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| Research Article / Araştırma Makalesi |

The Effect of Cooperative Learning Activities on Pre-service Teachers' Attitudes and Cognitive Perceptions towards Environmental Problems

İşbirlikli Öğrenme Etkinliklerinin Öğretmen Adaylarının Çevre Sorunlarına Yönelik Tutumlarına ve Zihinsel Algılarına Etkisi

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Keywords
1.Environmental problems
2.Cooperative learning
3.Attitude
4. Word association test
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Anahtar Kelimeler
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Abstract

Purpose: The aim of this study is to examine the effects of different methods of cooperative learning model on pre-service primary school teachers' attitudes towards environmental problems, conceptual knowledge changes and to reveal their cognitive perceptions.

Design/Methodology/Approach: The study group consists of 50 pre-service primary school teachers (30 females and 20 males) studying in the first year of the Department of Primary School Teaching at a state university. An embedded mixed design, one of the mixed research designs, was used in the research. In the quantitative part of the research, a quasi-experimental design without a control group was used. Therefore, the study group consists of two experimental groups, namely Student Teams Achievement Divisions (STAD) and Jigsaw, which are cooperative learning methods. In the qualitative part of the research, phenomenology was used. As data collection tools, the "Attitude Scale towards Environmental Problems (ASEP)," the "Environmental Problems Word Association Test (EPWAT)," and mind maps (MM) prepared by pre-service teachers were used.

Findings: According to the results obtained from the ASEP, it was determined that cooperative learning methods (STAD and Jigsaw) increased the post-test attitude scores of pre-service primary school teachers towards environmental problems compared to the pre-test scores, but this increase was not statistically significant. According to the results obtained from the EPWAT, cooperative learning methods increased pre-service teachers' conceptual knowledge and quality of concepts related to environmental problems. According to the results obtained from MM, it was determined that the pre-service teachers in the groups had perceptions about global environmental problems, types of environmental pollution and preventing environmental problems.

Highlights: It is seen that cooperative learning methods have positive effects on pre-service teachers' conceptual knowledge changes and cognitive perceptions about environmental problems. For this reason, it is emphasized that different methods of cooperative learning should be used in future research on environmental problems.

Öz

Çalışmanın amacı: Bu araştırmanın amacı, işbirlikli öğrenme modelinin farklı yöntemlerinin sınıf öğretmeni adaylarının çevre sorunlarına yönelik tutumlarına, kavramsal bilgi değişimlerine etkisini incelemek ve zihinsel algılarını ortaya koymaktır.

Materyal ve Yöntem: Araştırmanın çalışma grubunu bir devlet üniversitesinin sınıf öğretmenliği anabilim dalı birinci sınıfında öğrenim gören 50 (30 kadın ve 20 erkek) öğretmen adayı oluşturmaktadır. Araştırmada karma araştırma desenlerinden iç içe gömülü karma desen kullanılmıştır. Araştırmanın nicel kısmında kontrol grupsuz yarı deneysel desen kullanılmıştır. Bu nedenle çalışma grubu işbirlikli öğrenme yöntemlerinden Öğrenci Takımları Başarı Bölümleri (ÖTBB) ve Jigsaw olmak üzere iki deney grubundan oluşmaktadır. Araştırmanın nitel kısmında ise fenomenoloji kullanılmıştır. Veri toplama aracı olarak "Çevre Sorunlarına Yönelik Tutum Ölçeği (ÇSTÖ)", "Çevre Sorunları Kelime İlişkilendirme Testi (ÇSKİT)" ve öğretmen adayları tarafından hazırlanan zihin haritaları (ZH) kullanılmıştır.

Bulgular: Araştırmada ÇSTÖ'den elde edilen sonuçlara göre işbirlikli öğrenme yöntemlerinin sınıf öğretmeni adaylarının çevre sorunlarına yönelik son test tutum puanlarını ön test puanlarına göre artırdığı ancak bu artışın istatistiksel olarak anlamlı olmadığı belirlenmiştir. ÇSKİT'den elde edilen sonuçlara göre işbirlikli öğrenme yöntemleri, öğretmen adaylarının çevre sorunlarına ilişkin kavramsal bilgilerinin ve kavramların niteliğinin artmasını sağlamıştır. ZH'den elde edilen sonuçlara göre gruplarda yer alan öğretmen adaylarının küresel çevre sorunlarına, çevre kirlilik türlerine ve çevre sorunlarını önlemeye yönelik algıya sahip oldukları belirlenmiştir.

Önemli Vurgular: İşbirlikli öğrenme yöntemlerinin öğretmen adaylarının çevre sorunlarına yönelik kavramsal bilgi değişimlerine ve zihinsel algılarına olumlu etkilerinin olduğu görülmektedir. Bu nedenle işbirlikli öğrenmenin farklı yöntemlerinin çevre sorunlarına yönelik yapılacak araştırmalarda kullanılması vurgulanmaktadır.

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INTRODUCTION

Humanity has been in constant interaction with the environment in order to sustain its existence and meet its needs since the beginning of its existence on earth. Over time, with the increase in the population on earth, it has spread to large areas and continued this interaction wherever it went. Economic, social, and technological developments that have occurred in order to meet needs have brought along the problem of destruction of the environment and other elements in the environment; in other words, environmental problems.

Environmental problems are described as the deterioration of the natural environment caused by the pollution of the basic physical components of nature, such as air, water, and soil, as a result of improper and excessive use of natural resources (Güler and Çobanoğlu, 1997). Karabıçak and Armağan (2004) stated that people previously had a perception that the world's self-renewal capacity and environmental resources were unlimited. However, this perception turned out to be wrong as people could not meet their needs sufficiently from the environment, consumed resources rapidly, and environmental pollution reached levels that endangered human health. The behaviors that put human beings and the natural world, which is an integral part of human beings, in danger of extinction stem from the fact that people do not sufficiently comprehend the necessity of living in harmony with nature. For this reason, in order for people's sensitivity towards environmental problems to reach the desired levels, it is necessary to develop the necessary knowledge, skills, and attitudes towards the relationship between humans and the environment (Miser, 2010). This situation has led to an increase in the importance of environmental education (Erbasan & Erkol, 2020).

Environmental education is defined as a lifelong interdisciplinary approach that includes environmental problems and aims to create social awareness with knowledge, skills, attitudes, experience, and individual and social responsibilities that will prevent the formation of new problems by working towards the solution of environmental problems (Moseley, 2000). The aim of environmental education is to raise individuals with environmental awareness in order to eliminate environmental problems, provide individuals with the necessary knowledge and skills related to the protection of the environment, and develop positive behaviors and attitudes towards the environment (Deniz, 2014). Erten (2005) defined attitudes towards the environment as "all of the positive or negative attitudes and thoughts of people towards environmentally beneficial behaviors such as fears, anger, restlessness, value judgments, and readiness to solve environmental problems." Therefore, awareness, perceptions, and attitudes towards the environment and environmental problems should be developed from a very young age, and information about the environment should be provided at all levels of education. Atasoy (2019) stated that children's positive attitudes towards the environment begin to take shape in the family, continue to mature in primary and secondary education, and become the basis for the later periods of their lives, and that various characteristics such as the family's socio-cultural environment, socioeconomic status, place of residence, and cultural level also affect their environmental attitudes. In this context, teachers have great duties in raising individuals who are sensitive and conscious about the environment and environmental problems, changing negative behaviors towards the environment, and replacing them with positive, desired behaviors. Training teachers who have sufficient environmental knowledge, high sensitivity, knowledge, and experience to successfully carry out applied and theoretical environmental studies is very important in terms of achieving the purpose of environmental education (Kahyaoğlu & Özgen, 2012). Accordingly, it is important to determine and improve the attitudes of prospective teachers towards environmental problems during their undergraduate years and to investigate their knowledge levels and cognitive perceptions.

