Challenges in Sustainability
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Investigation of Biodiversity Awareness and Conservation Behaviors on Science Teachers Candidates

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Received: 01-04-2025 **Revised:** 02-27-2025 **Accepted:** 03-05-2025

Citation: Özyurt, Z., Türkoğlu, İ., & Bahçeci, F. (2025). Investigation of biodiversity awareness and conservation behaviors on science teachers candidates. *Chall. Sustain.*, *13*(1), 97-109. https://doi.org/10.56578/cis130107.

Abstract: This study investigates the levels of biodiversity awareness and conservation behaviours among science teacher candidates and examines the extent to which these levels vary across demographic and academic variables. A survey-based research design was employed, involving 216 teachers candidates enrolled in the Science Education program within the Department of Mathematics and Science Education at the Faculty of Education. Data were collected using the Biodiversity Awareness Measurement Tool (BAMT) and the Biodiversity Behaviour Measurement Tool (BBMT). Analysis revealed that the mean biodiversity awareness score was 3.57 ± 0.328, whereas the mean conservation behaviour score was 3.53 ± 0.370. A statistically significant gender-based difference was observed in biodiversity awareness, with female participants exhibiting higher awareness levels; however, no significant difference was detected in conservation behaviours. Class level was found to exert a partial influence on both awareness and behaviour scores. Notably, 93.5% of participants reported never having engaged in biodiversity-related activities, indicating a substantial gap between awareness and active conservation efforts. This disconnect underscores a critical challenge in translating theoretical knowledge into practical engagement in biodiversity preservation. Biodiversity is fundamental to ecosystem stability, species sustainability, and human well-being, yet it remains under threat due to rapid urbanisation, industrial pollution, agricultural chemical use, and deforestation. Given the role of educators in fostering environmental consciousness, it is imperative that teacher candidates receive comprehensive training in biodiversity conservation and sustainable ecosystem management. While theoretical knowledge is essential, active participation in conservation initiatives is equally crucial. Greater emphasis should be placed on experiential learning approaches that immerse students in ecosystems, foster direct engagement with nature, and cultivate a sense of responsibility for biodiversity protection. It is recommended that environmental education curricula incorporate nature-based activities, ecological restoration projects, and biodiversity monitoring programs. Furthermore, teacher candidates should be encouraged to participate in sustainability initiatives, field-based environmental studies, and community-led conservation efforts. By fostering a deeper connection with nature and embedding biodiversity conservation into educational practice, future generations of educators can be equipped to promote environmental stewardship and instil sustainable values in their students, thereby contributing to the long-term preservation of global biodiversity.

Keywords: Biodiversity awareness; Conservation behaviours; Environmental education; Sustainable ecosystem management; Science teacher candidates

1. Introduction

The environment can be defined as the entirety of physical, chemical, and biological factors that serve as the settings for living beings to sustain their vital activities and constantly influence them. Nature contains a highly complex system that we know and understand in only limited detail (Ateş, 2010). A functional spatial unit consisting of interrelated living and non-living elements, which sustains and renews itself through the circulation of matter and energy between these elements, is called an ecosystem. Ecosystems and the entirety of ecological relationships constitute the biodiversity of a region. Biodiversity is generally essential for the existence of humans,

natural habitats, and species (Ateş, 2010). Our country is quite rich in terms of biodiversity, and this richness represents our natural heritage. It is believed that this natural heritage has formed due to our country's division into seven geographical regions, each with its unique climate, vegetation, altitude, landforms, soil diversity, lakes, rivers, and wetlands. The biodiversity we possess provides various benefits to our country, including health, medicine, nutrition, pharmacy, forestry, fisheries, economy, industry, tourism, cultural values, and education. Most importantly, biodiversity ensures the continuation of life. Therefore, the presence of biodiversity holds great significance for future generations. Protecting biodiversity is crucial both to allow future generations to observe and recognize the species and ecosystems that comprise biodiversity and to leave them a balanced, healthy natural environment where they can live (Aşıcı, 2014; Robles-Moral et al., 2022).

The most effective solution for preserving biodiversity is to raise awareness among individuals and lay the groundwork for transforming this awareness into positive behavior. All of this is achievable through education. One of the goals of biodiversity education is to cultivate individuals who are aware of biodiversity issues, protect biodiversity, and exhibit positive behaviors toward its conservation and sustainable use (Şişman, 2016; Turan & Yangın, 2014). To raise a generation that respects biodiversity, protects it, understands the importance of sustaining it, and recognizes the necessity of its preservation and transmission across generations, it is essential first to foster awareness and positive behavior in people. In this way, individuals who are aware of biodiversity, respect it, and act according to ethical principles concerning biodiversity can be nurtured. However, biodiversity cannot be protected solely through behaviors. The conservation of biodiversity requires the establishment of bioethics-based, environment-focused biopolicies. Demonstrating behaviors such as being aware of biodiversity, protecting it properly, and using it sustainably is possible through bioeducation (Alpagut & Karataş, 2014; Selinske et al., 2020). Individuals who protect biodiversity are environmentally conscious, adopt sustainable lifestyles, and are capable of generating solutions to environmental problems. Furthermore, 21st-century skills enable individuals to develop environmental awareness and contribute to the preservation of ecosystems. For instance, critical thinking skills help individuals question the causes of biodiversity loss, while creative thinking aids in developing sustainable solutions. Collaboration and communication skills enable participation in social movements for biodiversity conservation and contribute to environmental awareness projects. Environmental behaviors can be influenced by variables such as socioeconomic conditions, living environment, education level, gender, profession, and ecological knowledge (Alp et al., 2008; Atasoy, 2006; Harman & Yenikalaycı, 2021).

