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The Effect of Out-of-School Learning Environments on Biology Teacher Candidates' Awareness of Biological Diversity

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ABSTRACT

This study aims to examine the effect of field trips to out-of-school learning environments on biology teacher candidates' awareness of biological diversity and their views on biological diversity awareness. A pretest-posttest quasi-experimental design without a control group was used in the research. The study group consisted of 39 volunteer biology teacher candidates enrolled in the 2nd and 3rd years of a state university in Ankara. Both quantitative and qualitative approaches were used to collect research data. In the quantitative phase, the Biological Diversity Awareness Scale developed by Özyurt, Türkoğlu, and Karakaya Cirit (2025) was used. In the qualitative phase of the study, three open-ended questions were used to determine the biology teacher candidates' views on biological diversity awareness. The t-test for dependent samples was used to analyse the quantitative data, while content analysis was used to analyse the qualitative data. It was concluded that there was a significant change in biology teacher candidates' awareness of biological diversity based on the pre-test and post-test results. The qualitative findings revealed that teacher candidates' direct interaction with nature deepened their awareness of the conservation of biological diversity and supported the development of environmental responsibility and sustainability awareness. According to the research findings, it is recommended that out-of-school learning activities be systematically planned in teacher training programmes and that biodiversity topics be supported with practical experiences.

Keywords: Out-of-school learning, biodiversity awareness, teacher education, herbarium, botanical garden, digital zoo.

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1. Introduction

Biological diversity encompasses the entirety of the diversity found within species themselves, between species, and within the ecological complexes that ecosystems harbour, as well as the relationships between terrestrial and aquatic ecosystems (The Convention on Biological Diversity, 2025). This diversity of living species and ecosystems not only maintains the balance of nature but is also of vital importance to human life. Ecosystems provide oxygen production (Chen, Costanza, & Kubiszewski, 2022), soil fertility (Furey & Tilman, 2021), water cycle continuity (UN, 2025), and food chain sustainability (Yang, Liu, Zhu, Wyckhuys, van der Werf, & Lu, 2021), and are direct outcomes of biological diversity (Correia & Lopes, 2023). Therefore, biodiversity is at the heart of sustainable development goals and affects the quality of life of all living beings through its ecological, economic and cultural dimensions (Naeem, Chazdon, Duffy, Prager, & Worm 2016). Today, biological diversity

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faces serious threats. Factors such as climate change, habitat loss, pollution, excessive use of natural resources, and the spread of invasive species are disrupting the natural balance and increasing the rate of species extinction to levels unprecedented in history (Prakash & Verma, 2022). For example, WWF's 2024 Living Planet Report reveals that wildlife populations have dramatically declined by 73 per cent over the past 50 years (WWF, 2024). This situation makes it more necessary than ever for individuals to understand the importance of biodiversity and develop conscious behaviour in this regard. The level of individual awareness is a decisive factor in the conservation of biological diversity (Ibrahim, Assim, Johari, Mohammad, Afandi, & Hassan, 2023). Awareness encompasses the components of knowledge, attitude, and behaviour and fosters a sense of responsibility towards nature. In this context, education plays a major role (Nima, Dorji, Rana, & Dorji, 2025). Education not only provides individuals with knowledge about species diversity and ecological processes but also contributes to their development of sensitivity towards nature, acquisition of ecological ethics, and improvement of their ability to produce solutions to environmental problems. Science and biology education, in particular, is one of the most effective areas for supporting students' holistic understanding of nature and their development as individuals with an awareness of conservation (Børresen, Ulimboka, Nyahongo, Ranke, Skjaervø, & Røskaft, 2023). At this point, teacher candidates' awareness of biological diversity is of particular importance (Özyurt, Türkoğlu, & Bahçeci, 2025). This is because teachers have the most powerful influence in developing environmental awareness and a love of nature in future students. Therefore, determining the level of biodiversity awareness among teacher candidates and developing educational practices to increase this awareness is a strategic necessity in terms of environmental education policies (Almeida, 2023).

