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Online citizen science to develop local species identification skills and biodiversity awareness of prospective biology teacher students

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ABSTRACT

Citizen Science (CS) currently involves massive public participation. CS activities have been transformed in various forms, one of which is through *Online Citizen Science* (OCS). This study aims to identify the outcomes of the OCS program on species identification skills (IS) and biodiversity awareness (KB) in prospective biology teacher students. This study used a survey method involving 30 research participants from two campuses in Majalengka and Cirebon. The research data were collected using non-test techniques in the form of analyzing the results of species identification and biodiversity awareness questionnaire. Data were analyzed qualitatively and described according to the findings. The results showed that OCS participants could identify species with an average level of accuracy in the good category. The level of biodiversity awareness in participants after participating in the OCS program was classified as very high. The OCS program can be an alternative in learning taxonomy that can increase awareness of biodiversity.

Introduction

Citizen Science (CS) is an approach to public participation in research activities [1,2]. CS is currently gaining attention in Indonesia. Activities and publications on CS have developed by involving the participation of the wider community and the world of education. Efforts to integrate CS in education have also been developed in Indonesia, one of which is at the University of Education Indonesia with the pioneer Prof. Topik Hidayat, Ph.D from the Department of Biology Education. Research and publications on the implementation of CS education in Indonesia have also been conducted by Aripin, Damayanti, and Faizah et al who developed CS programs in higher and secondary education in Indonesia [3-5].

CS is public participation in scientific research to solve problems in everyday life or discover new knowledge [2,6]. CS has become an effective means of scientific and social transformation. One form of CS that is currently in high demand is online citizen science (OCS).

OCS is a CS activity facilitated by online media in the form of a web/application connected to the internet network [7]. OCS can be an alternative in collecting research data globally without being hindered by distance and time [8,9]. *iNaturalist* is one of the OCS applications that is widely used around the world in global biodiversity data collection [10-12].

OCS can increase public participation in research through the internet. OCS is grouped into three forms, namely *Distributed Computing*, *Distributed Thinking* and *Citizen Science Games* [13]. *Distributed computing involves* participants contributing computing power for large volumes of data analysis, *distributed thinking* involves participants participating in classification, object annotation, or data transcription tasks (such as scientific logbooks or field notes), and *citizen science games involve* players helping to solve scientific research problems through a game interface [13].

OCS activities are very appropriate in Indonesia, because Indonesia is the second largest megabiodiversity country in the world. The limited number of scientists and unavailability of qualified biodiversity data base [14] so, CS activities can be an alternative solution for the collection, identification and publication of Indonesian biodiversity data [3]. To be able to contribute to the collection of Indonesian biodiversity data, the community needs to develop species identification (classification) skills. Species identification skills are very important, especially in learning taxonomy. Species identification skills play an important role in building public awareness of conservation [15].

The low interest of students and university students in taxonomy has caused concern for the future protection of species [16]. Efforts are needed to increase learner interest in taxonomy through effective and fun learning, one of which is through the phenetic method [17]. OCS activities can also be a fun alternative to taxonomic learning because it can conduct research projects that involve the community globally.

OCS can be a solution to facilitate participants' skills in identifying species and increase biodiversity awareness [18,19]. The results of research that has been conducted found that CS programs can improve species identification skills [20] and species literacy in CS participants [21,22]. CS programs have been shown to increase participants' environmental and biodiversity awareness [23]. This study aims to determine the impact of OCS activities on species identification skills and biodiversity awareness in prospective biology teacher students.

Method

This research used a survey method using the *Citizen Science* approach. Research participants came from two campuses in Majalengka and Cirebon regencies. OCS activities carried out from October - December 2022 involving participants as many as (n = 81) which were narrowed down again with the criteria of at least 10 species observation uploads and obtained (n = 30) participants who met the criteria. The research instrument used in data collection is in the form of analyzing the results of species identification in the *iNaturalist* application and a questionnaire to measure biodiversity awareness developed from World Wildlife Fund, data were analyzed using qualitative data analysis techniques and described in accordance with the research findings [45].