Since the loss of biodiversity can have significant impacts across various fields both today and in the future, raising awareness about these issues from primary education, or even from preschool, is crucial. Additionally, having individuals in society who can make informed decisions regarding biodiversity conservation is undoubtedly closely related to the efforts of science teachers. When examining studies conducted in our country, it is observed that there is a lack of large-scale research that specifically includes science teachers. In this context, determining the awareness and behavioral levels of science teacher candidates, who will teach in middle schools, regarding biodiversity is highly meaningful. The findings are expected to provide educators and teachers with insights into fostering awareness about biodiversity conservation and to guide the shaping of educational programs. Through this research, recommendations have been proposed for improving the awareness and behavioral levels of teacher candidates regarding biodiversity—individuals who have the potential and function to positively transform the environment of the future world with more sensitive behaviors and consistent policies, starting from the primary education level. Furthermore, the analyses conducted aim to contribute to their development regarding biodiversity and to shed light on further advanced research in this area. In this context, the main research question addressed in the study is: "What are the awareness and behavior levels of science teacher candidates regarding biodiversity?" The following sub-questions were determined to address this basic problem:

1. Do the awareness and behavior levels of science teacher candidates regarding biodiversity show a significant difference according to gender?
2. Do the awareness and behavior levels of science teacher candidates regarding biodiversity show a significant difference according to their participation in biodiversity-related activities?
3. Do the awareness and behavior levels of science teacher candidates regarding biodiversity show a significant difference according to their willingness to participate in in-service training?
4. Do the awareness and behavior levels of science teacher candidates regarding biodiversity show a significant difference according to grade level?

By seeking answers to these questions, we aim to better understand the effects of teacher candidates' awareness and behaviors regarding biodiversity on educational processes.

2. Material and Method

This study aims to determine the awareness and behavioral levels of science teacher candidates regarding biological diversity and to compare these levels based on gender, grade level, family income, participation in activities related to biological diversity, willingness to participate in in-service training, ability to accurately identify the fundamental components of biodiversity, and their self-reported knowledge and interest in biodiversity.

For this purpose, the survey model was used. The survey model is an approach that allows the description of a current or past situation as it is. In this model, the event, individual, or object under investigation is described as it exists, without altering conditions or exposing it to any external influences (Karasar, 2009).

2.1 Study Group

Simple random sampling, one of the random sampling methods, was used in the study. The method in which each sampling unit is given an equal probability of being selected is called simple random sampling. The sample of the study consists of 216 teacher candidates studying in the Science Education program of the Department of Mathematics and Science Education at the Faculty of Education.

2.2 Data Collection Process

In this study, teacher candidates participating in the research were asked questions to gather demographic information, including their gender, age, family income, whether they had taken any courses or classes on biodiversity during their university education, their willingness to participate in in-service training on biodiversity, and the resources they used regarding biodiversity. Additionally, teacher candidates were asked to write down the fundamental components of biodiversity. Furthermore, participants were asked to provide self-assessments regarding biodiversity. In the next phase, the BAMT and BBMT were developed to collect data on their levels of awareness and behavior related to biodiversity. Analyses were conducted using the data obtained from these measurement tools.

2.3 Data Analysis

The measurement tool used in the study consists of three sections. The first section includes 12 items related to demographic information. The second section contains the Biological Diversity Awareness Measurement Tool, which consists of 24 items prepared in six sub-dimensions to assess participants' biodiversity awareness levels. The third section includes the Biological Diversity Behavior Measurement Tool, which consists of 25 items prepared in seven sub-dimensions to evaluate participants' biodiversity behavior levels (Özyurt et al., 2025). The forms were handed out personally, with necessary rules and instructions explained. The data obtained were analyzed using computer software. Various analysis techniques were employed to answer the main and sub-research questions. To determine whether there was a significant difference between the arithmetic means of "two" independent variables, a t-test was conducted; if the number of groups being compared was greater than two, a one-way analysis of variance (ANOVA) test was performed. Additionally, to determine the biodiversity awareness and behavior levels of the students, frequencies, percentages, arithmetic means, and standard deviations were calculated.

3. Results

This section includes descriptive statistics, findings, and interpretations aimed at evaluating the biodiversity awareness and behavior levels of science teacher candidates. The findings and interpretations obtained from the implementation of the BAMT and BBMT are presented.

3.1 Some Statistics on Survey Results

The frequency and percentage distributions of science teacher candidates based on gender, age, grade level, whether they had taken any courses or classes on biodiversity during their university education, their willingness to participate in in-service training on biodiversity, and the resources they utilized regarding biodiversity are presented in tables. The distribution of teacher candidates based on the gender variable is shown in Table 1.