The attitudes and perceptions of society towards the environment can be better understood by evaluating their reactions to environmental problems, their level of taking environmental problems seriously, and the level of knowledge they have in their interactions with nature (Ziadat, 2010). In this respect, environmental education should be carried out in a way that can develop awareness, positive behaviors, and attitudes towards the environment in individuals, linked to daily life, from abstract to concrete, and in a permanent way, and strategies, methods, and techniques that will ensure this in teaching environments should be used (Güven, 2013). In the literature, it is stated that the conventional methods used in environmental education are not very successful in eliminating environmental problems; therefore, learning approaches in which students will take an active role in the learning process should be used in environmental education given in schools (Çimen & Yılmaz, 2014; Uyanık, 2016). One of these methods is thought to be the cooperative learning model.

Cooperative learning is a learning approach in which students form small heterogeneous groups to help each other learn in line with a common goal and actively participate in the learning-teaching process (Doymuş, Şimşek, & Şimşek, 2005). Cooperative learning differs from other methods and techniques in that students fulfill the main critical features such as face-to-face interaction, individual responsibility, and positive commitment in heterogeneous groups and contribute to the learning of both themselves and other individuals in the group. In addition, the fact that there are different methods that enable the use of the cooperative learning model in teaching environments (e.g., STAD, Learning Together, Jigsaw, etc.) facilitates the development of attitudes towards environmental problems and the determination of perception and levels of knowledge.

In light of these findings, this study aimed to reveal the effects of different methods of the cooperative learning model on pre-service primary school teachers' attitudes towards environmental problems, which are among the most important problems of today, their conceptual knowledge changes, and their cognitive perceptions. In the literature, it has been revealed that pre-service teachers' awareness of environmental problems is low, and this is directly related to their behaviors towards

environmental problems (Ünal, 2021). In addition, there are also research results showing that pre-service teachers have low knowledge levels and misconceptions about environmental problems (Aydemir & Alım, 2022; Durmuş & Kuruyer, 2023; Fettahlıoğlu, 2018; Özyürek et al., 2019; Şeker & Sert, 2022; Yalçın & Yalçın, 2018). In this context, it is thought that the study will contribute to the literature in terms of revealing the perceptions, attitudes, and conceptual knowledge changes of pre-service teachers towards environmental problems. In addition, when the literature is examined, it is seen that different methods and techniques (activity-based teaching, documentary filming activity, argumentation based learning, 5E learning model and mind maps) are used to develop perceptions, attitudes, and knowledge levels towards environmental problems (Aslan & Bulut, 2021; Efe, Yücel, & Efe, 2020; Eroğlu & Yıldırım, 2020; Güleç & Orhan, 2022; Öner, 2022). However, it is seen that the studies using the cooperative learning model are quite limited (Uyanık, 2016). Thus, it is thought that the results of the research will make important contributions to the literature.

In line with the aim of the research, the following research questions were sought to be answered:

1. Is there a significant difference between ASEP pre-test and post-test scores of the group in which STAD method was applied?
2. Is there a significant difference between ASEP pre-test and post-test scores of the group in which Jigsaw method was applied?
3. Is there a significant difference between ASEP pre-test scores of the groups in which STAD and Jigsaw methods were applied?
4. Is there a significant difference between ASEP post-test scores of the groups in which STAD and Jigsaw methods were applied?
5. How did the STAD method affect the conceptual knowledge changes of pre-service primary school teachers towards the concept of environmental problems?
6. How did the Jigsaw method affect the conceptual knowledge changes of pre-service primary school teachers towards the concept of environmental problems?
7. How are the cognitive perceptions of pre-service primary school teachers in the STAD group towards environmental problems?
8. How are the cognitive perceptions of pre-service primary school teachers in the Jigsaw group towards environmental problems?

METHOD

Research Design

In line with the aim of the study, an embedded mixed design, one of the mixed research designs, was used. Embedded mixed design is used when research data are collected and analyzed within traditional quantitative and qualitative designs. For example, the researcher may include a qualitative research design in an experimental study, which is a quantitative research type (Creswell & Plano Clark, 2015). In this context, pretest-posttest quasi-experimental design without a control group was used in the quantitative part of the study. In this design without a control group, the group or groups included in the research are tested before and after the experimental application and the effect of the application is evaluated according to the difference between the pre-tests and post-tests (Sönmez & Alacapınar, 2013). Phenomenology was used in the qualitative part of the study. Phenomenological research is a research design in which the researcher describes the experiences of the individuals participating in the research about a phenomenon in a way to reach the essence of the statements (Creswell, 2014).

Research Group

The study group of the research consists of 50 pre-service teachers (30 females and 20 males) who are enrolled in the first year of the Department of Primary School Teachers at a state university during the 2021-2022 academic year. The research includes two experimental groups. In the first experimental group, the cooperative learning method of Student Teams Achievement Divisions (STAD) was implemented, while in the second experimental group, the Jigsaw method was applied. The first experimental group consist of 22 pre-service teachers (13 females and 9 males), and the second experimental group consist of 28 pre-service teachers (17 females and 11 males). Criterion sampling, one of the purposeful sampling methods, was used in the research. Criterion sampling is a method in which the sample is selected based on specific criteria identified by the researchers (Yıldırım & Şimşek, 2013). In this research, the criterion was defined as pre-service primary school teachers who had taken an environmental education course at the undergraduate level.

Data Collection Tools

In the study, "Attitude Scale towards Environmental Problems (ASEP)," "Word Association Test towards Environmental Problems (EPWAT)," and "Mind Maps on the Concept of Environmental Problems (MM)" prepared by pre-service teachers were used as data collection tools. The ASEP is a 3-point Likert-type scale consisting of 45 items and five factors, developed by Güven (2013). The Cronbach alpha value of the scale was found to be .88. A word association test is a data collection tool that reveals the connections and semantic closeness between concepts in the cognitive structure of individuals by writing a certain number of words that come to mind about the key concepts given for any subject. The order of the words that students respond to the

key concept reveals the connections and semantic relations in their memory for the concept (Bahar & Özatlı, 2003). As in Figure 1, the concept of "Environmental Problems" was written 10 times underneath each other, and a space was left next to them. The pre-service teachers were asked to write the first words that came to their minds when they thought of environmental problems and were given 60 seconds to do so. At the end of the time, the papers were collected. The ASEP and the EPWAT were administered to the pre-service teachers in both groups as a pre-test before starting the experimental application and as a post-test at the end of the application. After the end of the applications, the pre-service teachers were asked to create mind maps with the help of colored pencils by using various branches between the words, shapes, and symbols that came to their minds about the concept of environmental problems. Hence, pre-service teachers' cognitive perceptions of environmental problems will be revealed.

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Environmental Problems, ...

Environmental Problems, ...

Environmental Problems, ...

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Environmental Problems, ...

Environmental Problems, ...

Figure 1. Environmental problems word association test

Implementation Process

Before starting the implementation process, the pre-service teachers in the experimental groups were given detailed information about the implementation process. Afterwards, the groups were administered the ASEP and the EPWAT as pre-tests. The applications in the groups were carried out as follows:

1. Groups of 4 pre-service teachers were formed in a heterogeneous (students' grade point averages and gender) way in the STAD and Jigsaw groups.
2. Taking into account the principles regarding the application of the cooperative learning methods of STAD and Jigsaw methods, environmental problems were covered for 10 weeks, 2 class hours per week. During the 10-week implementation process, the basic concepts of environmental education and environmental problems, types of environmental pollution, and global environmental problems were covered in the experimental groups under four sub-headings: (1) what it is and how it occurs; (2) what the causes are; (3) what the consequences are; and (4) how to prevent it and the measures to be taken. Within this context, the topics covered in the experimental groups are provided in Table 1.

Table 1. Topics Covered in the Groups

Topics	Topics
Week 1- Basic concepts	Week 6- Acid rain
Week 2- Air pollution	Week 7- Soil pollution
Week 3- Global warming	Week 8- Water pollution
Week 4 - Greenhouse effect	Week 9- Noise pollution
Week 5- Ozon layer	Week 10- Erosion and drought

3. *Implementations in the STAD Group:* Due to the class size, two heterogeneous groups of five and two heterogeneous groups of four were formed. After the groups distributed the tasks among themselves, the implementation started. The implementations started with the lecturer (researcher) explaining the topics. Then, the topic of the relevant week was given to the groups with subheadings, and the group members were asked to study the topic. In this process, the lecturer answered the questions of the pre-service teachers, if any, and provided guidance on the steps of

implementation. After the group members completed their work on the subtopics, midterm exams were held on that week's topic. Then, the scores of the group members from the midterm exams were calculated together, and their individual development scores were determined according to the evaluation criteria of the STAD. Team scores were calculated with the determined individual development scores. Finally, the team with the highest score was rewarded (Açıkgöz, 2009). In the groups, the process progressed in this way every week.