Results and Discussion

This research utilizes the *iNaturalist* application as a tool in OCS activities. *iNaturalist* can be utilized in the collection and identification of species in CS activities [24]. *iNaturalist* provides *image processing* facilities that help participants find the right species identification of both plant and animal species [24,25] following is the OCS activity page used in this study.

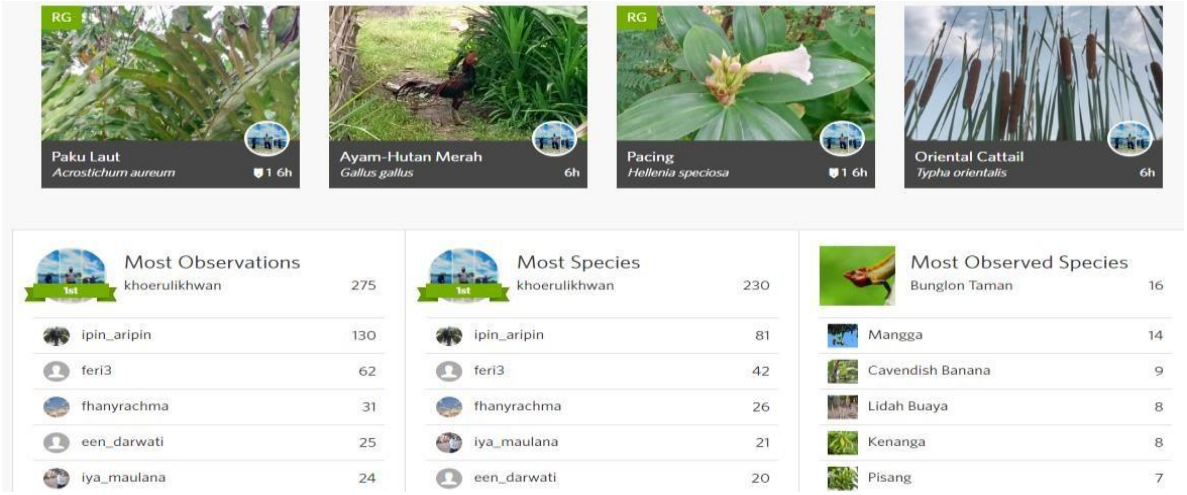

Figure 1. OCS Project Home Page

Figure 1 shows the front page of the OCS project used for biodiversity data collection in this study. The *iNaturalist* application was chosen because it is one of the most popular OCS applications that is easy for students to use and produces good identification data. This application is also available in the form of web and Apps. Project participants' results were then identified and analyzed and are presented in Table 1.

Table 1. Participant Observation Data Mapping

Species observation data	Average of observation data	Average identification accuracy	% Average identification accuracy
840	28.00	22.50	75.53

Table 1 shows the research data obtained by participants during the project from October 01 to December 05, 2022. A total of 840 observation data were collected. In general, the average achievement of species identification accuracy obtained by participants is 75.53% (good), meaning that research participants have been able to identify species well. Furthermore, the details of data acquisition are presented as follows

