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RESEARCH ARTICLE

Comparison of Prospective Science and Social Studies Teachers' Knowledge Levels of and Misconceptions about Atmospheric Environmental Problems

Mustafa ÜREY
Trabzon University, Trabzon, TURKEY

Kerem ÇOLAK
Trabzon University, Trabzon, TURKEY

Hafife BOZDEMİR YÜZBAŞIOĞLU*
Kastamonu University, Kastamonu, TURKEY

Selahattin KAYMAKCI
Kastamonu University, Kastamonu, TURKEY

Abstract

The aim of this study is to investigate and compare the prospective science and social studies teachers' knowledge of and misconceptions about atmospheric environmental problems. In this study, the causal-comparative design was used. The sample of the study consisted of 441 prospective science and social studies teachers studying at faculties of education in the 2017-2018 academic year. Convenience sampling was used in the study. In the study, the Atmosphere-Related Environmental Problems Diagnostic Test (AREPDiT) was used as the data collection tool. The AREPDiT is a three-tier diagnostic test consisting of 13 questions. The first tier includes multiple choice questions, the second tier asks for the rationale of the answers given in the first tier, and the third tier questions whether or not the participants are sure about their answers. The data obtained from the prospective teachers were evaluated with the rubric developed by the researchers and SPSS.20 software package was used in data analysis. At the end of the study, it was found that the prospective science and social studies teachers had similar misconceptions while misconceptions were more prevalent among the prospective social studies teachers. It has been determined that these misconceptions are related to the causes, consequences and prevention of global warming, acid rains, ozone layer, the function of ozone layer and the benefits and harm of greenhouse effect. When the knowledge levels of the prospective science and social studies teachers about atmospheric environmental problems were compared, it was seen that prospective science teachers were more successful.

Keywords: Science, social studies, atmospheric environment problems, prospective teachers.

Introduction

Humankind has acted with the effort to control the environment in which they live since their existence, and this effort has had various effects on the world. Lying behind the global problems faced by the world today, the destructive effects of human beings have a significant place. Because of this devastating impact, there are many global problems and environmental issues are the leading ones.

Human-related factors are the basis of environmental problems. In a report published by the IPCC (Intergovernmental Panel on Climate Change) in 2007, it was stated that the

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* Corresponding Author E-mail: hbozdemir@kastamonu.edu.tr

human-related factors in environmental problems are as high as 90% (Bayraç, 2014). Increasement of the destructive impact on nature day by day, especially by taking social welfare into the forefront with the developing technology, has made technology and human beings the source of environmental problems. Therefore, while today's technology facilitates the lives of human beings in many different areas through the opportunities it provides, it is the main actor of environmental problems in the world.

One of the environmental problems divided into sub-branches is the ones caused by the atmosphere. Among the environmental problems reaching dangerous dimensions, especially the direct environmental impacts caused by the atmospheric environmental problems have become a serious threat to the future of the world and humanity. After the Industrial Revolution, atmospheric problems such as global warming, ozone depletion, greenhouse effect, and acid rain have tremendously increased and they are among the most important problems of today's world, which can be considered in this context (Çiğdemoğlu & Arslan, 2017).

The human being, the source of many environmental problems, is also seen as an indispensable element in eliminating those problems (Goueli, 2003; Ürey & Alev, 2010). The role of the human being at this point can be realized by individuals who could be able to transform the awareness and consciousness necessary for the related problems into behavior. It is no doubt that formal or informal training is possible for individuals of this quality to be educated. Training about environmental problems in Turkey at a level of basic education is located especially in the context of the fields of science and social studies (Öztürk & Zayimoğlu Öztürk, 2016; Ürey & Aydın, 2014). As a matter of fact, one of the specific aims listed in the 2018 Social Studies Curriculum explicitly states that students are expected to “realize the limitation of the natural environment and resources, try to protect natural resources with environmental sensitivity, and have an understading of sustainable environment”. The curriculum also addresses environmental literacy among the skills to be acquired by students (Milli Eğitim Bakanlığı, 2018a). Likewise, there are explanations about environmental education in the objectives of the Science Curriculum. Moreover, compared to the Social Studies Curriculum, there are more environment-related learning outcomes and purposes listed in the Science Curriculum. When the specific objectives of the curriculum are examined, it is seen that there are aims related to environmental issues and within the scope of environmental literacy. For example, one of the aims is “to adopt scientific process skills and scientific research approach as well as to produce solutions to problems encountered in these areas in the process of discovering nature and understanding the relationship between human and environment. Another aim includes “to realize the interaction among the individual, the environment and the society as well as to increase awareness of sustainable development regarding society, economy and natural resources. Finally, another aim is stated as “to arouse interest and curiosity about the events occurring in nature and its immediate surroundings as well as to develop an attitude” (Ministry of National Education, 2018b).

