

# Analysis of change in the environmental perceptions of prospective science teachers: A longitudinal study<sup>1</sup>

Elif Ö ZATA YÜ CEL

Kocaeli University, Faculty of Education, Department of Primary Education,  
41380 Kocaeli, TURKEY

Corresponding Author Email: [elif.ozata@kocaeli.edu.tr](mailto:elif.ozata@kocaeli.edu.tr), [elifozatayucel@gmail.com](mailto:elifozatayucel@gmail.com)

Muhlis Ö ZKAN

Uludag University, Faculty of Education, Department of Mathematics and  
Science Education 16059 Bursa, TURKEY

Email: [muozkan@uludag.edu.tr](mailto:muozkan@uludag.edu.tr), [muozkan16@gmail.com](mailto:muozkan16@gmail.com)

Received 10 Jun., 2017

Revised 30 Apr., 2018

---

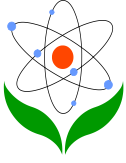
## Contents

- [Abstract](#)
  - [Introduction](#)
  - [Method](#)
  - [Findings](#)
  - [Discussion, results and recommendations](#)
  - [References](#)
- 

## Abstract

The aim of this study was to determine the changes in the environmental perceptions of prospective science teachers after various environmental-related subjects and concepts included in the curriculum were covered, and at the end of a sensitive and

---



cognitive acquisition period of three years. In the collection of the data, the Word Association Test (WAT), which included the key concept of ‘environment’, was utilized. Tests were applied to the students (55 subjects) twice, one of which was in the second class year, when they started taking Biology I and II, Biology Laboratory I and II, Ecology, Geology, etc. (2013) and the other in the second semester of the fourth class year (2016). It was determined that with the positive contribution of the courses taken regarding environment and the time spent on education and learning, the undergraduate students included many new concepts and subjects into environment concepts of their affective and cognitive status, and they had positive changes in their conceptual perception. However, it was concluded that this development was not at the expected level. It was even lower in certain themes and complex relationships were not fully understood.

**Keywords:** Environmental Perception, Science education, Word association, Prospective science teachers

---

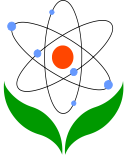
<sup>1</sup>This study was presented as oral paper at the 7th International Conference on New Horizons in Education (INTE-2016).

## Introduction

Disruption of natural relationships, population increase, increase in living standards and increase of resource needs, along with the introduction of technologies developed using resources and people unnecessarily exploiting nature by considering only their own needs, causes new and difficult to solve environmental problems that arise daily. These problems can also cause significant changes in people’s perception of the environment. In this study, such multidimensional problems demonstrated that environmental education has to be addressed in a widespread manner to become a permanent topic in modern societies.

It is known that action is being taken regarding the necessity that the environment and environmental problems must be reconsidered within the context of individuals, society and nations. Affective acquisitions must be approached from the perspective of the determinations included in the scientific databases regarding the environment (UNESCO-UNEP, 1977; Ünal & Dımişk1, 1999; Stokes, Edge & West, 2001; Özata

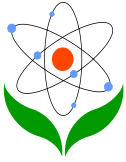
---



Yücel & Özkan, 2014c). Environmental problems started to be debated worldwide at the United Nations Conference on the Human Environment held in Stockholm in 1972. In 1975, the research of the United Nations Educational, Scientific and Cultural Organization (UNESCO) showed that environmental education was inadequate on a global scale (Ünal & Dımişkı, 1999). In 1977, with the cooperation of the United Nations Environment Programme (UNEP), UNESCO organized the International Environmental Education Conference for the purpose of identifying basic environmental problems, the function of environmental education in eliminating environmental problems and the international goals required for improving environmental education. Thus, the first international steps regarding environmental education were taken (Palmer, 2003). In this conference, it was determined that the ultimate aim of environmental education is to enable people to understand the complexities of the environment and the need for nations to adapt their activities and pursue their development in ways which are harmonious with the environment (UNESCO-UNEP, 1977, p. 6). Environmental education, which is regarded as one of the solutions for the prevention of environmental problems, aims to develop environmental consciousness, a positive attitude towards nature, interest, sensitivity, awareness and responsibility in individuals (UNESCO-UNEP, 1977). In order to understand the scientific reasons for environmental problems, first, it is necessary to understand what is the natural environment and what are the elements, factors and processes shaping it (Shepardson, Wee, Priddy & Harbor, 2007). Therefore, correct understanding of the concept of environment should be situated at the centre of environmental education by taking into account ecological data that can assist individuals to identify environmental problems correctly, and then work toward solutions to mitigate those problems. Therefore, it is important for society to understand environmental responsibilities, and thus, facilitate environmental education to reach its goals (Ahi, Balci & Alisinaoğlu, 2017). It is believed that perception and interpretation of environmental events by individuals can have a positive effect on their attitude, consciousness and knowledge (Yardımcı & Bağcı Kılıç, 2010).

According to the Oxford Dictionary perception is “the neurophysiological processes, including memory, by which an organism becomes aware of and interprets external stimuli”. Perception, which is influenced by anticipation and past experiences, can be defined as the process of explaining and interpreting sensory information on the basis of our knowledge acquired partly in an objective and partly in a subjective way

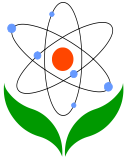
---



(Senemoğlu, 2005). This process starts when we are aware of sensory stimuli, and students can only learn the information which they can perceive. If the incoming environmental stimuli are correctly perceived and correctly interpreted, the information obtained becomes valid and accurate. Thus, perception is an important element in learning (Senemoğlu, 2005). Therefore, correct cognitive structuring of environmental concepts may be considered as a sign of correct environmental perception, and these concepts can be structured properly in the mind only by establishing correct environmental perception. In this context, it is important to determine the environmental perceptions of teachers and prospective teachers, who are important elements of environmental education, because teachers' approaches to the environment and their perception of the environment as a whole can have an effect on their students' cognitive understanding and interpretation of this concept when taught (Özata Yücel & Özkan, 2014a).

Environment is expressed as an integrated order created by living and non-living things that are constantly interacting with each other (Yavetz, Goldman & Pe'er, 2014). Shepardson et al. (2007) stated that this complex order actually consists of three basic elements. The first of these are natural systems, which include living and non-living things, the second are the humane systems consisting of social, cultural and political elements, and the third are the processes involving non-linear variable relations with each other (Shepardson et al., 2007). Approaches to the concept of the environment, which include such different transitions, make it difficult to understand and define the complex structure of the concept in order to explain it in a simpler manner (Hmelo-Silver, Marathe & Liu, 2007; Plate, 2010).