Recent studies have shown that learning is more effective not only in the classroom but also directly within life and in experience-based settings. Out-of-school learning environments enable students to interact with nature, observe, explore, and experience meaningful learning (Demirel & Özcan, 2020). Activities carried out in environments such as museums, botanical gardens, nature walks, national parks, or science centres contribute to the holistic development of cognitive, affective, and behavioural gains (Karbeyaz & Kurt, 2022; Yilmaz, Vural, & Yilmaz, 2023; Yanarateş, 2023). Numerous studies have shown that such environments are particularly effective in environmental and biology topics, positively changing students' attitudes towards the environment and permanently increasing their ecological awareness (Kocalar, 2016; Bolat, Karamustafaoğlu & Karamustafaoğlu, 2020; Özel, Güven Yıldırım, Önder & Taşdelen, 2022). Such activities also present an important opportunity for the professional development of teacher candidates. Learning experiences linked to real life strengthen trainee teachers' abilities to apply their theoretical knowledge in the field, observe, analyse, and transfer it to teaching processes (Akyön & Özel, 2025). In this process, trainees also gain experience in planning activities that will increase their students' motivation to learn. Therefore, teacher candidates' active participation in out-of-school learning environments enriches their professional skills and enhances the quality of their future teaching careers (Behrendt & Franklin, 2014).

Although studies on teacher candidates' awareness of biological diversity can be found in the literature (Yüce & Önel, 2015; Bulut & Beşoluk, 2019; Çavuş-Güngören & Özdemir, 2020; Kanat, 2020; Harman & Yenikalaycı, 2021; Koca, Aydın & Sert 2022), research examining how this awareness is shaped through out-of-school learning environments is quite limited (Mercan & Köseoğlu, 2019; Ürey & Kaymakcı, 2020; Utkugün, 2022). In Turkey, there is a continuing need for comprehensive research on biology teacher candidates' participation in experience-based learning activities on environmental and biological diversity issues and the effects of these activities on awareness. This research aims to fill the gap in the literature by revealing the effect of out-of-school learning environments on biology teacher candidates' awareness of biological diversity and by investigating teacher candidates' views on the implementation process. The study will examine the effect of out-of-school learning environments on biology teacher candidates' awareness of biological diversity using a pre-test–post-test quasi-experimental design without a control group. Furthermore, participants' views on their experiences were evaluated through qualitative data. It is thought that the findings obtained from this study will contribute to strengthening the environmental education dimension of teacher training

programmes, developing concrete recommendations regarding the integration of out-of-school learning environments into biology education, and structuring environmental education policies more effectively.

In line with the aim of the research, the problem statement is: 'What is the effect of field trips to out-of-school learning environments on biology teacher candidates' awareness of biological diversity, and what are their views on biological diversity awareness?' In this context, the sub-problems are as follows.

1. What is the effect of field trips to out-of-school learning environments on biology teacher candidates' awareness of biological diversity?

2. What are the views of biology teacher candidates regarding their awareness of biological diversity?

2. Methodology

2.1. Research Design

The study employed a pretest-post-test quasi-experimental design without a control group. Quasi-experimental designs are preferred when the controls required by a true experimental model cannot be provided or are insufficient (Karasar, 2012). In this study, three field trips were organised as out-of-school learning environments. The Biological Diversity Awareness Scale was administered before and after the field trips to determine the change in biology teacher candidates' awareness of biological diversity. In addition, a questionnaire prepared by the researchers was used to support the quantitative data.

