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Assessment of Changes in Teacher Candidates' Perceptions of the Concept of the Environment

İsmail Dönmez* Salih Gülen***

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Abstract

Higher education institutions are responsible for producing individuals with the knowledge, skills, and values to contribute to the improvement of society's quality of life. Environmental education is also one of the leading permanent solutions for environmental problems. The aim of this research is to understand teacher candidates' perceptions of the concept of "environment." In this context, a case study, as one of the qualitative research methods, was used. The participants consisted of 36 students enrolled in the primary school teaching department at a state university. The data collection tools included a word association test, metaphors, and drawing techniques. These data collection tools were applied before and after an environmental education course that participants attended for 14 weeks. From the research findings, it is understood that the participants' mental structures for the concept of "environment" shifted from being living creature-oriented to being pollution-oriented by the end of the environmental education course.

Keywords: Mental Structure, Drawing, Environment, Metaphor, Perceptions.

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* Corresponding Author's, Assosicate Professor, Mus Alparslan University, Bulanik Vocational School, Turkey, i.donmez@alparslan.edu.tr.

** Assosicate Professor, Mus Alparslan University, Malazgirt Vocational School, Turkey, s.gulen@alparslan.edu.tr.

Introduction

The environment is a multidimensional living space with sociological, biological, economic, physical, chemical, and cultural aspects, where all living beings interact with each other throughout their full lifespans (Torunoğlu, 2013). Various dangers arising as a result of human activities, such as drying rivers, deforestation, pollution of water resources, climate change, toxic wastes, decreasing biodiversity in nature, and acid rains have led people to reconsider their attitudes and behaviors toward the environment and their duties and responsibilities toward nature (McKibben, 2015). Due to rapid population growth and technological advances, today's children are born into a world where there are many environmental problems threatening both human health and nature, such as global warming, decreased biodiversity, soil erosion, decreased natural food supplies, and energy and water shortages (Diamond, 2011; Gunderson, 2014). The main source of these problems is known to be human behavior (Koger, 2013). The problems caused by industrialization and population growth also negatively affect human health. Living beings need the environment, and so it is important that people take care of it. Education is the main way to reduce environmental problems (Miser, 2019). Because with the environmental education course, both ecological information is learned and the attitude toward the environment develops, on the other hand, attitudes turn into behavior (Erten, 2004). The increase in environmental problems has accelerated studies seeking to create permanent solutions to these problems. The decision that environmental education is necessary for a sustainable environment was taken at the Rio Conference in 1992 (Ahi & Özsoy, 2015; Eilam & Trop, 2012). In this context, environmental education issues have started to take place in the curriculum in many countries. Especially in the last thirty years, the impact and importance of three key areas in education have become clear (Durkan, 2020). These three areas are environmental education, education for sustainable development, and education for sustainability (Eilam & Trop, 2012). It is possible to say that environmental education is a learning process that helps to improve many skills, attitudes, behaviors, and types of knowledge related to the environment (Sola, 2014). Each individual must have the knowledge to protect the environment (Mahajan & Darbari, 2014). Environmentally conscious individuals are aware of the importance of not only protecting nature but also recycling materials such as plastic, glass, and paper. In this sense, environmental consciousness is important for promoting recycling (Miranda & Blanco, 2009).

Environmental education is an area in which people and organizations strive to make the world a better place not just in the future, but also today. However, one significant obstacle to accomplishing this inclusive goal is deciding on a shared definition of what 'a better place' means. It's challenging to establish who the beneficiaries should be, under what circumstances the improvements should occur, and in what manner or methods these enhancements should be implemented (Clark et al., 2020). The aim of

environmental education should not only be to prevent the deterioration of ecosystems but also to minimize and prevent problems that seriously threaten the lives of species at alarming levels (Valderrama-Hernández et al., 2017). Providing environmental education for students affects their behavior later in their lives (Özcan & Demirel, 2019). Li (2018) found that environmental education for university students, which included the study of revisions of environmental protection laws, created a great difference in their awareness of the environment and their attitudes toward it. Çiftçi and Kayaer (2022) stated in a study they conducted with university students that environmental education is a way to increase environmental awareness. Irmak-Kazazoğlu (2020) determined that attitudes towards the environment differ according to gender, family education level and environmental education. Yıldız et al. (2021) pointed out that there is an increase in the attitudes of environmental education university students towards the environment and environmental problems. Bülbül and Yılmaz (2019) concluded that university students consider their civic duties and responsibilities conscious in the focus of environmental education and environment, raise awareness of their environment, take environmental education and inform the people around them about nature, and at the same time protect the environment and are sensitive to the environment. Ardoin et al. (2020) stated in their systematic review of environmental education that many environmental issues have cognitive and affective dimensions. However, these studies did not sufficiently examine the change in the mental structure of pre-service university students before and after environmental education. Since pre-service university students are potential teachers in the future, they should be equipped with environmental education. Therefore, teachers must be environmentally conscious in order to be role models for students. As stated in Turkey for the teaching profession's general qualifications, "a teacher is sensitive to the protection of historical and cultural heritage within a natural environment" (Ministry of National Education [MoNE], 2017, p. 23). It is important that teacher candidates receive environmental education and that mental models be identified in order for teachers to be able to pass on the knowledge that they have to future generations.

Universities, which are among the most important institutions where social change and development take place, are poised to oversee great changes and expectations in economic, social, educational, technological, and environmental fields. Universities are also expected to respond flexibly to all humanitarian demands (Tufaner et al., 2020). The focus of environmental education programs in higher education has been to ensure that attitudes toward the environment change positively by increasing students' knowledge about the environment (Pooley & O'Connor, 2000). However, it is not possible to say that basic ecological knowledge given within the scope of environmental education always improves environmental awareness and related behavior patterns in individuals (Schmidt, 2007). The concept of environmental education is not only related to knowledge; it is also about values, attitudes, ethics, and actions (Davis, 1998), and

higher education institutions are responsible for producing individuals who have the necessary knowledge, skills, and values that will contribute to the improvement of the quality of life in global society (Corcoran, 2004). It is thought that the behaviors and attitudes of teacher candidates acquired through environmental education courses and the wealth of knowledge that they accumulate will affect the environmental education that they later provide to their own students (Öztürk & Erten, 2020). However, the effect of environmental education courses applied in higher education on mental structures has not been studied sufficiently.