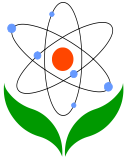
In the literature, it is apparent that the environment is generally perceived as an object or place which living beings inhabit (Barraza, 1999; Demirkaya, 2009; Lougland, Reid & Petocz, 2002; Shepardson et al., 2007; Yardımcı & Bağcı Kılıç, 2010; Yavetz et al., 2014). In these studies, the environment is regarded only as the place which living beings inhabit or living beings use to supply their vital resources, and in this kind of environmental perception, plants are highlighted more so than animals. It was highlighted in the studies of Shepardson et al. (2007), that students between classes 4 and 12 accept natural habitats as the environment, while they do not accept man-made areas as the environment. In the same study, the majority of the students kept human beings outside the environment.



It was determined that the environment is frequently associated with environmental problems. However, it was pointed out that the approaches of different social levels have both similarities and differences. Yardımcı and Bağcı Kılıç (2010) emphasized that the 8th grade students who participated in the study knew about environmental problems, were aware of the harm humans caused to the environment and took various measures to protect the environment. Barraza (1999) stated that participants associated the environment with pollution, nuclear waste, war, violence, litter, forest fires, etc., while Özsoy (2012) stated that participants associated the environment with problems such as air pollution, water pollution, soil pollution and irregular urbanization. Studies conducted by Yavetz et al. (2014) and Demirkaya (2009) found that prospective teachers tended to emphasize humans' relationship with the social environment.

From the evaluation of studies in the literature, it was understood that students have a limited environmental understanding and they cannot regard the environment as an integrated system consisting of living beings, non-living things and the relationship between them. Also, findings showed that humans tend to see themselves as placed at the centre of the environment, that a perspective focusing on humans is dominant and that there are problems in understanding and interpreting environmental events and facts.

When evaluated in terms of age groups, it would be expected that as the education grade increases, environmental perception also increases proportionally; however, studies in the literature do not support this. In this context, the similarities between the results and findings of the studies conducted with primary, middle, high school and undergraduate students are remarkable. As the limitation in environmental perspective continues while education grade increases, it appears that some difficulties regarding environmental education could not be eliminated. Although environmental education at secondary school level in Turkey does not take place as a separate course, it is apparent that some issues regarding the environment and its protection are scattered throughout several curricula (Akınoğlu & Sarı, 2009; Tanrıverdi, 2009; Ürey & Aydın, 2014). Environment and many other subjects and concepts related to it are covered in secondary school, mainly in science classes (Akınoğlu & Sarı, 2009; Özata Yücel & Özkan, 2014b; Tanrıverdi, 2009; Ürey & Aydın, 2014). Thus, science teachers have an important role in providing environmental education. The expertise of teachers will affect the quality of



environmental education. Therefore, the quality of education can be increased by improving teachers' skills in environmental education (Gökdere, 2005; Lang, 2000; Walker, 1997). It is important for teachers to be effective environmental educators, to be scientifically correct with their environmental information, as well as affective in their methodological delivery, and to teach environmental concepts in a consistent manner (logical and sequential). This conceptual approach is also expected to be provided by prospective teachers at the college level.

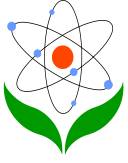
Science teachers who play a great role in environmental education in Turkey do not take a course under the heading of environmental education. However, during their education, they take courses which include subjects and concepts directly or indirectly related to the environment, such as Biology and Biology Laboratory Applications in the second class year, Ecology, Geology and Special Subjects in Chemistry in the third class year, Special Subjects in Biology and Biological Resources of Turkey in the fourth class year. The purpose of this study was to determine how prospective science teachers' perception of environment changed after their education and training based on college courses.

## Method

This study was designed as a longitudinal study. The study was carried out in three stages. In the first stage, the data was collected at the beginning of the second class year in the Faculty of Education in 2013, when prospective science teachers began taking courses related to the environment. Then, in the second stage, when they took routine courses such as Ecology, Geology, and Biological Resources of Turkey, a planned intervention was not carried out. In the third stage, data was collected again from the same prospective science teachers, at the end of the fourth class year in 2016, when they had completed these courses successfully. In this way, the change in prospective science teachers' perception of environment based on their college education was evaluated longitudinally.

### *Study Group*

While determining the study group, criterion sampling, a purposeful sampling method which aims to analyse all situations meeting all predetermined criteria, was utilized (Patton, 1990).

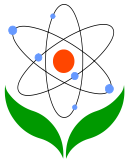


The study was conducted in a region where environmental pollution has been intense. This was the first criterion. The study was conducted in the province of Kocaeli located in the north-west of Turkey. Kocaeli is an industrial city, where a wide range of industrial establishments, such as a solid waste disposal facility, oil refinery, shipyards, chemical, metal, paint and food factories are located and where marine transportation is conducted. Moreover, it has a large population of migrants who come from different regions of the country due to the industrialization. All these factors keep many environmental problems, especially air pollution, soil pollution, water pollution and irregular urbanization, on the city's agenda (Demirarslan & Demirarslan, 2016; Kiliç & Deniz, 2010; Ministry of Environment and Urbanization, 2014; OECD, 2008; Özdilek, 2006).

The other criterion was that the concept of the environment and subjects related to the environment were mostly processed in science courses in Turkey. Thus, the working group was formed from prospective science teachers (Özata Yücel ve Özkan, 2014b; Akınoğlu ve Sarı, 2009; Ürey ve Aydın, 2014, Tanrıverdi, 2009). The courses taken during their college education were accepted as the criterion in order to determine the grade level of the study group. The first application included 63 prospective teachers continuing in the second grade, in which they had recently started taking courses such as Biology, Ecology, etc. These were expected to influence their environmental perceptions at a cognitive level. The second application included 55 prospective teachers of the same group who had taken and completed these courses successfully and who were in the fourth grade. In the second application, 55 of the 63 prospective teachers who participated in the first study could be reached. Eight prospective teachers who could not participate in the second application were not taken into consideration during the evaluation of the data.

### ***Data Collection Tool and Data Collection***

Data were obtained by means of a Word Association Test (WAT), which is an effective technique that is used to determine cognitive structure and misconception (Atabek Yiğit, Yılmazlar & Çetin, 2016; Ercan, Taşdere & Ercan, 2010), perception of a particular phenomenon, event or concept (Kurtde Fidan, 2015; Özata Yücel & Özkan, 2015). In the word association test, the respondents give one or two-word responses within a certain time, which they associated with the keyword they are given. It is considered that the sequential response given by the students to a keyword



reveals the connection in the cognitive structure between the concepts and shows semantic connection. The closer two concepts are in the cognitive structure, the faster they appear in the responses. Indeed, the number, accuracy and diversity of responses given to a keyword in WAT are considered to be important signs of understanding and perception of this concept (Bahar & Özatlı, 2003; Bahar, Johnstone & Sutcliffe, 1999; Gunston, 1980; Shevelson, 1974; Tsai & Huang, 2002; Özata Yücel & Özkan, 2015).

In this study, the concept of ‘environment’ was determined as the keyword, and it was written ten times in a vertical list on a blank sheet of paper. Thus, WAT was created so as to correspond to a single response per line (Figure 1). As occurred in many studies in the literature (Bahar, Johnstone & Sutcliffe, 1999; Canbazoglu Bilici, 2016; Nakipoğlu, 2008; Özata Yücel & Özkan, 2015; Özata Yücel & Özkan, 2014a), respondents were given 30 seconds to apply WAT.

