needs to support through learning in the classroom and outside the classroom, i.e. field trip. In the National Science Education Standards, grade 5-8th studies diversity and adaptations of organisms. They learn about extinction of a species other than biodiversity and biological adaptation [6]. For grade 9-12th, they learn about the biological classification to understand how an organism is relate. Meanwhile, in the biology curriculum senior high school in Indonesia for grade 10th, the least competencies for biodiversity is that students can analyze observational data on different levels of biodiversity (genes, species and ecosystems) in Indonesia as well as their threats and preservation [7].

The effort to develop biodiversity literacy through field trip activities. The field trip activities consist of a pre-field trip, during a field trip, and post-field trip [8,9]. In this case field trip to Bandung zoo, students are trained to find and analyze various environmental issues based on data and information surrounding environment. Learning biology in an outdoor environment has a positive cognitive and affective impact on pupils related to long-term knowledge retention [10]. During field trip and outdoor experiences, students expressed a positive attitude [8,12]. So through field trip, students not only enhance students’ understanding of process of science and influenced biology achievement [11], but also changes students environmental attitudes and behavior, opportunities for development of social and interpersonal skills [13], effected for students attitude and knowledge toward biology [14], can interacted with a context for science and literacy learning [15], improve students empathy and critical thinking skill through local environment problems [16], and enjoying the experience [17].

Characteristics of people who literate on the environment, i.e. they can consider their daily actions for the impact that will occur in the environment; make the right decision on the environment; willing to act to improve the welfare for people, communities, and the global environment; and they are willing to take part in community life to the environmental problems [18]. So the research question in this paper are how field trip activity can facilitating students to get information about the biodiversity issue and its context?, what are student’s findings during field trip?, and how students’ environmental literacy based on pre-test and post-test results?. The aim of this study are to describe the activities of students get information about the biodiversity issue and its context through field trip, (2) to describe the students’ findings during field trip, and (3) to describe students’ environmental literacy based on pre-test and post-test results. In this case, Bandung Zoo as a learning environment about biodiversity.

2. Methods
The research method used weak-experiment with one group pre-test post-test design [19]. The subject of research was 10th grade public senior high school in Bandung city. One class (10th grade MIA 5) was select be an experimental class as a convenience sampling class [20]. The sample was 34 participants (14 male and 20 female). The class implemented by field trip method integration with Group Investigation (GI) learning model [8,9,21,22]. Field trip activity was held in Bandung Zoo on Monday, August 27, 2017 and begin from 8.00 am until 1.00 pm.

All student was doing an environmental literacy test (pre-test and post-test) on early and ending field trip learning. The instrument test of environmental literacy has adapted from Middle School Environment Literacy Survey (MSELS) [23]. On during the field trip, students’ activity collected by observation sheets and questionnaire sheets for students
The process of field trip implementation has followed three stages i.e. pre-field trip, during a field trip, and post-field trip. The activity during field trips was designed to investigate the local biodiversity cases with a specific animal group i.e Mammalia, Primates, Aves, and Reptiles. Students worked in group. They used the book of guided field trips at Bandung Zoo and the field worksheet to record information to animal keepers, veterinarian, and visitors at Bandung Zoo. Data were collected by each group, then they discussion and led to compare information. They also will prepare and design oral presentation in class (post-field trip). The analysis data was quantitatively descriptive of this research [19]. Statistical data described as the mean values of pre-test post-test, standard deviation values, N-gain values and environmental grade level descriptions based on McBeth et al. [24], i.e low, moderate, and high level.

Students who have followed a field trip at Bandung Zoo were four groups i.e Mammals team, Primates team, Aves team, and Reptile team. Each team accompanied by one veterinarian/animal keeper and one observer. Field activities begin with a general introduction about the Bandung Zoo, then each team surrounded to several collections of animal cages until 10 am. After that, all students are given time to interview visitors until 11 am. Students take a rest to see the animal attraction that showed by the manager of Bandung Zoo. At the end of the field trip activity, all student filled out a questionnaire.

3. Results and Discussion

3.1. Student activity during field trip

Based on field observation, note by observer, on all team was very active in contributing to the process of collecting information with multi-task as an interviewer, as recorder, and as a documentary. All students were active in gathering information that was asking veterinarian, animal keeper and visitors, although there was visitor who refused to be interviewed. Then they gathered to complete the information. Each team also had gathered information by video, photographing, and writing information on their field worksheets.

Based on the questionnaire (Table 1) shows that more than 79% of the students gave positive views on each field trip activity, i.e students’ activity during work with group (97%-100%); students’ activity during gather information (79%-100%); and students’ activity during exchange information with friend (82%-100%). After field trips, students show their interest in biodiversity, i.e all of the student interested in effort to save, to protect and to endanger animals and interested to voice the important animal life through media such as poster or social media. They also interested in becoming a protected and endangered animal observer (85%).

