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Exploring Students' Perceptions of Outdoor Biology Learning Activities in Botanical Garden

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Abstract: Outdoor learning has become a relevant learning method to enrich students' learning experience in biology. Botanical gardens, as places that reflect biodiversity, offer unique potential for integrating outdoor learning. This study aims to describe students' perceptions of outdoor learning that has been carried out in the botanical garden as well as the potential and barriers. This research method is a case study. Data collection techniques were questionnaires, structured and semi-structured interviews. The sampling technique used was convenience sampling with a sample of 32 class x students at one of the high schools in Bandung. Responses were expressed in perception numeric index to quantitatively reveal the perceptions of grade 10 students towards the outdoor learning experience that has been carried out. The results revealed that out of 32 respondents, most students showed positive perceptions towards outdoor learning in the botanical garden with a mean index = 55.23 (range 42.5-65.0) with standard deviation (sd) = 6.0. This perspective is influenced by the potential and obstacles in the implementation of outdoor learning conducted in botanical gardens. The implications of this study open up opportunities to design learning strategies that are more effective and can be applied by teachers in organizing biology learning at the high school level.

Keywords: Biology education; Botanical garden; Outdoor learning; Student perception

Introduction

Outdoor learning is a method that utilizes the natural environment outside the classroom as a learning space where students can interact directly with nature and the objects being studied. The outdoor learning method is commonly used in science, especially the branch of biology, such as botany, ecology, zoology, and environmental biology from elementary school to college education (Jeronen et al., 2017, Marchant et al., 2019; Khan et al., 2020). The term outdoor education encompasses many different concepts and approaches to learning that takes place outside of school, such as Education Outside the Classroom, Learning Outside the Classroom, and Learning Outside the Classroom (Lacoste et al., 2021), Outdoor learning, Outdoor Adventure Education (OAE), Learning Outside the Classroom (LOTC) (Mackenzie et al., 2018), Outdoor Learning Activities, Adventure Education, Experiential Education, Outdoor Environmental Education, Outdoor Recreation or Expeditions. Fieldwork and field trips are examples of outdoor learning, or are synonyms of outdoor learning activities and outdoor activities (Jeronen et al., 2017).

Outdoor learning is not only a means to complement learning in the classroom, but can create concrete experiences and center on student activities to discover various concepts holistically, authentically, and meaningfully (Meighan & Rubenstein, 2019). In this context, learners do not only learn from books and classroom learning, but can engage in factual experiences with the outside environment such as school gardens, botanical gardens, forests, or other outdoor nature (Lacoste et al., 2021; Chen & Sun, 2018; Yilmaz et

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al., 2023). Through experiences and challenges in outdoor learning, students are exposed to complex issues such as climate change, biodiversity, habitat degradation, pollution, health and global well-being (Harris, 2018; Marchant et al., 2019). Such an approach will enable students to develop more holistic, creative, and contextualized problem-solving skills to cope with uncertainty, and find sustainable innovative solutions (Jeronen et al., 2017).

Previous research has shown that outdoor learning is believed to improve learning outcomes (Wahyuni et al., 2017; Maesaroh & Sriyanto, 2022; Khan et al., 2020), provide more memorable learning experiences (Wiratman et al., 2019), increase interest, and motivation to study (Harris, 2018; Sari et al., 2023), improving students' physical and emotional health (Marchant et al., 2019), develop science skills, as well as life skills such as problem solving, creativity, collaboration, etc. (Mackenzie et al., 2018). The integration of outdoor learning also aims to improve students' understanding of the environment and sustainability by being in direct contact with nature and the surrounding environment, students can develop awareness of the importance of maintaining and preserving the environment (Jeronen et al., 2017; Lismaya, 2018; Vare et al., 2020; Scherak & Rieckmann, 2020).