4. *Implementations in the Jigsaw Group:* The topics to be covered each week in the group were divided into four subtopics. Then, four subtopics were distributed to four students in each home group. In this way, seven *Home Groups* were formed. Then each group members in home groups worked on their own subtopics. Due to the nature of the Jigsaw method, each group member first works on his or her own topic, then the members working on the same topic come together to form *Expert Groups*. Accordingly, after the group members worked in the expert groups, each member returned to his/her home group and explained the sub-topic he/she had studied until the other group members learned it. In some weeks, group members of some groups could not attend the lesson for various reasons. In this case, it was ensured that a member of another group explained that subtopic to the group members so that the groups did not miss the topics. After the Jigsaw applications were completed in all groups, questions about the subject were asked to the group members for evaluation purposes. In addition, the lecturer answered the questions of the students, if any, at each stage and provided guidance on the application steps.

5. After the end of the implementations, ASEP and EPWAT were applied as post-tests in the groups. In addition, pre-service teachers were asked to make mind maps about the concept of "environmental problems" in 1 lesson hour. The applications lasted 12 weeks in total, including the application of pre-test and post-test. The implementation process of the research is given in Table 2.

Table 2. Implementation Process

	Pre-Implementation	Implementation		Post-Implementation
Experimental Groups	Pre-Tests	Topics	Method	Post-Tests
Experimental Group 1	ASEP-EPWAT	Topics Covered in Groups	STAD	ASEP-EPWAT-MM
Experimental Group 2	ASEP-EPWAT	Topics Covered in Groups	Jigsaw	ASEP-EPWAT-MM

Data Analysis

Since the research was designed with a mixed design, quantitative and qualitative analysis methods were used. In the analysis of quantitative data, parametric tests and descriptive statistics were used according to the results of the normality assumption. Content analysis was used to analyze qualitative data. In the analysis of the attitude scale, dependent groups t-tests and independent groups t-tests were used to determine whether there was a significant difference between the pre-test and post-test of the groups within and between the groups. Before starting the analysis of the data obtained for the word association test, the response papers of the pre-service teachers in both groups were numbered, and descriptive analysis was performed. In order to analyze the pre-test and post-test results of the groups, the words associated with the key concepts were examined in detail by the researcher and an expert. The aim here was to reveal the misconceptions, lack of knowledge, or words resulting from knowledge errors, if any, of the pre-service teachers about environmental problems. First, individual frequency tables were created by the researcher and the expert. Subsequently, these frequency tables were compared, the data obtained was checked again, and a consensus was reached. Thus, reliability was tried to be ensured. Based on the resulting frequency tables, concept networks were created in order to present the perceptions and conceptual changes of pre-service teachers in a formal way. Bahar et al.'s (1999) breakpoint (BP) technique was used to construct concept networks. Accordingly, in the frequency table, 3-5 words below the most frequently repeated word related to the key concepts in the KIT are considered the breakpoint, and the words above this response frequency are written in the first part of the map (Bahar & Özatlı, 2003). In the study, in order to prevent the concept networks from being too complex, 5<BP≤1 was not included in the concept network. In the SCM group, the colors for each BP range were expressed in purple for 15 and above, in blue for 15<BP≤10, and in orange for 10<BP≤5. In the Jigsaw group, purple for 20 and above, blue for 20<BP≤15, orange for 15<BP≤10, and dark blue for 10<BP≤5. analysis was used to analyze the mind maps. With this aim, the researcher and the expert independently analyzed the mind maps of the pre-service teachers, and codes were created. Then, categories and themes were created individually for the codes. The codes, categories, and themes were checked by the researchers, and comparisons were made. The checks and comparisons regarding codes, categories, and themes continued until a consensus was reached. Finally, tables of codes, categories, and themes were created, and the tables were interpreted.

FINDINGS

The findings obtained from the analysis of the data collected in line with the research questions are provided below.

Findings Obtained from the Environmental Problems Attitude Scale

Before starting the analyses, normality tests were conducted to determine whether the data showed a normal distribution and to identify which tests would be used for analysis. The results of the normality test for the attitude scores of pre-service primary school teachers towards environmental problems are presented in Table 3.

Table 3. Results of the Normality Test for Attitude Scores

Groups	N	Shapiro-Wilks	$\overline{X}$	sd	SS	Skewness	Kurtosis
STAD Pre-Test	22	,760	2,32	22	,159	-,292	,163
STAD Post-Test	22	,383	2,37	22	,139	-,357	1,454
Jigsaw Pre-Test	28	,497	2,37	28	,144	,596	1,441
Jigsaw Post-Test	28	,263	2,41	28	,150	,571	,768

Upon examining Table 3, it was determined that the pre-test and post-test attitude scores of pre-service primary school teachers towards environmental problems in the STAD and Jigsaw groups showed a normal distribution ($S\text{-}W_{\text{STAD Pre-Test}} = 0.760$, SD = 22, $p > .05$; $S\text{-}W_{\text{STAD Post-Test}} = 0.383$, SD = 22, $p > .05$; $S\text{-}W_{\text{Jigsaw Pre-Test}} = 0.497$, SD = 28, $p > .05$; $S\text{-}W_{\text{Jigsaw Post-Test}} = 0.263$, SD = 28, $p > .05$). Therefore, the pre-test and post-test scores of the groups were analyzed using parametric tests, specifically the T-Test.

The dependent samples t-test results for the impact of the STAD method on the attitude scores of pre-service teachers towards environmental problems are provided in Table 4.

Table 4. Dependent Samples T-Test Results for Pre-Test and Post-Test Scores with the STAD Method

STAD	N	X	SS	t	sd	p
Pre-Test	22	2,32	,159	-1,339	21	,195
Post-Test	22	2,37	,139			

Upon examining Table 4, it is observed that there is no statistically significant difference between the pre-test and post-test scores of the group where the STAD method was applied ($t = -1.339$; $p > .05$). According to this finding, the STAD method did not create any change in the attitudes of pre-service primary school teachers towards environmental problems.

The results of the dependent samples t-test conducted to determine the impact of the Jigsaw method on the attitude scores of pre-service teachers towards environmental problems are presented in Table 5.

Table 5. Dependent Samples T-Test Results for Jigsaw Method Pre-Test and Post-Test Scores

Jigsaw	N	X	SS	t	sd	p
Pre-Test	28	2,3722	,14484	-1,645	27	,112
Post-Test	28	2,4199	,15047			

Upon examining Table 5, it is observed that there is no statistically significant difference between the pre-test and post-test scores of the group where the Jigsaw method was applied ($t = -1.645$; $p > .05$). According to this finding, the Jigsaw method did not create any change in the attitudes of pre-service primary school teachers towards environmental problems.

Following these analyses, the results of the independent samples t-test conducted to determine whether there is a significant difference in the attitudes towards environmental problems before the implementation between the STAD and Jigsaw groups are presented in Table 6.

Table 6. Independent Samples T-Test Results for Pre-Test Attitude Scores of STAD and Jigsaw Methods

Groups	N	X	SS	t	sd	p
STAD Pre-Test	22	2,32	,159	-1,151	48	,255

Groups	N	X	SS	t	sd	p
Jigsaw Pre-Test	28	2,37	,144			

Upon examining Table 6, it is determined that there is no significant difference in the pre-test scores between the groups before the implementations (t = -1.151; p > .05). According to this finding, it can be said that the attitude levels of students in the groups towards environmental problems were similar before the implementations.

To determine which method, STAD or Jigsaw, had a greater impact on the attitudes of pre-service teachers towards environmental problems after the implementations, the results of the independent samples t-test are presented in Table 7.