Theoretical Background

Mental models or mental images are personal and intrinsic representations of external reality that people build to make sense of the world (Greca & Moreira, 2000). A mental structure is a special kind of mental representation of beliefs, thoughts, or events produced by individuals as a result of cognitive processes (Harrison & Treagust, 2000). Although mental models are incomplete, inconsistent, and even contradictory (Norman, 1983; Greca & Moreira, 2000), they mediate between reality and our minds and they help us filter, organize, and understand new information. Each student forms different mental models while attending science classes as they have different cultural, educational, and personal experiences (Glynn & Duit, 1995). To a certain extent, science learning requires students to think about their existing mental models and create new conceptual models (Glynn & Duit, 1995; Mintzes et al., 1998; Greca & Moreira, 2000; Libarkin et al., 2003). This modeling process depends on the complexity of the current mental models of students (Libarkin et al., 2003). Well-developed and organized mental models provide students with new information for their existing models, while less-developed mental models can easily be replaced depending on new experiences (Libarkin et al., 2003). According to Hanke (2008), who stated that the learning process is also a process of mental model construction, this process consists of the following stages: "(1) The process of mental model construction begins with new knowledge or a phenomenon that causes a mental imbalance. (2) Existing knowledge must be used to make the new situation clear. (3) Research must be performed in order to learn more. (4) The new situation must be combined with the available knowledge in a mental model and the details of this mental model must be developed until the new information becomes credible."

Research on students' concepts has been recognized as a fundamental concern for science education, especially after Ausubel developed the idea that prior knowledge affects the learning of scientific knowledge (Ausubel, 1963). Although we know that it is important to understand students' prior knowledge and misconceptions, it is difficult to investigate students' mental models about complex and abstract concepts. (Chang, 2007). A modern theory of conceptual change framework suggests that students need to increase, recategorize and reorganize their cognitive structures to reach a more

scientific understanding (Vosniadou, 2013). Cognitive structures are part of long-term memory and are accessed by working memory as mental models to address a problem (Doyle et al, 2008). It is possible to find many studies in the literature showing that mental models cause conceptual change (Gadgil et al. 2012; Bergan-Roller et al, 2020). The study of conceptual change examines misconceptions and their persistence in mental models (Duit et al., 2013). Palmunen et al. (2021) show that the change in students' mental models is related to adding new information and changing the misconceptions in existing information. There are studies showing that exemplary activities in environmental education contribute to students' conceptual change and mental models (Reinfried, 2006). These studies focused on conceptual change through issues such as water consumption and sustainability (Benninghaus et al., 2018), regional floods (Bosschaart et al., 2015), and climate change (Deisenrieder et al., 2022). However, in conceptual change, the environment concept was not adequately explained through holistic and long-term mental models. Today, in environments of formal and non-formal environmental education, the processes of changing the concepts, thoughts, and attitudes of learners towards the environment in a sustainable way should be examined (Denis et al, 2015).

Importance of Study

This research is important not only for pre-service teachers, but also for all stakeholders in the education system. Because research shows that pre-service teachers' knowledge of science-related content has both direct and indirect effects on classroom practices (Subramaniam & Esprivalo Harrell, 2013). Moreover, pre-service teachers who have more content knowledge tend to help students more to construct scientifically accepted knowledge (Gumala et al., 2019). This information can play an important role in determining education policies, organizing curricula and designing teacher training programmes. How models of concepts are developed in the minds of students in a classroom environment in higher education is an important question. Identifying the mental models of students can give us an idea of the extent to which a concept has been understood (Çiltaş & Işık, 2012). Inside a classroom environment, teachers or lecturers can measure the level to which in-class practices affect students' mental models in higher education. It is important to learn how to conduct interventions in a way that will help students review and eventually develop their current mental models with a deeper and more systemic understanding of the environment (Iliopoulou, 2016). Longitudinal studies of students developing their mental models are also useful in determining the effect of experience and education on students' conceptualization of the environment (Shepardson et al., 2007). Since mental models are personal representations of the concepts in the learner's mind (Coll & Treagust, 2003), eliminating the student's misconceptions about a subject will enable the mental models to turn into scientifically consistent information, that is, support them to create conceptual models (Ayvacı et al,

2018). Research in environmental education tends to focus less on students' factual knowledge of environmental issues, environmental attitudes, and behaviors, and less on students' environmental concepts; that is, while there are many studies investigating students' concepts of environmental phenomena, events, and topics, there are few studies that specifically examine how students conceptualize the environment (Shepardson et al., 2007; Petrou & Korfiatis, 2022). The aim of the study was to gain more insight into undergraduate students' understanding of the "environment" by investigating their underlying mental models and exploring implications for the teaching and learning of this concept. Research is to examine the conceptual change in mental structures of teacher candidates before and after a course on the environment in higher education. For this purpose, answers to the following sub-problems were sought:

"How do teacher candidates perceive their environmental education through the lens of their pre-application and post-application results in word association tests?"

"How do teacher candidates perceive their environmental education through the lens of their pre-application and post-application results in metaphors?"

"How do teacher candidates perceive their environmental education through the lens of their pre-application and post-application results in drawings?"

Method

A case study approach, as one of the qualitative research methods, was used in this research. Qualitative research methods are preferred for understanding the experiences of participants and analyzing them carefully. The case study approach is to conduct an in-depth examination of a current issue, phenomenon, or situation in a real-life environment by focusing on the individual or group. In addition, in these studies, a special subject is associated with more than one source of evidence and da-ta in a holistic framework. In order for the data to test and support each other, the data collection needs to be diversified (Merriam, 2013; Creswell, 2016). In the research, a holistic single-case design was preferred over case studies. This design aims to determine the status of a group on a topic by using different data sources (Ekiz, 2003; Yıldırım & Şimşek, 2016). The steps of the planning process in the case study are given below.

Characteristics of the Region and Participants

There are 209 universities in Turkey, 131 of which are state universities while 78 are foundation universities. Of the total 209 universities, 93 have education faculties (Higher Education Statistics, 2022). This research was conducted in the education faculty of a state university located in Turkey's Eastern Anatolia region. This region is socioeconomically disadvantaged compared to the other regions of Turkey (Lynn et al.,

2015). People in the Eastern Anatolia region generally sustain themselves through agriculture and animal husbandry. The students attending the education faculty of the university where this study was conducted are generally from families from the Eastern Anatolia region. The success ranking of the university can be described as low to medium between 2017-2022 (University Ranking by Academic Performance [URAP], 2022). Courses in the teaching department of the education faculty are divided into three categories: field education courses, professional teaching knowledge courses, and general culture courses. According to the "Teacher Training Undergraduate Programs", which was updated in 2018, the Environmental education course is a field education course (Council of Higher Education [CoHE], 2022). Environmental education is a compulsory course in the education faculty where the research is conducted.

The participants of the research included 36 students studying in the classroom teaching department of the education faculty of this state university. Of those 36 participants, 55% (n=20) were female students and 45% (n=16) were male. None of the participants had ever taken an environmental education course before. The convenience sampling method, as a type of non-probability sampling method, was used to determine the research sample. In this sampling method, the researcher selects a situation that is easy to access. This accelerates the research and makes it more practical. Among the other reasons for using this sampling method, it is also cost-effective (Yıldırım & Şimşek, 2016). This sampling method allows in-depth and detailed studies to be conducted in situations that are rich in information (Büyüköztürk et al., 2019). The convenience sampling method is known as the most widely used sampling strategy because it provides the opportunity to conduct fast and useful research (Patton, 2018).