Outdoor learning is one of the methods often used in biology learning in Indonesia, known as the fieldwork or field trip method. One of the high schools in Bandung City, West Java has implemented outdoor learning in biology learning by utilizing a botanical garden located in one of the main campus areas of the Indonesian University of Education (UPI). The botanical garden is one of the natural learning resources as well as a natural laboratory that acts as a means of educational activities, research, and community service (Chen & Sun, 2018). In addition, the botanical garden is also a green zone that is not only a place for plant collection and conservation but the presence of plants and animals forms an ecosystem (Donnell & Sharrock, 2017; Faraji & Karimi, 2020).

Botanical gardens play important and diverse roles as outdoor learning venues including the following: 1) Botanical gardens as "living laboratories" that allow students to conduct in-depth observation, identification, and field experiments; 2) The biodiversity contained in botanical gardens is useful in conducting observations and research on various aspects of biology learning; 3) As a place for the conservation of rare and endangered plant species; 4) Botanical gardens can also be a source of learning about ecology and the relationship between organisms and their environment; 5) Collections of medicinal plants and herbs that are beneficial to human health; 6) Practical and fun learning experiences can increase student motivation and engagement.

Student perceptions of outdoor learning activities have pedagogical importance (Goulder et al., 2013). In the context of education, understanding students' perceptions of outdoor learning conducted in botanical gardens is very important. Several previous studies have shown that students' perceptions play a key role in determining the effectiveness of learning, students' motivation and engagement in the learning process, as well as the impact on their understanding of biology concepts and attitudes towards the environment (Faraji & Karimi, 2020; Boca & Saraçlı, 2019; Goulder et al., 2013). Research on student perceptions of biology outdoor learning conducted in botanical gardens is still relatively minimal, especially in Indonesia. Therefore, this study aims to describe students' perceptions of outdoor learning activities carried out in botanical gardens.

Revealing students' perceptions of biology learning activities in botanical gardens not only provides insight into the benefits and potential of such learning, but also highlights aspects that may need to be improved and enhanced. Through this research, it is hoped to not only explore the successes and obstacles of outdoor learning, but also to provide an in-depth look at some of the factors that can shape students' attitudes towards biology learning.

Method

This research is a descriptive qualitative research with a case study method or approach (*case study*). This research describes, explains, and describes the object under study. Case study data can be obtained from all parties concerned and various sources (Nawawi, 2016). This research was conducted in February-April 2023 at one of the high schools in Bandung City. Based on the phenomenon encountered, one of these high schools has conducted outdoor learning in the botanical garden, precisely in the main campus area of the Indonesian University of Education (UPI).

The data collection technique was carried out by convenience sampling with consideration of classes that participated in biology learning in the UPI botanical garden. Case study data were obtained from all parties concerned, namely: a) 32 X grade students in the 2022/2023 school year who conducted teach in the botanical garden, b) 2 biology subject teachers, c) 2 UPI botanical garden administrators. The research data collection technique is a questionnaire of students' perceptions of outdoor learning in the botanical garden, structured interviews with biology teachers, and semi-structured interviews with students and UPI botanical garden administrators.

The questionnaire used was an adaptation of Perceptions of Biology Fieldwork (Boyle et al., 2007)

with several statements to determine students' perceptions of outdoor learning activities that have been carried out in the botanical garden. The measurement scale of the questionnaire consists of positive statements and negative statements using a Likert scale (4 point scale). For positive statements the measurement scale consists of strongly agree (SA) = 4, Agree (A), Disagree (DA) = 3, Strongly Disagree (SD) = 1; and the negative statement measurement scale consists of Strongly Disagree (SD) = 4, Disagree (DA) = 3, Agree (A) = 2, Strongly Agree (SA) = 1. Then the response of each student will be used to calculate the perception numeric index (Iol) to express quantitatively the student's perception of the outdoor learning experience that has been carried out. The perception index of each student is calculated using the formula adapted from (Goulder et al., 2013):

$$I_{ol} = 25 \times \frac{[(\Sigma scores) - N]}{N} \quad (1)$$

N is the number of statements and is multiplied by 25 to give a potential range of 0-100. A high perception index (I_{ol}) value indicates a positive perception of outdoor learning activities conducted in the botanical garden. Steps of Research Procedure can be seen in Figure 1.