Table 1. Student activity during field trip based on questionnaire

| Student Activity | Questionnaire | Percentage (%) |
|------------------|---------------|----------------|
|                  | Agree | Disagree | Agree | Disagree |
| A. Student’s activity during work with group | 1. Enthusiastic to collect various information in the field. | 97 | 3 |
|                  | 2. Helping each other in recording information during team work. | 100 | 0 |
|                  | 3. Feel sure with the correct information conveyed by animal keeper or veterinarian. | 97 | 3 |
| B. Student’s activity during gather information | 4. Gain knowledge of new information about animals. | 94 | 6 |
|                  | 5. Helping to recognize biodiversity in direct observation. | 100 | 0 |
|                  | 6. Less aware of the condition & existence of animals in Bandung Zoo. | 15 | 85 |
|                  | 7. Less understand the purpose of development of Bandung Zoo. | 9 | 91 |
|                  | 8. Less aware of important animal findings. | 9 | 91 |
|                  | 9. Difficult to distinguish animal characteristics from other animals. | 9 | 91 |
|                  | 10. Difficult to know the status protected, rare & endangered species. | 15 | 85 |
|                  | 11. Can know the similarity between one species with another species. | 94 | 6 |
|                  | 12. Can classify endemic animal from West Java with other regions. | 79 | 21 |
|                  | 13. Can easily explain the general characteristics of animal traits that | 94 | 6 |
### 3.2. Student findings during the field trip

Students identified factual information during a field trip, such as listing the number of protected species, rare and endangered species, questioning the source of the origin of the animals collected, and the status of the animals. In addition, students also interviewed visitors about the reason they visited to Bandung Zoo. The findings obtained by students during identifying information are presented in Table 2. The contexts of biodiversity that students learned during a field trip are the amount of animal biodiversity and the status of animal in the wild life. The biodiversity issues they have found in zoo are the case of illegal animal trade and hunting of wild animals. Then, the animal was rehabilitating and breeding in this zoo.

#### Table 2. Student findings factual knowledge about biodiversity issue and contexts in Bandung Zoo

| Finding Information | Group | Mammals, Primates, Aves and Reptile Team |
|---------------------|-------|-----------------------------------------|
| Number of Animal Collection | | Mammals team was founded 29 endemic species of 163 specimens and 10 exotic species of 35 specimens. |
| | | Primate team was founded 8 endemic species of primate from Indonesia and 1 primate species from Japan. |
| | | Aves team was founded 48 endemic species of 384 specimens and 8 exotic species of 64 specimens. |
| | | Reptile team was founded 15 endangered species and 2 species unprotected. |
| Source | | All teams got information that the animal collection at Bandung Zoo was a gift from other zoos, gifted by the Natural Resources Conservation Center (BKSDA) from trade and illegal cases, as well as gifts from residents who found the animals in their environment. |
| Animal Collection Status | | Mammal team was noted that more mammals were protected. |
| | | Primate team was noted that the primate species was protected and endangered. |
| | | Aves team was noted that there nine aves species are protected, seven species were threatened, and nine species were highly threatened. |
| | | Reptile team was noted that more reptile species were endangered. |

### 3.3. Students’ environmental literacy in field trip context

The information in Table 3 shows that the scores on post-test results have increased in all parts of the environmental literacy test. Based on data pre-test and post-test, the average of the environmental attitudes and behavior (action) scores higher than the components of ecological and biodiversity issue knowledge and cognitive skills scores. The field trip learning has been able to improve students’ environmental literacy. In this case seen in the acquisition of composite score n-gain value of 0.20 and categorized as low criteria. Meanwhile, the level of student’s environmental literacy tends a moderate level based on test (Table 4).
Table 3. Student’s environmental literacy component and score

| Environmental literacy components | Pre-test | Post-test | N-gain score | N-gain Criteria |
|-----------------------------------|----------|-----------|--------------|-----------------|
| **A. Ecological & Biodiversity Issue Knowledge** | 57.65 | 65.88 | 0.19 | Low |
| Mean score | 12.324 | 12.277 | | |
| Standard deviation score | 10.541 | 9.548 | | |
| **B. Cognitive Skills** | 38.03 | 56.47 | 0.29 | Low |
| Mean score | 6.198 | 5.935 | | |
| Standard deviation score | 7.653 | 8.033 | | |
| **C. Environmental Attitude** | 76.06 | 79.44 | 0.14 | Low |
| Mean score | 21.613 | 23.153 | | |
| Standard deviation score | 253.47 | 283.91 | 0.20 | Low |
| **D. Behavior (Action)** | 81.74 | 82.12 | 0.02 | Low |
| Mean score | 68% low, 26% moderate, 3% stable and 3% decrease |
| Standard deviation score | 9% | 100) | 100) | 100) |