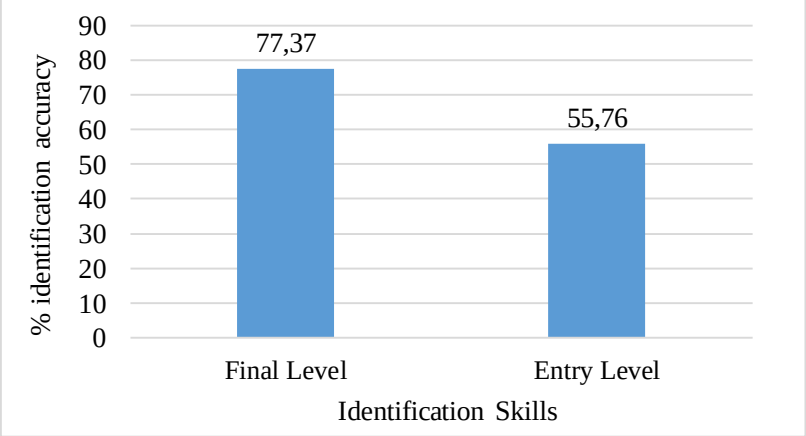

Figure 2. Species Identification Skills by Semester Level

Figure 2 shows the achievement of species identification skills based on semester level. The final year biology teacher candidate students have better species identification skills thanthe first year biology teacher candidate students. Based on these achievements, it can be analyzed that some of the causes of low species identification skills in early level students arethat early level students have not fully obtained taxonomy courses in both plant and animal taxonomy so that they still have difficulty determining the right species identification. Furthermore, identification skills based on gender are presented in Figure 3.

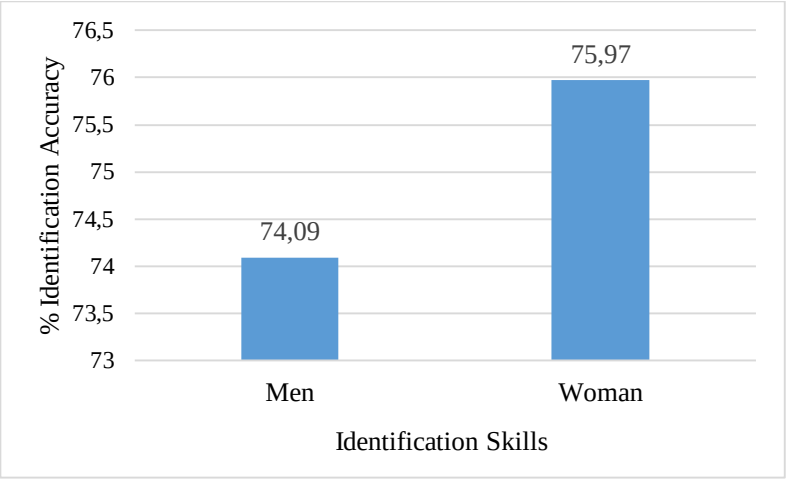

Figure 3. Species Identification Skill Outcomes by Gender

Figure 3 shows the achievement of species identification skills of prospective biology teacher students based on gender, showing that woman are superior to men. The number of OCS participants in this study who were dominated by woman could have influenced this result. Further analysis is needed to determine the results achieved. Furthermore, to find out the indicators of biodiversity awareness achievement in research participants, it is presented in Figure 4

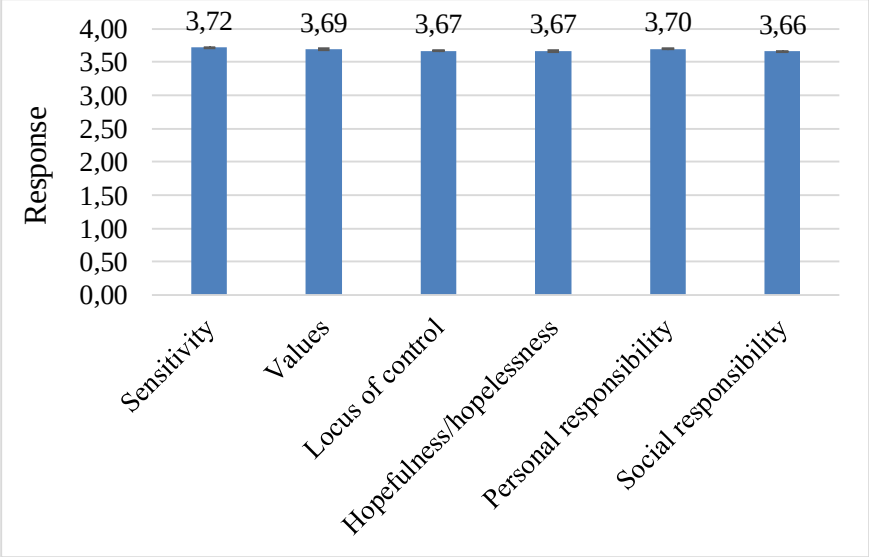

Figure 4. Biodiversity Awareness in Participants

Figure 4 shows the concern of prospective biology teacher students towards biodiversity. Overall, all indicators show high achievement, meaning that students' attitudes and concern for biodiversity have been formed as part of the biology learning

