The potential of citizen science as a follow up program of student project assignment for biodiversity studies to be meaningful

U Faizah 1,2*, N Y. Rustaman3, B Supriatno3

1Doctorate Program of Science Education, Universitas Pendidikan Indonesia, Bandung, Indonesia
2Department of Biology, Universitas Negeri Surabaya, Surabaya, Indonesia
3Department of Biology, Universitas Pendidikan Indonesia, Bandung, Indonesia

*ulfifaizah@unesa.ac.id; ulfifaizah_19@upi.edu

Abstract. Nowadays, the implementation of project assignments of the study of biodiversity material in college is generally still local action, it is badly needed follow-up as a global perspective. Citizen science is one of the activities that have the potential to be applied. This descriptive study aims to investigate the implementation of student project assignments related to biodiversity studies and to propose the potential of citizen science as a global perspective and follow-up to project assignments in studying biodiversity to enhance its meaningfulness. Several students of the Biology Department in one university in East Java-Indonesia were involved as respondents (n = 74) and several scientific articles were used as sources of potential information of citizen science (n = 15). A questionnaire collected through Google form. The potential of citizen science data was obtained and combined with a literature review using descriptive qualitative data analysis. The conclusion of this study indicates that student project assignments in biodiversity studies were with field practice assignments or conducting research and reports performed in scientific articles. Citizen science has the potential as a follow-up to project assignments in studying biodiversity to be a global perspective and more meaningful.

1. Introduction

Education for Sustainable Development (ESD) is an effort to encourage people to face global challenges constructively, creatively, and create a resilient which sustainable society. The key issues of sustainable development into teaching and learning for example issues on climate change, disaster risk reduction, biodiversity, poverty reduction, and sustainable consumption [1]. Indonesia currently one of a high level of biodiversity in the world and based on results of the 2003-2020 Indonesia Biodiversity Strategy and Action Plan (IBSAP) evaluation to address issues related to Indonesia's biodiversity issues, several solutions have been carried out to strengthen biodiversity issues into the curriculum at various levels of education, support to various communities that carry out activities to increase understanding of important values biodiversity preservation; improve identification, inventory, mapping, and publication of potential biodiversity values [2, 3]. In line with IBSAP, Konsorsium Biologi Indonesia (KOBI) and Konsorsium Pendidikan Biologi Indonesia (KPBI), active to develop the teaching and learning at the level of higher education in biology education to
understand the biodiversity and the optimal and sustainable use of living natural resources for the welfare of humanity [4, 5].

Students at the college level as andragogy learners, they are learning relates to how to direct an individual to ask questions and seek answers to the problems they faced [6]. In pedagogical studies, one of the learning models that is suitable for andragogy students is Learning Through Experience such as Project-Based Learning (PjBL) can improve problem-solving skills and collaborate [7-10]. Students who carry out research projects on biodiversity can produce scientific articles as a form of training student scientific literacy and can enhance creativity in implementing the concept of biodiversity [11, 12]

Nowadays, based on the results of research related to the PjBL mentioned earlier, the implementation of project assignments is generally still local action, it is badly needed follow-up as a global perspective so that the implementation can be more meaningful and can be global action. In the future, the activities that will be carried is hoped not just to satisfy the objectives of lectures can also be utilized to solve real problems related to biodiversity in the real-life and the data obtained can be utilized more globally for the benefit of the wider community who need information related to biodiversity. One of the potential alternative follow-ups is citizen science, activities that are appropriate with the biodiversity preservation program with activities to collect data involving biologists, other fields experts general, and the public to carry out biodiversity conservation in various regions so it is a way that can be used to develop knowledge and science literacy [13-17].

This descriptive study aims to investigate the implementation of student project assignments related to biodiversity studies and to propose the potential of citizen science as a global perspective and follow-up to project assignments in studying biodiversity to enhance its meaningfulness.

2. Methods
This research was descriptive. Sources of information related to the implementation of project assignments of biodiversity studies were obtained from several students of the Biology Department in one university in the East Java-Indonesia were involved as respondents (n = 74). It consisted of biology education (70.3%) and biology (29.7%) program students and had become alumni (43.2%) and some were active (56.8%). A questionnaire was used as an instrument and data collected with a rapid survey through Google form. The survey included questions about the implementation, the form, the benefit, and the difficulty of the project tasks. Several scientific articles were used as sources of potential information about citizen science (n = 15). Literature review used to obtain information about citizen science potential, the Google Scholar database ranging from 2015 to 2020 was used and analyzed in this study. Topic areas with titles, keywords, and abstract criteria in citizen science potential were used as a reference for extracting search results. The potential of citizen science data was obtained and combined with a literature review using descriptive qualitative data analysis.