Table 7. Independent Samples T-Test Results for Post-Test Attitude Scores of STAD and Jigsaw Methods

Groups	N	X	SS	t	sd	p
STAD Post Test	22	2,37	,139	-1,147	48	,257
Jigsaw Post Test	28	2,41	,150			

Upon examining Table 7, it is determined that there is no significant difference in the post-test scores between the groups after the implementations (t = -1.147; p > .05). According to this finding, it can be said that neither the STAD nor the Jigsaw method created a significant difference in the attitudes of pre-service teachers towards environmental problems compared to each other after the implementations.

Findings from the Word Association Test Regarding the Concept of Environmental Problems

The findings regarding the impact of the STAD and Jigsaw methods on the conceptual changes of pre-service primary school teachers regarding the concept of "Environmental Problems" are presented in Table 8.

Table 8. Findings from the Word Association Test

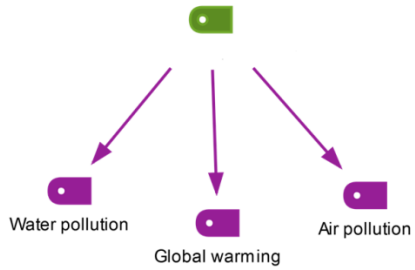
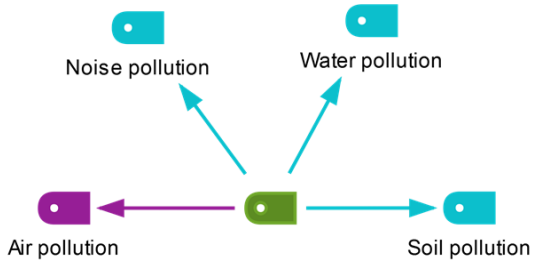
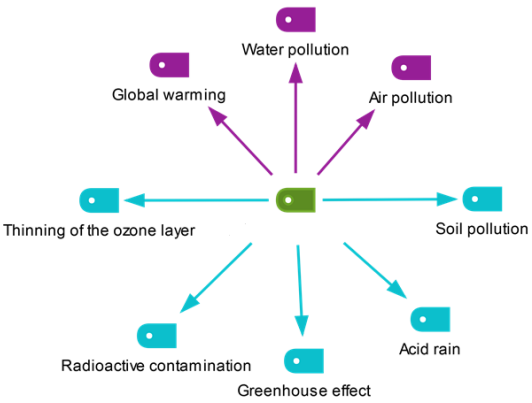
	The Most Repeated First Ten Words				Response Word Type		Total Response Word	
	Pre-Test	(f)	Post-Test	(f)	Pre-Test (f)	Post-Test (f)	Pre-Test (f)	Post-Test (f)
STAD	Air pollution	15	Air pollution	16	74	56	193	220
	Soil pollution	12	Water pollution	16				
	Water pollution	11	Global warming	15				
	Noise pollution	10	Soil pollution	13				
	Acid rain	7	Thinning of the ozone layer	12				
	Waste	7	Radioactive pollution	12				
	Unconsciousness	7	Greenhouse effect	12				
	Garbage	7	Noise pollution	12				
	Global warming	6	Acid rain	11				
	Sea pollution	5	Light pollution	9				
Jigsaw	Air pollution	22	Water pollution	24	79	61	242	280
	Water pollution	20	Air pollution	23				
	Soil pollution	16	Soil pollution	21				
	Global warming	12	Erosion	19				
	Acid rain	10	Global warming	19				
	Unplanned urbanization	7	Noise pollution	16				
	Waste	6	Light pollution	14				
	Unconsciousness	6	Thinning of the ozone layer	14				
	Lack of education	6	Acid rain	13				
	Health problems	6	Drought	13				

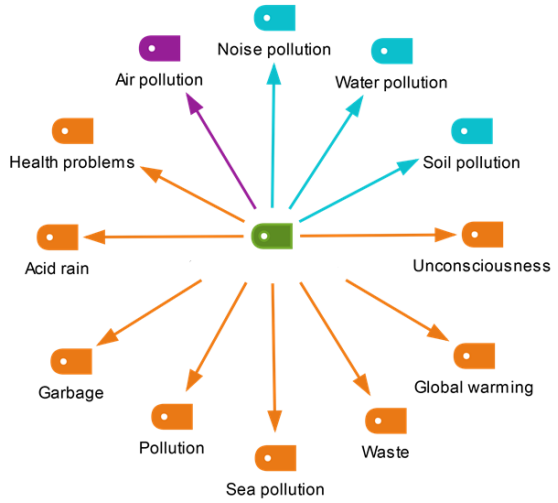
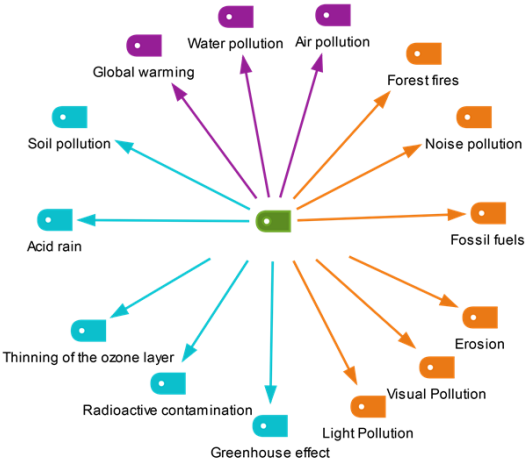
In Table 8, the variety and number of response words associated with the concept of environmental problems in the pre-test and post-test for the STAD and Jigsaw groups are presented. In the STAD group, before the implementation of STAD, the variety of response words related to environmental problems in the pre-test was 74, with a total of 193 response words. In the post-test, the variety of response words decreased to 56, while the total number of response words increased to 220. For the Jigsaw group, the pre-test exhibited a variety of 79 response words with a total of 242, and in the post-test, the variety decreased to 61, while the total number of response words increased to 280. It was determined that in both groups, all blanks (10 blanks) were filled with meaningful words in the post-tests.

Table 8 provides the most frequently repeated words related to the concept of environmental problems in the STAD and Jigsaw groups. In the STAD group, during the pre-test, the most frequently repeated response words were air pollution (f=15), water pollution (f=12), and soil pollution (f=12), while in the post-test, air pollution (f=16), water pollution (f=16), and global warming (f=15) were determined as the most repeated. In the Jigsaw group, during the pre-test, the most frequently repeated response words were air pollution (f=22), water pollution (f=20), and soil pollution (f=16), while in the post-test, water pollution (f=24), air pollution (f=23), and soil pollution (f=21) were identified as the most repeated. One noteworthy aspect in both groups is that, even though terms related to environmental problems were most frequently repeated in the pre-tests, in the post-tests, fundamental concepts related to global environmental problems and types of environmental pollution were more frequently reiterated instead of terms like ignorance and lack of education. Therefore, it can be concluded that cooperative learning methods positively influenced the conceptual changes of pre-service teachers.

In the figures provided in Table 9, concept networks created from the most frequently repeated response words in the pre-test and post-test of pre-service teachers in the STAD group towards the "environmental problems" concept are presented.

Table 9. Concept Networks Created for Pre-Test and Post-Test of the STAD Group

Cutting Point (CP)	Pre-Test	Post-Test
CP ≥15		
15> CP ≥10		

Cutting Point (CP)	Pre-Test	Post-Test
10> CP ≥5		

The pre-test findings in Table 9 can be interpreted as follows:

For the breakpoint 15 and above, it is noteworthy that students associated the key concept of environmental problems only with the response word air pollution. Air pollution was the first concept that came to students' minds when environmental problems were mentioned. Since air is a substance shared by everyone in all areas and air pollution is among the most likely types of environmental pollution, it is thought that environmental problems are associated with this response word the most.

For the breakpoint between 15<BP≤10, students associated the key concept of environmental problems with the response words soil pollution, water pollution, and noise pollution, respectively. Similarly, it is thought that students associate these words with the key concept of environmental problems since they are the most frequently encountered types of pollution in our environment.

For the breakpoint between 10<BP≤5, students associated the key concept of environmental problems with the response words acid rain, waste, unconsciousness, garbage, global warming, marine pollution, pollution, and health problems, respectively. Although the majority of these words associated with the concept of environmental problems are related to environmental problems, it can be said that they are words that are frequently encountered in daily life and at a superficial knowledge level. Furthermore, it is seen that words related to global environmental problems were encountered for the first time in this range.