Ethical and Data Collection Process of the Study

Ethical process; ethical permission for the research was obtained from the university where the research was conducted. Participation was provided on a voluntary basis throughout the research process. There were 40 students in the classroom teaching department and 36 of those students participated in the research process on a voluntary basis.

Data collection process; word association test, metaphor, and drawing techniques were used to collect data in this research. A four-part booklet was prepared accordingly. The first part contained text for the participants about the purpose, scope, and features of the research together with a reminder that participation was voluntary. Participants were asked to note their gender and whether they had taken an environmental education course before. In the second part, there was a word association test consisting of five words and one sentence. Participants were given 40 seconds to write associated words and 20 seconds to form a sentence. In the third part, participants were asked to complete a metaphor and provide an explanation of their choice. In the fourth part, it was

requested that participants draw a picture related to the concept of "environment." There was no time limit for the metaphor and drawing parts. The entire application took approximately 30 minutes.

Data Collection Tools and Data Analysis

Drawings, interviews, tests, scales, surveys (Ültay et al., 2017) and metaphors (Sözcü et al., 2016) are used to determine mental structures. The data collection tools used in the present research were a word association test, metaphors, and drawings. These techniques are also frequently used to determine mental structures. They have been used for the in-depth examination of situations that exist due to the nature of qualitative research rather than generalizations and to provide opportunities to examine situations from a broad perspective. In previous research, drawing-word association tests and drawing metaphors were used in a binary way. For example, in Yoğurtçu's (2021) study, the drawing-writing techniquewas used to determine students' conceptual structures and metaphorical perceptions about "cell". Again, Polat (2013) used a word association test to determine students' knowledge about the environment. It is understood that the same or similar measurement tools have been used before in the literature (Ercan et al., 2010). In addition, the diversity of measurement tools in data collection is also important. Thus, internal validity was increased (unlike in previous studies) by using the data triangulation technique (Houser, 2015; Streubert & Carpenter, 2011). Multi-source data are more meaningful for research because multiple sources provide a more complete understanding of the studied phenomenon (Bogdan & Biklen, 1998).

Word association test

Word association tests are among the most common techniques used for resolving mental structures and the interconnections between concepts in those structures, as well as for identifying relationships between the concepts in an individual's long-term memory (Atasoy, 2004). Word association tests can reveal the concepts that students have created in their minds (Bahar et al., 1999). Thus, they can help uncover the conceptual associations that students have created in their minds about the environment and environmental concepts. In a word association test, a frequency table and conceptual networks are created in accordance with the answers, and the answers given are evaluated (Tokcan, 2015).

Table 1.

Participants' Concepts in Pre- and Post-Application Word Association Tests

Pre-application	Post-application
Word 1: Building	Word 1: Water
Word 2: Tree	Word 2: Drought
Word 3: Soil	Word 3: Rain
Word 4: Human	Word 4: Living being
Word 5: Animal	Word 5: Temperature
Sentence: The human love for high-rise buildings and concrete negatively affects the trees growing from the soil, the water that feeds the trees, and the lives of the animals that need the fruit of those trees.	Sentence: As we waste water, the amount of our resources decreases, which causes drought. When it rains less and the temperature increases, living beings are negatively impacted.

Table 1 shows an example of the findings obtained from pre- and post-application word association tests. In pre-application results, the words given by a participant were encoded as follows: buildings, trees, soil, humans, and animals. The sentence written by the participant was analyzed in order to check the words that he/she had provided. In the post-application results, the participant's words were encoded as water, drought, rain, living being, and temperature.

Metaphors

A metaphor technique was used to examine the participants' perceptions of the concept of "environment" in the present research. Metaphors, as a special language form, allow humans to express themselves implicitly (Wu, 2020). Metaphor forms can be used as data collection tools to reveal participants' perceptions of the concepts given in the forms (Kılcan, 2017). The metaphor form applied in the present work was prepared as the environment is like/similar to ... because ... Teacher candidates were asked to create an analogy about the environment and explain their reasons for choosing those analogies (Kılcan, 2017).

Table 2.

Participants' Pre- and Post-application Metaphors

Pre-application	Post-application
The environment is like the solar system. At the center are human beings, and around them are planets, satellites, and stars that affect people. All of them are combined to form the environment, because the environment is composed of all the factors that exist with or without humans.	The environment is like the human body. Just as the disruption in the functioning of one of the organs in the human body affects the whole body, the slightest disruption in the surrounding area affects the whole environment.

Table 2 shows the metaphors produced by a participant before and after the study application. In the pre-application results, it is seen that the participant thinks that the environment is like the solar system. It is also seen that the participant thinks humans are at the center of the solar system. In the post-application results, the same participant thinks the environment is like the human body and that any problem in a local environment can damage the whole system, as in the human body.

Drawings

Participants were asked to make a drawing for the purpose of understanding their perceptions of the concept of "environment." In many studies, it has been stated that the drawings that children make are powerful tools in analyzing their perceptions and images of specific subjects (Rodari, 2007). It is also stated that it is possible to see participants' internal worlds, feelings, real thoughts, and desires within a visual structure through their drawings (Özsoy & Ahi, 2014).

Figure 1.

Pre-Application (a) and Post-Application (b) Drawings of a Participant

(a) (b)

In the data analysis, the categories obtained by Özsoy (2012) were used, which are environment, people, animals, plants, abiotic items, buildings/vehicles, and garbage. Figure 1 shows a participant's pre- and post-application drawings. The participant drew buildings, flowers, trees, birds, rabbits, cows, cats, mountains, and the sun before the application. In the post-application drawing, a dirty environment is seen. It was observed that participants used the concepts of people, trees, garbage, papers, bottles, flowers, rivers, and grass. In Figure 1, it is also seen that the participant depicted the environment as both clean and dirty.

Descriptive analysis was used in the analysis of the data obtained in the research. The data obtained are summarized in a descriptive analysis and interpreted under previously

determined headings. It is important for the reliability of the research to get some quotations from the data sources in the data collection process. In descriptive analysis, the aim is to arrange the data in such a way that readers can easily understand the data and use it if they wish. The steps taken in the present research were as follows: 1) creating a framework for the descriptive analysis, 2) processing the data according to the thematic framework, 3) describing the findings, 4) interpreting the findings (Altunışık et al., 2010, p. 322). In this context, participant citations were examined by field experts. The codes determined as a result of the examination were placed in the appropriate categories by consensus. Thus, a suitable framework for descriptive analysis was created. Within the scope of this framework, the coding on the quotations is given (underlined) and interpreted. In this context, the findings were designed and presented with a thematic relationship in the study. The consensus was reached at all of these stages. Concept maps were created using the Concept MindMup program for the words obtained from the analyzes and pre-and post-applications. These maps are given as an indicator of the changes in the mental structures of the participants before and after the application.