Table 1. Frequency and percentage values for the gender variable

Groups	*f*	%
Female	165	76,4
Male	51	23,6
Total	216	100,0

As shown in Table 1, 76.4% (165 individuals) of the sample group participating in the study are female, while 23.6% (51 individuals) are male. The distribution of teacher candidates based on the age variable is presented in Table 2.

As seen in Table 2, when the age levels of the sample group participating in the study are examined, it is

determined that 39 individuals (18.1%) are in the 18-19 age range, 10 individuals (49.1%) are in the 20-21 age range, and 71 individuals (32.9%) are 22 years or older.

The distribution of teacher candidates based on the grade level variable is presented in Table 3.

Table 2. Frequency and percentage values by age levels

Groups	*f*	%
18-19 Age range	39	18,1
20-21 Age range	106	49,1
22 and above	71	32,9
Total	216	100,0

Table 3. Frequency and percentage values by grade levels

Grade Level	*f*	%
1st Grade	56	25,9
2nd Grade	52	24,1
3rd Grade	68	31,5
4th Grade	40	18,5
Total	216	100,0

As seen in Table 3, when the grade levels of the sample group participating in the study are examined, 25.9% (56 individuals) are in the 1st grade, 24.1% (52 individuals) are in the 2nd grade, 31.5% (68 individuals) are in the 3rd grade, and 18.5% (40 individuals) are in the 4th grade.

The frequency and percentage distribution of teacher candidates' responses to the question, "Have you taken a course on biodiversity during your undergraduate studies?" are presented in Table 4.

Table 4. Status of taking courses on biodiversity during undergraduate studies

Course Attendance Status	*f*	%
Yes, I attended	126	58,3
No, I did not attend	90	41,7
Total	216	100,0

As seen in Table 4, 58.3% (126 individuals) of the sample group participating in the study stated that they had taken a course related to biodiversity, while 41.7% (90 individuals) indicated that they had not. Accordingly, it is observed that the majority of the teacher candidates participating in the study had taken such a course during their undergraduate education.

The frequency and percentage distribution of teacher candidates' responses to the question, "In which grade did you take a course on biodiversity during your undergraduate studies?" are presented in Table 5.

Table 5. Distribution of biodiversity course attendance by grade levels

Grade Level	*f*	%
1st Grade	10	8,3
2nd Grade	50	41,3
3rd Grade	55	45,5
4th Grade	6	5,0
Total	121	100,0

*Those who did not mark were not taken into consideration

According to Table 5, the distribution of teacher candidates who took courses on biodiversity during their undergraduate studies by grade level is as follows: 8.3% (10 individuals) took the course in the 1st grade, 41.3% (50 individuals) in the 2nd grade, 45.5% (55 individuals) in the 3rd grade, and 5.0% (6 individuals) in the 4th grade.

The frequency and percentage values of the responses to the question, "Write down the concepts you learned from the biodiversity-related courses you took during your undergraduate studies," are presented in Table 6.

As seen in Table 6, 68.1% (147 individuals) of the sample group participating in the study stated "I don't know" regarding biodiversity-related concepts, while 4.2% (9 individuals) mentioned genetics, 10.6% (23 individuals) biodiversity, 3.2% (7 individuals) ecosystem, 0.9% (2 individuals) ecological event, 1.9% (4 individuals) species, 4.2% (9 individuals) environment, 1.9% (4 individuals) everything in nature, 2.3% (5 individuals) definition and meaning, 1.4% (3 individuals) endangered species, and 1.4% (3 individuals) conservation of biodiversity as concepts they learned.

Table 6. Concepts learned from biodiversity-related courses

Concepts	*f*	%
I don't know	147	68,1
Genetics	9	4,2
Biodiversity	23	10,6
Ecosystem	7	3,2
Ecological event	2	,9
Species	4	1,9
Environment	9	4,2
Everything in nature	4	1,9
Definition and meaning	5	2,3
Endangered species	3	1,4
Conservation of biodiversity	3	1,4
Total	216	100,0

The distribution of teacher candidates' responses to the question, "What is the primary resource you use for biodiversity-related topics?" is presented in Table 7.

Table 7. Distribution of resources used for biodiversity

Resource	*f*	%
Internet	70	54,7
Magazine or Newspaper	8	6,3
Book	41	32,0
TV or Radio	4	3,1
Others	5	3,9
Total	128	100,0

*Those who did not mark were not taken into consideration

According to Table 7, of the 128 teacher candidates who indicated that they used a source for biodiversity, 54.7% (70 individuals) stated that they used the internet as a source, 6.3% (8 individuals) used magazines and newspapers, 32.0% (41 individuals) used books, 3.1% (4 individuals) used TV or radio, and 3.9% (5 individuals) used other sources. Additionally, 88 teacher candidates left this question unanswered.

The frequency and percentage distribution of teacher candidates' responses to the question, "Have you participated in any activities related to biodiversity?" are presented in Table 8.

Table 8. Frequency and percentage values for participation in biodiversity activities

Participation Status	*f*	%
Yes	14	6,5
No	202	93,5
Total	216	100,0

According to Table 8, 6.5% (14 individuals) of the sample group participating in the study stated that they had participated in an activity related to biodiversity, while 93.5% (202 individuals) had not participated in any biodiversity activities. It is observed that the participation rate of teacher candidates in such activities is quite low.