2.2. Study Group

The study group consisted of 39 biology teacher candidates enrolled in the 2nd and 3rd years of a state university in Ankara. Fourteen of the teacher candidates were in their 2nd year, while 25 were in their 3rd year. During an information meeting, these teacher candidates were informed about the purpose, content, duration of the study, and the importance of confidentiality, continuity, and voluntariness for the participants. Furthermore, to ensure the confidentiality of the teacher candidates' identity information, they were numbered independently of the research. For this purpose, the 1st teacher candidate was named TC1, the 2nd teacher candidate TC2, ……. and the 39th teacher candidate TC39.

2.3. Implementation Process

This research was conducted with biology teacher candidates and volunteer second- and third-year students during the spring term of the 2024-2025 academic year. The programme lasted a total of five weeks. In the first week, the Biological Diversity Awareness Scale was administered to the teacher candidates. Over the following three weeks, the teacher candidates were taken on field trips to the Ankara Digital Zoo, the Ankara University Herbarium, and the Turkish National Botanical Garden, respectively. When determining the field trip locations, particular attention was paid to selecting places with high biological diversity. After determining the out-of-school learning environments, the trip dates were planned, and the necessary permissions were obtained from the university. Before the trips, the researchers provided the teacher candidates with information about the out-of-school learning environments and the importance of biological diversity. Guide/expert services were utilised for the Ankara University Herbarium and the Turkish National Botanical Garden. During the out-of-school learning activities, teacher candidates were given additional time to take photographs, examine and observe, either individually or in groups. After the trips, the Biological Diversity Awareness Scale was re-administered to the teacher candidates as a final test. In addition, at the end of the application, teacher candidates were asked to complete a feedback form consisting of three open-ended questions.

2.4. Data Collection Tools

Both quantitative and qualitative approaches were utilised in the collection of research data. In the quantitative phase, the Biological Diversity Awareness Scale developed by Özyurt, Türkoğlu and

Karakaya Cirit (2025) was employed. The Biological Diversity Awareness Scale consists of 24 items, which are rated on a 5-point Likert scale. The Biological Diversity Awareness Scale consists of six sub-dimensions. These are: ecological function, species diversity, use value, elements of biological diversity, loss of biological diversity, and the current state of biological diversity. The Cronbach's alpha value of the measurement tool is 0.72.

In the qualitative phase of the research, open-ended questions were used to determine the biology teacher candidates' views on their awareness of biological diversity. A draft form consisting of seven questions was prepared by the researchers, based on a review of previous relevant studies, covering the effects of out-of-school learning environments on teacher candidates' awareness of biological diversity, the relationship between them, and suggestions for their more effective use, etc. The questions for the final form were determined based on the opinions and suggestions of two subject matter experts. The final form was created after obtaining opinions from three biology teacher candidates who did not participate in the research regarding the comprehensibility and applicability of the questions. The questionnaire on biology teacher candidates' views on the effects of out-of-school learning environments on their awareness of biological diversity consisted of three open-ended questions.

2.5. Data Analysis

The SPSS statistical package programme was used for the analysis of quantitative data in the study. The Biological Diversity Awareness Scale was administered before and after field trips to out-of-school learning environments. Table 1 shows the number of questions for each sub-dimension of the scale and the minimum and maximum scores that can be obtained.

Table 1. Number of questions and minimum and maximum scores for the Biological Diversity Awareness Scale

	Number of questions	Lowest score	Highest score
Ecological function	7	7	35
Species diversity	5	5	25
Usage value of biodiversity	3	3	15
Elements of biodiversity	4	4	20
Biodiversity loss	3	3	15
Current state of biodiversity	2	2	10
Biological Diversity Awareness Scale	24	24	120

To examine whether the data showed a normal distribution, skewness and kurtosis values were calculated for each sub-dimension and the total. The results are shown in Table 2.