process. Sensitivity and individual response are the indicators with the highest achievement. This shows that prospective biology teacher students already have high sensitivity and individual response to the destruction of biodiversity around them. CS programs based on environmental activitiesprovide contextual experiences to students so as to build their sensitivity and concern for the environment and biodiversity.

Discussion

The importance of learning taxonomy to identify species is a fundamental skill in biological research. Species classification and identification are important for determining the scale of conservation [26]. Living things that are small inpopulation will range in extinction so that they will get priority in conservation programs [27,28]. CS programs have been shown to improve participants' skills in species identification [29]. Research participants involved in CS activities were able to improve their species identification skills with a high category, this is because participants also received guidance from scientists involved in the project [15].

OCS that utilizes various technological facilities both using smartphones and cameras can improve the ability of participants to identify a species [30]. OCS programs that use mobile application facilities can improve species identification skills and biodiversity awareness [31-33]. The OCS can also utilize social media as a means of collecting and building public awareness of biodiversity [34]. The low level of species identification skills in undergraduates may be influenced by learning experience, interest, and age [20,29].

Species identification skills between male and female students showed average abilities that were not significantly different as they only differed by 1.88 points. Research results Melis et al., found that there were no differences in species identification skills based on gender but there were differences in negative attitudes towards invertebrate species, this was driven by a sense of phobia towards certain species [35]. Species identification skills provide different perceptions in terms of gender. Men have positive attitudes and behaviors towards certain species compared to women.

Past research has found that a combination of in-person and online biodiversity data collection activities is more accurate in identifying species [36]. One of the weaknesses of the data generated from CS activities is that there are biasesin the research data, including in the identification of species by participants [36-38]. In this study, species identification was based more on morphological identification and image analysis, making it possible that the identification results were not fully accurate. To obtain identification data with a high level of accuracy can be done through the DNA Barcode technique, this technique can identify living things up to the molecular level [39,40].

OCS activities can be used as an initial stage in species identification before proceeding to the DNA testing stage for more accurate species determination. One form of *Citizen Science project* that provides facilities for species identification up to the molecular stage is the Wolbachia Project [41]. This OCS project facilitates participants to sendresearch samples for further research until DNA testing so that the data generated is accurate so that it can be utilized for the benefit of further scientific research.

The results of the analysis of biodiversity awareness among participants were high. The indicator of sensitivity to biodiversity obtained the highest average compared to the others. Sensitivity to biodiversity issues is a parameter for someone who has a high concern for biodiversity. Good CS programs in their various forms have been shown to increase awareness of biodiversity and conservation [42-44]. This is inseparable from the implementation of CS, which is an activity that provides meaningful learning to participants so that they are able to build their concern for biodiversity [5].

The results of this study can be a reference in the implementation of the OCS programin education, especially basic education and higher education. The OCS program is very relevant to be applied to taxonomy lectures both animal taxonomy and plant taxonomy. Further research can integrate the CS model in a hybrid form so that research data findings can be analyzed directly and virtually so that the accuracy of species identification obtained is more accurate.

Conclusion

OCS activities can facilitate students in improving their species identification skills and biodiversity awareness. Students involved in the OCS project were able to identify species with good categories. OCS proved to be able to increase participants' concern for biodiversity, afterparticipating in this activity participants were interested in taking concrete actions in efforts toconserve biodiversity, especially on a local scale. OCS can be an alternative solution in learning related to biodiversity and taxonomy for prospective biology teacher student.

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