Validity and Reliability

Interviews were conducted with the participants to ensure the validity of the research and the participants were asked to explain their drawings about the concept of "environment" (these interviews were made as conversations after the research was completed and were not recorded). Thus, the findings obtained from each participant were examined comparatively in terms of the gains and the concepts of the environmental education program. The conceptual framework for the data collection was taken as a guide. In the study, it was aimed at increasing the validity by providing data diversity. The diversity of data collection in this study provides this. The adequacy of the working time also increases its validity. As a matter of fact, data collected from studies lasting between 6 and 8 weeks increases the validity of the research. Presenting the citations of the participants as they also affect the validity. Apart from these, the analysis of the quotations by taking expert opinions and reaching a consensus also increases the reliability (two academicians with a Ph.D. in Science Education). The reliability of the research was determined using the formula of Miles and Huberman (1994): Reliability = Consensus / Consensus + Disagreement × 100. The consistency between the codes made by the experts was determined to be 93% in total. If the percentage of reliability is found to be over 70%, the research should be considered reliable (Miles & Huberman, 1994).

Table 3 illustrates the research process. Before the application, the word association test, metaphor technique, and drawings were used to determine the participants' mental structures regarding the environment. In the course of the application, the researcher spent 12 weeks teaching the participants about the common characteristics of living beings, the classification of living beings, community ecology, living beings and energy,

environmental problems, environmental pollution and solutions, energy sources and recycling, biodiversity, environmental literacy, environmental pollution in teaching programs, methods and techniques used in environmental education, and out-of-school learning environments in environmental education. The course was taught using the narrative-based technique and the question-and-answer teaching technique.

Table 3.

Research Process

Weeks	Subject	Explanation
Pre	Data collection tools	Word association test, Metaphor, Drawing
1	General characteristics of the living creatures	It was ensured that the participant got to know the living thing and learn about its characteristics. The similar, common and different characteristics of living things were comprehended.
2	Classification of living beings	It is provided to classify living things according to their similar and common characteristics and to learn the general characteristics of these classes.
3	Ecological concepts	It is provided to define ecology, to learn the concepts in ecology and to understand the relationship between them.
4	Community ecology, living creatures, and energy	Recognizing living things in ecologies, learning their characteristics and nutritional relations, defining energy and how energy transfer takes place are comprehended.
5	Environmental problems	Environmental problems were defined, learned and classified.
6	Environmental pollution and solutions	Environmental pollution was defined, solution suggestions were presented and participant opinions were taken.
7	Energy resources and recycling	Energy sources and renewable energies are defined and participatory ideas and sample applications are explained.
8	Biological diversity	Biodiversity is defined, examples from Turkey and the world are given, and the diversity in the immediate environment is indicated.
9	Environmental literacy	Literacy and environmental literacy have been defined. The importance and steps of being literate are explained. Environmental media were introduced.
10	Environmental pollution in curriculum	The environmental awareness that they will convey to the students in terms of their professional development and task processes has been emphasized. Environmental gains in the curriculum were transferred and interpreted.
11	Methods and techniques in environmental education	The appropriate methods and techniques for achieving environmental education are explained and examples from the literature are given. Integrated with the participants' ideas on this subject.
12	Out-of-school learning environments in environmental education	Out-of-school learning approach, which is one of the most popular approaches in environmental education, is explained. Features and application examples are presented.
Post	Data collection tools	Word association test, Metaphor, Drawing

Findings

Findings Obtained by the Word Association Test

In this part of the research, a word association test was applied to determine the concepts in the mental structures of the participants. For understanding the concepts obtained, concept mapping was used (Figures 3 and 4). The concepts that the participants frequently expressed related to the concept of "environment" as formed in their minds are shown closer to the center in the concept maps. For example, because the concept "human" was expressed 28 times, it appears closer to the concept "environment." In contrast, the concept "flower" was repeated only twice, and so it appears further away from "environment."

Table 4.

Concepts in the Mental Structure Related to the Subject (Pre-Application)

Concept	f	%	Concept	f	%
Human	28	15	Natural Events	4	2
Tree	14	7	Lifeless	2	1
Animal	12	6	Building	2	1
Life	12	6	Child	2	1
Society	10	5	Soil	2	1
Water	10	5	Cloud	2	1
Nature	10	5	Flower	2	1
Cleanliness	10	5	Sun	2	1
Order	10	5	Dirty	2	1
Ailve	8	4	Home	2	1
Plant	6	3	Shelter	2	1
Oxygen	6	3	Value	2	1
Mountai	6	3	Season	2	1
Lifetime	6	3	Universal	2	1
Sea	4	2	Ecologival Balance	2	1
Total				182	100

Table 4 shows the pre-application mental structures of the participants before receiving environmental education concepts. The participants were observed to use the concepts of "human" (f=28), "tree" (f=14), "animal" (f=12), "life" (f=18), "nature" (f=10), "order" (f=10), "water" (f=10), "cleaning" (f=10), "society" (f=10), "living being" (f=8), "plant" (f=6), "mountain" (f=6), "oxygen" (f=6), "sea" (f=4), "ecosystem" (f=4), "forest" (f=4), "existence" (f=4), and "mentality" (f=4). The concepts of "human," "tree," and "animal" were used most frequently.

Table 5.

Concepts in the Mental Structure Related to the Subject (Post-Application)

Concept	f	%	Concept	f	%
Life	12	6	Education	2	1
Human	10	5	Dissolution	2	1
Pollution	10	5	Family	2	1
Waste	8	4	Structures	2	1
Global Warming	8	4	İnteraction	2	1
Ecosystem	8	4	Friends	2	1
Water	6	3	Peace	2	1
Plastic Waste	4	2	Plant	2	1
Animal	4	2	Grasshopper	2	1
Sun	4	2	Farmer	2	1
Nature	4	2	Baby	2	1
Clear	4	2	Atmosphere	2	1
Rain	4	2	Chain Of Cloth	2	1
Renewable Energy	4	2	Frog	2	1
Tree	4	2	Sky	2	1
Sun	4	2	Soil	2	1
Living Space	4	2	Fouling	2	1
Green	4	2	Mountain	2	1
Future	4	2	Relative	2	1
Sea	4	2	Energy	2	1
Lifeless	4	2	Items	2	1
Drought	4	2	Irregation	2	1
İgnorance	4	2	Color	2	1
Heat	4	2	Health	2	1
Presence	4	2	Snake	2	1
Poison	2	1	Organization	2	1
Compliance	2	1	World	2	1
Agriculture	2	1	Fish	2	1
System	2	1	Scrambling	2	1
Wind	2	1	Flower	2	1
Plastic	2	1	Education	2	1
Birds	2	1	Dissolution	2	1
Total				210	100

Table 5 shows the number of concept in the mental structures of the participants after the application. The participants were observed to list more concepts following the application. These primarily included the concepts of "human" (f=10), "life" (f=10), and "pollution" (f=10). Concepts such as "ecosystem" (f=8), "global warming" (f=8), and "waste" (f=8) were also used.