The frequency and percentage distribution of teacher candidates' responses to the question, "Would you like to receive in-service training on biodiversity topics?" are presented in Table 9.

Table 9. Willingness to receive training on biodiversity topics

Response	*f*	%
Yes	133	61,6
No	83	38,4
Total	216	100,0

According to Table 9, 61.6% (133 individuals) of the teacher candidates participating in the study stated that they were willing to attend the proposed biodiversity education program, while 38.4% (83 individuals) stated that they were not willing to attend the program. Accordingly, it can be said that the willingness of teacher candidates to receive education on biodiversity topics is high.

The frequency and percentage distribution of teacher candidates' responses to the question, "Write the four basic components of biodiversity," are presented in Table 10.

Table 10. Ability to write the components of biodiversity

Response	*f*	%
Could not write any	152	70,4
Could write 1 correctly	25	11,6
Could write 2 correctly	12	5,6
Could write 3 correctly	26	12,0
Could write all 4 correctly	1	,5
Total	216	100,0

According to Table 10, 0.5% (1 individual) of the teacher candidates participating in the study were able to correctly write all four basic components of biodiversity, while 12.0% (26 individuals) could correctly write three components, 5.6% (12 individuals) could correctly write two components, and 11.6% (25 individuals) could correctly write only one component. Finally, 70.4% (152 individuals) could not correctly write even one of the basic components of biodiversity.

The frequency and percentage distribution of teacher candidates' responses to the question, "Which of the following statements best describes your interest and knowledge regarding biodiversity?" are presented in Table 11.

Table 11. Personal knowledge evaluation on biodiversity

Knowledge Status	*f*	%
I have at least some knowledge about biodiversity and its benefits.	68	31,5
I am willing to learn about biodiversity and think I have sufficient knowledge about its benefits.	48	22,2
I do not have sufficient knowledge about biodiversity and its benefits	81	37,5
I do not want to have knowledge about biodiversity.	2	0,9
No opinion	17	7,9
Total	216	100,0

*Those who did not mark were not taken into consideration

According to Table 11, 31.5% (68 individuals) of the teacher candidates participating in the study stated that they have some knowledge about biodiversity, and 22.2% (48 individuals) indicated that they are willing and feel they have sufficient knowledge about the subject. 37.5% (81 individuals) reported that they do not have enough knowledge about biodiversity, 0.9% (2 individuals) stated that they do not want to have knowledge about it, and 7.9% (17 individuals) mentioned that they have no opinion on the matter.

As seen in Table 12, it was determined that the average level of students' biodiversity behavior was 3.53 ± 0.370, while the average level of their biodiversity awareness was 3.57 ± 0.328.

Table 12. Averages of biodiversity awareness and behavior levels

	N	Mean	Ss	Min.	Max.
Biodiversity Behavior	216	3,53	,370	2,56	4,48
Biodiversity Awareness	216	3,57	,328	2,38	4,42

As seen in Table 13, while the biodiversity behavior levels of the students participating in the study did not show a significant difference based on the gender variable, their biodiversity awareness levels significantly differed according to gender. This difference was in favor of female students.

Table 13. Biodiversity awareness and behavior levels by gender

	Group	N	Mean (M)	Ss	t	p
Biodiversity Awareness	Female	165	3,60	,31	2,51	,01
	Male	51	3,47	,36		
Biodiversity Behavior	Female	165	3,55	,36	1,45	,14
	Male	51	3,46	,38		

As seen in Table 14, it was determined that the biodiversity awareness levels of the individuals participating in the study and all its sub-dimensions did not differ according to the age variable ($p > .05$).

As seen in Table 15, it was observed that the biological diversity behavior levels of the individuals participating in the study did not significantly differ according to their age levels ($p > .05$).

As seen in Table 16, a significant difference was found only in the “Utilization Value” dimension between 1st and 2nd-year students, in favor of the 2nd-year students. However, no significant differences were detected in the “Overall Biological Diversity Awareness” and other sub-dimensions ($p > .05$).

Table 14. Biological diversity awareness levels by age

Measurement Tool	Age Group	N	Mean (M)	Ss	L	p	F	p
Ecological Function	18-19 Age Group	39	4,00	,62	,38	,68	1,83	,16
	20-21 Age Group	106	3,94	,62				
	22 and Above	71	4,11	,51				
	Total	216	4,00	,59				
Species Diversity	18-19 Age Group	39	3,11	,54	1,73	,17	,23	,78
	20-21 Age Group	106	3,05	,67				
	22 and Above	71	3,01	,74				
	Total	216	3,05	,67				
Utilization Value of Biodiversity	18-19 Age Group	39	3,77	,63	,42	,65	,39	,67
	20-21 Age Group	106	3,84	,62				
	22 and Above	71	3,88	,66				
	Total	216	3,84	,63				
Elements of Biodiversity	18-19 Age Group	39	3,58	,43	1,57	,20	,83	,43
	20-21 Age Group	106	3,53	,39				
	22 and Above	71	3,48	,37				
	Total	216	3,52	,39				
Biodiversity Loss	18-19 Age Group	39	3,27	,46	,14	,86	,76	,46
	20-21 Age Group	106	3,38	,49				
	22 and Above	71	3,38	,52				
	Total	216	3,36	,49				
Current State of Biodiversity	18-19 Age Group	39	3,45	,70	,25	,77	1,29	,27
	20-21 Age Group	106	3,36	,65				
	22 and Above	71	3,25	,63				
	Total	216	3,34	,65				
Overall Biological Diversity Awareness	18-19 Age Group	39	3,58	,35	,25	,77	,27	,76
	20-21 Age Group	106	3,55	,33				
	22 and Above	71	3,59	,31				
	Total	216	3,57	,32				