Table 4. Student’s environmental literacy level

| Environmental literacy components | Level (Pre test) | Level (Post test) |
|-----------------------------------|------------------|-------------------|
| Low | Moderate | High | Low | Moderate | High |
| **A. Knowledge** | Range | f(n = 34) | % | Range | f(n = 34) | % | Range | f(n = 34) | % |
| (0-30) | (31-69) | (70-100) | (0-30) | (31-69) | (70-100) | 1 | 29 | 4 | 0 | 20 | 14 |
| (3%) | (85.3%) | (11.7%) | (0%) | (58.9%) | (41.1%) | | | | | | |
| **B. Cognitive Skills** | Range | f(n = 34) | % | Range | f(n = 34) | % | Range | f(n = 34) | % |
| (0-35) | (36-70) | (71-100) | (0-35) | (36-70) | (71-100) | 15 | 19 | 0 | 0 | 32 | 2 |
| (44.1%) | (55.9%) | (0%) | (0%) | (94.0%) | (6.0%) | | | | | | |
| **C. Attitude** | Range | f(n = 34) | % | Range | f(n = 34) | % | Range | f(n = 34) | % |
| (20-46) | (47-74) | (75-100) | (20-46) | (47-74) | (75-100) | 0 | 14 | 20 | 0 | 5 | 29 |
| (0%) | (41.1%) | (58.9%) | (0%) | (14.7%) | (85.3%) | | | | | | |
| **D. Behaviour** | Range | f(n = 34) | % | Range | f(n = 34) | % | Range | f(n = 34) | % |
| (20-46) | (47-72) | (73-100) | (20-46) | (47-72) | (73-100) | 0 | 3 | 31 | 0 | 3 | 31 |
| (0%) | (8.8%) | (91.2%) | (0%) | (8.8%) | (91.2%) | | | | | | |
| **Composite score** | Range | f(n = 34) | % | Range | f(n = 34) | % | Range | f(n = 34) | % |
| (40-157) | (158-285) | (286-400) | (40-157) | (158-285) | (286-400) | 0 | 31 | 3 | 0 | 20 | 14 |
| (0%) | (91.2%) | (8.8%) | (0%) | (58.9%) | (41.1%) | | | | | | |

The findings show that all students worked with their respective teams by helping each other in gathering information during a field trip (Table 1). The most common teaching method was students working in groups and participating actively in the learning process [25]. The experience to work with clear goals and tasks will achieve to know field facts. Work through field experiences encouraged a multiple ways of knowing such as observing nature, developing empathy, and participating in environment using resources [26]. In this case, the objects they found are Mammals, Primates, Aves, and Reptiles with their characteristics, numbers, and status in the wild life.

The findings also indicated that all students use of field worksheets provided by a teacher and work with structurally. They share tasks cooperatively, such as writing information, taking notes, photographing objects of animal diversity, and documenting field trip activities with video. Field trips help students to carry out practical works in biology and significantly enhances their academic performance in biology [27]. Hands-on activity includes exploring, investigating, collecting data, and learning new skills are given the impact on student learning [28]. Based on questionnaire in Table 2 a
small amount of students agreed that they are less aware on condition and existence of animals in Bandung Zoo (15%). They got difficult to knowing a status of protected, rare and endangered animal species (15%). They couldn't classify endemic animal from West Java with other regions (21%). We assume that because they are just the first experience to work in the field as long as they get information about animal condition, status and classify other endemic species. Generally, seeing the environment helped students to visualize and understand the issues and importance of the problems [28]. In this case the condition at Bandung zoo as a local context for learning environment.

On Table 1, student activity during exchange information with friend. They complement each other’s lack of information on the field worksheets they have recorded. In this activity, observers note that some team members had a complete record of the results of the data collection process. The use of worksheets were also one of the least often observed activity [28]. This also applies to student activities in giving ideas for animal care. Only a few of the team members did not convey ideas for animal concern through the design of posters (18%). Therefore, more team members (97%) received all opinions and ideas that have communicated by their friends.

Indirectly, field trip activity as an effort to know the students concerns for animals. Learning outside the classroom not only provides experience and contextual learning, it also helps students to easily connect the theory and practice [29]. Based on the questionnaire, they are interested in saving endangered animals by voicing the important animal life through certain media such as posters or social media. Field trip experience is particularly important to addressing students’ environmental attitudes and actions [28]. Meanwhile, some students are not interested in being an animal observer (15%). In this case, we can not find an immediate reason for this item from students. However, there is one research result that confirms about field trip method. Field trip method is positive for students (64%) to learn the important about conservation efforts [30].

