Determining the Changes in the Cognitive Structures of Ecology-Based Natural Education Participants through the Word Association*

Sema Nur Güngör [i]
Uludag University

Elif Özata Yücel [ii]
Kocaeli University

Dilek Zeren Özer [iii]
Uludag University

Muhlis Özkan [iv]
Uludag University

Abstract

This study aims to determine the changes in the cognitive structures of the 35 participants after ecology-based nature education in Bursa Uludag and its vicinity. This study used a single group pretest-posttest experimental mode where the data was collected by a word association test. It included the key concepts of nature, national parks, biodiversity, ecosystem, and environmental problems. The analyzed data determined that ecology-based nature education strengthened the cognitive structures of the participants regarding the key concepts. It was also concluded that the participant's awareness of the destruction of nature and the importance of nature protection had increased. The research results show that such education programs, providing one-to-one interaction with nature, help participants to understand nature and natural holistic cycles correctly, thus encouraging its protection.

Keywords: Nature Education, Teacher, Cognitive Structure

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[i] **Sema Nur Güngör,** Dr., Bursa Uludag University, Faculty of Education, Department of Early Childhood Education, Bursa, Turkey, ORCID: 0000-0001-5755-4280

Correspondence: semanur.gungor@hotmail.com

[ii] **Elif Özata Yücel,** Assoc. Prof. Dr., Education Faculty, Kocaeli University, ORCID: 0000-0001-5815-7041

[iii] **Dilek Zeren Özer,** Assoc. Prof. Dr., Faculty of Education, Uludag University, ORCID: 0000-0003-4869-0015

[iv] **Muhlis Özkan,** Prof. Dr., Faculty of Education, Uludag University, ORCID: 0000-0001-6011-1675

INTRODUCTION

Nowadays, only using technology and operating various protocols and laws to solve rapidly increasing environmental problems is insufficient (Tilbury, 1995). Environmental awareness, environmental ethics, correct value judgments, positive attitude toward nature, interest, sensitivity, awareness, and sense of responsibility in individuals are significant for environment and nature education (Çepel, 2006; Genc, Genc & Goc Rasgele, 2018; Tilbury, 1995; UNESCO-UNEP, 1977). However, environmental and nature education should include schools and their environment, and also be supported by outdoor education environments.

Outdoor education environments are considered complementary to school education and training processes (Weiss, Coffman, Post, Bouffard, & Little, 2005). It includes schoolyards, science centers, museums, planetariums, aquariums, zoos, botanical gardens, and natural environments (Bell, Lewenstein, Shouse, & Feder, 2009). It has been frequently discussed that such environments might aid education (Gerber, Cavallo, & Marek, 2001; Tatar & Bağrıyanık, 2012; Morentin & Guisasola, 2015; Bakioğlu & Karamustafaoğlu, 2017; Hansen & Sandberg, 2019; Thomas, 2018; Thomas et al., 2019; Cure, Hill, & Cruickshank, 2018). Previous research shows that outdoor education environments positively affect education (Bamberger & Tal, 2008; Morag & Tal, 2012; Sturm & Bogner, 2010; Balçın & Yavuz Topaloğlu, 2018; Demircioğlu & Aslan, 2018; Gürsoy, 2018).

Environmental education in outdoor education environments helps students to hear, see, and touch, which is limited in classrooms. Outdoor education also makes students more sensitive and conscious, inspiring independent thinking by interacting with nature. Therefore, teaching ecological subjects and concepts in outdoor education environments helps develop correct value judgments and relationships with nature. It inspires their responsible behavior (Pfundt & Duit, 2002; Özkan, Tekkaya, & Geban, 2004).

Environmental education changes individual knowledge, attitude, and behavior using different approaches for this purpose (Tidball & Krasny, 2011). One of them, helping effective environmental education, is nature-based learning (Chawla, 2018; Genc, Genc & Goc Rasgele, 2018). Nature-based learning is an educational approach where the natural environment becomes a learning environment and individuals learn directly related to nature. It encompasses informal learning like playing and exploring natural areas. Individuals learn through informal programs created in nature centers and parks, and formal training where participants go to planned out-of-class or natural areas (Chawla, 2018). Accordingly, nature education can be evaluated regarding nature-based education.

Nature education offers the real-world equivalent of knowledge through field trips and practical activities (Erentay & Erdoğan, 2012). These training in natural areas help participants become a partner of nature, where they interact directly and perceive its different dimensions (NAAEE, 2010; Palmerg & Kuru, 2000). However, it is important to prepare an environment in nature education to realize. Individuals, here, perceive natural environments as laboratories and learn by discussing and questioning them. Thus, it supports a holistic understanding of nature by observing, practicing, and questioning.

In Turkey, the environmental, natural, and ecological concepts associated with them are studied in almost every grade level, beginning from primary school. It places them in various courses like Life Science, Social Studies, Science, Biology, and Geography with an interdisciplinary understanding (Akınoğlu & Sarı, 2009; Çağlar & Karapınar, 2017). Studies show that nature education is confined to certain courses and units (Sadık & Çakan, 2010; Köse et al., 2011). Confining nature education to formal education within the classroom is the biggest obstacle to cognitive and affective development, practice, and alternative solution approaches (Wilson, 2008; Bilton, 2010; Özerbaş, 2011). Effective nature education can be achieved by implementing “in-school” and “out-of-school” programs in a supportive or complementary manner. The current scientific research, and the 4004-Nature Education and Science Schools Projects, which is a sub-program of the Scientific and Technological Research Council of Turkey’s [TUBITAK] Science and Society Projects, are

significantly practiced to address this deficit. Among these projects supported by TUBITAK, activities in an out-of-classroom environment are crucial (Akay, 2013).

Similar educational projects share ecology-based scientific data with the majority of society and increase their effectiveness in life. They have been implemented in developed countries like the United States of America, Canada, England, and Japan since the 1990s (Hale & Golley, 1995). It was the first time in Turkey's national parks, that an ecology-based nature education project was launched by coordinating with TUBITAK in 1999 in Thermessos (Güllük Mountain) National Park. It has increased since that time daily. Today, 85 projects under the 4004 Nature Education and Science Schools 2018/2 Call Period continue through TUBITAK's support and the participation of competent trainers.