In order to determine the relationship between the keyword and the responses of WAT more clearly, Gunston (1980) developed Shavelson’s technique by requesting a sentence about the keyword after completion of the word association. Moreover, he emphasized that the sentence can also be used to evaluate cognitive relations (Gunston, 1980). Thus, following completion of WAT, the prospective teachers were asked to write a sentence regarding the environment.

Environment: .....  
Environment: .....  
Environment: .....  
Environment: .....  
Environment: .....  
Environment: .....  
Environment: .....  
Environment: .....  
Environment: .....  
Environment: .....  
A sentence about the environment:.....

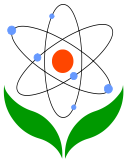
**Figure 1:** *Word Association Test*

### ***Data Analysis***

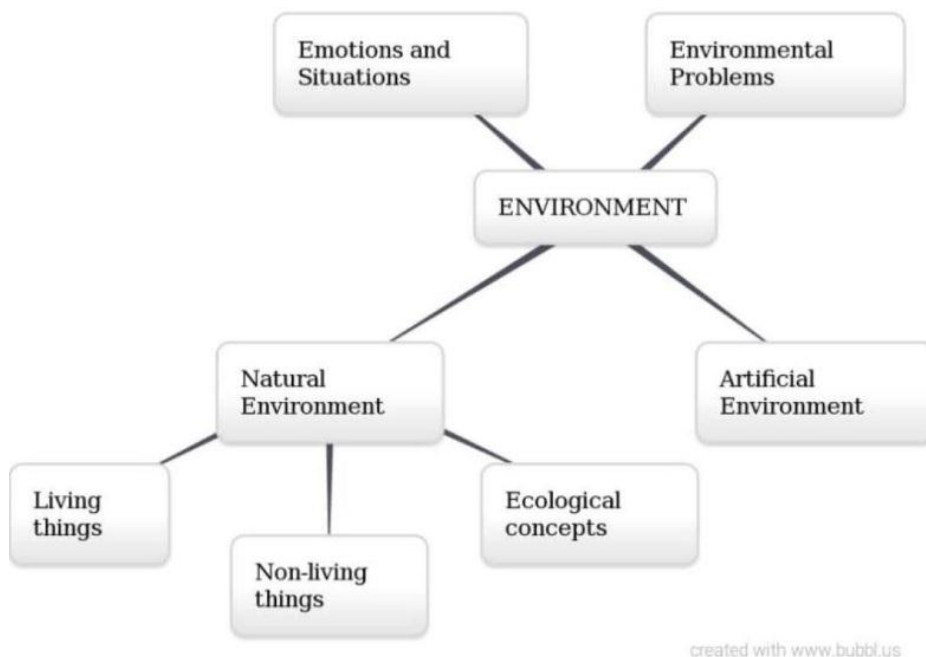
In the analysis of the data, the number, accuracy, diversity of responses and sentences given to the keyword of environment were used. The responses were subjected to content analysis. Firstly, a frequency table was created that showed the repeated

---

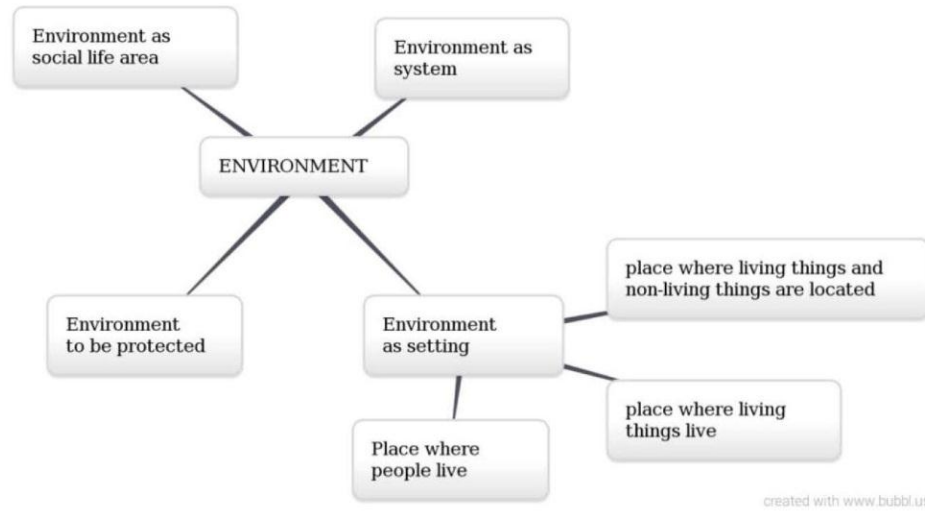
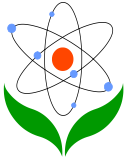




numbers of all the responses given by respondents to the keyword. Then, these responses were grouped according to their similarity and were examined under four main themes: ‘natural environment’, ‘artificial environment’, ‘environmental problems’ and ‘emotions and situations’. The natural environment theme was divided into sub-themes of ‘living things’, ‘non-living things’ and ‘ecological concepts’ (Figure 2). Also, sentences were subjected to content analysis and the forms were analysed under four main themes: ‘environment as social life area’, ‘environment to be protected’, ‘environment as setting’ and ‘environment as system’. The theme of environment as setting was examined in three sub-themes: ‘place where people live’, ‘place where living things live’ and ‘place where living things and non-living things are located’ (Figure 3).



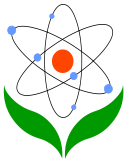
**Figure 2.** Themes created in line with the responses given