Table 15. Biological diversity behavior levels by age

Measurement Tool	Age Group	N	Ort.	Ss	L	p	F	p
Biodiversity Conservation Behavior	18-19 Age Group	39	3,51	,78	,21	,80	1,25	,28
	20-21 Age Group	106	3,48	,73				
	22 and Above	71	3,66	,76				
	Total	216	3,55	,75				
Economic Value of Biodiversity	18-19 Age Group	39	2,63	,51	,43	,65	,27	,76
	20-21 Age Group	106	2,58	,55				
	22 and Above	71	2,64	,59				
	Total	216	2,61	,55				
Ethical Value of Biodiversity	18-19 Age Group	39	3,48	,48	1,25	,28	1,40	,24
	20-21 Age Group	106	3,62	,47				
	22 and Above	71	3,53	,56				
	Total	216	3,57	,50				
Threat Factors of Biodiversity	18-19 Age Group	39	3,79	,66	,19	,82	,09	,91
	20-21 Age Group	106	3,85	,65				
	22 and Above	71	3,82	,68				
	Total	216	3,83	,66				
Political and Legal Behaviors of Biodiversity	18-19 Age Group	39	3,90	,76	,87	,41	,56	,57
	20-21 Age Group	106	3,98	,89				
	22 and Above	71	4,08	,85				
	Total	216	4,00	,85				
Utilization Value of Biodiversity	18-19 Age Group	39	3,29	,68	,86	,42	,69	,50
	20-21 Age Group	106	3,15	,75				
	22 and Above	71	3,11	,82				
	Total	216	3,16	,76				
Individual and Societal Persuasion of Biodiversity	18-19 Age Group	39	3,77	,89	1,89	,15	1,67	,19
	20-21 Age Group	106	3,80	,85				
	22 and Above	71	4,01	,72				
	Total	216	3,86	,82				
Overall Biological Diversity Behavior	18-19 Age Group	39	3,51	,41	1,00	,36	,47	,62
	20-21 Age Group	106	3,51	,33				
	22 and Above	71	3,56	,39				
	Total	216	3,53	,37				

Table 16. Biological diversity awareness levels by grade levels

Measurement Tool and Sub-Dimensions	Grade Level	N	Mean (M)	Ss	Levene Test		ANOVA		Difference
					L	p	F	p	
Ecological Function	1st Grade	56	3,95	,67	,81	,48	,31	,81	
	2nd Grade	52	4,04	,60					
	3rd Grade	68	3,98	,56					
	4th Grade	40	4,05	,52					
	Total	216	4,00	,59					
Species Diversity	1st Grade	56	3,18	,61	2,61	,05	1,67	,17	
	2nd Grade	52	2,90	,54					
	3rd Grade	68	3,07	,76					
	4th Grade	40	3,00	,74					
	Total	216	3,04	,67					
Utilization Value	1st Grade	56	3,64	,64	1,64	,18	3,90	,01	2>1
	2nd Grade	52	4,05	,52					
	3rd Grade	68	3,86	,62					
	4th Grade	40	3,80	,71					
	Total	216	3,84	,63					
Elements of Biodiversity	1st Grade	56	3,54	,40	1,91	,12	1,15	,32	
	2nd Grade	52	3,57	,44					
	3rd Grade	68	3,52	,33					
	4th Grade	40	3,42	,38					
	Total	216	3,52	,39					
Biodiversity Loss	1st Grade	56	3,33	,48	,81	,48	,72	,54	
	2nd Grade	52	3,29	,54					
	3rd Grade	68	3,40	,43					
	4th Grade	40	3,41	,54					
	Total	216	3,36	,49					
Current State of Biodiversity	1st Grade	56	3,48	,63	,76	,51	2,37	,07	
	2nd Grade	52	3,22	,68					
	3rd Grade	68	3,39	,68					
	4th Grade	40	3,18	,56					
	Total	216	3,33	,65					
Overall Biological Diversity Awareness	1st Grade	56	3,56	,37	1,24	,29	,09	,96	
	2nd Grade	52	3,56	,33					
	3rd Grade	68	3,58	,29					
	4th Grade	40	3,54	,30					
	Total	216	3,56	,32					

As seen in Table 17, in groups where the distribution was homogeneous, the ANOVA analysis conducted to compare students' biological diversity behavior levels according to their grade levels did not reveal any significant differences in the “Overall Biological Diversity Behavior” and other sub-dimensions ($p > .05$). Since the distribution was found to be non-homogeneous in the “Individual and Societal Persuasion of Biodiversity” sub-dimension, the Kruskal-Wallis H analysis was performed, and the results are presented in Table 18.