Natural areas as fields of education and training are significantly important to developing environmental awareness, sensitivity, consciousness, interest toward nature, correct attitudes, and behavior. Positive changes occur in the environmental sensitivity and behaviors of the participants due to education based on nature experience (Palmberg & Kuru, 2000; Coyle, 2010; Ajiboye & Olatundun, 2010; Karpudewan et al., 2015). Many studies state that such applied trainings affect the attitudes and knowledge of the participants (Bogner, 1998; Gülay Ogelman, Önder, Durkan & Erol, 2015; Gülay Ogelman & Durkan, 2014; Keleş, Uzun & Varnacı Uzun, 2010; Balkan Kıyıcı, Atabek Yiğit & Selcen Darçın, 2014). We also see that nature training mostly satisfies the participants' expectations and their ecological perspectives change (Meydan, Bozyiğit & Karakut, 2012). When considering these positive contributions, it becomes beneficial to engage with the wider masses of nature education with the help of educators from different specializations. Research on the training effectiveness will also support the development of subsequent training to become more efficient. The public sees national parks and natural protected areas in Turkey as mere rest and pastime places. However, these areas are suitable for ecology-based scientific education and ecotourism activities with the necessary infrastructure. The open approach to nature education and ecotourism activities in national parks is important to not exceed the bandwidth of those parks (Keleş, Uzun & Varnacı Uzun, 2010). This way, these areas fulfill their purpose, and society will realize the importance of protecting them with this training.

We see, by examining the studies in this field, that it is primarily studied with primary and secondary school students (Akay, 2013; Avcı, Özenir, Kurt & Atik, 2015; Bogner, 1998; Bogner, 2010; Palmberg & Kuru, 2000; Genc, Genc & Goc Rasgele, 2018; Gülay Ogelman, Önder, Durkan & Erol, 2015; Kossack & Bogner, 2012; Leong, Fischer & McClure, 2014; Ok, 2016; Özdemir, 2010). There are also fewer studies with teachers (Balkan Kıyıcı, Atabek Yiğit & Darçın, 2014; Güler, 2009; Keleş, Uzun & Varnacı, 2010; Meydan, 2012; Singh, 2011). Teachers help children develop and improve their environmental knowledge and awareness by encouraging their natural curiosity and interest. However, an eco-friendly teacher can effectively provide students with environmental information (Doğan, 2007; Haktanır, 2007; Keleş, Uzun & Varnacı Uzun, 2010; Lewin-Benham, 2006; Malone & Tranter, 2003; Phenice & Griffore, 2003). Currently, the literacy levels of teachers, prospective teachers, and academically related people are vital. However, when studies are examined, we see that teachers and prospective teachers' levels of environmental literacy is inadequate (Diekmann & Peter, 1998; Jordan, 2008; Kışoğlu, 2009; Kibert, 2000; Kuhlemeier, Huub & Nijs, 1999; Sevinç, Kıyıcı, Altaş & Altınöz, 2008; Tuncer, Tekkaya, Sungur, Çakıroğlu & Şahin, 2008).

In Turkey, the environmental and natural concepts are positioned in various courses as an inter-disciplinary approach. The studies performed to increase the knowledge and awareness of teachers of all levels and different branches about nature are also gaining importance. This kind of nature education helps teachers and prospective teachers to obtain multi-faceted information. The opinions about environmental protection may change positively, and they may even share their knowledge and experiences with the students and those around them. They also may feel responsible for raising environmental awareness. This will influence prospective teachers participating in nature education to develop a positive perception and awareness of nature. When they become teachers, they will communicate these positive feelings and thoughts to their students.

It is also an inevitable fact that to raise environmentally conscious individuals, we need teachers who take preventive measures before the issues escalate, set examples for their students, and are educators from different professions. Thus, environmentally literate teachers having this awareness should be trained. (Balkan-Kıyıcı, Atabek-Yiğit & Darçın, 2014). We think that this study will contribute to the field in this context. This study aims to determine the change in the cognitive structures of the ecology-based nature education participants related to nature, national parks, biodiversity, ecosystem, and the participants' environmental problems through a word association test.

METHODOLOGY OF RESEARCH

General Background of Research:

This study was performed under a 10-day training project called "Ecology Based Nature Education VI (EBNE) in Uludag National Park in Bursa and its surroundings". It was supported by TUBITAK-4004 Nature Education and Science Schools Program. This study was considered an experimental study since it aimed to determine the effect of the training on the participants' cognitive structures. In experimental studies, the effect of the independent variable, created by the researchers, on the dependent variable is determined and cause-effect relationships are revealed (Büyüköztürk, Kılıç Çakmak, Akgün, Karadeniz & Demirel, 2020; Christensen, Johnson & Turner, 2020). This study used one group pretest-posttest experimental model. Intervention is performed between pretest and posttest measurements in this model (Christensen, Johnson & Turner, 2020).

Sample of Research:

The study group included 35 participants from 185 individuals who applied to EBNE. The first criterion to determine the participants was their personal information requested during the practice, their reasons for participating in the training, the associations containing membership, and information regarding fields of special interest and occupation. It even involved a written text, explaining their reason for participating in the project in at least 100 words. The completed forms from all applicants were examined. The candidates whose project participation overlapped with its purpose were chosen. The study included 24 (68.6%) teachers, 6 (17.1%) graduates and doctorate students working in education, 1 (2.9%) research assistant, 1 (2.9%) volunteer from non-governmental organizations, and 3 (8.5%) public personnel from rural areas, total 35 people.

Procedures and Instrument:

The activities performed under EBNE, including both theoretical and practical studies, and observation and field studies, are presented in Table 1. The scope of the project involves a total of 10 faculty members, consisting of experts from various branches, who participated in the project as instructors. Each instructor congregated with the participants on their specified day and trained them in their area of expertise. They evaluated the training with the participants by sharing the study in the evening.