*Figure 3. Themes created in line with the sentences formed*

### ***Validity and Reliability***

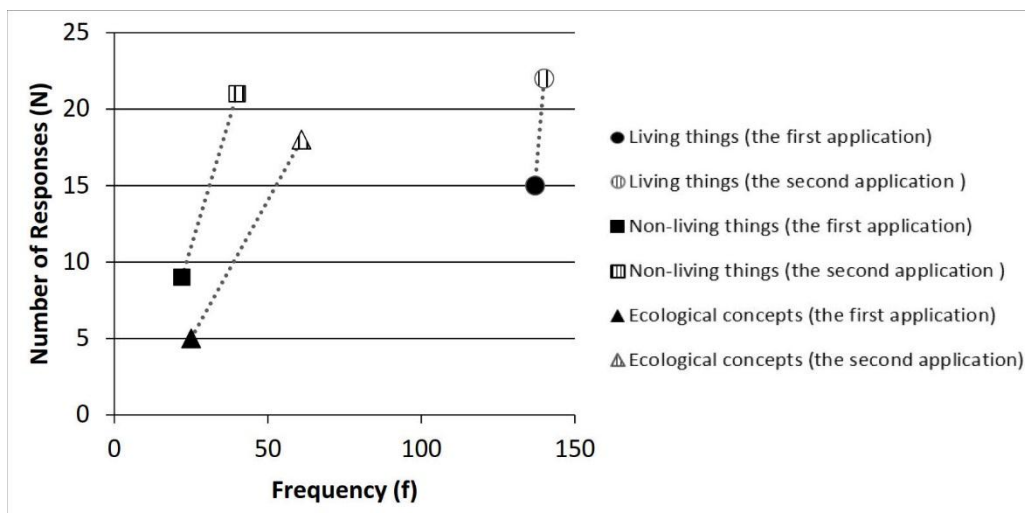
Word association is one of the methods applied to determine the relationship between conceptual perception, conceptual understanding and establishment of relationships between the concepts (Bahar et al., 1999; Bahar & Özatlı, 2003; Canbazoğlu Bilici, 2016; Gunston, 1980; Nakiboğlu, 2008; Özata Yücel & Özkan, 2014a; Özata Yücel & Özkan, 2015; Shavelson, 1974; Tsai & Huang, 2002). Furthermore, WAT was implemented following the positive opinion of two experts. Thus, content and face validity was established. In order to ensure the reliability of the WAT, each response to the keyword was arranged so as to be written on a separate line, and thus, the impact between the responses was kept at a minimum level (Bahar, Johnstone & Sutcliffe, 1999). The responses given to the keyword were compared to the sentences formed and listed, and responses considered to be unrelated or randomized were not included in the evaluation (Gunston, 1980). Moreover, in establishment of the themes, separate draft themes were determined by both researchers for both the responses and the sentences. Then, the percentages of consistency between the two researchers were calculated as 87.01% for responses and 83.64% for sentences. Having a consistency percentage of 70% or more (Miles & Huberman, 1994) is considered acceptable. Accordingly, it is possible to say that the percentage of consistency was high. Divergent codings were re-evaluated and final themes were formed by reaching consensus. In addition, a complete list of participant responses was provided as a list



and examples of formed sentences were given. This method was intended to increase reliability.

## Findings

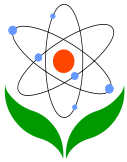
Upon examination of the theme of natural environment and related sub-themes, it was found that both the number and the diversity of responses of the prospective teachers increased (Figure 4). Although there was no great increase in the total frequency of responses evaluated under the living things sub-theme ( $f_1=137$ ;  $f_2=140$ ), the number of responses increased from 15 to 22. In the sub-themes of non-living things and ecological concepts, both the number of responses and the increase in their total frequencies were found to be higher (Figure 4).



**Figure 4.** The change in natural environment theme.

In the sub-theme of living things, the responses ‘human’, ‘animal’, ‘plant’ and ‘live’ were given by more respondents in the second application than in the first. Fewer prospective teachers gave responses of ‘tree’, ‘greens/grass’, ‘flower’, ‘friend/neighbour’, ‘family’ or ‘society’. Moreover, although few prospective teachers gave the response, responses such as ‘fungus’, ‘microorganism’ and ‘virus’ were also included in the second application (Table 1).

In the sub-theme of non-living things, the responses ‘air’, ‘earth’ and ‘sun’ were prominent. Results showed that in both applications, these responses were given by a large number of prospective teachers. In the second application, ‘atmosphere’,

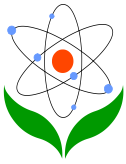


‘temperature’, ‘fossil’ and ‘rain’ responses were added to these. However, it was seen that the number of prospective teachers who gave these responses was very limited (Table 1).

**Table 1.** Responses under natural environment theme and their frequencies

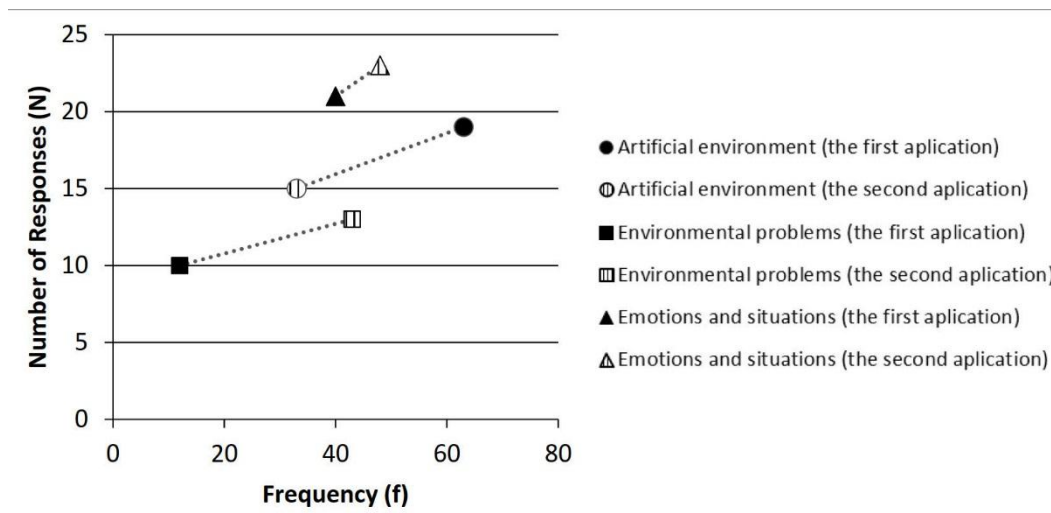
<i>Sub-themes</i>								
<i>Living things (N1=15; N2=22)</i>			<i>Non-living things (N1=9; N2=21)</i>			<i>Ecological concepts (N1=5; N2=18)</i>		
<i>Responses</i>	<i>f1</i>	<i>f2</i>	<i>Responses</i>	<i>f1</i>	<i>f2</i>	<i>Responses</i>	<i>f1</i>	<i>f2</i>
Human	18	29	Air	4	6	Nature	12	20
Tree	32	24	Sky/Blue	4	2	Forest	10	6
Animal	11	17	Sun	3	4	World	1	4
Green/Grass	15	12	Soil	3	3	Ecosystem	1	5
Plant	3	15	Sea	2	2	Spring	1	1
Flower	14	7	Oxygen	2	3	Habitat	-	4
Friend/Neighbour	13	2	Water	2	3	Ecology	-	6
Society	6	4	Non-living things	1	3	Biodiversity	-	1
Living things	3	8	Stream	1	-	Population	-	2
Family	7	1	Atmosphere	-	2	Species/member	-	2
Child	3	3	Temperature	-	1	Niche	-	2
Dog	4	2	Carbon dioxide	-	1	Evolution	-	1
Bird	3	2	Cloud	-	1	Producer	-	1
Bug	3	-	Mountain	-	1	Consumer	-	1
Cat	2	2	Rock	-	1	Community	-	1
Fungus	-	3	Fossil	-	1	Biology	-	2
Microorganism	-	2	River	-	1	System	-	1
Virus	-	2	Nitrogen	-	1	Cycle	-	1
Seed	-	1	Ozone	-	1			
Mammal	-	1	Rain	-	1			
Caterpillar	-	1	Spring	-	1			
Daisy	-	1	Rainbow	-	1			
Leaf	-	1						
Total	137	140	Total	22	40	Total	25	61

The second application, which was performed after the respondents had successfully completed courses such as Biology, Ecology, Geology, etc. which were expected to influence their environmental perceptions, shows the increase in the diversity of responses. In the sub-theme of ecological concepts, the diversity of responses was quite high. While the responses of ‘nature’, ‘forest’, ‘world’, ‘ecosystem’ and ‘spring’ were given in the first application, concepts such as ‘habitat’, ‘species’, ‘population’,



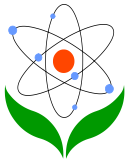
‘community’, ‘producer’ and ‘consumer’ were added to these in the second application (Table 1).