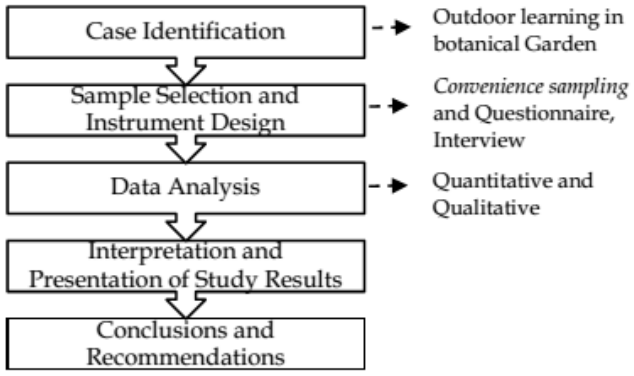

Figure 1. Steps of research procedure

Result and Discussion

Analysis of students' perceptions was conducted to get an overview of students' responses to outdoor learning conducted in the botanical garden. Questionnaire data was obtained from 32 students in 10th-grade after outdoor learning was completed. The results of student perceptions of outdoor learning conducted in the botanical garden can be seen in Table 1.

Table 1. Students' Perceptions of Outdoor Learning Activities in the Botanical Garden

Statement	DS	DA	A	SA
Outdoor learning in botanical garden is something that I enjoy [a]	0	0	5	27
I would rather have lectures in the classroom rather than do outdoor learning in botanical garden[b]	15	13	4	0
I lose interest in outdoor learning in botanical garden because it is boring[b]	7	14	10	1
I always feel well prepared for outdoor learning in botanical garden[a]	0	4	21	7
I feel that time in outdoor learning in botanical gardenis a waste of time[b]	3	23	6	0
Outdoor learning activity in botanical garden teaches me valuable skil	0	0	21	11
I prefer outdoor learning activities in botanical garden engaging physical activity[a]	0	0	25	7
It would be better to work on material brought into the classroom rather than have to go into the botanical garden[b]	8	19	5	0
I learn most about the biology topics in outdoor learning activities in botanical garden[a]	0	7	7	18
I feel difficult to understand biology topics through outdoor learning activities in botanical garden[b]	7	20	5	0

Note: Value in the table are number of student
[a]Statement that show a positive perception of outdoor learning activities
[b]Statement that show a negative perception of outdoor learning activities

Table 1 shows that responses from a total of 32 students mostly expressed positive perceptions of outdoor learning with an average perception index (Iol) = 55.23 (range 42.5-65.0), standard deviation (sd) = 6.0. Students overall agreed that they enjoyed the outdoor learning activities conducted in the botanical garden, M= 3.84, sd = 0.37 (no students did not enjoy outdoor learning in the botanical garden). A total of 28 people agreed or strongly agreed with the learning activities carried out outside the classroom (M = 3.34, sd = 0.70), while 4 students prefer to learn in the classroom. A total of 21 students felt interested in outdoor learning activities in the botanical garden (M = 2.84, sd = 0.81), while 11 students felt bored. A total of 28 students felt ready for outdoor learning in the botanical garden (M= 3.09, sd = 0.59), while 4 students felt unprepared. A total of 26 students disagreed or strongly disagreed that outdoor learning wastes their time (M= 2.91, sd = 0.53), while 6 students agreed.

All students agreed or strongly agreed that outdoor learning activities in the botanical garden taught them valuable skills (M= 3.34, sd = 0.48). All students also agreed that they liked outdoor learning activities with interesting physical activities (M= 3.22, sd = 0.42). A total

of 27 students disagreed or strongly disagreed that it would be better to work on learning materials inside the classroom than outside the classroom (M= 3.09, sd = 0.62), while 5 students agreed. A total of 25 students agreed or strongly agreed that they learned many things about biology through outdoor learning activities (M= 3.34, sd = 0.83), while 7 students disagreed. A total of 27 students disagreed or disagreed that they found it difficult to understand biology material through outdoor learning activities in the botanical garden (M= 3.06, sd = 0.42). Students' perceptions of each questionnaire statement can be seen from the percentage of students' choices of each statement. The results of the percentage of students' choices of each statement can be seen in Figure 2.