Table 1. EBNE Program

Day	Activities	Day	Activities
1	Biological and ecological concepts and nature education The relationship between folk culture and nature Nature sports and first aid	2	Flora and fauna of Uludağ Plant and animal collection and storage techniques Uludağ's lichen and fungi
3	Practice and observation trip on fauna and flora of Çobankaya-Sarıalan and Alpine Regions Night walk and observation of nocturnal animals in Uludağ	4	Geomorphological observation trip in Uludağ and Uludağ Lakes Region
5	Geomorphological investigations in Aras Waterfall, Barkal Pond, Keles, and Kocayayla; study trip on soil organisms and forest vegetation Uludag University Zoological Museum visit	6	Fauna and flora observations at Uluabat Lake, Mustafa Kemal Paşa, and Suuçtu Waterfalls, Observation of environmental pollution around Uluabat Lake and discussions about solution proposals
7	Investigation of the lake ecosystem and soil formation and varieties in and around İznik Lake Discussion on the place and importance of documentaries in nature education Documentary screening about Uludağ	8	Investigation of the pressure of the settlement areas on nature in Cumalıkızık Investigation of river systems and fauna in Saitabad and Kürekli Waterfalls National parks legislation and compliance with nature tourism
9	Investigation of cave fauna in İnegöl, Hilmiye Village, and Oylat Cave and discussion of pollution in the region	10	Importance of nature education in creating environmental awareness Ethics of respect for life and nature in ecology

The change in the participants' cognitive structure after EBNE was determined by a word association test (WAT). WAT is a technique that determines the cognitive structure of individuals, cognitive structural changes, and misconceptions to analyze the relationships between concepts in this structure (Bahar & Özatlı, 2003; Cardellini & Bahar, 2000; Hovardas & Korfiatis, 2006, Özata Yücel & Özkan, 2018). During the WAT, the participants provide one or two-word responses to the key concept (stimulus words) that they recall over time. The number of responses given to a key concept and their nature indicates the understanding of that key concept. The speed of the answers given to the key concept is directly proportional to the relatability of that response to the key concepts (Bahar & Özatlı, 2003; Tsai & Huang, 2002; Shevelson, 1974). The sentences formed after the WAT determines the relationship established between the key concepts and their responses, and they can also help evaluate cognitive and affective relationships (Gunston, 1980).

This study uses WAT for participants before and after the practice as pretest and posttest. Nature, national parks, ecosystems, environmental problems, and biodiversity are considered key concepts. It is related to the project's purpose and the content and considers the expert opinions. The participants wrote down the first ten answers to the key concepts, on separate pages, in 30 s. This was to minimize the impact between responses by providing each answer in a separate line that the key concept repeats (Bahar, Johnstone & Sutcliffe, 1999). An example page layout is as follows:

Ecosystem:……..

Ecosystem:……..

Ecosystem:……..

Ecosystem:……..

Ecosystem:……..

Ecosystem:……..

Ecosystem:……..

Ecosystem:……..

Ecosystem:……..

Ecosystem:……..

Sentence about ecosystem:…….

Data Analysis:

A frequency table was prepared, showing the responses to each key concept and their frequency of repetition in the pretest and posttest for the WAT analysis. The concept network was then established by using the Cut-off Technique (Bahar, Johnstone & Sutcliffe, 1999) to reveal the relationships between the concepts. This technique takes the cut-off point as 3–5 points below the most repeated response in the frequency table for the key concept. The cut-off is then reduced periodically until all responses to the key concept emerge and its other steps in the network are completed. The responses to the key concept are listed by comparing them with formed sentences, and the unrelated or random responses were not evaluated (Gunston, 1980).

The thematic analysis helped analyze the sentences related to the key concepts. Two researchers separately examined and classified the sentences and determined their draft themes. If no consensus could be reached, the opinion of a third researcher was taken, and the final decision was made. The main themes constituted a unanimous decision of the researchers. These themes are classified as information/concept, affective, destruction/protection, and others.

Research Results:

Table 1 shows the number of responses (N) and frequency of participant repetition (f) for each concept in the WAT, applied before and after EBNE. The participants gave 320 different answers in the pretest and 337 different responses in the posttest. The repetition frequency of these responses increased from 916 to 1031. The highest increase in the repetition frequency was the responses to the key concepts of nature and biodiversity. There was a slight decrease in responses to the key concepts of the ecosystem (Table 2).

Table 2. Total Number of Responses to Key Concepts and the Repetition Frequency of Repetition

Stimulus words	Responses			
	Pre-implementation		Post-implementation	
	N	F	N	F
Nature	68	205	79	249
National Park	59	163	63	182
Biodiversity	66	162	69	203
Ecosystem	74	205	71	196
Environmental Problems	53	181	55	201
Total	320	916	337	1031

Figure 1 shows the concept network formed by the WAT and the responses given before the EBNE. Figure 1.a. shows the strongest cognitive structure, and Figure 1.d. shows the weakest cognitive structure.

Cut-off Point 19 and above (Figure 1.a.): At this level, the participants' cognitive structures related to the key concepts are very limited. Only the key concept of "Nature" is associated with the "plant/plant species/green/foliage" response.

Cut-off Point 14 and above (Figure 1.b.): The key concepts of the national park, biodiversity, ecosystem, and nature have emerged. However, the number of responses associated with them is still limited. Participants associated the "protection/must be protected" to the national park key concepts, "species" to the biodiversity key concepts, "mindfulness/sensitivity/conscious/awareness" to the nature education key concepts, and "interaction/relation", "living beings/liveliness", "Inanimate/inanimate environment" to the ecosystem key concepts.

Cut-off Point 9 and above (Figure 1.c.): Environmental issues, the last key concept, were introduced at this level. The number of responses to key concepts also increased. The indirect relationship between the key concepts was introduced at this level. For example, all three key concepts of biodiversity, nature, and ecosystem received the common answer "living beings/liveliness". Similarly, we see that the concepts of nature and biodiversity are indirectly related. The direct association of key concepts remains to be seen.

Cut-off Point 4 and above (Figure 1.d.): We see the highest response and the highest relatability between key concepts at this level. The number of responses to each key concept has increased significantly. The indirect relationships are established by giving common answers, and direct relations are also established among the key concepts. For example, the key concepts of the national park directly relate to the key concepts of biodiversity and nature.