Of the responses given by the prospective teachers to the key concept of the environment, ten in the first application and 13 in the second application are related to environmental problems. There was a limited increase in the diversity of responses in the second application. However, the total frequency increased from 12 to 43 (Figure 5). The largest part in this increase was the ‘pollution’ response. In the first application, only one prospective teacher gave the pollution response, while in the second application this number increased to 16. While responses such as ‘factory’, ‘problem’ and ‘erosion’ were not given in the first application, they were given in the second application by prospective teachers (Table 2).



**Figure 5.** The change in the number and frequency of responses in the themes of artificial environment, environmental problems, emotions and situations.

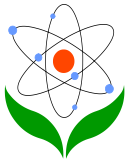
In the artificial environment theme, there was a decrease between the two applications in both the response type ( $N_1=19$ ;  $N_2=15$ ) and the total frequency of these responses ( $f_1=63$ ;  $f_2=33$ ) (Graph 2). Of these, the responses ‘home’, ‘building/apartment’ and ‘car/vehicle’ were prominent in both applications (Table 2). In the theme of emotions and situations, the number of responses in both applications ( $N_1=21$ ;  $N_2=23$ ) and their total frequency ( $f_1=40$ ;  $f_2=48$ ) were close to each other (Figure 5). In both applications, responses of ‘life’, ‘clean’, ‘protection’ and ‘order’ seemed to be prominent (Table 2).



From the sentences formed by prospective teachers regarding the key concept of the environment, one in the first application and five in the second application were evaluated as unrelated. When the distribution of the other sentences formed according to the themes were analysed, it was seen that in both applications the most-used concept was environment to be protected. In the first application, 23 prospective teachers' sentences and in the second application, 28 prospective teachers' sentences were evaluated under this theme in this study (Table 3).

**Table 2.** Responses and their frequencies in the themes of artificial environment, environmental problems, emotions and situations

<i>Artificial Environment</i>			<i>Environmental Problems</i>			<i>Emotions and Situations</i>		
<i>Responses (N1=19; N2=15)</i>	<i>f1</i>	<i>f2</i>	<i>Responses (N1=10; N2=13)</i>	<i>f1</i>	<i>f2</i>	<i>Responses (N1=21; N2=23)</i>	<i>f1</i>	<i>f2</i>
Home	13	6	Traffic		1	Love	1	-
Building/ Apartment	8	5	Noise/sound	3	3	Life	5	9
Neighbourhood/ street/avenue	7	1	Petrified structures	1		Friendship	1	-
Outside our home	1	-	Pollution	1	16	Safety	1	-
Garden	2	-	Cigarette	1		Happiness	1	-
Park	5	3	Smoke	1	-	Clean	9	7
School	3	5	Litter	1	6	Health	1	2
Dormitory	1	-	Problem	-	4	Protection	3	3
Car/vehicle	4	4	Crowded	1	2	Safe	1	-
Litter bin	5	-	Waste treatment plant	1	-	Decent	1	-
Workplace	1	-	Theme	1	-	Discipline	1	-
Market	1	-	Industry	1	-	Order	2	3
Tent	1	-	Factory	-	4	Power	1	-
Barbecue	1	1	Erosion	-	2	Relationship	1	-
Road	3	1	Waste	-	1	Book	1	-
Pond	1	-	Recycling	-	1	Hobby	1	-
Dam	1	-	Petrol	-	1	Entertainment	4	2
Channel	1	-	Economy	-	1	Travel	1	-
Country/City/ Town	4	1	Gas	-	1	Bad habit	1	-
Concrete	-	1				Crowded	1	2
Settlement	-	1				Picnic	2	1
Paper	-	1				Boring	-	1
Farm	-	1				Serenity	-	2
Sidewalk	-	1				Calmness	-	1
Nuclear power plant	-	1				Consciousness	-	3
						Suffering	-	1
						Sharing	-	1
						Emotion	-	1
						Complexity	-	1



						Value	-	1
						Virtual environment	-	1
						Picture	-	1
						Wonder of nature	-	1
						Natural life	-	2
						Crime	-	1
						War	-	1
		63	33		12	43	40	48

In these sentences, respondents often emphasized the negative effects of people on the environment. They also mentioned the effects of environmental problems on people and that they were less concerned with their effect on other living things. The emphasis on the need for protection of the environment was high. However, the precautions to be taken were rarely mentioned. Prospective teachers presented gaining consciousness, not littering and keeping the environment clean as a protection element. Some examples are provided below.

*Life will be more beautiful if our environmental consciousness increases.*

*People need to do their best to protect our environment and nature.*

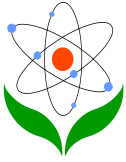
*People destroy the environment and nature by destroying vegetation and polluting seas.*

**Table 3.** Distribution of sentences formed by theme

Theme	2nd grade	4th grade	Total
Environment to be protected	23	28	51
Environment as setting	15	12	27
Environment as a social life area	15	3	18
Environment as system	1	7	8
Total	54	50	104

Another theme which was frequently mentioned in the respondents' sentences was environment as habitat. In the first application, 14 and in the second, 12 respondents' sentences were evaluated under this theme (Table 3). We interpreted that respondents regard environment as a 'place where people live', a 'place where living things live' and a 'place where living things and non-living things are located' (Table 4).

**Table 4.** Theme of environment as habitat



Sub-theme	2nd grade	4th grade	Total
Place where people live	6	3	9
Place where living things live	2	4	6
Place where living things and non-living things are located	7	5	12
Total	15	12	27

As in the following examples, it was seen that the number of respondents indicating that environment is the place where people live was six in the first application and three in the second. In addition, the number of respondents perceiving environment as a place where not only people live, but also living things live, increased from two to four. From this, it is understood that the human-oriented perspective of respondents reduced with their education, but it still continued.

*The place where people live together.* (Place where people live sub-theme)

*By knowing his/her environment, a person must know what kind of habitat he/she is in.* (Place where people live sub-theme)

*People live together with animals and plants in the environment.* (Place where living things live sub-theme)

*Environment is a place where living things such as animals, plants, fungus live.* (Place where living things live sub-theme)

One of the most notable findings was that the number of prospective teachers who perceived the environment as a social life area was 15 in the first application, while it decreased to three in the second application. Some example sentences are given below.