The post-test findings in Table 9 can be interpreted as follows:

For breakpoint 15 and above, students associated the key concept of environmental problems with the response words air pollution, water pollution, and global warming. It is noteworthy that one of the words associated with global environmental problems (global warming), which was encountered for the first time in the pre-test between the breakpoint 10<BP≤5, was the first word that came to students' minds and made the most associations when environmental problems were mentioned in this range. In addition, while only one concept emerged in this range in the pre-test, three concepts emerged in this range in the post-test.

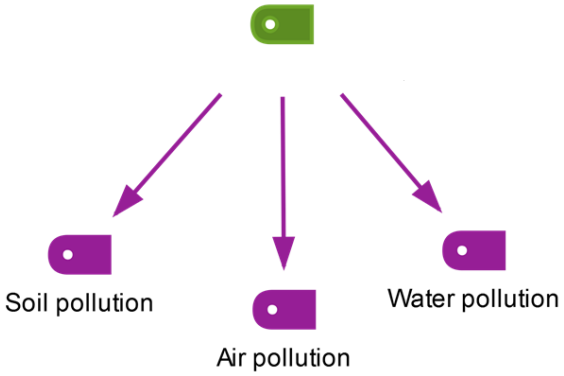
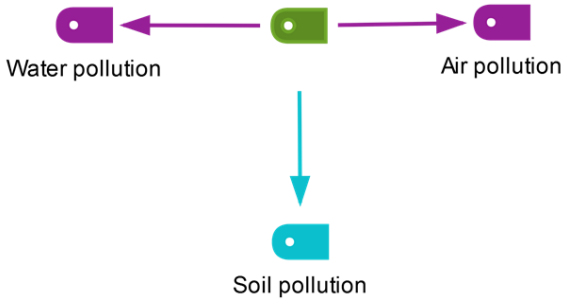
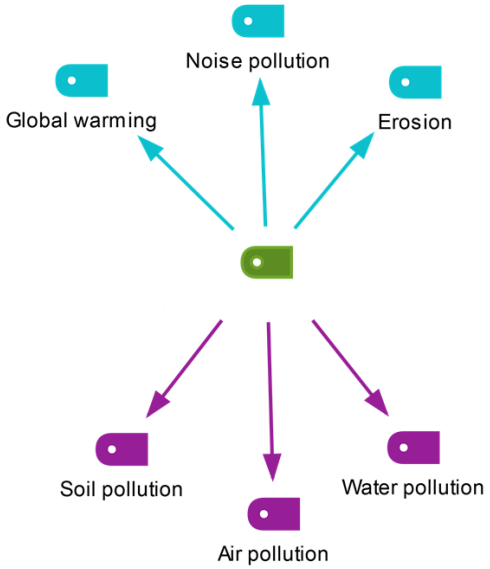
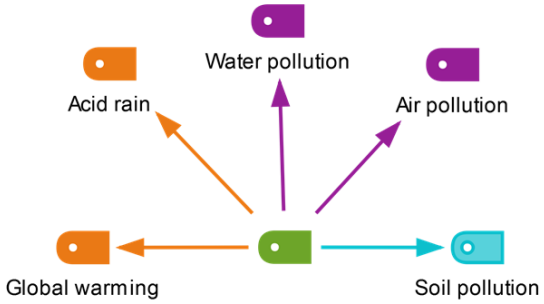
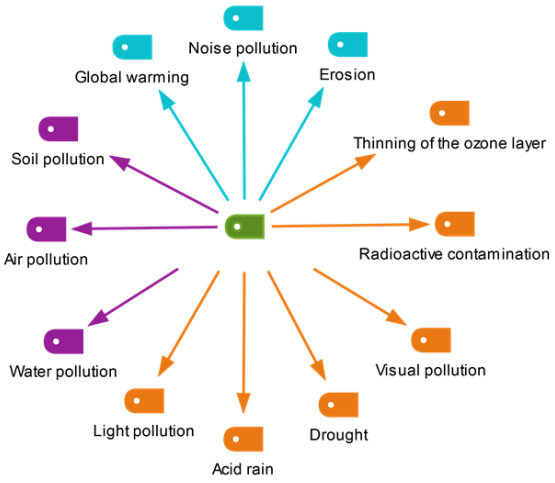
For the breakpoint between 15<BP≤10, students associated the key concept of environmental problems with the response words soil pollution, ozone depletion, radioactive pollution, greenhouse effect, and acid rain, respectively. What is noteworthy in this range is the emergence of words belonging to different global environmental problems, together with some of the most frequently encountered types of pollution as well as some of the types of environmental pollution that are not always seen (radioactive pollution).

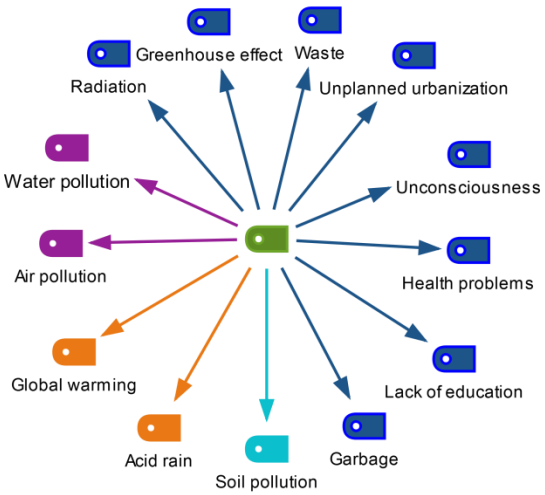
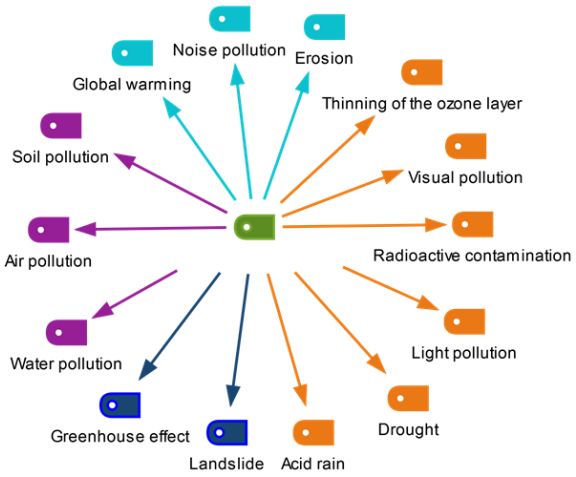
For the breakpoint between 10<BP≤5, students associated the key concept of environmental problems with the response words light pollution, visual pollution, erosion, fossil fuels, noise pollution, and forest fires, respectively. Among these words associated with the concept of environmental problems, it is possible to say that fossil fuels and forest fires are the most important human resources that cause environmental problems. In addition, when compared to the pre-test, it is seen that words that cause environmental problems, such as unconsciousness and pollution, are not included in this range and that there are more qualified words associated with the sources that cause environmental problems (such as fossil fuels and forest fires). This shows that the quality of the words produced by the students increased with the practices.

In general, when looked at overall, there were no concept misconceptions in both the pre-test and post-test.

Table 10 provides concept networks created from the most repeated response words in the pre-test and post-test of the pre-service teachers in the Jigsaw group towards the concept of environmental problems.

Table 10. Concept Networks Created for the Pre-test and Post-test of the Jigsaw Group

Cutting Point (CP)	Pre-Test	Post-Test
CP ≥20		
20> CP ≥15		
15> CP ≥10		

Cutting Point (CP)	Pre-Test	Post-Test
10> CP ≥5		

The pre-test findings in Table 10 can be interpreted as follows.

For the breakpoint 20 and above, students associated the key concept of environmental problems with the response words air pollution and water pollution. It can be said that the first words that come to students' minds when environmental problems are mentioned are air pollution and water pollution. Since air and water pollution are the most common environmental problems encountered in daily life, it is thought that these response words emerged the most.

For the breakpoint between 20<BP≤15, students associated the key concept of environmental problems only with the response word soil pollution. It can be said that in this range, students attributed one of the types of environmental pollution that can be heard frequently. It is noteworthy that only one word was produced in this range.