Figure 1. a: Concept network formed according to the answers of the pretest (Cut-off Point 19 and above)

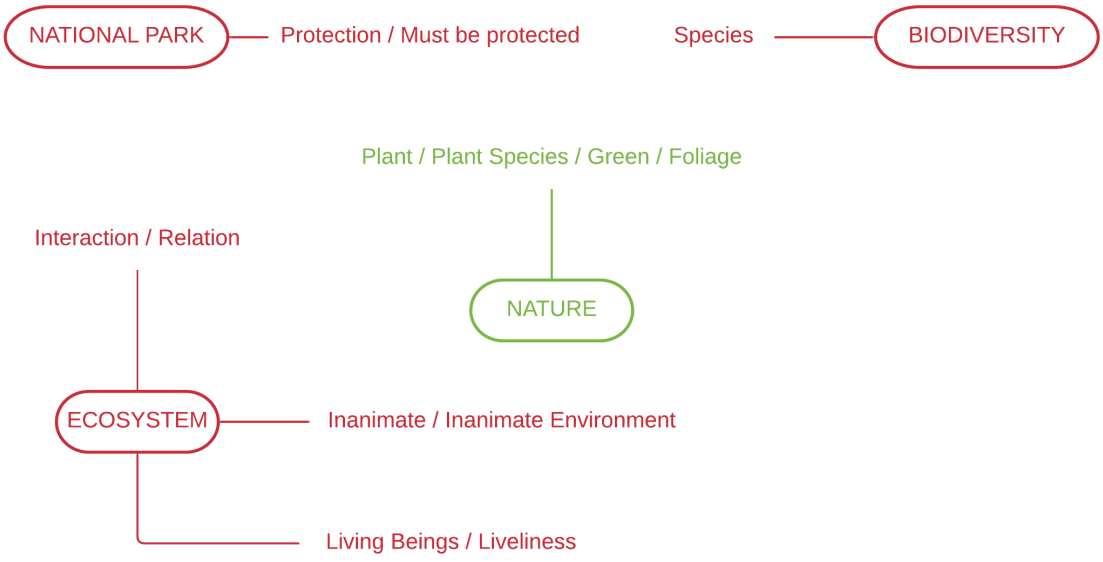

Figure 1. b: Concept network formed according to the answers of the pretest (Cut-off Point 14 and above)

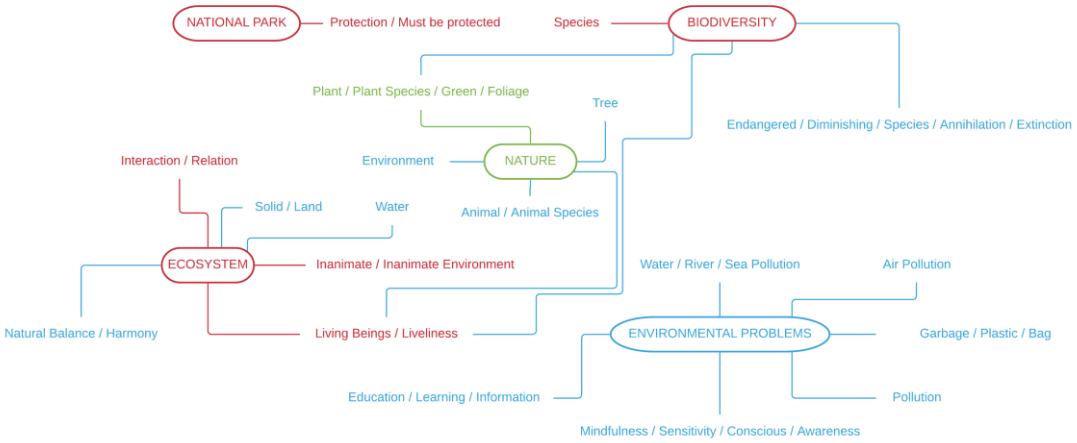

Figure 1. c: Concept network formed according to the answers of the pretest (Cut-off Point 9 and above)

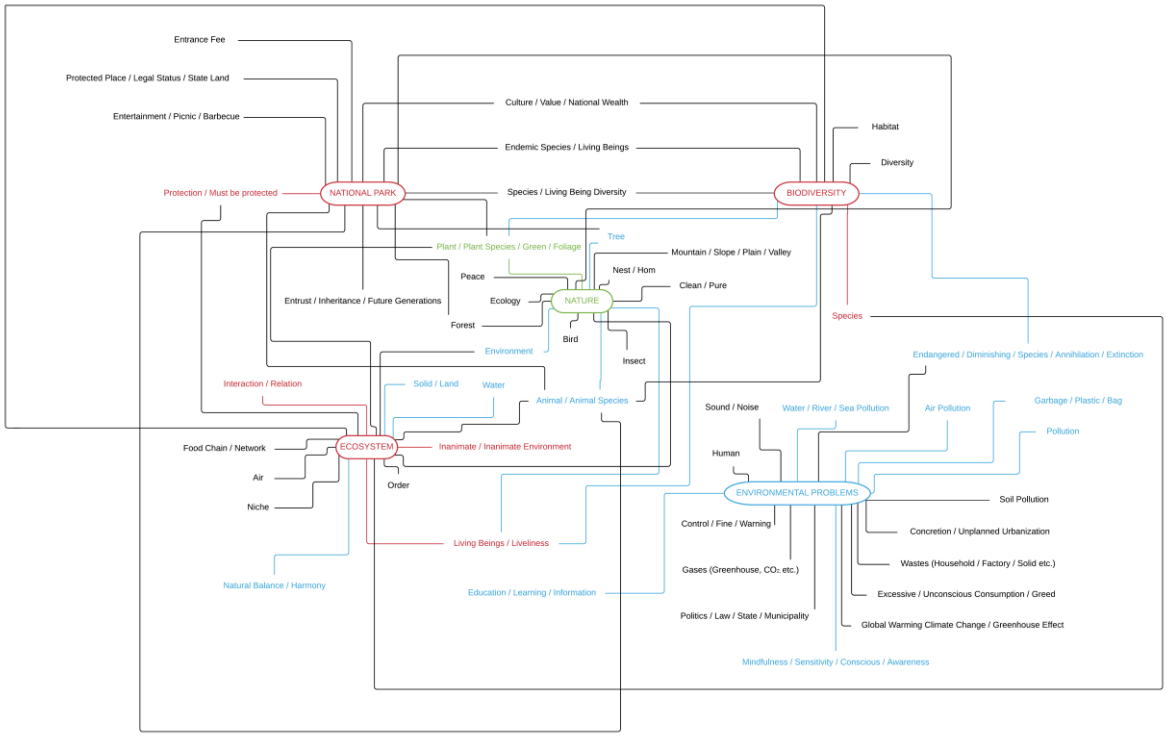

Figure 1.d: Concept network formed according to the answers of the pretest (Cut-off Point 4 and above)

Figure 2 presents the concept network prepared based on the findings of WAT applied after EBNE.