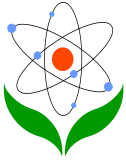
*The people in our environment are very friendly.*

*The environment is everything that characterizes me, it is everything that is friend, family, book, and nature.*

*The environment can colour human life and it may be upset from time to time.*

The perception of environment as system, examples of which are given below, was emphasized in the sentence of one prospective teacher in the first application, while





in the second application this number increased to seven, which gave the impression that with the education they received, prospective teachers' perception of the environment and understanding of social environment weakened and there was a tendency towards themes from the ecological database (Table 3).

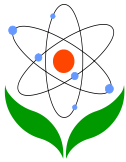
*Environment is an ecosystem set up with an order.*

*Environment is a system consisting of people, animals, houses, trees and mountains.*

## **Discussion, results and recommendations**

The complex nature of the concept of the environment, which has as many economic and political dimensions as biological and that involves the relationships of living things with each other and with non-living things around them, makes it difficult to understand. In the literature, it has been shown that the difficulties in perceiving the environment as a whole, with all its dimensions, has been observed in students at all levels of education from primary school to high school (Barraza, 1999; Lougland et al., 2002; Özsoy, 2012; Shepardson et al., 2007; Yardımcı & Bağcı Kılıç, 2010). These complexities were found even in undergraduate students of various fields (Desjean-Perrotta, Moseley & Cantu, 2008; Moseley, Desjean-Perrotta & Utley, 2010; Özata Yücel & Özkan, 2014a; Yavetz et al., 2014;). We tried to determine the effect of some courses, such as Ecology, Geology and Biology, in the Science Teacher Education Program of the Faculty of Education on the change of participants' understanding of the environment through WAT, in the longitudinally implemented application conducted with the prospective science teachers.

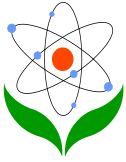
The number and diversity of responses given to a key concept in WAT are considered to be an important sign of understanding this concept (Bahar et al., 1999). The results show that as the number of responses given to a keyword increases and diversifies, the cognitive structures also develop proportionally. In addition, as correct apprehension of a fact or situation is considered to be a sign of correct perception (Senemoğlu, 2005), when the responses given by respondents were examined, the perception of living things, non-living things and ecological concepts in the natural environment theme became stronger with the passing of time, while the perception regarding the artificial environment weakened. The study conducted by Shepardson et al. (2007) with students from 4th grade to 12th grade determined that only natural



areas were considered as the environment. In the studies included in the literature, (Özsoy, 2012; Shepardson et al., 2007; Shepardson, 2005) plants and animals, which are living elements of the environment, were emphasized by a large number of respondents. Although fungus and microorganisms were added to these in the second application, the fact that these responses were given by very few participants shows that the determination of respondents regarding living elements of the environment is deficient and their perception regarding living elements of the environment has not been adequately enriched and altered.

The development regarding non-living things is much more limited. Although responses such as atmosphere, rain and rock were added to responses such as air, sun, soil and water in the second application, it is apparent that these responses were given by very few respondents. In the literature, it was reported that there was an emphasis on sun, water, mountains and lakes (Barraza, 1999; Özsoy, 2012). In these studies, the conceptual understanding and perception regarding non-living things was weaker than the conceptual understanding and perception regarding living things. This supports our findings.

The results indicate that with the increase in the courses taken by respondents in this study regarding the environment, the respondents' cognitive structures altered and thus, they associated the concept of environment with more concepts, added new concepts to these and there was a change in their cognitive perception in connection with this increase. For example, in the sub-theme of living things, the number of lower-level concepts such as tree, flower, dog, bug given in the first application decreased in the second application, and higher-level concepts such as plant and animal, which include others, were given more frequently in the responses. Similarly, the fact that the respondents emphasized ecological concepts, such as nature, forest and ecosystem, more frequently in the second application, that they included responses such as habitat, biodiversity, ecology, evolution and system, and that in the sentences formed, the emphasis towards social environment decreased while the systematic perception increased, shows that respondents' cognitive structures were developed. Another finding which will support this result is that although there was a limited increase of change in the diversity of responses to 'environmental problems', there was an increase in total frequency. This is because while the number of responses, such as cigarette, smoke and crowded, decreased, the responses

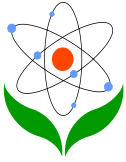


involving all of these, such as pollution and problem were adopted by many more respondents.

As was the case in other studies (Demirkaya, 2009; Yavetz et al., 2014), in this study it was determined that the environment in terms of ‘artificial environment’ was associated with social environment. However, the fact that the number of responses in the second application greatly decreased and that this decrease was caused by the decrease in the responses that are related to social dimensions of environment such as home, neighbourhood/street, country, city, garden and park, shows that the environment perception of prospective teachers moved away from social environment perception and evolved into a more ecological and scientific environment perception. Again, the fact that the number of sentences that have been evaluated in terms of environment as a social life area was reduced supports the argument that the ecological perception was strengthened. This may be indicative that prospective science teachers’ perception of environment, which they create based on their experiences in daily life in their cognitive structures, is reshaped based on college courses.

There was no change in the responses that expressed the emotions and situations of the respondents towards the environment. In various studies conducted, it was determined that the emotional closeness to nature is influential on willingness to protect nature and making behavioural decisions towards nature, and that the time spent in nature and personal experiences have an importance in strengthening emotional closeness to nature (Kals, Schumacher & Montada, 1999; Müller, Kals & Pansa, 2009). Therefore, it is thought that it is important to develop positive environmental emotions, to feed a realistic perception of the environment with correct information and to develop and change it in environmental education. In this respect, it is understood that integration of courses in which topics and concepts related to environmental education are included with the field studies of nature education, in addition to the teaching activities in the faculty, would have a significant role on effectively performing environmental education.

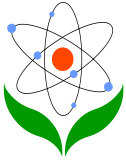
One of the common points of all the studies on environmental perception is that the participants associate environment with environmental problems (Barrazza, 1999; Özsoy, 2012; Shepardson et al., 2007; Yardımcı & Bağcı Kılıç, 2010). The same situation was also identified in this study. When the responses given in both



applications are compared, it is understood that the perception towards environmental problems strengthened. In parallel with this, when the sentences formed were analysed, it was determined that the perception of the ‘environment to be protected’ of respondents continued to increase in the second application. It is argued that the cause of this strengthening of perception of environmental problems and environment to be protected may be the information acquired during their education, or that between the applications they had lived in a city, the pollution of which is higher than Turkey’s average, namely Kocaeli (Demirarslan & Demirarslan, 2016; Kiliç & Deniz, 2010; Ministry of Environment and Urbanization 2014; OECD, 2008; Özdilek, 2006). This is an industrial city and by means of facing these problems personally, they were able to monitor and observe certain environmental events and facts closely. It was emphasized in the literature that environmental awareness and sensitivity develops in the students who are aware of the degradation and environmental problems in their close environment (Özdemir, 2010). Moreover, it is thought that the frequent emphasis of these issues in television, newspapers and social media is likely to be effective in the alteration of environment perception.