Table 2. Skewness and kurtosis values for the scale and sub-dimensions

	f	Skewness	Kurtosis
Ecological function	39	-,457	-,305
Species diversity	39	,069	-,785
Usage value of biodiversity	39	-,014	-1,002
Elements of biodiversity	39	-,673	,399
Biodiversity loss	39	-,320	1,422
Current state of biodiversity	39	,296	-,554
Biological Diversity Awareness Scale	39	-,784	-,025

According to Table 2, it is understood that the skewness and kurtosis values range from a minimum of -1.002 to a maximum of 1.422. When skewness and kurtosis values are obtained between ±1.5, parametric analyses are performed (Tabachnick & Fidell, 2013). Therefore, the t-test for dependent samples, which is a parametric test, was used for data analysis.

In the analysis of the data obtained from open-ended questions, the content analysis method was used. In content analysis, similar data are grouped within the framework of specific concepts and

themes and interpreted in an understandable manner (Yıldırım & Şimşek, 2013). Frequency and percentage values were used in the presentation of the data. In addition, the data were supported by sample teacher candidate statements. The data obtained were analysed by two researchers. The Miles and Huberman (1994) reliability formula was used to ensure the reliability of the data. Inter-coder reliability was calculated as 90%. The literature suggests that this rate should be 85% or higher (Miles et al., 2020).

3. Findings

This section contains the results obtained from analyses conducted to determine the change in biology teacher candidates' awareness of biological diversity and their views on biological diversity awareness following field trips to organised out-of-school learning environments.

For the first sub-problem of the research, 'What is the effect of field trips to out-of-school learning environments on biology teacher candidates' awareness of biological diversity?', it was examined whether there was a statistically significant change in biology teacher candidates' awareness of biological diversity before and after field trips to out-of-school learning environments. The results of the paired samples t-test are presented in Table 3.

Table 3. T-test results for the pre-test and post-test measurements of the biological diversity awareness scale for biology teacher candidates

	N	$\bar{X}$	ss	sd	t	p
Ecological function	39	27.74	4.76	38	-3.414	.002*
		30.90	3.24			
Species diversity	39	15.59	3.09	38	4.147	.000*
		13.36	2.51			
Usage value of biodiversity	39	10.62	2.37	38	-4.007	.000*
		12.38	1.79			
Elements of biodiversity	39	15.97	2.55	38	-5.117	.000*
		18.10	1.65			
Biodiversity loss	39	10.36	1.27	38	-1.979	.055
		10.90	1.25			
Current state of biodiversity	39	6.51	1.21	38	-1.086	.284
		6.79	1.51			
Biological Diversity Awareness Scale	39	86.79	7.89	38	-3.474	.001*
		92.44	6.28			

According to the information in Table 3, biology teacher candidates' awareness of biological diversity, ecological function ($t_{(38)}$=-3.414; $p<0.05$), species diversity ($t_{(38)}$=4.147; $p<0.05$), and use value of biodiversity ($t_{(38)}$=-4.007; $p<0.05$), and elements of biodiversity ($t_{(38)}$= -5.117; $p<0.05$) differ significantly. However, no significant difference was found in the subscales of biodiversity loss ($t_{(38)}$= -1.979; $p>0.05$) and current state of biological diversity ($t_{(38)}$= -1.086; $p>0.05$). The total scores on the Biological Diversity Awareness Scale also showed a significant change based on the pre-test and post-test results ($t_{(38)}$= -3.474; $p < 0.05$).

Three open-ended questions were asked of the teacher candidates regarding the second sub-problem of the study, 'What are the biology teacher candidates' views on biodiversity awareness?' The codes, frequencies, and percentages of the responses given by the biology teacher candidates are provided, supported by sample teacher statements.

In the discussion forum, teacher candidates were first asked to answer the question, 'How did your visits to out-of-school learning environments affect your awareness of biological diversity? Please explain.' The findings are presented in Table 4.