Even though education on global issues in general and on environmental problems in particular are provided at different levels ranging from primary education to higher education, and generations with this awareness are aimed to be raised, such efforts do not always yield positive results. In fact, misunderstanding, misconception and confusion about environmental concepts can be encountered at every level of education (Chiu, 2007). However, this study focuses on the misconceptions of prospective science and social studies teachers in the field of teacher education at higher education level in particular. Indeed, the misconceptions of the teachers of the future might correspondingly cause misconceptions of the generations they will educate as well.

There are several studies in both the national and international literature about the conceptual understanding and misconceptions of prospective teachers about environmental problems. In general, these studies investigated prospective teachers' misconceptions about greenhouse effect (Arsal, 2010; Groves & Pugh, 1999; Selvi, 2007; Topsakal & Altınöz, 2010), global warming (Aksan & Çelikler, 2013; Eroğlu & Aydoğdu, 2016; Kaya, 2013; Odabaşı Çimer, Çimer & Ursavaş, 2011), acid rains (Kara, 2015; Pabuçcu, 2016) and ozone depletion (Boyes, Chambers & Stanisstreet, 1995; Cordero, 2000; Topsakal & Kara, 2009). In addition, there are studies in the literature that focused on more than one environmental problem (Arslan, Çiğdemoğlu, & Moseley, 2012; Summers, Kruger, Childs, & Manta, 2000; Ürey, Şahin & Şahin, 2011).

The above mentioned studies have revealed that prospective teachers have many misconceptions about the environment. The studies showed that prospective teachers incorrectly correlated the greenhouse effect with acid rains (Arsal, 2010; Groves & Pugh, 1999) and with ozone depletion (Topsakal & Altınöz, 2010), and that there were information deficiencies regarding the concepts of global warming and greenhouse effect (Eroğlu & Aydoğdu, 2016). Moreover, the studies pointed out that prospective teachers made the wrong association between the causes and results of global warming (Kaya, 2013), and they considered global warming as the reason for the depletion of the ozone layer (Odabaşı Çimer, Çimer & Ursavaş, 2011). In addition, the studies revealed that prospective teachers did not have enough knowledge about acid rains and their direct or indirect effects (Kara, 2015), and that they established wrong cause and effect relationships between environmental problems such as greenhouse effect, global warming, ozone depletion and acid rains (Aksan & Çelikler, 2013; Arslan, Çiğdemoğlu, & Moseley, 2012; Khalid, 2003). Based on the results of these studies, even though the atmospheric environmental problems are examined seperately, there are misconceptions among prospective teachers in associating these environmental problems with each other. That is, these studies revealed that prospective teachers have many misconceptions about the environment. However, it has been found that these studies either provide an overview of environmental problems or address one of the atmospheric environmental problems (global warming, greenhouse effect, ozone depletion, acid rain) separately to present the current situation.

As it is known, environmental issues and environmental education have an interdisciplinary structure and are for the benefit of both science and social science. Considering the field of education, environmental problems at basic education level are the common area of science and social studies courses. In this regard, the competence level of the teachers, who will transfer the learning outcomes in the curriculum to their students, is very important because students who are trained by inadequate teachers will not be aware of the importance and sensitivity of the subject. In other words, individuals who have acquired awareness and consciousness about environmental problems cannot be raised. In fact, even if they can be raised with these senses, the awareness and consciousness they develop cannot lead to the formation of a society that transform into behavior. In this sense, correcting thefuture teachers' misconceptions about these issues will make a worthy contribution to what needs to be done for the source and elimination of environmental problems. As a matter of fact, future generations will gain sensitivity and awareness about environmental problems and turn these features into behavior only with the help of the teachers who are aware of these problems. Moreover, the importance of teachers' awareness of environmental issues will become more obvious as the children who will be directly affected by the environmental problems which are expected to become more severe in the future are also expected to solve these problems (Campell, Waliczek & Zajicek, 1999). In this regard, the results of this research draw attention to the issue of the necessity or enrichment of the courses related to environmental problems in teacher education programs as well.