Although there was a change in the respondents’ cognitive structures and perception towards the environment, this change was limited and complex relationships could not be fully comprehended (Table 4). This is interpreted from the sentences formed by the respondents. In the second application, the perception of ‘place where people live’ weakened while the perception of ‘place where living things lived’ became stronger (Table 4). In addition, it was determined that in the sentences formed in the first application, there was a tendency for ‘the place where living and non-living things are located’ to move towards ‘environment as system’. However, this increase was seen to be limited to only seven respondents (Table 4). This is thought to be due to the fact that environment and environmental relationships is a complex system.

It is appears that students have problems being able to recognize the relationship between the elements that constitute the environmental system, establishing the connection between the levels in the system, being able to comprehend the structure and mechanism thereof, being able to establish relationships between levels, and associating the relationship of living and non-living things (Hmelo, Holton & Kolodner, 2000; Eberbach, Hmelo-Silver, Jordan, Sinha & Goel, 2012). It is emphasized that in order to eliminate these problems, the basic concepts must be well internalized and that not only the observable dimensions of the system, but also all

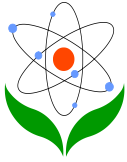


other dimensions must be considered during education (Jordan, Brooks, Hmelo-Silver, Eberbach & Sinha, 2014).

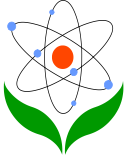
The inability to understand the complex nature of the environment is a major drawback for prospective teachers who will teach environmental subjects and concepts. The knowledge that this perception has changed very little in their education process suggests that it is necessary to improve teacher education programs and prioritize practice-oriented teaching activities.

## References

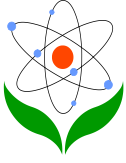
- Ahi, B., Balci, S. & Alisinanoğlu, F. (2017). Exploring Turkish preservice teachers' mental models of the environment: Are they related to gender and academic level? *The Journal of Environmental Education*, 48(3), 182-195.
- Akınoğlu, O. & Sarı, A. (2009). İlköğretim programlarında çevre eğitimi [Environmental education in primary school curriculum]. *M. Ü. Atatürk Eğitim Bilimleri Dergisi*, 30, 5-29.
- Atabek Yiğit, E., Yılmazlar, M., & Çetin, E. (2016). Investigation of classroom teacher candidates' cognitive structures on some basic science concepts. *European Journal of Education Studies*, 1(4), 33-57.
- Bahar, M., & Özatlı, N.S. (2003). Kelime iletişim test yöntemi ile lise 1. Sınıf öğrencilerinin canlıların temel bileşenleri konusundaki bilişsel yapılarının araştırılması. [Investigation of the first year high school students' cognitive structures in the subject of basic components of living things through word association test]. *Balıkesir Üniversitesi Fen Bilimleri Enstitüsü Dergisi*, 5(2), 75-85.
- Bahar, M., Johnstone, A. H., & Sutcliffe, R. G. (1999). Investigation of students' cognitive structure in elementary genetics through word association tests. *Journal of Biological Education*, 33(3), 134-141.
- Barraza, L. (1999). Children's drawings about the environment. *Environmental Education Research*, 5(1), 49-66.
- Canbazoğlu Bilici, S. (2016). An examination of science teachers' knowledge structures towards technology. *International Journal of Environmental and Science Education*, 11(5), 571-586. DOI:10.12973/ijese.2016.403a
- Demirarslan, K. O. & Demirarslan, D. (2016). Development of new settlement areas and solid waste problem in cities: Case study on İzmit - Yahyakaptan Neighbourhood (in Turkish). *Journal of Natural Hazards and Environment*, 2(2), 108-120.
- Demirkaya, H. (2009). Prospective primary school teachers' understanding of the environment: A qualitative study. *European Journal of Educational Studies*, 1(1), 75-81.
- Desjean-Perrotta, B., Moseley, C., & Cantu, L.E. (2008). Preservice teachers' perceptions of the environment: Does ethnicity or dominant residential experience matter?. *The Journal of Environmental Education*, 39(2), 21-32.
- Eberbach, C., Hmelo-Silver, C., Jordan, R., Sinha, S., & Goel, A. (2012). Multiple Trajectories for Understanding Ecosystems. In the *Future of Learning: Proceedings of the 10th*
-



- International Conference of the Learning Sciences (ICLS 2012)*, Vol. 1, Full Papers, edited by J. van Aalst, K. Thompson, M. J. Jacobson, and P. Reimann, 411–418. Sydney: ISLS.
- Ercan, F., Taşdere, A. & Ercan, N. (2010). Observation of cognitive structure and conceptual changes through word associations tests. *Journal of Turkish Science Education*, 7(2), 136-154.
- Gökdere, M. (2005). A study on Environmental Knowledge Level of Primary Students in Science Education. *Asia-Pacific Forum on Science Learning and Teaching*, 6, S.2, artical 5.
- Gunston, R. F. (1980). Word association and the description of cognitive structure. *Research in Science Education*, 10, 45-53.
- Hmelo, C. E., Holton, D. L. & Kolodner, J. L., (2000). Designing to learn about complex systems. *The Journal of the Learning Science*, 9(3), 247-298.
- Hmelo-Silver, C.E., Marathe, S. & Liu, L. (2007). Fish swim, rocks sit, and lungs breathe: Expert-novice Understanding of complex systems. *Journal of the Learning Sciences*, 16(3), 307-331, doi:10.1080/10508400701413401
- Jordan, R. C., Brooks, W. R., Hmelo-Silver, C., Eberbach, C. & Sinha, S. (2014). Balancing broad ideas with context: an evaluation of student accuracy in describing ecosystem processes after a system-level intervention. *Journal of Biological Education*, 48(2), 57-62.
- Kals, E., Schumacher, D., & Montada, L. (1999). Emotional affinity toward nature as a motivational basis to protect nature. *Environment and Behavior*, 31(2), 178-202.
- Kiliç A. & Deniz, C. (2010). Inventory of Shipping Emissions in Izmit Gulf, Turkey. *Environmental Progress & Sustainable Energy*, 29(2), 221-232.
- Kurtdede Fidan, N. (2015). Identifying the perceptions of pre-service classroom teachers about constructive theory: A phenomonographical study. *Celal Bayar Üniversitesi Sosyal Bilimler Dergisi*, 13(4), 263-282.
- Lang, J. (2000). Tracing changes in teacher environmental education understanding. *Australian Journal of Environmental Education*, 15/16, 59-67. in Loughland, T, Reid, A., & Petocz, P. (2002). Young people's conceptions of environment: A phenomenographic analysis. *Environmental Education Research*, 8(2),187-197
- Loughland, T., Reid, A., & Petocz, P. (2002). Young people's conceptions of environment: A phenomenographic analysis. *Environmental Education Research*, 8(2),187-197, doi: 10.1080/13504620220128248
- Miles, M. B., & Huberman, A.M. (1994). *Qualitative data analysis*. USA: Sage Publication.
- Ministry of Environment and Urbanization (2014). *Türkiye Çevre Sorunları ve Öncelikleri Değerlendirme Raporu. [Assessment report of Turkey environmental problems and priorities]*. Ankara. [https://www.csb.gov.tr/db/ced/editordosya/cevre\\_sorun\\_2014.pdf](https://www.csb.gov.tr/db/ced/editordosya/cevre_sorun_2014.pdf)
- Müller, M. M., Kals, E., & Pansa, R (2009). Adolescents' Emotional Affinity toward Nature: A Cross-Societal Study. *The Journal of Developmental Processes*, 4(1), 59-69.
- Moseley, C., Desjean-Perrotta, B., & Utley, J. (2010). The draw an environment test rubric (DAET-R): Exploring pre-service teachers' mental models of the environment. *Environmental Education Research*, 16(2), 189-208.
- Nakiboğlu, C. (2008). Using word associations for assessing non major science students' knowledge structure before and after general chemistry instruction: the case of atomic structure. *Chemistry Education Research and Practice*, 9, 309-322.
-