Table 17. Biological diversity behavior levels by grade levels

Measurement Tool and Sub-Dimensions	Grade Level	N	Mean (M)	Ss	Levene Test		ANOVA		Difference
					L	p	F	p	
Biodiversity Conservation Behavior	1st Grade	56	3,37	0,82	,64	,58	2,31	,07	
	2nd Grade	52	3,63	0,64					
	3rd Grade	68	3,52	0,73					
	4th Grade	40	3,75	0,76					
	Total	216	3,55	0,7					
Economic Value of Biodiversity	1st Grade	56	2,69	0,52	,90	,44	1,47	,22	
	2nd Grade	52	2,51	0,58					
	3rd Grade	68	2,68	0,52					
	4th Grade	40	2,54	0,61					
	Total	216	2,61	0,55					
Ethical Value of Biodiversity	1st Grade	56	3,52	0,54	,52	,66	,77	,50	
	2nd Grade	52	3,65	0,46					
	3rd Grade	68	3,57	0,51					
	4th Grade	40	3,51	0,50					
	Total	216	3,57	0,50					
Threat Factors of Biodiversity	1st Grade	56	3,79	0,66	,03	,99	,40	,74	

	2nd Grade	52	3,90	0,64				
	3rd Grade	68	3,79	0,68				
	4th Grade	40	3,86	0,65				
	Total	216	3,83	0,66				
	1st Grade	56	3,87	0,89				
	2nd Grade	52	4,00	0,82				
Political and Legal Behaviors of Biodiversity	3rd Grade	68	4,04	0,90	,52	,66	,68	,55
	4th Grade	40	4,11	0,78				
	Total	216	4,00	0,85				
	1st Grade	56	3,25	0,72				
	2nd Grade	52	3,09	0,74				
Utilization Value of Biodiversity	3rd Grade	68	3,23	0,79	,44	,72	1,16	,32
	4th Grade	40	3,01	0,78				
	Total	216	3,16	0,76				
	1st Grade	56	3,65	0,99				
	2nd Grade	52	3,97	0,76				
Individual and Societal Persuasion of Biodiversity	3rd Grade	68	3,84	0,78	3,56	,01	-	-
	4th Grade	40	4,05	0,66				
	Total	216	3,86	0,82				
	1st Grade	56	3,48	0,411				
	2nd Grade	52	3,55	0,33				
Overall Biological Diversity Behavior	3rd Grade	68	3,54	0,37	,53	,65	,40	,74
	4th Grade	40	3,54	0,35				
	Total	216	3,53	0,37				

Table 18. Comparison of the ındividual and societal persuasion dimension of biodiversity by grade level

Dimension	Grade	N	Mean Rank	X^2	sd	p
	1st Grade	56	96,85	4,69	3	,19
	2nd Grade	52	117,35			
Individual and Societal Persuasion of Biodiversity	3rd Grade	68	104,74			
	4th Grade	40	119,70			
	Total	216				

As seen in Table 18, the “Individual and Societal Persuasion of Biodiversity” sub-dimension does not significantly differ according to students' grade levels ($p > .05$).

As seen in Table 19, it was determined that the biodiversity awareness levels of the students participating in the study did not significantly differ based on whether they participated in any biodiversity-related activities ($p > .05$).

Table 19. Biodiversity awareness levels by participation in biodiversity-related activities

Measurement Tool and Sub-Dimensions	Participation Status	N	Mean Rank	U	Z	p
	Yes	14	54,04			
Ecological Function	No	112	64,68	651,50	-1,03	,30
	Total	126				
	Yes	14	66,18			
Species Diversity	No	112	63,17	746,50	-,29	,77
	Total	126				
	Yes	14	62,00			
Utilization Value	No	112	63,69	763,00	-,16	,86
	Total	126				
	Yes	14	56,71			
Elements of Biodiversity	No	112	64,35	689,00	-,76	,44
	Total	126				
	Yes	14	56,04			
Biodiversity Loss	No	112	64,43	679,50	-,83	,40
	Total	126				
	Yes	14	73,54			
Current State of Biodiversity	No	112	62,25	643,50	-1,12	,26
	Total	126				
	Yes	14	56,89			
Overall Biological Diversity Awareness	No	112	64,33	691,50	-,71	,47
	Total	126				

As seen in Table 20, it was determined that the biodiversity behavior levels of the students participating in the

study did not significantly differ based on whether they participated in any biodiversity-related activities (p > .05).

As seen in Table 21, a significant difference (p < .05) was found in favor of those who were willing to receive in-service training on biodiversity in the "Overall Biodiversity Awareness" and "Current State of Biodiversity" sub-dimensions. However, no significant differences were found in the other sub-dimensions (p > .05).

As seen in Table 22, a significant difference (p < .05) was found in favor of those who were willing to receive in-service training on biodiversity in the "Overall Biodiversity Behavior," "Ethical Value of Biodiversity," and "Individual and Societal Persuasion of Biodiversity" sub-dimensions. However, no significant differences were found in the other sub-dimensions (p > .05).