It was initially seen that the participants prioritized the concepts of "human," "tree," and "animal." These concepts are biotic factors that make up the environment. In the post-application results, in contrast, they highlighted the concepts of "human," "life," and "pollution." Concepts such as "ecosystem," "global warming," and "waste" were also

found in their post-application mental structures. Thus, participants had a life-oriented mental structure regarding the environment before the application, while after the application, they also had concepts in mental structures pertaining to pollution, global warming, and waste. It is thought that the participants acquired life-oriented knowledge through situations such as TV, magazines, or hidden learning elements, whichever of the concepts related to the environment they came across in their daily lives. In fact, the number and variety of concepts before implementation prove this. With the application, it is seen that the participants learned new and various concepts together with environmental concepts, knowledge structure, and the structuring of knowledge.

Findings Obtained with the Metaphor Test

In this part of the research, the conceptual changes in the mental structures of the participants are shown which are metaphors and metaphorical sentences. Results were organized into categories in order to understand the concepts obtained (Table 3). The metaphors constructed by the participants for the concept of "environment" as formed in their minds were expressed within particular categories. Results were expressed numerically as (f, %) to better understand similar metaphors.

K1: The environment is like bird sounds, because the more beautiful it is, the better it feels.

K7: The environment is like human life, because human life is shaped around the environment, the two are separate wholes, and without one, it is not possible for the other to exist.

K11: The environment is like society, because the cleanliness of the environment depends on the order in the environment. The more the social mentality falls behind, the worse the environment will be.

K15: The environment is like a box, because it includes a lot of things like society and values.

K29: The environment is like a solar system, because it not only centers around the human but also includes all the factors that are human-independent.

The pre-application metaphors provided by participants K1, K7, K11, K15, and K29 are given above. K1 saw a resemblance between the environment and a bird, with the explanation that they both make him/her feel better. K7 saw a resemblance between the environment and human life, with the explanation that the environment is shaped by humans. Therefore, humans are at the center of the environment. K11 saw a resemblance between the environment and society, as people's and society's awareness create humanity's approach to the environment. K15 stated that the environment is like a box that contains society and its values. K29 saw a resemblance between the environment and the solar system and also indicated that people are at the center of both. It can be said that the above quotations of the participants and the codes underlined in their quotations are always human in the metaphors created for the environment.

K5: The environment is like a human, because you will be rewarded as much as you give. We get as much back as the value and importance that we give to the environment.

K13: The environment is like our lungs, because we need it to breathe well. It is like our homes, because we have to keep both of them clean.

K21: The environment is like a human body, because any malfunction of one of the organs affects the whole body, and the slightest disruption in the surrounding area affects the whole environment in the same way.

K27: The environment is like existence, because the life of all living beings depends on it.

Following the application, K5 saw a resemblance between the environment and humans with the explanation that humans get back as much value and importance as they give to the environment. It was stated that we need to give importance to the environment. K13 saw a resemblance between the environment and our lungs, stating that we need the environment to survive. K21, like K13, saw a resemblance between the environment and the human body, stating that just as any malfunction of one of the organs affects the whole body, the slightest disruption in the surrounding area affects the whole environment. K27 stated that the environment is similar to existence because the continuity of life depends on it. Participants thus saw the environment as a must-have, necessary structure.

Table 6.

Participants' pre-application and post-application metaphors

Category	Pre-application Metaphors	f	%	Post-application Metaphors	f	%
Environment as an expression of life	Life (5), Bird (3), Living being (2)	10	27	Breath (3), Life (3)	6	16
Environment as an expression of importance	Oxygen (1), Air (1)	2	5	Lungs (3), Heart (1)	4	10
Environment as an expression of reflectiveness	Human (3), Society (1), Box (1), Paper (1)	6	13	Human (2), Homeland (2) Deposit (2), Existence (1), Mirror (1), Lungs (1), Lizard tail (1)	10	30
Environment as an expression of a place	Home (4), Lab (1) Room (1)	6	16	World (2), Home (3), Shopping Mall (1)	6	16
Environment as an expression of protection	Baby (2)	2	5	Tree (4), Child (2), River (2)	8	22
Environment as an expression of happiness and peace	Cloud (4), Rainbow (3), Solar system (2), Music (1)	10	27	Sun (1), Peace (1)	2	11

Table 6 shows the pre- and post-application metaphors created by the participants. There were 36 metaphors created by the participants before and after the application. The environment was divided into six metaphorical categories, which are "Environment as an expression of life," "Environment as an expression of importance," "Environment as an expression of reflectiveness," "Environment as an expression of a place," "Environment as an expression of protection," and "Environment as an expression of happiness and peace." It was seen that the participants' pre-application metaphors were concentrated within two main categories: "Environment as an expression of life," with metaphors of Life (f=5), Bird (f=3), and Living being (f=2), and "Environment as an expression of happiness and peace," with metaphors of Cloud (f=4), Rainbow (f=3), Solar system (f=2), and Music (f=1). It can be said that metaphors that affect people emotionally are formed in the categorization of metaphors produced. These categories and participant metaphors reflect a more self-centered perspective, where in the environment exists for life and provides happiness and peace. The post-application metaphors were particularly concentrated within the categories of "Environment as an expression of reflectiveness" with metaphors of Human (f=2), Homeland (f=2), Deposit (f=2), Existence (f=1), Mirror (f=1), Lungs (f=1), and Lizard tail (f=1) and "Environment as an expression of protection" with metaphors of Tree (f=4), Child (f=2), and River (f=2). Here, the environment is metaphorized as entities such as protected (child, living thing, etc.), sacred (homeland, human, etc.), and reflective (mirror). These results showed that after the application, the participants thought the environment was sacred and reflective and should be protected.

When the pre-application metaphors produced by the participants are examined, it is seen that they thought that the environment was for sustaining life and that it provided happiness and peace. Turning to the post-application metaphors, it is seen that the participants' concepts in mental structures were related to the protection of the environment, seeing the environment as a reflective tool. Therefore, the participants expressed themselves as the center and focus of the environment in their pre-application metaphors, while in the post-application metaphors they presented themselves as a part of the environment.

Findings from the Drawing Test

In this part of the research, the drawing technique was used to determine the concepts in the mental structures of the participants. The concepts used in each of the drawings were noted and listed according to frequency. They were then thematically classified according to themes of "environment," "human," "plant," "animal," "abiotic elements," and "buildings/vehicles" (Table 7).