The aim of this study is to investigate and compare the prospective science and social studies teachers' knowledge of and misconceptions about atmospheric environmental problems. In this context, the following questions were posed:

1. What kind of misconceptions do the prospective science and social studies teachers have about atmosphere-related environmental problems?
2. Is there a significant difference between the prospective science and social studies teachers' knowledge level of atmospheric environmental problems?

Methodology

The study was conducted within the causal-comparatice research design. Causal-comparative research aims to investigate the cause and consequences of existing differences in the behavior or status of groups or individuals. In the basic causal comparative design, two groups of different variables can be selected, differing in various variables (Gay, Mills, & Airasian, 2012). The reason of using the causal comparative design is to be able to describe the prospective science and social studies teachers` current knowledge levels of and misconceptions about atmospheric environmental problems and to examine the differences between these prospective teachers' knowledge levels and misconceptions thoroughly.

Working Group

The sample of this study consisted of the prospective science and social studies teachers in Turkey. The study was conducted with the participants studying in the faculty of education at five different universities in Turkey in the 2017-2018 academic year. In the selection of the universities and the participants, convenience sampling was used. Moreover, criterion sampling was also utilized as that the participants had taken courses on environmental education at the undergraduate level was taken into consideration when they were selected. A total of 441 prospective teachers, 229 of whom were studying science education and 212 of whom were studying social studies education, participated in the study.

Table 1 shows the distribution of university, gender, program and grade levels of the prospective teachers:

Table 1.

Distribution of prospective teachers by universities

University	*Science (f)*				*Social Studies (f)*				*Total (f)*			
	Gender		*Level of Class*		*Gender*		*Level of Class*		*Gender*		*Level of Class*	
	W	*M*	*3*	*4*	*W*	*M*	*3*	*4*	*W*	*M*	*3*	*4*
Kafkas University	13	5	7	11	19	8	12	15	32	13	19	26
Karadeniz Technical University	52	17	30	39	43	31	14	60	95	48	44	99
Kastamonu University	39	11	21	29	22	17	18	21	61	28	39	50
Marmara University	41	23	26	38	24	20	10	34	65	43	36	72
Recep Tayyip Erdoğan University	19	9	11	17	17	11	13	15	36	20	24	32
Total (f)	164	65	95	134	125	87	67	145	289	152	162	279

Data Collection Tool and Collecting Data

In this study, the Atmosphere-Related Environmental Problems Diagnosis Test (AREPDiT) which was developed for prospective teachers by Arslan, Çiğdemoğlu & Moseley (2012) in the USA and which was adapted to Turkish by Çiğdemoğlu & Arslan (2017) was used as a data collection tool. The AREPDiT is a 3-tier diagnostic test. The three-tier tests are based on the idea that they can eliminate the drawbacks of two-tier tests, developed by Treagust (1998) to identify misconceptions. Thanks to three-tier tests, the misconception can be distinguished from the lack of knowledge that emerges from the participants' predictive answers (Caleon & Subramaniam, 2010; Peşman & Eryılmaz, 2010). In this respect, the AREPDiT is considered important in terms of revealing the level and quality of misconceptions as a more valid and reliable measurement.

The AREPDiT is a three-tier diagnostic test consisting of 13 questions, and it questions the causes, consequences and precautions of the concepts of global warming, greenhouse effect, ozone depletion and acid rain, which are the environmental problems caused by the atmosphere. The first tier of the AREPDiT consists of multiple-choice questions, while the second tier asks the reason for the answers given in the first tier. In the third tier, whether the participants were sure about their answers in the first or second tiers is questioned. The questions are about the causes, results and solutions of environmental problems. In particular, four of the questions in the AREPDiT are on global warming (1, 2, 5, 6), two of them are on greenhouse effect (3, 4), four were on ozone depletion (7, 8, 9, 10), and three were on acid rain (11, 12, 13).