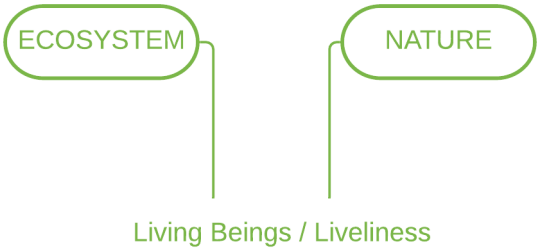

Figure 2.a: The concept network formed according to the answers of the post-test (Cut-off Point 19 and above)

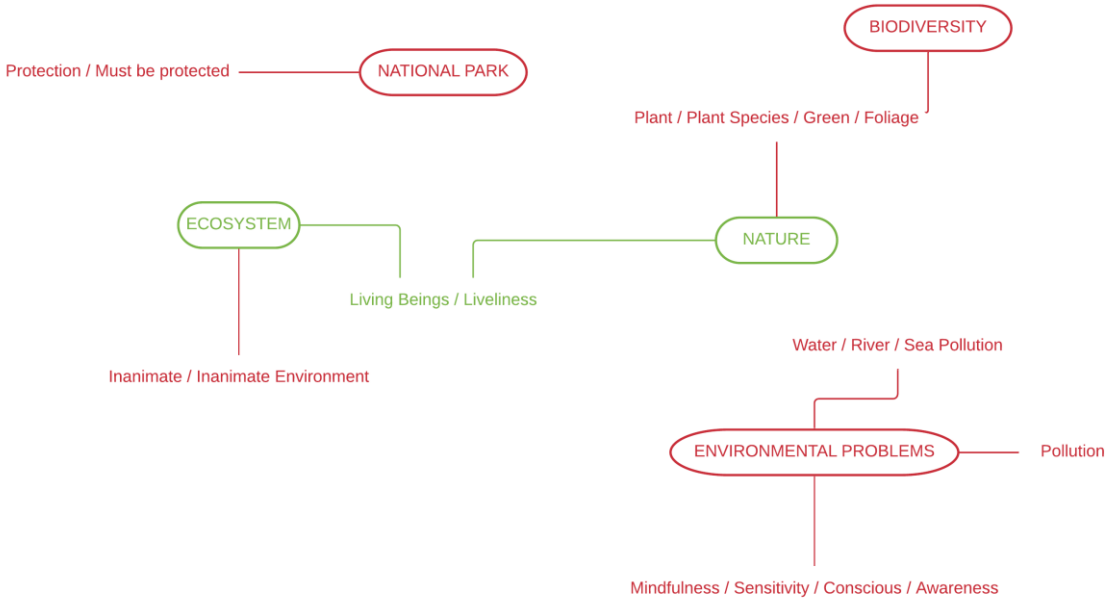

Figure 2.b: The concept network formed according to the answers of the post-test (Cut-off Point 14 and above)

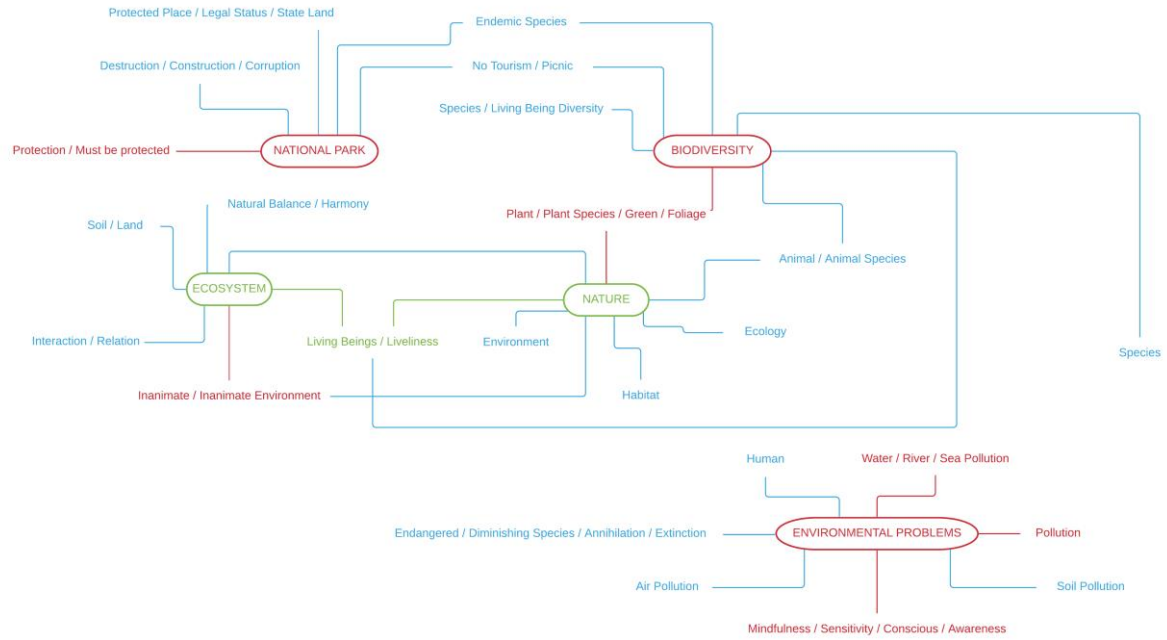

Figure 2.c: The concept network formed according to the answers of the post-test (Cut-off Point 9 and above)