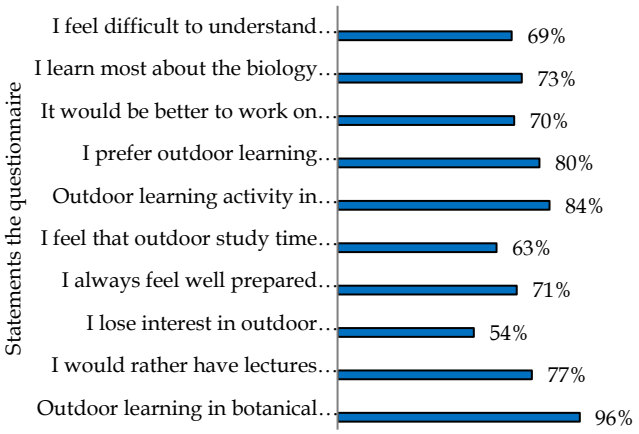

Figure 2. Students' positive responses to questionnaire statements

Based on Figure 2, it is known that the three most positive perceptions of students are found in the first statement, that students really enjoy outdoor learning (96%), then 84% of students' positive perceptions state that outdoor learning teaches them valuable skills, and 80% of students' perceptions state that they like outdoor learning with interesting physical activities. Furthermore, the results of interviews with students revealed the following responses regarding outdoor learning activities in the botanical garden:

> *"Learning is more interesting because we interact directly with nature. We can see plant and animal species that we have never seen before, and identify them. The air is also fresh and cool".*

Based on the results of semi-structured interviews with botanical garden caretaker, it was revealed that the botanical garden has been used several times as an outdoor learning location by high school students, although it is more often used by university students. The implementation of learning carried out by high school students is usually in the morning until noon.

Analysis related to the implementation of outdoor learning conducted in the botanical garden is also recorded through structured interviews with biology teachers. Based on the results of the interview, it can be seen that outdoor learning has often been carried out in the botanical garden, precisely in the main campus area of Universitas Pendidikan Indonesia. Outdoor learning is generally carried out on topics of biodiversity, ecosystems and environmental change, all of these topics are found in grade 10. The learning time allocation adjusts to the learning that is carried out in the classroom, namely 2x45 minutes. The learning strategy that is generally carried out by the teacher is to bring students into the botanical garden area, then students are divided into groups and each group is asked to observe and identify plants, animals or ecosystems in the botanical garden. The identification of plants and animals is accompanied by scientific names using the help of smarthpone. Then each group of students will present their findings at the next meeting in class.

According to the biology teacher, there are several obstacles to the implementation of outdoor learning carried out in the botanical garden, namely the distance to the botanical garden area, the carrying capacity of teachers, weather factors, and the lack of plant and animal collections in the botanical garden. The teacher said that: The distance traveled is enough to drain learning time. Then if the weather is raining, then learning cannot be done. The collection of plants and animals in the botanical garden needs to be increased, so that students can observe new things if they return to study in the botanical garden. Then the teacher's carrying capacity is not sufficient to help the implementation of learning can be carried out properly. This is in line with the results of student interviews which state that additional plant and animal collections are needed in the botanical garden, students said that:

> *"We have to identify food webs in the ecosystem material, but the collection of plants and animals found in botany is still lacking".*

Based on the results of the study, it can be seen that the implementation of outdoor learning conducted in the UPI botanical garden overall shows a positive response. The feeling of pleasure in carrying out outdoor learning is obtained from the experience of interacting directly with natural learning resources outside the classroom which is interesting and fun, so that it can overcome boredom and provide a memorable learning experience in memory. As in previous research shows that outdoor learning has a positive impact on students' long-term memory through memorable experiences, so it will increase students' learning motivation (Jeronen et al., 2017; Sari et al., 2023).