- OECD (2008). *OECD Environmental Performance Reviews: Turkey 2008*. OECD Publishing, Paris. DOI: <http://dx.doi.org/10.1787/9789264049161-en>
- Oxford Living Dictionaries. Retrieved from <https://en.oxforddictionaries.com/definition/perception> (13.04.2018).
- Ö zata Yücel, E. & Ö zkan, M. (2015). Determination of secondary school students' cognitive structure, and misconceptions in ecological concepts through word association test. *Educational Research and Reviews*, 10(5), 660-674.
- Ö zata Yücel, E., & Ö zkan, M. (2014a). Determining the Environmental Perceptions of Pre-Service Science Teachers through Word Association. *e-International Journal of Educational Research*, 5(4), 44-56.
- Ö zata Yücel, E., & Ö zkan, M. (2014b). Ekosistem, biyolojik çeşitlilik ve çevre sorunları konularıyla ilgili fen ve teknoloji öğretmen görüşlerinin öğretim tasarımı açısından değerlendirilmesi [Evaluation of science and technology teachers' views about ecosystem, biological diversity and environmental problems in terms of the instructional design]. *Milli Eğitim Dergisi*, 201, 165-182.
- Ö zata Yücel, E. & Ö zkan, M. (2014c). A Comparative Study of the Subjects on Ecosystem, Biological Diversity, and Environmental Problems in Turkish Science Curriculum with the International Curricula", *Journal of Turkish Science Education (TUSED/TUFED)*, 11(4), 31-46, (2014)
- Ö zdemir, Ö. (2010). Doğa Deneyimine Dayalı Çevre Eğitiminin İlköğretim Öğrencilerinin Çevrelerine Yönelik Algı ve Davranışlarına Etkisi [The Effects of Nature-Based Environmental Education on Environmental Perception and Behavior of Primary School Students]. *Pamukkale Üniversitesi Eğitim Fakültesi Dergisi*, 27, 125-138.
- Ö zdilek, H. G. (2006). An analogy on assessment of urban air pollution in Turkey over the turn of the millennium (1992–2001). *Environmental Monitoring and Assessment*, 122, 203–219.
- Ö zsoy, S. (2012). Investigating elementary school students' perceptions about environment through their drawings. *Educational Science: Theory & Practice*, 12(2), 1132-1139.
- Palmer, J. A. (2003). *Environmental Education in the 21st Century. Theory, Practice, Progress and Promise*. Routledge: New York.
- Patton, M. Q. (1990). *Qualitative evaluation and research methods* (second edition). USA: Sage Publications.
- Plate, R. (2010). Assessing individuals' understanding of nonlinear causal structures in complex systems. *System Dynamics Review*, 26(1), 19-33.
- Senemoğlu, N. (2005). *Gelişim Öğrenme ve Öğretim Kuramdan Uygulamaya [Development Learning and Teaching] (12. Baskı)*. Gazi Kitabevi:Ankara.
- Shepardson, D. P. (2005) Student ideas: What is an environment?. *The Journal of Environmental Education*, 36(4) 49-58.
- Shepardson, D.P, Wee, B., Priddy, M., & Harbor, J. (2007). Students' mental models of the environment. *Journal of Research in Science Teaching*, 44(2),327–348.
- Shavelson, R. J. (1974). Methods for examining representations of a subject matter structure in a student's memory. *Journal of Research in Science Teaching* 11(3), 231-249.
- Stokes, E., Edge, A. & West, A. (2001). *Environmental Education in the Educational Systems of European Union Final Report*. Commissioned by Environment Directorate-General of the European Commission. [http://www.medies.net/uploaded\\_files/ee\\_in\\_eu.pdf](http://www.medies.net/uploaded_files/ee_in_eu.pdf) (13.04.2018.)



- Tanrıverdi, B. (2009). Sürdürülebilir çevre eğitimi açısından ilköğretim eğitim programlarının değerlendirilmesi [Analyzing primary school curriculum in terms of sustainable environmental education]. *Eğitim ve Bilim*, 34(151), 89-103.
- Tsai, C.C., & Huang, C.M. (2002). Exploring students' cognitive structures in learning science: a review of relevant methods. *Journal of Biological Education*, 36(4), 163-169.
- UNESCO-UNEP 1977. Intergovernmental Conference on Environmental Education Final Report. (14-26 Ekim 1977), Tbilisi. 13.01.2008 tarihinde [http://www.gdrc.org/uem/ee/EE-Tbilisi\\_1977.pdf](http://www.gdrc.org/uem/ee/EE-Tbilisi_1977.pdf)
- Ünal, S. & Dımışkı, E. 1999. UNESCO-UNEP himayesinde çevre eğitiminin gelişimi ve Türkiye'de ortaöğretim çevre eğitimi. *Hacettepe Üniversitesi Eğitim Bilimleri Dergisi*, 17, 142–154.
- Ürey, M. & Aydın, M. (2014). İlköğretim fen ve teknoloji programında yer alan çevre konularına yönelik bir program analizi [A curriculum analyzing associated with environment topics in primary science and technology curriculum]. *Kafkas Üniversitesi e-Kafkas Eğitim Araştırmaları Dergisi*, 1(1), 37-50.
- Walker, K. (1997) Challenging Critical Theory in Environmental Education, *Environmental Education Research*, 3(2), 155-1
- Yardımcı, E., & Bağcı Kılıç, G. (2010). Çocukların gözünden çevre ve çevre sorunları [Children's views of environment and environmental problems]. *İlköğretim Online*, 9(3),1122-1136.
- Yavetz, B., Goldman, D., & Pe'er, S. (2014). How do preservice teachers perceive 'environment' and its relevance to their area of teaching?. *Environmental Education Research*, 20(3),354-371.