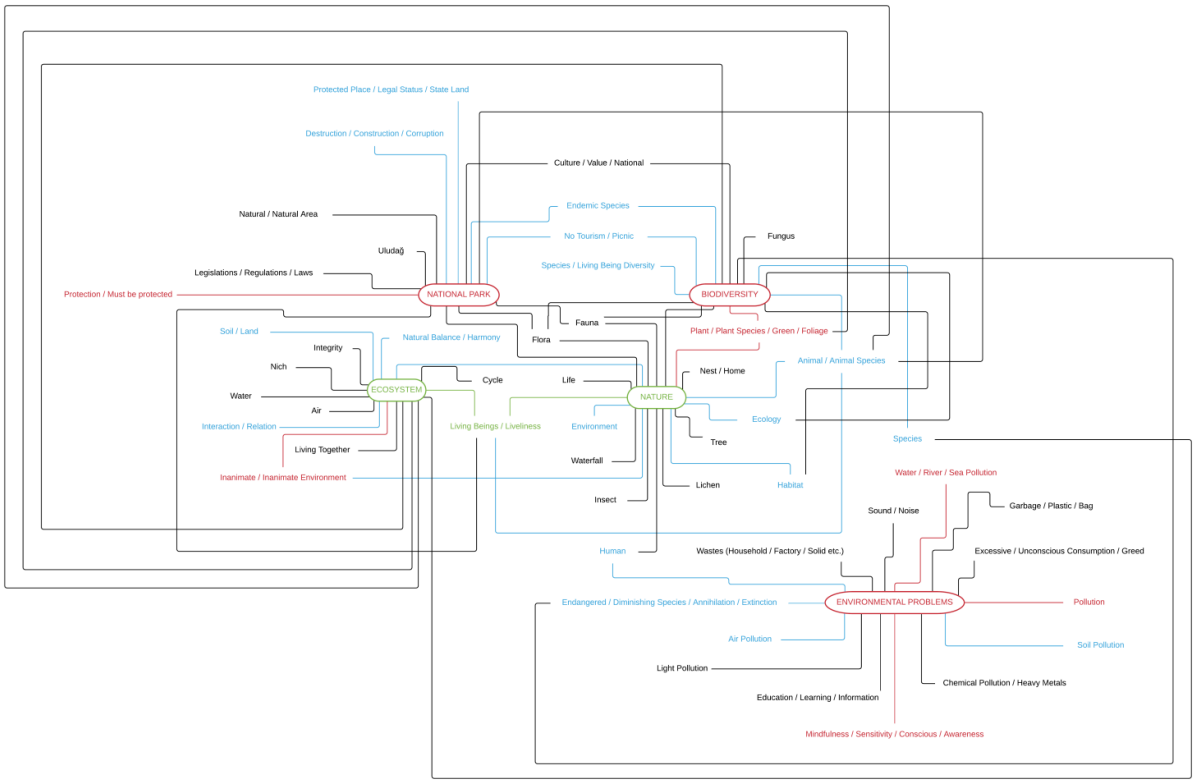

Figure 2.d: The concept network formed according to the answers of the post-test (Cut-off Point 4 and above)

Cut-off Point 19 and above (Figure 2.a.): Here, only the concept of "nature" emerged in the pretest, and the concept of ecosystem emerged in the final test. The indirect correlation between the key concepts was introduced only in the pretest at the cut-off level of 9 and above. However, in the

posttests, the cut-off point appeared at the level of 19 and above. The participants associate key concepts of nature and ecosystem with the common responses to "living beings/liveliness".

Cut-off Point 14 and above (Figure 2.b.): At this level, all key concepts have emerged. The participants indirectly associated the two key concepts by responding to that of biodiversity and nature as "plant/plant species/green/foliage". The key concept of the national park is associated with "protection/must be protected". The ecosystem key concept is associated with inanimate/inanimate environment" and the environmental problems key concept with "pollution and water/river/sea pollution" responses. When this level is compared with the pretest, the number of key concepts and responses is more than the posttest.

Cut-off Point 9 and above (Figure 2.c.): At this level, the number of responses to key concepts has increased. The responses given are also higher-level concepts compared to the pretest. For example, "Endemic species" has received the key concept of biodiversity, and "habitat" has received the key concept of nature.

Cut-off Point 4 and above (Figure 2.d.): Similar to the pretest, the highest relationship between response and key concepts is at this level. Like the previous level, here, the responses are higher than those of the pretest. The "flora and fauna" responses to the key concept of nature are some examples.

Table 3 shows the distribution of the sentences formed by the participants in the pretest and posttest according to the themes. When the overall table was evaluated, it showed that the participants formed more sentences in the posttest (N = 214) than in the pretest (N = 205), and the formed sentences were evaluated with more themes. In the "knowledge/concept" theme, they formed a total of 77 sentences and 5 misconceptions in the pretest and 96 sentences and 1 misconception in the same theme in the posttest. The number of sentences formed with the theme of "destruction/protection" has increased from 64 to 71. In the "Affective" theme, the number of sentences decreased from 60 to 42.

Table 3. Distribution of Sentences According to Themes

Stimulus Words	Pre-implementation						Post-implementation					
	Information/Concept	Affective	Destruction/Protection	Other	Empty	Total	Information/Concept	Affective	Destruction/Protection	Other	Empty	Total
Nature	6+1 MIS*	24	13	-	-	43+1 MIS	15	10	14	3	1	43
National Park	17	5	18	4	1	45	19	3	20	3	0	45
Biodiversity	20	7	7	1	3	38	23	5	10	2	1	41
Ecosystem	22+4 MIS	4	5	1	3	35+4 MIS	24+1 MIS	5	3	3	2	37+1 MIS
Environmental Problems	12	6	21	5	-	44	15	8	24	1	-	48
Total	77+5 MIS	46	64	11	7	205+5 MIS	96+1 MIS	32	71	11	4	214+1 MIS

*MIS: Misconception

The number of sentences formed by the students in the "information/concept" theme increased from 6 to 15 about the key concept of "nature". Misconceptions were also determined in one sentence. In the pretest, 17 Participants defined nature as "a whole united with soil and water". It corrected the definition of "the combination of living and inanimate beings" in the posttest. The number of sentences in the "affective" theme reduced from 24 to 10 (Table 3). In the sentences formed in the pre-test, the living and inanimate environment were predominant, and only two sentences emphasized the wholeness of nature. In the last practice, the interaction between the elements was frequently mentioned, various ecosystems and biodiversity were emphasized, and the regional species were mentioned in sentences. Thus, we determined that they increased (Tables 4 and 5).

The total number of sentences related to the "national park" key concept remains equal in both practices. The distribution of these sentences according to themes doesn't change remarkably (Table 3). The participants, in the sentences evaluated in the theme of "information/concept", in both practices, emphasized the area, including various species that require protection. In the posttest, however, participants emphasized the legislation and laws. They even focused on sentences with the theme "destruction/protection" (Tables 4 and 5)

The number of sentences about the key concept of "biodiversity" increased from 38 to 41 (Table 3). The participants, in either case, make sentences about biodiversity under the theme of "information/concept", which is rich and important in Turkey. However, we see that the sentences in the second practice are more explanatory and concrete. For example, in the first practice, "Biodiversity is very important for an ecosystem. (K5)" emphasizes that biodiversity is crucial. In the second practice, "Biodiversity is of great importance for the ecological balance of the living species. (K3)" also provides a reason for that mentioned importance. In the theme of "destruction/protection", opposite to the first practice, participants frequently stated in the second practice that spaces belonging to living things should be protected to preserve biodiversity (Tables 4 and 5).