3. Result and Discussion
The results of the survey on the implementation of the project tasks showed the students most did lectures that integrate project work activities related to the study of biodiversity on Animals Systematics course (94.6%). The biodiversity topics of the project on several courses in this research (Table 1) following the main of study biodiversity includes a study of the diversity of living things on the genes level, species, ecosystems in some place, the distribution of a variety of living things, the benefits and disadvantages of the diversity, threats occurring, and efforts to overcome threats [18]. The main objectives of learning biodiversity are awareness, reasoning, and student participation behaviour, and learning biodiversity or bioresources can improve reasoning, productive thinking habits, and flexible thinking to make decisions for them [19]. The list of courses with the biodiversity topics of project based on students’ responses such as at Table 1.
Table 1. Biodiversity topics of the project on several courses

| No. | Courses                  | The Biodiversity topics of project                                      |
|-----|--------------------------|-------------------------------------------------------------------------|
| 1   | Animal Systematics       | Invertebrate and vertebrate animals                                    |
| 2   | Parasitology             | Parasitic organisms                                                    |
| 3   | Entomology               | Insects                                                                 |
| 4   | Protozoology              | Protozoa                                                                |
| 5   | Zoogeography             | Animal groups based on the geographical distribution                   |
| 6   | Plant Systematics        | flowering plants, gymnosperms, bryophytes, ferns, lycophytes, algae    |
| 7   | Ornithology              | Aves                                                                   |
| 8   | Malacology               | Mollusk                                                                 |
| 9   | Phytogeography           | Plant groups based on the geographical distribution                    |
| 10  | Pharmacognition          | Groups of animals and plants that can be used as natural medicine      |
| 11  | Waste Management         | Groups of animals and plants that can be used to treat waste            |
| 12  | Mycology                 | Fungi                                                                   |

Respondents stated that the most common form of project work was writing scientific articles based on the results of fieldwork (73%) and the other form were research project assignments (plan and conduct simple research with the guidance of lecturers) (67.6%), follow up on assignments that have been made by participating in Student Creativity Programs (67.6%). From the respondent's statement, it was known that the project task was undertaken was to do a practicum or project then the results made into scientific articles or research proposals. The natural science teaching skills (especially biology) developed manually especially practical work or lab was indispensable. It would construct various skills psychomotor, high-level thinking, and characterize learning outcomes. The processes of science adopted as part of the method of science learning so that learners acquire knowledge as practiced by scientists, trained to write scientific articles, and can solve problems in their lives [20, 11]. Moreover, participants involved in citizen science activities could carry out data sharing and communicate the results of the research in scientific work [21].

There were benefits and difficulty in the biodiversity project assignments from this research. Respondents expressed benefit were they trained in making scientific works (71.6%) and better understand the material due to direct practice (70.3%). The survey results from active students and alumni, it was known that they have benefited greatly from the project assignment activities related to biodiversity, both regarding understanding lecture material, training them in conducting research, and writing scientific papers. This was consistent with the explanations of previous researchers who examined the benefits of PJBL [8-12]. Related to the student's difficulty, more than half of the respondents said they had trouble in reference to writing assignments (54.1%). The respondents revealed the difficulties associated with a reference in carrying out the project tasks such as the lack of a reference in made scientific writing, difficulties found references were appropriate, difficulties found the latest references, and they felt did not able to choose a good reference to writing. From the respondents' answers about the difficulties of references from their experienced, it is in line with previous research that stated that reference is one of the difficulties of students in writing scientific articles [22]. To overcome this problem, students should be equipped with skills to search, choose, and use the correct references in writing scientific articles.

In general, from this research, the activity of the project work that has been carried out indicated good results followed the objectives of the student academic achievement that has been determined in the curriculum. It will be better if the activities followed up into a global perspective and more meaningful activities. It means the activities carried out in addition to applying the material being studied are also used to solve problems related to biodiversity in the community, helping people's lives, and the data obtained can be utilized for the benefit the wider. Citizen science is one alternative that has the potential can follow-up the activities. The results of the literature review were done in the research was to clarify the citizen science potential as a follow-up the student's project about the
biodiversity more meaningful performing in Table 2 which presents citizen science has a lot of potentials that can be used to carry out various activities related to biodiversity in the environment and has many benefits for the community. This potential can also be used in the implementation of citizen science for student project assignments (Table 1).