Table 20. Biodiversity behavior levels by participation in biodiversity-related activities

Measurement Tool and Sub-Dimensions	Participation Status	N	Mean Rank	U	Z	p
Biodiversity Conservation Behavior	Yes	14	54,46	657,50	-,98	,32
	No	112	64,63			
	Total	126				
Economic Value of Biodiversity	Yes	14	65,07	762,00	-,17	,86
	No	112	63,30			
	Total	126				
Ethical Value of Biodiversity	Yes	14	64,75	766,50	-,13	,89
	No	112	63,34			
	Total	126				
Threat Factors of Biodiversity	Yes	14	45,79	536,00	-1,93	,05
	No	112	65,71			
	Total	126				
Political and Legal Behaviors of Biodiversity	Yes	14	57,57	701,00	-,65	,51
	No	112	64,24			
	Total	126				
Utilization Value of Biodiversity	Yes	14	61,11	750,50	-,26	,79
	No	112	63,80			
	Total	126				
Individual and Societal Persuasion of Biodiversity	Yes	14	57,32	697,50	-,68	,49
	No	112	64,27			
	Total	126				
Overall Biological Diversity Behavior	Yes	14	52,93	636,00	-1,15	,25
	No	112	64,82			
	Total	126				

Table 21. Biodiversity awareness levels by willingness to participate in ın-service training on biodiversity

Measurement Tool and Sub-Dimensions	Participation Status	N	Mean	Ss	Levene F	Levene p	T-Test t	T-Test sd	T-Test p
Ecological Function	Yes	133	4,03	,59	,00	,95	,99	214	,32
	No	83	3,95	,58					
Species Diversity	Yes	133	3,12	,67	,71	,39	2,21	214	,02
	No	83	2,91	,66					
Utilization Value	Yes	133	3,84	,65	,19	,65	,13	214	,89
	No	83	3,83	,62					
Elements of Biodiversity	Yes	133	3,53	,39	,90	,34	,47	214	,63
	No	83	3,50	,38					
Biodiversity Loss	Yes	133	3,39	,50	1,67	,19	1,34	21	,18
	No	83	3,30	,47					
Current State of Biodiversity	Yes	133	3,41	,64	,09	,75	2,15	214	,03
	No	83	3,21	,66					
Overall Biological Diversity Awareness	Yes	133	3,60	,32	,01	,89	2,36	214	,01
	No	83	3,50	,32					

Table 22. Biodiversity behavior levels by willingness to participate in ın-service training on biodiversity

Measurement Tool and Sub-Dimensions	Participation Status	N	Mean	Ss	Levene F	Levene p	T-Test t	T-Test sd	T-Test p
Biodiversity Conservation Behavior	Yes	133	3,62	,76	,82	,36	1,95	214	,05
	No	83	3,42	,71					
Economic Value of Biodiversity	Yes	133	2,62	,55	,07	,79	,41	214	,67
	No	83	2,59	,56					
Ethical Value of Biodiversity	Yes	133	3,62	,49	,01	,89	2,21	214	,02
	No	83	3,46	,52					

Threat Factors of Biodiversity	Yes	133	3,86	,67	,10	,75	1,03	214	,30
	No	83	3,77	,63					
Political and Legal Behaviors of Biodiversity	Yes	133	4,06	,84	,01	,90	1,50	214	,13
	No	83	3,88	,87					
Utilization Value of Biodiversity	Yes	133	3,22	,77	1,51	,22	1,59	214	,11
	No	83	3,05	,73					
Individual and Societal Persuasion of Biodiversity	Yes	133	3,95	,82	,08	,77	2,12	214	,03
	No	83	3,71	,81					
Overall Biological Diversity Behavior	Yes	133	3,58	,38	3,58	,06	3,05	214	,00
	No	83	3,43	,31					

4. Discussion

The research findings indicate that science teachers candidates biodiversity awareness and behavior levels are generally at a moderate level (M = 3.53 ± 0.370; M = 3.57 ± 0.328). These findings are consistent with the study conducted by Teksöz et al. (2010). which also emphasized that human behavior is at the core of biological and ecological threats and that environmental awareness needs to be increased, as highlighted in previous research. According to the Global Biodiversity Framework Monitoring System developed by Affinito et al. (2024), biodiversity awareness is directly related to the level of education, and the long-term effects of awareness-raising strategies should be carefully evaluated (Affinito et al., 2024). In this context, providing meaningful and accurate information about biodiversity can support individuals in adopting positive behaviors towards conserving and consciously utilizing biodiversity (Veríssimo, 2019; Yilmaz et al., 2018). Increasing environmental awareness through education and enhancing science teacher candidates knowledge in this field can contribute positively to the conservation of biodiversity in the long term. Additionally, Yenice et al. (2022) found in their study that teacher candidates possess accurate cognitive understandings but remain indecisive on certain topics and put forward misconceptions.