For the breakpoint between 15<BP≤10, in this range, students associated the key concept of environmental problems with the response words global warming and acid rain. It is noteworthy that the words related to global environmental problems appeared for the first time in this range.

For the breakpoint between 10<BP≤5, students associated the key concept of environmental problems with the response words unplanned urbanization, waste, unconsciousness, lack of education, health problems, garbage, radiation, and greenhouse effect, respectively. In this range, it is seen that students mostly produced words related to human resources that can be frequently heard in daily life that cause environmental problems.

The post-test findings in Table 10 can be interpreted as follows.

For the breakpoint 20 and above, students associated the key concept of environmental problems with the response words air pollution, water pollution, and soil pollution, respectively. In this range, it is possible to say that the first words that come to students' minds are the types of environmental pollution, as in the pretest.

For the breakpoint between 20<BP≤15, students associated the key concept of environmental problems with the response words erosion, global warming, and noise pollution, respectively. It is noteworthy that one of the words associated with global environmental problems (global warming), which was encountered for the first time in the pre-test between the breakpoint 15<BP≤10, was the first word that came to students' minds and made the most associations when environmental problems were mentioned in this range. In addition, the number of responses given by the students in this range increased compared to the pretest.

For the breakpoint between 15<BP≤10, students associated the key concept of environmental problems with the response words light pollution, ozone depletion, acid rain, drought, radioactive pollution, and noise pollution, respectively. What is noteworthy in this interval is the emergence of words belonging to different global environmental problems (drought), together with some of the most frequently encountered types of pollution (radioactive pollution) as well as some of the less common types of environmental pollution (radioactive pollution). In addition, when compared to the pretest, there was an increase in the number of words that emerged in the other intervals. This shows that the students gained more knowledge about environmental problems with the practices.

For the breakpoint between 10<BP≤5, students associated the key concept of environmental problems with the response words greenhouse effect and landslide, respectively, in this range. Compared to the pre-test, it was determined that words related to human resources (such as lack of awareness and lack of education) that cause environmental problems were not included in this range. However, it is seen that words related to global environmental problems (such as drought) and different types of environmental pollution that cannot be encountered frequently in daily life (radioactive pollution) have much more

destructive and negative effects in terms of their consequences, although they are not recognized by society. This shows that the quality of the words produced by the students increased with the practices.

In general, when looked at overall, there were no concept misconceptions in both the pre-test and post-test.

Findings Obtained from Mind Maps Regarding the Concept of Environmental Problems

The findings obtained from the analysis of mind maps of the pre-service teachers in the STAD group are presented in Table 11.

Table 11. Mind Maps of the STAD Group

Theme	Category	Code	Frequency (f)
Environmental Problems	Global environmental problems	Acid rain	14
		Global warming	13
		Erosion	10
		Thinning of the ozone layer	10
		Drought	7
		Greenhouse effect	6
		Desertification	1
	Types of environmental pollution	Water pollution	27
		Air pollution	19
		Noise pollution	18
		Soil pollution	16
		Visual pollution	9
		Light pollution	5
		Radioactive contamination	6
	Natural causes	Volcanic eruptions	10
		Desert dust	4
		Volcanoes	2
		Mucus	2
		Water vapor	2
		Floods	1
		Krakatoa	1
		Tambora	1
	Artificial causes	Forest fires	16
		Wastes	8
		Exhaust	8
		Exhaust gases	8
		Heavy metals	7
		Garbage	7
		Deodorants	6
		Factory waste	6
		Gases from factory chimneys	5
		Incorrect agricultural practices	5
		CO_2	4
		Factory chimneys	4
		Factory smoke	4
		Fossil fuels	4
		Use of chemical fertilizers	4
		Perfumes	4
		Excessive volume	3

Theme	Category	Code	Frequency (f)
		CFC	3
		CH_4	3
		CO	3
		Overlighting of skyscrapers	3
		NO_2	3
		Industrialization	3
		Deforestation	2
		Factories	2
		Technological devices	2
		Sewage waters	2
		Urbanization	2
		Horn	2
		Cosmetic products	2
		Population density	2
		Nuclear industry	2
		Sprays	2
		Aircraft noise	2
		Excessive slope	1
		Energy wastage	1
		H_2SO_4	1
		Livestock activities	1
		HCFC	1
		HNO_3	1
		Human	1
		Rural to urban migration	1
		Motor vehicles	1
		Plastics	1
		Temperature increase	1
		SO_2	1
		SO_4	1
		Tanker accidents	1
		Agricultural pesticides	1
		Transportation	1
	Results	Melting of glaciers	3
		Climate change	2
		Polar bears	1
		Historical artifacts	1
	Precautions	Filter	1

In Table 11, it can be seen that the mind maps made by the pre-service teachers in the STAD group were categorized under the theme of "environmental problems" as "global environmental problems," "types of environmental pollution," "natural causes," "artificial causes," "consequences," and "precautions." Among these categories, the codes "acid rain," "global warming," "erosion," and "ozone depletion" came to the fore under the category of "global environmental problems." When the mind maps of the pre-service teachers were examined, it was seen that almost all of these codes were expressed by drawing one-to-one figures related to the code. For example, acid rain was depicted as compounds such as "SO_2", NO_2", H2SO_4" coming down from dark clouds in the form of raindrops. Under the category of "types of environmental pollution," "water pollution," "air pollution," "noise pollution," and "soil pollution" were the most prominent codes. It is noteworthy that the codes under this category in the mind maps are depicted with details in a way to express the concepts exactly. For example, while expressing the noise pollution code, the figures of loudspeakers, airplanes, megaphones, and the figure of the world plugging its ears to express excessive noise were depicted. While expressing water pollution, the formation of waste on the water surface due to the

discharge of sewage water into the puddle was also depicted. Again, light pollution is depicted in the form of skyscrapers and buildings painted yellow. When the "natural causes" category is analyzed, the code "volcanic eruptions" stands out. While expressing this code, the picture of "Tambora Volcano" was drawn by specifying the specific name. Under the category of "artificial causes," the codes "forest fires," "wastes," "exhaust," and "exhaust gases" were formed. When the artificial causes category was analyzed, it was noteworthy that human-induced situations that cause global environmental problems and environmental pollution types were depicted in a way to create a plot. For example, the exhaust code was illustrated using a figure of gas coming out of a car exhaust. Under the "consequences" category, the codes "melting of glaciers" and "climate change" were formed. It is noteworthy that these codes are among the consequences of global warming and are depicted by drawing an image of melting ice. Finally, under the category of "Precautions," one person expressed the code "filter." The filter code was illustrated with a picture of gas coming out of the factory chimney.

Examples from the mind maps of pre-service teachers related to these codes and themes are given in Figure 2.