The pre- and post-application drawings of teacher candidates were compared. Before the application, drawings of clean environments (f=30) were more common than

drawings of dirty environments (f=6). After the application, drawings of dirty environments (f=20) were more common than drawings of clean environments (f=16). This finding shows that the participants thought more about environmental problems after receiving environmental education. It was observed that the students produced 167 concepts after the application in comparison to 140 concepts before the application. These results were divided into six categories: "human," "plant," "animal," "abiotic items," "buildings/vehicles," and "garbage." Participants produced more concepts after the application. Before the application, the four concepts most frequently produced by the students were "trees" (f=17), "home" (f=12), "human" (f=18), and "bird" (f=11). After the application, the concepts of "tree" (f=21), "human" (f=15), "the sun" (f=13), "cloud" (f=11), and "home" (f=11) were offered by the students most often. While participants perceived the environment as oriented toward humans, plants, and animals in their pre-application answers, they perceived it as being related to abiotic elements, buildings/vehicles, and garbage after the application. This may be due to the fact that while they had life-oriented concepts in mental structures before the application, they started to perceive the environment as a contaminated structure as a result of the environmental education.

Table 7.

Pre-application and post-application drawings of teacher candidates who received environmental education

Pre-application			Post-application		
Environment					
	f	*%*		*f*	*%*
Clean	30	83	Clean	16	45
Dirty	6	17	Dirty	20	55
Total	36	100	Total	36	100
Living Beings					
Human	18	13	Human	15	8
Plant					
Tree	17	12	Tree	21	12
Flower	8	5	Flower	3	1
Apple	3	2			
Grass	1	0.5			
Total	29	20		24	14
Animal					
Bird	11	7	Fish	7	4
Dog	2	1	Bird	4	2
Animal	2	1	Seahorse	2	1
Rabbit	2	1	Octopus	2	1
Cat	1	0.5			
Giraffe	1	0.5			
Snake	1	0.5			
Total	20	14		15	8
Abiotic Elements					

Sun	9	6	Sun	13	7
Road	8	5	Cloud	11	6
Mountain	6	4	Mountain	9	5
Cloud	5	3	Flower	7	4
Forest	5	3	Stream	5	3
River	3	2	Grass	3	1
Stream	2	1	Branch	3	1
Rain	2	1	Sea	3	1
Water	1	0.5	Soil	2	1
Soil	1	0.5	Moss	1	0.5
			Rain	1	0.5
Total	42	30		58	34
Buildings/Vehicles					
Home	12	8	Home	11	6
Car	3	2	Car	7	4
Building	2	1	Bridge	4	2
Playground	2	1	Way	4	2
Mosque	1	0.5	Building	4	2
Fountain	1	0.5	Bank	2	1
Helicopter	1	0.5	Playground	2	1
			Parking area	2	1
Total	22	15		36	21
Garbage					
Trash can	4	2	Garbage	5	2
Garbage	2	1	Acid Rain	3	1
			Plastic	3	1
			Carrier bag	3	1
			Bottle	3	1
			Nuclear Power Plant	2	1
Total	6	4		19	11
Final Total	**140**	**100**	**Final Total**	**167**	**100**

Table 7 allows for a comparison of the pre- and post-application drawings of teacher candidates who received environmental education. Before the application, more drawings reflected a clean environment (f=30) than a dirty environment (f=6). After the application, more drawings portrayed a dirty environment (f=20) than a clean environment (f=16). These findings show that the participants began thinking more about environmental problems. It was also observed that the students produced 167 concepts after the application compared to only 140 concepts before the application. Those concepts, as described above, were divided into six categories of "living beings," "plant," "animal," "abiotic items," "buildings/vehicles," and "garbage."

Differences can be seen in the pre- and post-application thematic analysis regarding the participants' drawings of the concept of "environment." Before the application, their drawings largely portrayed a clean environment. After the application, however,

participants depicted a dirty environment. Before the application, participants' drawings were oriented toward humans, plants, and animals, but after receiving environmental education, they produced drawings oriented toward abiotic elements, buildings/vehicles, and garbage. It can be inferred that they learned to perceive the environment as it is, as a contaminated structure, while before the application they had living-oriented mental structures.

Results and Discussion

In this study, which examines the conceptual changes in the minds of teacher candidates regarding the concept of "environment", word association tests, metaphors and drawings were used to analyze the mental conceptual changes of students before and after receiving environmental education at the university level. The high total frequencies of the responses given by the participants in the word association tests provide information about the concept of "environment" in the mental structures of the teacher candidates who participated in the research (Özata Yücel & Özkan, 2015). When the concepts that participants created in the word association test before receiving environmental education are considered, it is clear that they had concepts of "human," "tree," and "animal" at the forefront. These are some of the biotic factors that constitute the environment. After the application, however, the concepts of "human," "life," and "pollution" came to the forefront. It was also observed that concepts such as "ecosystems," "global warming," and "waste" were present in their mental structures. The participants had life-oriented concepts in mental structures regarding the environment before the application but had concepts in mental structures involving pollution, global warming, and garbage after the application. These findings show that conceptual changes occurred in the mental structures of these pre-service teachers with the environmental education they received. It is possible to say that the environmental education caused them to think about environmental problems. As McKibben (2015) stated, environmental problems such as drying rivers, deforestation, water pollution, climate change, toxic wastes, decreased biodiversity, and acid rains drive people to review their attitudes, behaviors, duties, and responsibilities toward the environment and nature by questioning their relationships with nature. When the participants' metaphors were examined, it was observed that they often produced metaphors involving life, clouds, and home before the application while they produced metaphors about breath, lungs, and trees after the application. Similar research was conducted by Aydın (2011), who concluded that students in education and technical faculties often produced metaphors of home, children, and family. Meral et al. (2016) stated that the metaphors of social studies teacher candidates for the concept of "environment" entailed family, mothers, and homes. Examining these previous studies, it is seen that the students' metaphors, except for "home," are not generally similar to each other. This situation reveals that students

studying in different faculties or departments experience different conceptual changes in their mental structures based on different experiences and different prior knowledge. Similarly, Hoban et al., (2011) stated that individuals focus primarily on concrete situations for environmental issues and create mental schemas for concrete concepts.

When the pre-application metaphors produced by the participants were examined, they were seen to reflect a self-centered perspective, whereby the environment is for life, and provides happiness and peace. Humans were portrayed as being at the center of the environment by these students, with a common human-centered perception, as in the example of "The environment is the natural habitat for humans," rather than humans being just one element that interacts with other elements of the environment (Desjean-Perrotta et al., 2008; Moseley et al., 2010; Özata Yücel & Özkan, 2015).