Table 4. Teacher candidates' responses to the first question

Code	f	%	Example statements
Concretisation	31	32	*TC21: I gained a concrete understanding of the concepts explained theoretically in the lessons.*
The importance of environmental protection	27	28	*TC9: It helped me better understand the importance we should give to nature and the environment.*
New species	17	17.5	*TC13: I had many opportunities to learn about new species.*
Observation in the natural environment	15	15.5	*TC8: Thanks to learning environments outside of school, we were able to observe the biodiversity at the places we visited, which allowed us to see the natural environment, habitats, and relationships between species.*
Rich	7	7	*TC30: I realised that the same plants and animals are not found everywhere. I realised that Turkey is a country rich in biodiversity.*

Table 4 presents the results of the question regarding how biology teacher candidates' visits to out-of-school learning environments affected their awareness of biological diversity; concretisation (f=31; 32%), the importance of environmental protection (f=27; 28%), new species (f=17; 17.5%), observation in natural environments (f=15; 15.5%) and richness (f=7; 7%).

Secondly, the study sought answers to the question, 'What are the benefits of out-of-school learning environments in raising awareness of biological diversity? Please explain.' The findings are presented in Table 5.

Table 5. Teacher candidates' responses to the second question

Code	f	%	Example statements
Concretisation	28	33	*TC10: Theoretical information about biodiversity that we sometimes teach in school environments may not always be fully absorbed. Therefore, learning environments outside of school provide the opportunity to see this diversity in a tangible way.*
Observation in a natural environment	16	19	*TC25: It enabled us to see biodiversity in its natural environment. It gave us the chance to examine living things in relation to each other and the ecological factors around them.*
Engaging	12	14	*TC15: It is impossible not to be impressed by feeding the carp and turtles in the lake together and seeing the diversity of plants.*
Lasting learning	10	12	*TC32: Taking students to different places in out-of-school learning environments is a good learning experience for them. This is because it is very effective for students to learn by doing and experiencing things for themselves.*
The importance of environmental protection	9	11	*TC19: After seeing the beauty of the environment, students use their surroundings and the environment more consciously. They behave more carefully and attentively towards their surroundings and the environment.*
Identifying new species	9	11	*TC11: Out-of-school learning environments allowed us to see some new types of living creatures.*

Table 5 shows the benefits of out-of-school learning environments in raising teacher candidates' awareness of biological diversity: observation in a concrete setting (f=28; 33%), observation in natural environments (f=16; 19%), engaging (f=12; 14%), lasting learning (f=10; 12%), the importance of environmental protection (f=9; 11%), and recognising new species (f=9; 11%).

Thirdly, the study sought answers to the question, 'As a teacher, what would you do to increase students' awareness of biological diversity? Please explain.' The findings are presented in Table 6.

Table 6. Teacher candidates' responses to the third question

Code	f	%	Example statements
Organising trips	37	46	*TC12: I can organise field trips. We can visit botanical gardens and herbariums.*
Live examples in class	24	30	*TC5: I can provide each student with samples of different organisms and examine them in class, enabling them to appreciate biological diversity.*
Information	8	10	*TC37: Turkey is a very rich country. Therefore, I provide information specifically about our country's biological diversity.*
Activities	6	7.5	*TC31: When I cannot take them on field trips, I plan different activities, such as growing plants or identifying insects.*
Documentary/Animation	5	6.5	*TC3: Resources such as animations and documentaries related to biodiversity can also be used.*

According to Table 6, biology teacher candidates stated that when they become teachers, they will increase students' awareness of biological diversity by organising field trips (f=37; 46%), using live specimens in class (f=24; 30%), providing information (f=8; 10%), and conducting activities (f=6; 7.5%), documentaries/animations (f=5; 6.5%).