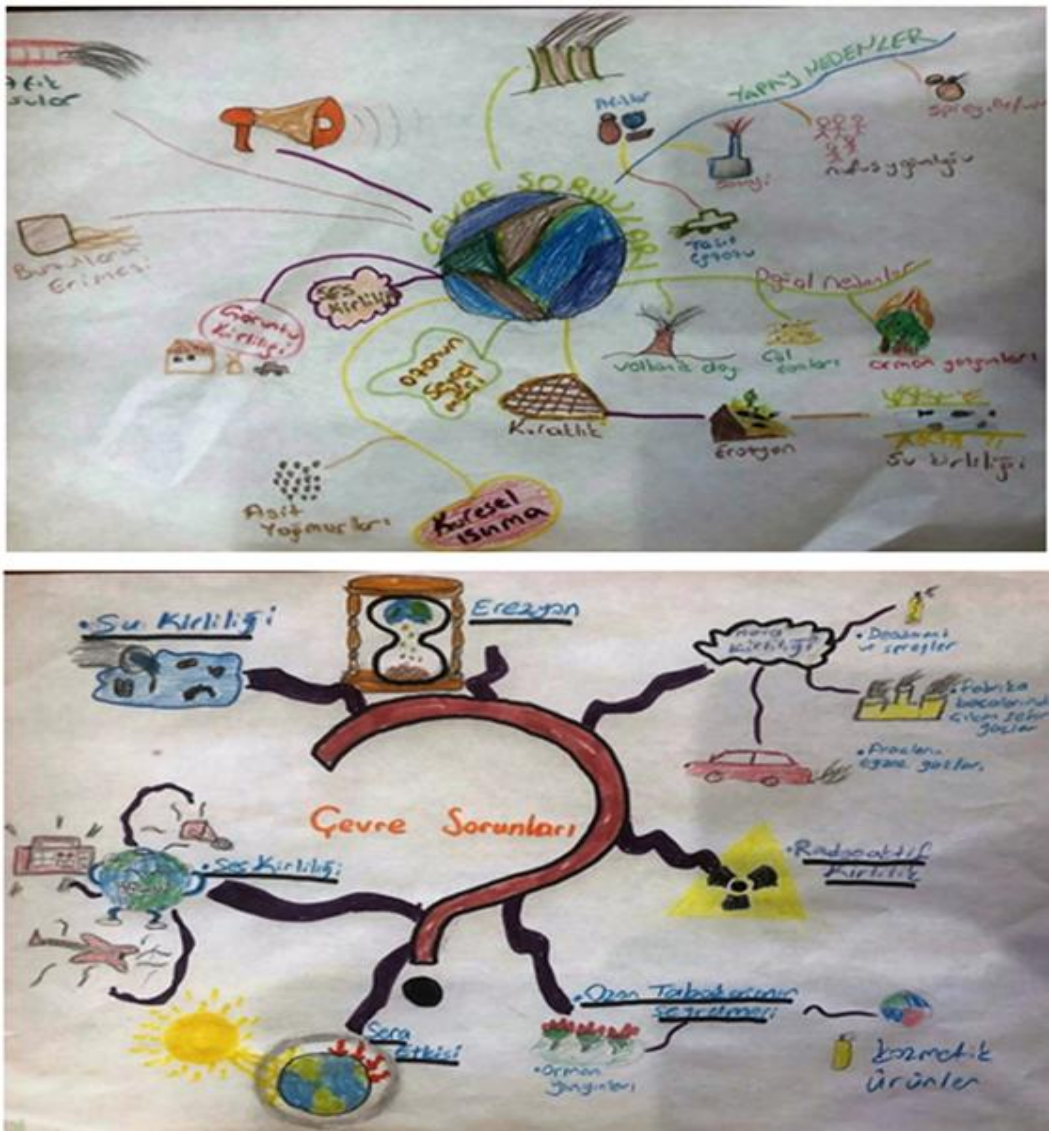


Figure 2. Examples from mind maps of the STAD group

Findings from the analysis of mind maps of the pre-service teachers in the Jigsaw group are presented in Table 12.

Table 12. Mind Maps of the Jigsaw Group

Theme	Category	Code	Frequency
Environmental Problems	Global environmental problems	Acid rain	15
		Drought	11
		Global warming	10
		Erosion	9
		Thinning of the ozone layer	7
		Ozone layer	4
		Greenhouse effect	4
	Types of environmental pollution	Air pollution	24
		Noise pollution	24
		Water pollution	18
		Soil pollution	14
		Visual pollution	7
		Radioactive contamination	6
		Light pollution	4
	Natural causes	Volcanic eruptions	7
		Volcanoes	6
		Evaporation of seawater	5
		Desert dust	4
		Landslide	2
		Excessive heat	2
		Flood	1
		Wind	1
		Tsunami	1
		Snow	1
		Sweeping	1
		Avalanche	1
		Scarcity of rainfall	1
	Artificial causes	Forest fires	10
		Garbage	9
		Motor vehicles	8
		Industrialization	8
		Factories	7
		High sound	5
		Exhaust gases	5
		Gases from factory chimneys	5
		CO_2	4
		Deodorants	4
		Factory smoke	4
		Fossil fuels	4
		Coal	4
		Deforestation	4
		Plastics	4
		Cigarette smoke	4
		Solid waste	3
		Waste batteries	3
		Wastes	3
		CH_4	3
		Unplanned urbanization	3
		Factory chimneys	3
		Residence	3

Theme	Category	Code	Frequency
		Fires	3
		NO_2	3
		Nuclear power plants	3
		Perfumes	3
		SO_2	3
		Incorrect agricultural practices	3
		Noise	2
		Slope of lands	2
		Heating methods	2
		Dumping of waste into streams	2
		Exhaust	2
		Exhaust smoke	2
		Chimneys	2
		Animal waste	2
		Factory wastes	2
		Human activities	2
		Use of chemical fertilizers	2
		Urbanization	2
		Irrigation of soil with polluted water	2
		Chemical wastes	2
		Honking	2
		Plastic bag	2
		Tires	2
		Wood	2
		Stove	2
		Plastic bottle	2
		Cigarette butt	2
		Agricultural activities	2
		Airplane noise	2
		UV rays	2
		Carbon	1
		Carbon footprint	1
		Fire	1
		Unconscious consumption	1
		CFC	1
		CO	1
		Lack of education	1
		Phone ringtone	1
		Energy	1
		Sewage waters	1
		Metal cans	1
		Match	1
		N_2O	1
		Radio	1
		Street lamp	1
		Medical wastes	1
		Transportation activities	1

Theme	Category	Code	Frequency
		Toxic substances	1
	Results	Historical artifacts	3
		Climate change	2
		Inefficient agriculture	2
		Inefficient soil	2
		Environmental pollution	2
		Death of fish	1
		Danger	1
		Ice age	1
		Polar regions	1
		Depletion of natural resources	1
		Melting of glaciers	1
		Harm to living beings	1
		Disturbance of the ecosystem	1
		Diseases	1
		Animal deaths	1
		Stress	1
		Poisoning	1
		Skin cancer	1
	Precautions	Filter	1
		Recycling	1
		Mask	1

According to Table 12, the mind maps made by the pre-service teachers in the Jigsaw group were categorized under the theme of "environmental problems" as "global environmental problems," "types of environmental pollution," "natural causes," "artificial causes," "consequences," and "precautions." Among these categories, the codes "acid rain," "drought," "global warming," and "erosion" came to the fore under the category of "global environmental problems." When the mind maps of the pre-service teachers were examined, it was seen that almost all of these codes were expressed by drawing one-to-one figures related to the code. For example, while expressing the drought code, the figures of dried, cracked soil and a single green tree on cracked soil were used. Under the category of "types of environmental pollution," the codes "air pollution," "noise pollution," "water pollution," and "soil pollution" are seen as the most prominent codes, respectively. It is noteworthy that the codes under this category in the mind maps are depicted with details in a way to express the concepts exactly. For example, while expressing the noise pollution code, a figure of a man shouting with a megaphone in his hand and, while expressing air pollution, the gases emitted from factories, the gases from car exhausts rising into the air, and forest fires were depicted. Again, soil pollution was depicted in the form of small grains of chemical fertilizer and solid wastes on the soil. When the "natural causes" category is analyzed, the codes "volcanic eruptions" and "volcanoes" stand out. While expressing these codes, volcano and erupting volcano figures were generally drawn. Under the "artificial causes" category, the codes "forest fires," "garbage," "motor vehicles," and "industrialization" were formed. When the artificial causes category was examined, it was noteworthy that human-induced situations that cause global environmental problems and environmental pollution types were depicted in a way to create a plot. For example, the industrialization code is usually depicted with figures of factories and gases emitted from factories. Under the "Consequences" category, the codes "historical artifacts" and "climate change" were formed. It is noteworthy that these codes are among the consequences of acid rain and global warming and are depicted with figures of polar bears, ice ages, and acid rain on historical artifacts. Finally, although there was no particularly emphasized code under the "Precautions" category, the codes "Filter," "Mask," and "Recycling" were formed and illustrated. For example, the recycling code was illustrated with a recycling symbol, and the mask code was illustrated with a medical mask figure.

Examples from the mind maps of pre-service teachers related to these codes and themes are given in Figure 3.