After the application, the participants saw the environment as a reflective tool, and they had gained a mentality for protecting it. Therefore, it can be said that the participants had a conceptual scheme in their minds that saw themselves as the center and focal point of the environment before they received environmental education. It is clear that after receiving this training, conceptual changes have occurred in their mental schemas and they see themselves as a part of the environment. These findings show that the perceptions of teacher candidates can be shaped through environmental education based on the possible consequences of environmental problems (Kızılay, 2020). This conclusion is consistent with the results of the word association test. While humans were first considered to be the center of the environment with a life-oriented mentality, the environment was subsequently considered as a whole with abiotic and non-living elements and a mentality oriented toward taking environmental problems into consideration. It is clear from previous studies that drawings can be used to understand the mental structures for the concept of "environment" at various age levels (Moseley et al., 2010; Judson, 2011; Pan & Liu, 2018). For example, such conceptual change in mental structures was examined through drawings with preschoolers (Ahi & Alisinanoğlu, 2016), primary schoolers (Pınar & Yakışan, 2017), middle schoolers (Taş, 2016; Özcan & Demirel, 2019), secondary schoolers (Shepardson et al., 2007), and university students (Moseley et al., 2010). Shepardson (2005) concluded that forests and trees were dominant in students' drawings. Similar results were reached in the present research. When the post-application drawings of the participants were examined, it was seen that they depicted the environment as dirty. In pre-application drawings, participants portrayed the environment as oriented toward humans, plants, and animals, while after the application they portrayed it as a whole with abiotic elements, buildings/vehicles, and garbage.

Moseley et al. (2010) found that 66.4% of teacher candidates made irrelevant drawings with biotic elements on their own, while 57% of drawings had abiotic elements. In this research, this percentage decreased from 47% before the application to 30% after the

application for biotic elements, while it decreased from 34% before the application to 30% after the application for abiotic elements. Accordingly, the drawings shifted in content to become more oriented toward buildings/vehicles and garbage. This shows that the participants dissected the elements of nature, rather than seeing them as a whole, and understood that the environment has been corrupted and polluted, with the integrity of the concept being lost with human activities (Moseley et al., 2010). The people in the drawings were often depicted as polluting the environment or trying to clean up the polluted environment. As also observed by Özsoy (2012), these findings reveal that people are not only affected by environmental pollution; they also think that human activities are a factor that pollutes the environment. The results obtained with the data collection tools in these studies are consistent with each other. Although more concepts were produced with word association tests compared to metaphors and drawings, the drawing technique is thought to be a more understandable practice in demonstrating conceptual concepts in the mental structures of participants. With a holistic view of the environment, peers, teachers, parents, and social interactions can all focus on how concepts change in mental models about the environment. Environment-related education is increasingly important in higher education (Liu & Lin, 2015). Graduates of secondary and higher education institutions must demonstrate not only assimilation of basic environmental information but also independent deepening, enrichment, systematization, and application under varying conditions (Jefferson et al., 2017). Teacher education programs are challenged to develop curricula and programs that support pre-service teachers' development of a conceptual model of the environment that integrates humans with the abiotic and biotic factors within the environment (Moseley et al., 2010). The findings of the current research show that as a result of environmental education, participants experience an environmentally-centered conceptual change in their minds rather than a self-centered environmental view. In general, when the pre-test and post-test data of the participants are compared, it can be said that a conceptual change has taken place in their minds. The mental conceptual structures of the participants for the concept of the environment have changed from being self-centered to being a part of the environment. It is assumed that 12-week training in environmental education provides these changes. In addition, these changes were determined by the concept association test, metaphor, and drawing-based data collection tools. It is thought that the participation of the participants in the environmental education process strengthens this. It is thought that the suggestions are given within the scope of the research purpose and the consistency of the results will contribute to the field. Environmental education seems to contribute to the development of conceptual change in mental models; in the present work, the environmental education of teacher candidates in higher education allowed them to develop new perspectives on the environment. As teacher candidates will work as teachers in the future, they have the power to influence the next generation. It was understood in the course of this training that human beings harm the environment more than other biotic factors. Therefore, it is

thought that these teacher candidates will play important future roles in producing environmentally conscious students and reducing the negative impact of people. Environmental education should be implemented in all departments of higher education because it should focus not only on knowledge and skills related to advanced professions but also on social values and sustainability. Increasing the number of individuals in higher education who are sensitive to the environment and who believe in sustainability will facilitate the production of social solutions for environmental problems.

Recommendations

Building on the present research, the socioeconomic level, age, gender, education, and department of participating candidates can be compared with the methods of word association, metaphors, and drawing in order to better understand the conceptual change in mental structures of students who have received or have not received environmental education.

It is clear that the comparisons of previous studies have been largely built upon quantitative data. Environmental education processes should be compared according to both quantitative and qualitative data in the future to make the findings more valuable.

In the present research, participants received environmental education for 14 weeks. In this work, the process of environmental education was carried out using traditional methods of education. Future research could be supported by enriched and student-centered applications. The contribution of different educational methods to conceptual change in mental structures can also be examined in future research.

Limitations and Assumptions

The research is limited to the voluntary participation of 36 teacher candidates. It is assumed that the participants responded to the data collection tools in an objective way without worry or expectation. In the research, conceptual changes in the minds of the participants were discussed based on the interpretation of the data obtained from these data collection tools. In the pre-test results of the research, it was determined that the participants had conceptual structures about the environment and environmental education, they formed some conceptual relations and had a certain knowledge. Although they thought of themselves as the center of these conceptual structures and relations, this research is limited to developing and changing the existing knowledge of the participants and the conceptual structure-relationships. Considering the pre-application and post-application knowledge of the participants, it is assumed that they construct the knowledge. The visible changes when comparing the pre-application responses with the post-implementation responses prove this.

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Genişletilmiş Türkçe Özet

Çevre, insanların yaşamları boyunca etkileşim içinde oldukları çok boyutlu bir yaşam alanıdır (Torunoğlu, 2013). Ancak günümüzde, nehirlerin kuruması, ormansızlaşma, su kaynaklarının kirlenmesi, iklim değişikliği, zehirli atıklar, biyoçeşitlilik kaybı ve asit yağmurları gibi çevre sorunları, insanları çevreleri ve çevrelerine yönelik tutumlarını gözden geçirmeye zorlamıştır (McKibben, 2015). Özellikle hızlı nüfus artışı ve teknolojik gelişmeler hem insan sağlığını hem de doğayı tehdit eden birçok çevresel sorunla karşı karşıya bırakmıştır (Diamond, 2011; Gunder-son, 2014). Bu sorunların temel kaynağı ise insan davranışlarıdır (Koger, 2013). Bu nedenle, insanlar ve çevre arasındaki ilişki artık daha da önemlidir, çünkü insanların doğadan ihtiyaçları her geçen gün artmaktadır. Sanayileşme ve nüfus artışının yarattığı sorunlar, insan sağlığını olumsuz etkilemektedir. Bu nedenle, çevre sorunlarını azaltmanın temel yolu eğitimdir (Miser, 2019). Eğitim, insan yaşamının ayrılmaz bir parçasıdır ve pratik deneyim kazanmamızı sağlar. İnsanlar arasında eğitime ihtiyaç duyan tek canlı organizma insanlardır. Bu nedenle, insanların ihtiyaç duyduğu eğitim sürekli olarak geliştirilmeli ve yeniliklere açık olmalıdır. Doğaya uygun bir eğitim, gelecek nesillerin daha mutlu ve çevre dostu olmalarını sağlayabilir (Bartlett ve Burton, 2014). Çevre eğitimi, insanlara çevre ve çevre sorunları hakkında bilgi kazandırma, çevre sorunlarıyla başa çıkma becerileri ve uzmanlık geliştirme, bilinçli kararlar alma ve çevresel sorunlara çözümler bulma motivasyonunu teşvik eden bir süreçtir (Ryan ve diğerleri, 2020). Özellikle son yıllarda çevre eğitimi, çevre sorunlarına kalıcı çözümler sunma konusundaki önemini artırmıştır. Bu bağlamda, çevre eğitimi, çevre ile ilgili birçok beceriyi, tutumu, davranışı ve bilgiyi geliştirmeye yardımcı olan bir öğrenme sürecidir (Sola, 2014). Çevreye duyarlı bireyler, doğanın korunmasının yanı sıra geri dönüşüm gibi çevresel önlemlerin de önemini kavramışlardır (Miranda & Blanco, 2009). Ancak, çevre eğitiminin etkili bir şekilde uygulanması ve çevre bilincinin geliştirilmesi için eğitim kurumlarının, özellikle üniversitelerin, önemli bir rol oynaması gerekmektedir. Bu nedenle, bu çalışmanın amacı, öğretmen adaylarının çevre eğitimi derslerinin öncesi ve sonrasındaki zihinsel yapılarını incelemektir. Çalışmanın alt problemleri, öğrencilerin kelime ilişkilendirme testleri sonuçlarını, metaforları ve çizimlerini uygulama öncesi ve sonrası olarak karşılaştırmayı amaçlanmıştır.