Table 4. Pre-test Sentence Examples

Stimulus Words	Theme			
	Information/Concept	Affective	Destruction/Protection	Other
-				
Nature	Alive and inanimate environment. A circular environment in which living and inanimate beings interact in nature. (K 32).	Nature is a place where I feel peaceful (K 31).	Nature is not an inheritance from our ancestors but trust to our children. (K 25).	-
National Park	Biodiversity is very rich in national parks. (K 15) The Place or region where plants and animals are protected in a certain environment (K 32)	I love hiking in national parks. (K 30)	The most important thing that comes to mind when it comes to the national park is that it should be protected. (K 31)	I was in Uludağ, one of our national parks, for 10 days for training purposes. (K 9)
Biodiversity	There is an inverse relationship between biodiversity and environmental problems (K 21) Several species indicate the number of living things. (K 32)	Biodiversity is our diversity and our diversity is our wealth. (K 14)	Humans should ensure the continuation of biological diversity by protecting animal species and plant species as a part of their environment. (K 7).	The more diverse the biodiversity, the more the studies would be. (K 23)
Ecosystem	Living and inanimate beings coexist in an ecosystem. (K 5) All ecosystems in the world are interrelated. (K 29)	I like to study the world ecosystem. (K 20)	Human interventions are destabilizing the ecosystem. (K 11)	Everyone needs each other. (K 13)
Environmental Problems	These are the problems that arise with the developing industry and endanger living spaces. (K 7)	The environment is getting polluted, we are diminishing. (K 16)	It is our civic duty to make our people more sensitive to environmental problems. (K 10)	Are environmental problems the balance of the new ecosystem? (K 27)

Table 5. Examples of Sentences Formed in the Post-test

Stimulus Words	Theme			
	Information/Concept	Affective	Destruction/ Protection	Other
Nature	The whole of the interactions of living and inanimate (K 32). I now know the Apollo butterfly, the endemic species of Bursa. (K 1)	Nature is the mother of everything. (K 33)	Please, Let's not leave any trace to nature other than our footprint. (K 21)	We need to spend time in nature. (K 4)
National Park	Protection of an area with different species exists (K 32) National Park legislation should be rearranged to include strict rules. (K 24)	We should give the necessary value to the national parks in our country. (K 20)	Pressure on national parks should be reduced. (K 15)	The entrance of national parks should be built aesthetically. (K 33)
Biodiversity	Allowing only a single species to live in an area reduces biodiversity. (K 11)	The most valuable of our wealth was our biological diversity. (K 13)	To preserve biodiversity, we must not destroy the living's habitats. (K 19)	There had been so much biodiversity in life that we could not see. (K 16)
Ecosystem	Ecosystem diversity directly affects biodiversity. (K 2) In the ecosystem, every living thing has a niche. (K 11)	The balance of ecosystems is amazing (K 31)	If we could protect ecosystems, we would talk about our species' diversity better to future generations. (K 25)	Ecosystems are above all ideological systems. (K 6) I learned about lake ecosystems. (K 19)
Environmental Problems	Many species are in danger of extinction because of environmental pollution. (K 5)	It is the betrayal of man to nature. It is his own grave digging. (K 14)	I saw how nature was massacred by unconscious tourism and people. (K 19) We must protect our environment with education. (K 34)	Developed societies have the least problems with nature. (K 25)

In the first practice of the key concept of "environmental problems", the sentences related to the most destruction/protection were formed (N = 21). In the second practice, this number increased to 24. The sentences in the information/concept theme increased from 12 to 15 (Table 3). After examining the sentences in the destruction/protection theme in the first practice, we saw it was frequently emphasized that insensitivity and considering it irrelevant caused the environmental problems. These environmental problems should be prevented, people should be informed, and sensitivity should be increased. In the second practice, sentences emphasizing the importance of education were added. A sentence has also been formed about the pressure of tourism on nature. In both practices, the participants formed sentences containing the definition of environmental pollution and information/concepts according to their types, causes, and consequences. However, we understand from the examples of sentences formed in the first practice *"events that cause problems to affect the living"* and in the second practice, *"chemical, physical, and biological pollution affecting the life of living things"*. We find that the sentences formed in the second practice contained more ecological concepts (Tables 4 and 5).

The theme with the highest number of sentences formed by the participants about the key concept of "ecosystem" is the information/concept theme. In the first practice, 22 sentences and in the second practice, 24 sentences were formed. There are also misconceptions in 4 sentences in the first practice and 1 sentence in the second practice (Table 3). Misconceptions in the first practice are accepting humans as the most important element of the ecosystem, confusing ecosystem with ecology and habitat, and limiting it as a human-plant relationship. In the second practice, the misconception was reduced to one. For example, in the first practice, the participant defining the ecosystem as *"the environment where living things interact with the inanimate"* changed it to *"the system where the*

living and non-living things interact". Only the participant, who mixed up the definition of ecosystem and ecology, continued this misconception in both practices. In this theme, during the first practice, we frequently see that the ecosystem contains living and inanimate elements and they are related. In the second practice, more concepts like ecological niche, biodiversity, and substance cycles were included in the sentences. The destruction/protection theme emphasized the pressures exerted on the ecosystem by humans in both practices (Tables 4 and 5).

DISCUSSION AND CONCLUSIONS

This study aims to determine the changes in the cognitive structures of EBNE participants regarding the key concepts of ecology after training through a WAT. The results showed that the type of response and the repetition frequency increased after EBNE. The number and variety of responses to a key concept received in the WAT are important indicators of concept acknowledgment (Bahar et al., 1999; Shevelson, 1974a). The increased number of responses was considered crucial in the key concepts of "nature" and "biodiversity". This situation, which may be an important sign of cognitive empowerment, remains consistent with EBNE's objectives and educational content.