Figure 3. Examples from Mind Maps of the Jigsaw Group

CONCLUSION AND DISCUSSION

In this study, it was aimed to examine the effects of different methods of the cooperative learning model on pre-service primary school teachers' attitudes towards environmental problems, conceptual knowledge changes and to reveal their cognitive perceptions. In line with the aim of the study, according to the findings obtained from the pretest of the attitude scale, it was concluded that the attitudes of the pre-service teachers in the STAD and Jigsaw groups towards environmental problems were similar and positive before starting the applications. It is thought that the reason for this result is that the prospective teachers enrolled in the department with similar scores and had similar experiences in the same environment. According to the findings obtained from the post-tests, the STAD and Jigsaw methods slightly increased the pre-service teachers' attitudes towards environmental problems. However, this increase was not statistically significant. In other words, cooperative learning methods were not effective in changing pre-service teachers' attitudes towards environmental problems. When the averages of the scores of the pre-service teachers from the scale were analyzed, it was concluded that the averages in the pre-tests were very close to the highest average score value that could be obtained from the scale (agree level), that is, the attitudes of the pre-service teachers were high. Therefore, the fact that the attitudes of the pre-service teachers in the STAD and Jigsaw groups towards environmental problems were quite high in the positive direction before the applications started caused the difference to be statistically insignificant, although there was an increase in the post-tests. In addition, it was determined that the attitudes of the pre-service teachers in the Jigsaw group towards environmental problems were positively and higher than the attitudes of the pre-service teachers in the STAD group. However, when the test scores of both groups were compared, it was concluded

that this difference was not statistically significant. In other words, STAD and Jigsaw methods affected pre-service teachers' attitudes towards environmental problems positively at a similar rate, albeit slightly. When the literature was examined, similar to the results of the study, it was concluded that the attitudes of pre-service teachers did not change significantly in the courses in which environmental problems were taught with activities based on an active learning approach (Muşlu Kaygısız, 2020). Considering that cooperative learning is one of the active learning approaches, it can be said to be in parallel with the research results. Contrary to the research results, Uyanık (2016) found that cooperative learning methods positively increased the attitudes of pre-service teachers towards environmental problems and that cooperative teaching increased motivation and interest in the course. Akkurt (2010) concluded that activities prepared according to active learning methods improved students' attitudes towards environmental pollution compared to traditional methods. As an outcome of their study, Muşlu Kaygısız, Benzer, and Dilek Eren (2019) stated that activities based on active learning did not have a significant effect on pre-service teachers' environmental behaviors and environmental ethics awareness, while they caused a positive change in environmental education self-efficacy.

Concerning the findings on how the cooperative learning methods (STAD and Jigsaw) applied to the pre-service teachers affected the change in their conceptual knowledge, it was determined that while the number of words revealed in the post-tests increased, the number of word types decreased in the STAD and Jigsaw groups. In addition, in both groups, although all the blanks (10 blanks) left for the pre-service teachers to write the concepts in the pre-tests were partially empty, they were filled with directly related and meaningful words related to environmental problems in the post-tests. One of the striking elements here is that in both groups, instead of the concepts such as unconsciousness and lack of education, which were repeated the most in the pre-tests, although they were related to environmental problems, the basic concepts related to global environmental problems (greenhouse effect, ozone depletion, etc.) and environmental pollution types (radioactive pollution, noise pollution, etc.) were repeated more in the post-tests. This result shows that the quality of the concepts increased in the post-tests. In the literature, it is stated that the level of understanding of a concept depends on the other words associated with that concept and the quality of these words. In addition, it has been stated that in order to determine how much a concept is understood, the relationship level and number of response words associated with that concept can be utilized (Boz & Arı, 2020; Bahar et al., 2006). In parallel with this situation, it can be said that the main factor in the decrease in the variety of response words while the number of response words increased in the study is related to the increase in the quality of the response words produced. For example, while a pre-service teacher in the STAD group produced words such as death, fear, uneasiness, and burnout in the pre-test, he produced words such as greenhouse effect, global warming, air pollution, and water pollution in the post-test. In the Jigsaw group, one pre-service teacher produced words such as crowd, hopelessness, and disease in the pre-test, while in the post-test he produced concepts related to global environmental problems and various types of environmental pollution such as drought, global warming, air pollution, and water pollution. This situation is similarly observed among the other pre-service teachers in the groups. According to these findings, it was concluded that cooperative learning methods had positive effects on pre-service teachers' knowledge about environmental problems and provided a positive change in their conceptual knowledge. In the literature, it is stated that the cooperative learning model enables students to achieve a high level of success in subjects related to humans and the environment (Eyüboğlu & Doymuş, 2023), and this is due to the fact that peers are responsible for each other's learning and information sharing in groups during the implementation of cooperative learning methods (Sunggingwati, 2018; Thurston, Cockerill, & Chiang, 2021). It can be stated that critical features such as positive commitment, face-to-face interaction, and individual responsibility, which are inherent in cooperative learning methods, are effective. Similarly, it can be said that change occurs due to the nature of co-operative learning methods. It can be said that the fact that each student knows that he/she will contribute to the group in line with his/her individual success and the mini-exams related to the subjects in the STAD method provide better learning of the concepts. In the Jigsaw method, it can be said that activities such as forming expert groups and then returning to the original groups and continuing learning until the subjects are learnt are effective in the formation of this result. In the literature, it was determined that cooperative learning increased pre-service teachers' academic achievement towards environmental problems and their level of knowledge about environmental problems (Uyanık, 2016). Okumuş (2021) stated that cooperative learning methods increased pre-service teachers' academic achievement in environmental problems. In Gürbüz, Çakmak, and Derman's (2012) study, in the environmental education given to experimental and control groups with similar cognitive levels, it was revealed that the effects of the cooperative learning model applied in the experimental group on the increase of students' cognitive levels were higher than in the control group. In the studies conducted in the literature, it was concluded that active learning methods and techniques have positive effects on increasing the level of knowledge about environmental problems and developing positive attitudes towards the environment (Arık & Yılmaz, 2020).

Based on the findings obtained from the mind maps prepared by the pre-service teachers in both groups after the practices carried out in the STAD and Jigsaw groups, it was concluded that an awareness was formed about global environmental problems, types of environmental pollution, natural and artificial factors causing environmental problems, the consequences of environmental problems, and the measures that can be taken to prevent these problems. The most frequently expressed concepts in mind maps were air pollution, water pollution, and noise pollution, although the order changed in both groups. It is thought that this result is due to the fact that there are environmental problems that pre-service teachers encounter the most in their environment, depending on their daily life experiences. When the categories were analyzed, it was concluded that the titles were global environmental problems, types of environmental pollution, causes, consequences, and precautions. It is

thought that this is due to the fact that the subjects in cooperative learning groups are learned in an organized and systematic way by dividing them into subheadings such as what environmental problems are, how they occur, their consequences, and the measures to be taken against environmental problems. Parallel to the results of the research, in a study conducted by Kiryak, Candas, and Özmen (2021), the cognitive structures of pre-service teachers on environmental problems were examined, and the findings revealed that pre-service teachers tended to explain environmental problems with their observations in daily life rather than scientific facts. Such detailed and systematic results were not found in the studies in which the cognitive perception of environmental problems was revealed without using any teaching method. In the studies, it was determined that themes and codes related to types of environmental pollution and natural and human environmental problems were generally formed (Erduran Avcı et al., 2013; Hamalosmanoğlu, 2020; Öner, 2022; Özata Yücel & Özkan, 2018).

RECOMMENDATIONS

Some suggestions were made in line with the results obtained from the research. According to the results obtained from the research, it was determined that the attitudes of pre-service teachers were high before the applications. For this reason, it is recommended to identify individuals with low attitudes towards environmental problems at the beginning and to carry out studies with these individuals and to investigate the effectiveness of cooperative learning methods. Additionally, qualitative studies can be conducted to deeply explore the effects of cooperative learning methods on attitudes towards environmental problems. Given that cooperative learning methods positively influence the conceptual knowledge change of pre-service teachers towards environmental problems, it is suggested to carry out similar studies using cooperative learning methods at different educational levels. In parallel, it is recommended to conduct mixed-method studies investigating the effects of cooperative learning methods on cognitive perceptions related to environmental problems with students at different educational levels, especially in early childhood education, primary school, and middle school, where environmental awareness begins to develop.

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I hereby declare that the study has not unethical problems and that research and publication ethics have been observed carefully.

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