Outdoor learning also provides variety in the daily learning routine that is confined to the room, so students

enjoy a different atmosphere and feel freer to explore their surroundings. Outdoor learning is also interesting because teachers can teach scientific knowledge by utilizing everything in the natural environment (Widodo, 2021). This makes outdoor learning a more engaging learning experience for students than classroom learning (Yilmaz et al., 2023). Hands-on experiences with nature, such as direct observation, field experiments, and adventure activities, spark students' curiosity and interest (Mackenzie et al., 2018).

On the other hand, most students are not interested and motivated to do outdoor learning in the botanical garden, even though students enjoy it. This is due to the learning activities that tend to be monotonous, it is known that students only visit and tour the botanical garden and identify plants using smartphones. Students may feel less interested due to the lack of connection between the activities in the botanical garden and the learning material being studied. Learning in the botanical garden should be carefully planned by the teacher as a facilitator to enable students to be actively involved in practical activities, such as observation, identification and measurement. This can improve students' science skills and cooperation in deepening their understanding of biological concepts (Meighan & Rubenstein, 2019; Boca & Saraçlı, 2019; Yilmaz et al., 2023). Therefore, it is necessary to develop learning activities or activities that attract and motivate students to learn biology.

Students who feel motivated to learn will affect their learning outcomes. Based on the results of previous studies, it is stated that there are significant differences in learning outcomes between students who follow outdoor learning and students who follow conventional learning (Yilmaz et al., 2023). Outdoor-based activities are influential in driving student learning outcomes with reinforcement between cognitive and affective and psychomotor domains (Goulder et al., 2013; Jeronen et al., 2017; Meighan & Rubenstein, 2019; Permana et al., 2020).

Outdoor learning motivates students to learn biology topics characterized by a tendency towards feelings of pleasure to learn things related to the environment, these conditions will form a caring attitude towards the environment (Agusta & Noorhapizah, 2018; Sari et al., 2023; Yilmaz et al., 2023). Developing a relationship with nature is important in understanding sustainability. Awareness of environmental sustainability is one of the prerequisites for changes in environmental attitudes and behaviors in caring for the natural environment for raising sustainability awareness. Some previous research also integrates outdoor learning that focuses on environmental and sustainability issues such as climate change, pollution, and habitat loss (Hamid et al., 2017; Agusta & Noorhapizah, 2018; Harris, 2018).

Learning motivation obtained through outdoor learning in botanical gardens has a role to bring out the spirit of learning in each student when following the process of learning activities (LIbao et al., 2016). Based on research in the last few years, students have low motivation and learning engagement (Saxena & Mishra, 2021), tend to give up when given difficult challenges (Seibert, 2021), Social media and internet addiction (Khairunnisa et al., 2022), tend to reduce physical activity (Irianto et al., 2021). An active learning strategy that involves learning experiences is needed (Hernandez et al., 2020) and emphasizes active student empowerment (student center) (Ernawati, 2016).

Based on the questionnaire results, it is also known that students say that outdoor learning teaches them valuable skills. Through outdoor learning activities, students are also directly involved in honing science skills such as observing plants and animals and their interactions in the ecosystem, identifying rare plants, analyzing interactions between organisms and collaborating among groups. This is in line with previous research which shows that the average value of science process skills and problem-solving ability is in the good category. The potential of outdoor learning can develop life skills for students, such as communication skills, collaboration and teamwork, problem solving, leadership, critical thinking, and adaptability and flexibility (Wahyuni et al., 2017; Jeronen et al., 2017; Harris, 2018; Marchant et al., 2019; Khan et al., 2020).

Education needs to develop soft skills such as teamwork that are needed in the world of work (Brookes, 2017; de Prada Creo et al., 2021; De Prada et al., 2022). Working in teams will help you lead an effective and productive life, each member helps each other to do things and get better results by coordinating tasks, communicating with other team members, and adapting to team environmental conditions (Agusta & Noorhapizah, 2018; de Prada Creo et al., 2021). Working together in a team has a positive impact on other social skills, such as problem-solving skills (Brookes, 2017; Bennett & Gadlin, 2012; Mcewan et al., 2017; Vance et al., 2014).