The natural environment is a complex structure involving multidimensional relationships (Shepardson et al., 2007). It places the ecological concepts adjacent to each other and makes them difficult to understand (Hmelo-Silver, Marathe & Liu, 2007; Plate, 2010). It is important to establish this close relationship in the cognitive structure to understand these concepts effectively. The WAT is a technique that helps reveal this relationship (Bahar et al., 1999; Kurt et al., 2013; Shevelson, 1974a, Özata Yücel & Özkan, 2015). In the WAT, the number of responses for two different key concepts is directly proportional to the relatability of these key concepts with the cognitive structure (Bahar et al., 1999; Shevelson, 1974a). Concept networks show that the number of concepts associated with the posttest is higher than its pretest. This association was also made in the pretest but with the response of "Living beings/liveliness" given in the third step (Figure 1.c.) common to all three key concepts of "biodiversity", "nature", and "ecosystem". In the posttest, it emerged in the first step (Figure 2.a.), with "Living beings/liveliness" as the common response to "nature" and "ecosystem" key concepts. This indicates a strong cognitive structure.

Another sign of the strong cognitive structure in the WAT is the quality of the responses and established relationships (Ayas, 2005; Özata Yücel & Özkan, 2015). When the concept networks were examined, we determined that the number of answers, types, and related concepts increased in the posttest, and the quality of the responses changed. For example, in the pretest, the concept of "nature" is given as the answers frequently used in daily life like "plant, green/foliage" and "liveliness". In the posttest, additionally, more ecology-based concepts are given like "habitat", "fauna", "flora", and "lichen". This specified that before EBNE these concepts were more superficial in the participants' cognitive structures. There was also a more subjective and deeper understanding of education according to its widespread use in the scientific field. (Bahar et al., 1999; Gunston, 1980, Nakiboğlu, 2008; Özata Yücel & Özkan, 2015; Shavelson, 1974).

When the number of responses to key concepts and their results from concept networks was evaluated, it was concluded that the participants of EBNE evolved their conceptual understanding of ecology in their cognitive structures related to the key concepts. Similar studies conducted in the literature also show that practice-based nature education helps strengthen cognitive structures (Bogner, 2010; Eaton, 2000; Eryaman et all. 2010; Gülay Ogelman, Önder, Durkan & Erol, 2015; Gülay Ogelman &Durkan, 2014; Keleş, Uzun & Varnacı Uzun, 2010; Balkan Kıyıcı, Atabek Yiğit & Selcen Darçın, 2014). The primary rule of the new nature education is that generally, it does not make life difficult for our successors. The things to avoid include that indifferent consumption of resources, destruction of natural areas, and overpopulation. Enforcing these rules is difficult as it inevitably contradicts selfish individual thoughts. A long educational process helps understand and internalize the ethics of nature. However, it is crucial to start nature education early on when children are interested in nature and living things. We must ensure that this interest and sensitivity are strengthened in the later stages of life. This makes nature education suitable and important for all age groups. Every

correctly linked concept in the cognitive structure will ensure that nature's patterns are read and interpreted correctly. Therefore, cognitive comprehension is useful as a part of education.

According to the themes determined after the EBNE, the maximum increase was in the sentences containing information/concepts. It was followed by sentences, including the theme of destruction/protection. The number of sentences related to the nature key concept has increased the most for the information/concept theme. The missing and erroneous information in the sentences formed in the second practice has also been completed and corrected after the training. The holistic view of nature has been emphasized in the sentences and various species and genera like the Apollo Butterfly *(Parnassius apollo)* and the Bambus Bee. These sentence analysis results support the conclusion that EBNE provides participants' cognitive development related to ecological concepts. Rickinson (2001) also examined 110 different studies that included out-of-class education related to environmental education between 1993 and 1999. He showed that such nature education affected the participants' environmental knowledge. The increase in all key concepts is similar to each other regarding destruction/protection.

In contrast to the themes of information/concept and destruction/protection, the number of sentences in the affective theme decreased in the posttest. The maximum decrease is in sentences related to the nature key concept, while the decrease in other key concepts is similar to each other. This decrease shows that the information/concept and destruction/protection have become more prominent in the participants' cognitive structures after EBNE. However, this does not imply the weakness of the affective field. In EBNE, emphasizing the importance of ecological concepts, problems in nature, its precautions, and the protection of nature explains this prominence in cognitive structure. Many studies support the positive effects of nature education on the affective characteristics of students. Gowin (1981), Hungerford and Peyton (1978), and Hungerford and Volk (1990) said the objective of these educational approaches was to educate individuals who respect the environment. Dunlap and Heffernan (1975), Geisler, Martinson, and Wilkening (1977), Sia, Hungerford, and Tomera (1985) found that contact with nature might affect environmental concerns. Mygind (2009), O'Brien, and Murray (2007) found that long-term practices in school settings and the relationships between students in these practices positively affect students' learning motivation and attitudes toward nature. Janssen (1988) reported that nature education promoted positive attitudes, while Drissner et al. (2010) reported that a short-term environmental education program positively affected environmental attitudes even after a half-day project. However, as this study states, Urban (1986) concluded that ecological information is not significant in the formation of environmental attitudes. Maloney, Ward, and Braucht (1975) stated that these two variables are not significantly related. It is vital for people to feel nature by experiencing it. Intertwining and interacting with nature can help understand nature conservation behavior. Nature studies are effective at this point in many studies (Bogner, 2010; Jung 2009; Nisbet et al. 2009; Mayer vs. McPherson Frantz 2004; Schultz 2002). According to the literature, the increase in the number of sentences related to destruction/protection in the posttest supports the effect of EBNE on the participants' wishes and thoughts about protecting nature. When these trainings are given sufficient time, it helps individuals to develop long-term environmental protection awareness. It will encourage them to become more sensitive to the destruction of nature and willing to take environmental planning and action. This training helps realize an effort about human position and influence within the natural cycles of the ecosystem. They help focus on the complementary relationships in the components' structure and function of the ecosystem and recognize the functioning and order in natural environments. It even supports perceiving nature.

In nature education, individuals needing to establish a more harmonious and more balanced relationship with nature by using scientific data should be excluded from the usual learner-teacher approach. Participants should identify nature-human-society relations and their problems by using nature as a practice environment and support their ability to understand and develop solutions to these problems. Sustainable development, usage of our consciousness, generations with a true nature perception, and a scientific, environmental awareness can reduce the harm that people can cause to their environment.

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