4. Results, Discussion and Recommendations

Out-of-school learning environments enable students to experience learning processes beyond the classroom boundaries, providing them with real-life, lasting, and meaningful learning experiences. Numerous studies in the literature emphasise that such environments enhance individuals' attitudes towards the environment, scientific process skills, and levels of environmental awareness (Erten & Taşçi, 2016; Bakar, Avan, Aydınlı, Şeker, & Turgut, 2021; Uludağ, & Erkan, 2023; Çetin, & Akman, 2024; Arıkan, Arıkan, Uğur, Şepşul & Birinci, 2024). Particularly in science education, out-of-school learning environments enable students and teacher candidates to interact directly with natural ecosystems, thereby concretising the concept of biological diversity and strengthening environmental responsibility awareness (Çavuş, Topsakal, & Kaplan, 2013; Ocak, & Korkmaz, 2018; Köseoğlu, & Mercan, 2020; Uzel, 2020; Uzel, 2023).

This research utilised both quantitative and qualitative data to determine the effect of out-of-school learning environments, which support the permanence of learning and environmental awareness, on biology teacher candidates' awareness of biological diversity. The quantitative data analysis revealed a significant change in the total scores of the biological diversity awareness scale between the pre-test and post-test results. This result shows that out-of-school learning environments are effective in increasing teacher candidates' awareness of biological diversity. Similarly, Özgel, Aydoğdu and Yıldırım (2018) investigated the effect of out-of-school learning environments on primary school students' awareness of environmental issues in their study. The study involved two groups: 24 experimental and 24 control group students in the 7th grade. In the study, the experimental group students participated in seven days of field trip observation activities in nature camps, which were an out-of-school learning environment, while the control group used traditional teaching methods in lessons on environmental issues for one week. When the results obtained were examined, they were consistent with our study, showing a significant difference in the pre-test and post-test awareness scores of the students in the experimental group.

In this study, when examining the sub-dimensions of the biological diversity awareness scale, it was observed that the scores obtained by teacher candidates created a significant difference in four sub-dimensions before and after the application (field trips to Ankara Digital Zoo, Ankara University Herbarium, and Turkey National Botanical Garden as out-of-school learning environments). These sub-dimensions are ecological function, species diversity, usage value of biodiversity, and elements of biodiversity. Harman and Yenikalaycı (2021) investigated science teacher candidates' awareness of

biodiversity, stating that teacher candidates were aware of biodiversity in terms of species, genetic, ecosystem, and ecological function diversity. In this respect, the study is similar to the findings of the present research. Similarly, Çağlar and Şahin (2025) examined the effect of nature school activities developed with 64 sixth-grade secondary school students on their levels of nature awareness. The findings of the study revealed that nature school activities significantly increased students' levels of awareness towards nature. In this respect, it is similar to this study.

No significant difference was found in the last two sub-dimensions of the biodiversity awareness scale (biodiversity loss, current state of biodiversity). This situation can be explained by the fact that candidates already have a certain level of awareness on these topics or that the trips did not focus directly on these issues. A review of the literature reveals that Çavuş-Güngören and Özdemir (2020) applied a scale to science teacher candidates to assess their biodiversity literacy, examining sub-dimensions that included the concept and importance of biodiversity in order to identify threats to biodiversity loss and the current state of biodiversity. The researchers stated that there was no significant difference in each dimension of biodiversity, but that the ratio increased slightly after the application, although not statistically significant. The findings obtained by the researchers are similar to this study in that there was no significant difference.

In the qualitative dimension of the study, three open-ended questions were also asked to biology teacher candidates. These questions support the quantitative results. The first question, regarding how visits to out-of-school learning environments affected teacher candidates' awareness of biological diversity, revealed that the most common responses were: concretising the concept of biodiversity (f=31; 32%), the importance of environmental protection (f=27; 28%), recognising new species (f=17; 17.5%), observing in a natural environment (f=15; 15.5%), and observing rich diversity (f=7; 7%). In their studies, Uzel (2020) with biology teacher candidates and Elmas, Aslan and Can (2021) with science teacher candidates emphasised that such informal visits are important in making abstract knowledge concrete. Uzun, Özsoy, and Keleş (2010) obtained opinions on the concept of biological diversity from 66 teacher candidates studying in the first year of science and classroom teaching. One of these opinions was the question, 'What do you think about Turkey's biological diversity?' The students' responses to this question, which included the abundance of species diversity in Turkey, the richness of biodiversity, and the need for necessary work to be done to protect biological diversity, are consistent with our study.