Bu araştırmada, nitel araştırma yöntemlerinden biri olan durum çalışması yaklaşımını kullanmıştır. Katılımcılar, bir devlet üniversitesinin eğitim fakültesinde sınıf öğretmenliği bölümünde öğrenim gören 36 öğrenciden oluşmaktadır. Araştırmanın yapıldığı üniversiteden etik izin alınmış ve katılımcılar araştırmaya gönüllülük esasına göre katılmıştır. Veri toplama yöntemleri olarak kelime ilişkilendirme testi, metaforlar ve çizimler kullanılmıştır. Veri analizi betimsel analiz kullanılarak yapılmıştır. Bulgular, tematik çerçeveye göre işlenmiş ve yorumlanmıştır. Araştırmanın geçerliliği katılımcılarla yapılan görüşmelerle sağlanmış ve güvenilirlik % 93 olarak hesaplanmıştır.

Çalışmanın sonuçlarına göre, öğrencilerin zihinsel yapılarında önemli değişiklikler gözlemlenmiştir. Kelime çağrışım testi sonuçlarına göre, çevre kavramı öncesi zihinsel

yapılarında katılımcılar sıklıkla "insan," "ağaç," ve "hayvan" gibi biyotik unsurlarla ilişkilendirilirken, çevresel eğitim müdahalesi sonrasında bu ilişkilendirilen terimler "insan," "hayat," ve "kirlilik" gibi kavramlara kaymıştır. Bu değişim, çevresel eğitimin katılımcıların çevresel sorunlar hakkında daha derin düşünmelerine yol açtığını göstermektedir. Metafor analizi sonuçları, öğrencilerin çevre kavramını önceki olarak insan merkezli bir perspektifle gördüklerini, ancak çevresel eğitimi takiben çevreyi bir yansıtma aracı olarak gördüklerini göstermektedir. Bu, çevresel eğitimin katılımcıların kendilerini çevrenin ayrılmaz bir parçası olarak görmelerine katkıda bulunduğunu yansıtmaktadır. Çizim testi sonuçları, öğrencilerin çevreyi önceki olarak temiz bir şekilde tasvir ettiklerini, ancak çevresel eğitim sonrasında kirli bir çevreyi daha sık tasvir ettiklerini göstermektedir. Ayrıca, çevresel eğitimi takiben katılımcıların çevreyle ilgili daha fazla kavram ürettikleri ve bu kavramların öncelikle abiyotik unsurlar, binalar/araçlar ve çöpler gibi faktörlere odaklandığını göstermektedir. Bulgular, çevresel eğitimin öğrencilerin zihinsel yapıları üzerinde önemli etkileri olduğunu göstermektedir. Özellikle çevre kavramını daha geniş bir perspektiften anlamalarına ve çevresel sorunlara daha fazla dikkat etmelerine katkıda bulunmuştur. Bulgular, çevre eğitiminin önemini göstermekte ve çevresel farkındalığın artırılması için eğitim programlarının çevre odaklı bileşenlerle güçlendirilmesinin gerekliliğini göstermektedir. Araştırma, üniversite düzeyinde çevre eğitimi alan öğretmen adaylarının "çevre" kavramına yönelik zihinsel değiştiğini göstermektedir.

Çalışma, önceki çalışmaların sonuçları ile uyumlu bir şekilde, yükseköğretim müfredatına çevre eğitimini dahil etmenin önemini vurgulamakta ve özellikle öğretmen adayları arasında çevreyi daha iyi anlamalarını ve çevresel sorunları ele almalarını sağlayacak bir bütüncül kavram modeli geliştirmeye odaklanması gerektiğini göstermektedir. Çalışma, gelecekteki araştırmalar için birkaç yol önermektedir, bunlar arasında çevre eğitimi alan ve almayan öğrencilerin kavramsal yapılarındaki değişimi anlamak için kelime çağrışımı, metaforlar ve çizimler yöntemleriyle farklı sosyo-ekonomik düzeyler, yaş grupları, cinsiyetler ve akademik bölümler arasında karşılaştırmalar yapılabilir. Ayrıca, gelecekteki araştırmalar farklı ve daha öğrenci merkezli çevre eğitimi yöntemlerinin etkisini inceleyebilir. Ancak, bu çalışmanın sınırlamalarını kabul etmek önemlidir, bunlar arasında yalnızca 36 gönüllü katılımcının kullanılması ve katılımcıların veri toplama araçlarına objektif yanıtlar verdiği varsayımı bulunmaktadır. Bu araştırma, öncelikle mevcut bilgi ve kavramsal yapıdaki değişiklikleri değerlendirmeye odaklanmış ve bilgi oluşturma sürecine derinlemesine inmemiştir. Sonuç olarak, bu çalışma, çevresel eğitimin bireylerin çevre algılarını şekillendirmedeki dönüştürücü potansiyelini vurgulamakta ve özellikle gelecekteki öğretmenler arasında çevresel sorunlara yaklaşmalarını sağlayacak bilinçli bireyler yetiştirmenin önemini vurgulamaktadır.

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Authors	Contact
İsmail Dönmez	Mus Alparslan University, Turkey E-mail: i.donmez@alparslan.edu.tr
Salih Gülen	Mus Alparslan University, Turkey E-mail: s.gulen@alparslan.edu.tr.