Prior to the implementation, item analysis for the AREPDiT had been performed and the internal consistency coefficient of Cronbach Alpha was calculated as 0.73 and difficulty level was calculated as 0.22. According to Büyüköztürk (2011), tests with a reliability coefficient above 0.70 are considered sufficient in terms of reliability. In this context, it can be claimed that the AREPDiT is a viable measurement tool for determining the level of knowledge and misconceptions of prospective teachers about environmental problems caused by the atmosphere.

The data collection tool was implemented and the data was collected by the researchers directly at the two universities, while the data was collected by the representatives at the other three universities. The process was carried out face-to-face through representatives.

Analyzing Data

In the analysis of the AREPDiT, the questions were grouped by considering each of the environmental problems originating from the atmosphere (global warming, greenhouse effect, ozone depletion, acid rain) and each group was evaluated within itself. The rubric presented in Table 2 was used to determine the participants' knowledge level of and misconceptions about atmospheric environmental problems.

Table 2.

Assessment of AREPDiT rubric

Answers			*Categories*	*Point*
Tier 1	*Tier 2*	*Tier 3*		
Correct	Correct	Sure	Scientific Knowledge (SK)	4
Correct	Correct	Unsure	Lack of Luck / Confidence (L-	3
Correct	Wrong	Unsure	Lack of Knowledge (LK)	2
Wrong	Correct	Unsure		
Wrong	Wrong	Unsure		
Correct	Wrong	Sure	Misconception (MC)	1
Wrong	Correct	Sure		
False	False	Sure		

The triple combination structure developed by Arslan, Çiğdemoğlu & Moseley (2012) was used to create the rubric. In this context, the categories were created according to the answers of the questions in the first and second tiers and whether the participants were sure of their answers or not. In the process of creating categories, the opinions of three faculty members who were experts in the field of measurement-evaluation, science education and social studies education were consulted. Four categories were developed in line with the expert opinions. The prospective teachers who were sure that their answers for the questions in the first and second tiers were correct were put in the "scientific knowledge" category; the prospective teachers who were not sure of theirs answers were in the “lack of luck / confidence” category; the prospective teachers who were not sure of their answers for one of the questions in the first and second tiers correctly or both wrongly, were in the “lack of knowledge” category; and the prospective teachers who were sure of their answers were put in the category of "misconception". In the evaluation process, while 4 points were given to the “scientific knowledge” category for each question, 3 points were given to the “lack of luck / confidence” category, 2 points to the “lack of knowledge” category, and 1 point to the “misconception” category. The data from the prospective teachers who did not answer any tiers in the test were not included in the study.

The data obtained from the evaluation rubric were analyzed by using SPSS.20 software package. In this regard, the knowledge levels of prospective science and social studies teachers about atmospheric environmental problems were compared with the t-test for independent groups. Global warming, greenhouse effect, ozone depletion, acid rain and overalll total knowledge levels were analyzed separately. The maximum point of the test from the global warming and ozone depletion dimensions is 16 while the minimum point is 4; the maximum point from the greenhouse effect dimension is 8 and the minimum point is 2; the maximum point from the acid rain dimension is 12, the minimum point is 3, and the maximum total score is 52 while the minimum score is 13. Likewise, the rubric in Table 2 was also used to determine the misconceptions of the prospective teachers. Moreover, their answers and rationales at each tier of the test were compared with the frequency and percentage values.

Findings

Findings are presented according to sub-problems.

As for the first sub-problem of the study

To answer this question, the misconceptions of prospective science and social studies teachers about each of the environmental problems caused by atmosphere were examined. In this context, the prospective teachers' misconceptions about global warming, greenhouse effect, ozone depletion and acid rain were investigated comparatively.

The misconceptions of the prospective science and social studies teachers about global warming were discussed comparatively, and the findings are presented in Table 3.

Table 3.