Secondly, in response to the question of what the benefits of out-of-school learning environments are in raising awareness of biodiversity, biology teacher candidates cited concretisation (f=28; 33%), observation in natural environments (f=16; 19%), engaging (f=12; 14%), lasting learning (f=10; 12%), the importance of environmental protection (f=9; 11%), and identifying new species (f=9; 11%). These findings are also consistent with the constructivist learning approach, as students can construct knowledge through direct experience and observation. A review of the literature reveals similar findings. For example, in his study on the effect of out-of-school learning environments on 7th grade students' perception of nature and awareness level regarding recycling, Katırcıoğlu (2019) stated that the students in the experimental group learned while having fun during the trip to the out-of-school learning environment and expressed that such out-of-school learning environments greatly contributed to their learning. Similarly, Topaloğlu and Balçın (2021) provided nature education to 17 fourth-grade primary school students in out-of-school learning environments and then gathered their opinions through open-ended questions. The findings revealed that the pupils enjoyed learning these subjects, found them easier to grasp, had the opportunity to examine examples, and were able to access more examples through these trips.

In the qualitative dimension of the study, when asked what they would do to increase students' awareness of biological diversity as teachers, teacher candidates responded as follows: organising field trips (f=37; 46%), using live specimens in the classroom (f=24; 30%), providing information (f=8; 10%), activities (f=6; 7.5%), documentaries/animations (f=5; 6.5%). The fact that teacher candidates suggested organising field trips, using live specimens in the classroom, providing information,

planning activities, and using visual materials such as documentaries to increase their students' awareness of biological diversity in the future shows that these experiences also developed their professional awareness. Uzun (2023) collected examples of student-centred applications for biodiversity lessons and the views of science teacher candidates on the process. Activities were conducted with teacher candidates both inside and outside the classroom before they prepared their activities. Among the open-ended questions asked at the end of the study was 'In your opinion, which methods, tools, and materials should be used to teach the lesson?' Fifteen out of 25 students responded that the lecture method supported by visual elements should be used, while the remaining 10 students responded that the lesson could be conducted not only in the classroom but also in out-of-class environments, showing similarity with the results of the informational and field trip organisation in this study. This result demonstrates that out-of-school learning environments contribute significantly not only to cognitive development but also to pedagogical and professional development.

This research found that field trips to out-of-school learning environments organised for teacher candidates are an important tool for increasing biology teacher candidates' awareness of biological diversity. The quantitative findings from this research show that activities carried out in out-of-school learning environments significantly increase biology teacher candidates' awareness of biological diversity. The qualitative findings reveal that teacher candidates' direct interaction with nature deepens their awareness of the conservation of biological diversity and supports the development of environmental responsibility and sustainability awareness. These results emphasise the need to give more space to nature-based and experiential learning environments in the teacher education process.

Based on research findings, it is recommended that school-based learning activities be systematically planned in teacher training programmes and that biodiversity topics be supported by practical experiences. In addition to field trips, activities covering the loss of biodiversity, sustainability and conservation themes should be developed. Furthermore, the limitations of this study include the fact that it involved only one university, the relatively small sample size, the short intervention period, and the absence of a control group. Therefore, it is recommended that new studies be conducted involving different age groups, multiple universities, long-term follow-up, and comparisons with control groups.

Ethics Statement

Ethical Committee Approval for this study was obtained from the Gazi University Ethics Committee at its meeting dated 15 April 2025 and numbered 06, with decision code 2025-691.

Conflict of Interest Statement

We declare that there is no academic or financial conflict of interest in this study.

Informed Consent

The authors declare that informed consent was obtained from all individual participants involved in the study.

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