Based on Table 2, all student are identifying and analyzing information about biodiversity issues on field during field trip. Students take field work as an important way of learning [29], such as identifying and analyzing information. They found many species of Mammals, Primates, Aves, and Reptiles. They also found the status of animals in nature based on the International Union for Conservation of Nature and Natural Resources (abbreviated as IUCN) red list; as well as the source of animal origin. Then, the information analyzed into several conclusions. All teams got information that animal collection of Bandung Zoo was a gift from the Natural Resources Conservation Center (namely Balai Konservasi Sumber Daya Alam). Animal from trade and illegal cases as well as gifts from residents who found the animals in their environment. Other findings from each team i.e The primate team explained that all primates are ever affected with diseases such as flu, fever, tuberculosis and typhoid. Meanwhile primates given 1 vaccine each year for health. The mammal team explained that more mammals are a protected species. Not all mammals are given the vaccine. Only animals from big cat groups like leopards, lions and tigers are given the vaccine. For example, rabies vaccine is given once in every year. The Aves team informed that many birds are already over population in one cage, so the zoo plans to release them to nature. Most of the birds in the zoo are grain and fruit eaters (herbivores), so they feed only once a day. These findings based on interviews by students to zoo managers or animal keepers. Based on previously research, the important factors that support the cognitive domain during field trip are the students drawing connections to their daily lives, a guide using the environment to explain natural processes, the tasks students explored, and the demonstrations [31]. Therefore, the results of student activities during field investigations need be concerned with teachers in preparing post-field trip learning. The activity in the classroom, i.e students communicate the results of field work and teacher guide students by providing more information.

Based on Table 3, there are efforts that have been facilitated by researcher to make students literate on environmental case related to biodiversity issues. In this study, students’ attitudes and actions related to biodiversity issues as greater achievement than their ecological and biodiversity issue knowledge, and their cognitive skills to solve biodiversity cases. One of the characteristics of literate people on the environmental is awareness to consider their daily actions for the impact that will occur in the environment [18]. Not only the attitude changes, but also the effect of a field trip learning can
change students’ behavior on the environment [14]. Based on item questionnaire in action. Positive response is more than 70% for wise action efforts on natural resource and over 80% for student action efforts on the application biodiversity preservation rules. Wise actions in the utilization for natural resources (including biodiversity), by avoiding the capture of wild animals in nature with poisonous tools, selecting adults fish from wild catches and not fish juvenile, using enough natural resources for daily use, conserving water, saving waste, and try to conserve pets. One study showed that 60% of students do recycle, because recycling and waste disposal has a positive role in protecting biodiversity [32]. Based on test results, the positive response more than 60% of students committed for pro-environmental to biodiversity, more than 70% of students believe in biodiversity values, and more than 74% of students have sensitivity to environmental phenomena. On a previous study show that during field trip and outdoor field experiences, students can prove a positive attitude toward the environment [8,12]. There is a positive effect of a field trip learning can change students’ attitudes toward the environment [14].

Most students (over 60%) have been able to recognize the role of ecosystem components, to explain the impacts of disturbed ecosystems, to give examples of dependence relationship between ecosystem components, to explain energy flow in ecosystem, to give examples of species adaptation, and to identify human activities that threaten ecosystems and their effects on biodiversity. Meanwhile the achievement of 60% of students (Knowledge of biodiversity issues ) has been able to find the cause of species extinction, to identity the impact of excessive use of natural resources and the impact of habitat destruction by illegal logging, to predict the problem of biodiversity loss due to invasive alien species, to explain rescue action biodiversity from extinction threats, and to give examples of biodiversity conservation strategies. For cognitive skill, the cases that have studied by the students, i.e the case of decreasing Java eagle population, the case of humans conflict with Java leopard, and the case of entry of invasive species in Java. However, the case of Java eagle population declines is more contrasting and able studied by students than any other case. Through field trip and field work, learning in the environment not only enjoys field experience [17], but also enhances students’ empathy and critical thinking skills through local environmental issues [16].

4. Conclusion

Based on the research findings. Through field trips method, students tend active to teamwork, especially the process of recording information and interviewing to veterinarian and visitors. More than 79% of the students gave positive views on each field trip activity, i.e students’ activity during work with group (97%-100%); students’ activity during gather information (79%-100%); students’ activity during exchange information (82%-100%), they also interested in effort to save protected and endangered animals, to voice the important animal life through media, they also interested in becoming a protected and endangered animal observer. Students gain knowledge about the diversity (vertebrate) and characteristics of animals, the status and condition of animals, and the source of animal with the cases of animal trade/or illegal as a biodiversity issues and context. The findings information on the field are the basis of factual knowledge for students to increase environmental literacy on biodiversity issues. The level of students’ environmental literacy tends a moderate level based on test. Meanwhile, the average of the attitudes and action greater than the components of knowledge and cognitive skills.

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