Table 2. Potential citizen science as a follow up to the biodiversity study project task

| No | Source of citation | Potential Citizen Science |
|----|-------------------|--------------------------|
| 1  | Toomey A H, et al. 2020 | Citizen science-based on regional “sense of place” had the potential to increase community participation in programs related to social and ecology/environment, both for current and future activities [23]. |
| 2  | Herodotou et al. 2020 | The Citizen Science program by involving young people in Zooniverse projects had the potential to train young people to get closer to nature and be able to know how a science process works [24]. |
| 3  | Roger E, et al. 2019 Schubert SC, et al. 2019 | The government of New South Wales (NSW) Australia state that citizen science had the potential to assist the government in contributing to environment-related information [25]. Citizen science had the potential to assist the Brazilian government in observing birds migration with participating as volunteers who collected data on the kinds of birds migrating through WikiAves and e-Bird [26]. |
| 4  | Pocock MJO, et al. 2019 Chepkwony R K, et al. 2018 | Citizen science had great potential to increase knowledge about natural resources and biodiversity trends that benefit society, government, and the environment [27]. |
| 5  | Fulton S, et al. 2019 | Data produced by participants of the Citizen Science program in the field of fisheries in Brazil could be used to evaluate stocks and habitats, detect the effects of climate change, and increase knowledge about fisheries [29]. |
| 6  | Irga PJ, et al. 2018 Afrianto WF and Najah SK 2017 | Citizen science had the potential to assist mushroom conservation activities in Australia because with the participation of the community it could raise awareness about the importance of conservation including mushroom biodiversity and help conducted surveys in a broad scope [30]. Some android applications such as BiodiversityWarrior, Burungnesia, and Amfibii Reptil Kita (ARK) were programs that involve contributions from citizen scientists program to increase public awareness of conservation, education on biodiversity, and Indonesia’s databases biodiversity [14]. |
| 7  | Levy M and Gemonprez M 2017 | People engaged in the Citizen Science program had potential as a tool in conducting a research information system including those related to the development sustainable environment [31]. |
| 8  | Yuda P 2017 | The citizen science approach was proven to improve Indonesian’s bird research and conservation. The ornithology was evolving in this era [32]. |
| 9  | Ballard H L, et al. 2017 Fritz S et al. 2017 | The results of research on youth in the community and citizen science (CCS) showed that they learn about true collecting data, communicating the result to the public, and investigating complex socio-ecological problems [33]. Citizen Science and crowdsourcing are two potentially valuable data sources for Earth Observation (EO) activities. Citizen Science in EO’s role was to provide data on trends covering a variety of fields ranging from disaster response to environmental monitoring [34]. Transformative learning through Citizen science had the potential to be a tool in studying conservation and biodiversity because it could train the skills, awareness, and behaviour of participants towards environmental problems [35]. |
| 10 | Bela G et al. 2016 Vallabha P et al. 2015 | Understanding the epistemic culture of science in the citizen science project on social ecology could help reflectively develop learning curves [36]. |

Education on the global perspective has some challenges of providing meaningful education for students and citizen science can be used in the student project assignments that allow them to...
participate and be able to exploit in citizen science in the academic sector, one example of an activity was the galaxy observation project called Green Peas [37-39]. The global perspective in a learning activity is a view when teachers and students jointly develop perspectives and skills to investigate something related to global issues, the way of thinking is to think globally and act locally. Therefore, it must be noted that what is done will affect the world globally [40]. The research that discusses global perspectives on the contribution of citizen science volunteers in river, shale gas extraction, and the Oak Bodyguard were monitor and management referred that was an example of emerging new generation tools to support ecological research [41-43]. Furthermore, since 2012, three associations did global cooperation with the incidence of regional knowledge support program Citizen Science in the academic sector with a program to implement real practice on the environment and society, channelling scholarship programs, and promote research activities [44].

Citizen science can be interpreted as a collaboration between scientists (experts) and non-scientists (amateurs) to collect authentic data, share, and analyzed [45]. The citizen science program is also an effective educational process for non-conservation communities, they can get information about what they find, so they get a sense of satisfaction about it. For scientists, citizen scientist participation will certainly help them to facilitate the process of collecting the required data [14]. Students who are learning about conservation on the course including in amateur/non-scientist/non-conservation communities who will participate and help scientists.

4. Conclusion
The conclusion of this study indicates that student project assignments in biodiversity studies were carried out with field practice assignments or conducting research and reports performed in scientific research articles. Citizen science has the potential as a follow-up to project assignments in studying biodiversity to be a global perspective and more meaningful because local research activities in the student's environment can become a global contribution of data and strategic problem solving for biodiversity issues.

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