Cooperation skills arise because of the awareness of each individual that they have common interests so as to create a positive social interaction relationship (Hobson et al., 2013). Cooperation skills can be done through working together in teams (Team Work) (Rudawska, 2017;Tarricone & Luca, 2002; Teaching and Learning Services, 2020; Tetep et al., 2021; Xyrichis & Ream, 2017). Team work is the behavior, knowledge and attitudes that contribute to a team's efforts to achieve a common goal (Assbeihat, 2016). Effective teamwork is necessary for students especially in science where students are

often involved in laboratory experiments and research projects. Working together in teams makes it possible to divide tasks and collect data more efficiently (Bennett & Gadlin, 2012).

The fact that students loved every time they did outdoor learning in the botanical garden, although some students felt that learning activities tended to be monotonous and lacked structured physical activities that spurred students to be more centered into learning and fun. Students are often directed to walk around looking at plants and animals in the botanical garden and then identify them through smartphones. Students' activities tend to be limited to the interactions that occur in the ecosystems they observe. Previous research into students' experiences of outdoor learning suggests that there are several factors that can inhibit outdoor learning, including the structure of activities, duration, and novelty of outdoor learning settings (Jeronen et al., 2017). Fun physical activities for students not only benefit their academics, but also contribute significantly to their physical and mental health (Ernst, 2014; Marchant et al., 2019; Khan et al., 2020; Lacoste et al., 2021).

In addition, based on the analysis of the data obtained, there are some obstacles in the outdoor learning process. Unpredictable weather, when involving outdoor activities, weather can be an important factor. Rain, storms or other extreme weather conditions can disrupt outdoor learning activities or even make them impossible. The availability of cover or alternative means in the event of bad weather becomes important to ensure the smooth implementation of activities (Goulder et al., 2013; Permana et al., 2020).

The implementation of outdoor learning in the botanical garden requires good preparation in terms of learning resources and supporting equipment for active learning. Previous research reveals that outdoor learning will be better with activities that are challenging, competitive and make students collaborate with teamwork (Kamarainen et al., 2018; Cottafava et al., 2019). Ensuring the availability of necessary equipment, such as observation tools, guidebooks, student worksheets, is important.

In addition, based on interviews with biology teachers, there are difficulties in managing study groups, when activities are carried out outdoors, students can be more explorative and energetic. Supporting teachers are needed to manage student groups to keep them focused, obeying the rules. Effective monitoring and coaching by teachers, educators or supervisors are needed to maintain the smooth running of activities and the safety of students.

The implementation of outdoor learning also has limited time. Until now, outdoor learning still adapts to the learning time carried out in the classroom. The right strategy is needed in integrating outdoor learning to be able to carry out effective and efficient learning. The use of botanical gardens can be one of the solutions for schools or educational institutions that do not have adequate resources to support the implementation of outdoor learning. Such as limited funds, facilities, or access to open spaces. Collaborative efforts with communities or external parties that can provide additional resources can help overcome this obstacle.

Conclusion

Overall, students showed positive perceptions towards outdoor learning conducted in the botanical garden. Feeling happy and enjoying learning, developing science and life skills and having fun physical activities are the top three positive responses from students. Students' perceptions become valuable input for improvement and development of more effective and efficient learning strategies and methods related to outdoor learning. The implementation of outdoor learning in the botanical garden has potentials and obstacles. The botanical garden is one of the relevant places for various biology learning topics, because there are various types of plants and animals that form an ecosystem. On the other hand, unpredictable weather conditions, incomplete botanical garden collections are one of the obstacles in outdoor learning activities.

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Writing-original draft preparation, result, discussion, methodology, conclusion, Asyah Dwi Hastika (A.D.H); validation and review, Saefudin (S.), Bambang Supriatno (B.S.) and Kusnadi (K.); All authors have agreed to the published version of the manuscript.

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Conflicts of Interest
The authors declare no conflict of interest regarding the publication of this paper.

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