In the study, it was determined that biodiversity awareness levels significantly differed by gender, with this difference being in favor of women. The fact that female students have higher awareness levels than male students is also supported by studies examining the effects of social and psychological factors on biodiversity awareness. Nielsen et al. (2021) state that individual differences in environmental behaviors are shaped by gender, cultural factors, and social norms (Nielsen et al., 2021). However, in terms of biodiversity behavior levels, the gender variable did not create a significant difference. This finding is consistent with the study by Özbaş (2016), while it contradicts some others (Çelikkol, 2011; Teksöz et al., 2010). Ateş (2010) identified a significant difference in biodiversity behavior levels between male and female students, with the results favoring women. These findings indicate that gender is an important variable in biodiversity awareness; however, its effect on environmental behaviors varies across different studies.

In the study, no significant difference was found between biodiversity awareness and behavior levels based on the age variable. The finding that students' biodiversity awareness levels do not change with age suggests that the age factor is not a direct determinant of awareness but that educational experiences and environmental factors play a more critical role in its development. Monitoring studies conducted within the framework of the Global Biodiversity Framework emphasize that awareness levels are directly related to the quality of education rather than to age groups (Affinito et al., 2024). Similarly, in the evaluation based on grade levels, a significant difference was found only in the “Utilization Value” dimension between first and second-year students, while no significant change was observed in overall awareness and behavior levels. This finding indicates that the acquisition of knowledge and awareness regarding biodiversity during the educational process is more related to the quality of the content rather than the grade level. It was concluded that there was no significant difference among science and technology teachers candidates environmental attitudes across different grade levels (Uğulu, 2013). Accordingly, it can be stated that, regardless of age and grade level variables, educational processes play a decisive role in the development of individuals' biodiversity awareness and behavior.

In the study, it was determined that participation in biodiversity-related activities did not significantly affect individuals' awareness and behavior levels. This finding is consistent with the study conducted by Ateş (2010), indicating that merely participating in activities is not sufficient to enhance awareness. It is thought that factors such as the content of the activities, the duration of implementation, and the level of information provided during education play a more decisive role in the development of individuals' awareness. Indeed, Nielsen et al. (2021) also emphasize the necessity of long-term and systematic education to achieve behavioral changes related to biodiversity. However, Karabal (2011) found that the most effective individuals in terms of biodiversity awareness were those who participated in ecology-based nature education, reaching results that contradict the findings of this study. This situation suggests that the most crucial factor determining the effectiveness of activities is not participation itself but rather the quality of the education provided and the implementation process. Therefore, the content of educational programs aimed at increasing biodiversity awareness and behaviors should be carefully planned and supported by long-term strategies.

In the study, significant and positive differences were observed in the awareness and behavior levels of individuals who wished to receive in-service training on biodiversity. Particularly in the sub-dimensions of "Overall Biodiversity Awareness" and "Current State of Biodiversity" significant differences were found in favor of those who wanted to receive training. Similarly, significant differences were observed in favor of those who wished to receive training in the sub-dimensions of "Overall Biodiversity Behavior", "Ethical Value of Biodiversity" and "Individual and Societal Persuasion of Biodiversity". This finding highlights the importance of educational programs and awareness-raising activities for teacher candidates. Affinito et al. (2024) state that biodiversity awareness is directly related to the educational process and that the quality of education is a critical factor in determining the level of awareness (Affinito et al., 2024). On the other hand, it was determined that the majority of teacher candidates participating in the study could not accurately define the four fundamental components of biodiversity. This finding indicates that teacher candidates do not have sufficient knowledge about biodiversity and that their awareness levels are low. Uzun et al. (2010) also support this study's findings by determining that teacher candidates knowledge of biodiversity is limited. Therefore, in-service training can be considered an effective method for increasing biodiversity awareness. To enhance teacher candidates' knowledge levels and develop their environmental attitudes, it is recommended to increase biodiversity-focused educational programs and support them with applied training.

5.Conclusion

This study examined the biodiversity awareness and behavior levels of science teacher candidates and analyzed their differences according to various demographic variables. The research results showed that the gender variable created a significant difference in biodiversity awareness levels in favor of women, while it did not cause a notable change in behavior levels. Age and grade levels generally did not create a significant difference in awareness and behavior levels. Participation in biodiversity-related activities did not lead to a significant change in awareness and behavior levels. The desire to receive in-service training on biodiversity resulted in significant and positive differences in awareness and behavior levels. The level of knowledge about the fundamental components of biodiversity was found to be quite low among teacher candidates.

By utilizing the data obtained in this study, the quality of biodiversity-related courses in undergraduate education can be improved, or new approaches can be added to biodiversity-related studies and activities for teachers. Since individuals with the necessary level of biodiversity awareness also develop positive behaviors in this regard, exposing individuals to concrete concepts that will raise awareness will facilitate the learning process. In this way, a new generation of teacher candidates will be trained who both develop environmental conservation behaviors and are aware of biodiversity for sustainability.

Universities play a key role in educating teachers who will train future generations of students. In particular, science teacher candidates must receive a high-quality education on biodiversity and similar environmental concepts. The importance of education in raising individuals who can analyze, question, and find solutions to changing negative conditions in their environment is an undeniable fact. A teacher who understands the value of biodiversity in their environment, is aware of it, and exhibits behaviors to protect it will, in turn, inspire their students to grow up as conscientious and responsible citizens in this regard.

Data Availability

The data used to support the findings of this study are available from the corresponding author upon request.

Conflicts of Interest

The authors declare that they have no conflicts of interest.

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