The comparison of the prospective science and social studies teachers' misconceptions about global warming

Question No	Science (n=229)								Social Studies (n=212)							
	MC		LK		L-LC		SK		MC		LK		L-LC		SK	
	f	%	f	%	f	%	f	%	f	%	f	%	f	%	f	%
1	121	53	13	6	17	7	78	34	134	63	17	8	7	3	54	26
2	61	27	22	10	12	5	134	58	66	31	17	8	9	4	120	57
5	151	66	3	1	15	7	60	26	138	65	40	19	13	6	21	10
6	78	34	44	19	17	7	90	40	76	36	50	24	29	13	57	27

Items 1, 2, 5 and 6 were used to reveal the misconceptions about the problem of global warming. In the Questions 1 and 2, where the causes and consequences of global warming were questioned, it was seen that misconceptions were more common among the prospective social studies teachers. On another hand, it was seen that the misconceptions rates are equal for the 5th and 6th questions where the solutions that could be effective in preventing global warming and the responsibilities of the officials were questioned.

In the Question 1, which addressed the cause of global warming, while 53% of the prospective science teachers were found to have misconceptions, it was seen that the prospective social studies teachers had such misconceptions more (63%). In the second question where the results of global warming were questioned, it was found that similar statistical results emerged and that the prospective social studies teachers had more misconceptions about the results of global warming (31%) than the prospective science teachers had (27%). In the 5th and 6th questions, where the solutions that could be effective in preventing global warming and the responsibilities of the officials were questioned, it was seen that the differentiations between the two groups were very close to each other. In the fifth question, where solution suggestions for global warming were questioned, it was seen that 66% of the prospective science teachers and 65% of the prospective social studies teachers had misconceptions. In the sixth question, where the responsibilities of the officials in the prevention of global warming were questioned, it was seen that the prospective science teachers (34%) and social studies (36%) had similar misconceptions.

The results obtained when the prospective teachers were asked to justify their answers about global warming were examined comparatively, and the findings were presented in Table 4.

Table 4.

The prospective science and social studies teachers' misconceptions about the causes of global warming

Question No	*Option*	*Science (S)*				*Social Studies (SS)*				*Option*	*Question No*
		Tier 1 (Answer)		*Tier 2 (Reason)*		*Tier 1 (Answer)*		*Tier 2 (Reason)*			
		f	*%*	*f*	*%*	*f*	*%*	*f*	*%*		
1 (n_1=229, n_2=121)	a	97	42	47	39	95	45	39	29	a	1 (n_1=212, n_2=134)
	b	132*	58*	51	42	117*	55*	74	55	b	
	c	-	-	6**	5**	-	-	8**	6**	c	
	d	-	-	17	14	-	-	13	10	d	
2 (n_1=229, n_2=61)	a	149*	65*	29	47	146*	68*	37	56	a	2 (n_1=212, n_2=66)
	b	31	14	28	46	33	16	25	38	b	
	c	49	21	4**	7**	33	16	4**	6**	c	
5 (n_1=229, n_2=151)	a	43	19	85	56	102	48	74	54	a	5 (n_1=212, n_2=138)
	b	120*	52*	7	5	52*	25*	34	24	b	
	c	37	16	23	15	32	15	17	12	c	
	d	29	13	36**	24**	26	12	13**	10**	d	
6 (n_1=229, n_2=78)	a	48	21	32	41	69	33	32	42	a	6 (n_1=212, n_2=76)
	b	42	18	5**	6**	55	26	5**	7**	b	
	c	32	14	17	22	15	7	7	9	c	
	d	107*	47*	24	31	73*	34*	32	42	d	

n_1: prospective teachers answering Tier 1, n_2: prospective teachers with misconceptions, * correct answer, ** correct justification

In Question 1 asking the cause of global warming, the reasons of the prospective teachers who gave wrong answers by choosing the option of “ozone depletion” instead of the option of “Periodic increase in the temperature of the atmosphere with the effect of greenhouse gases” (S=42%, SS=45%) were examined. Here, it was seen that both prospective science and social studies teachers focused on the options “a” and “b” for justification. It was also observed that the prospective teachers showed *“…due to the fact that more ultraviolet (UV) rays to the world*” (S=42%, SS=55%) and *“due to the direct sun rays into the earth because of ozone depletion”* (S=39%, SS=29%) as the reasons for global warming.

In the 2nd question, where the consequences of global warming were asked, when the reasons of the prospective teachers who gave the wrong answer by marking “skin cancer” (S = 14%, SS = 16%) and “acid rain” (S = 21%, SS = 16%) instead of "drought” option were examined, it was seen that they focused on the options “a” and “b”. It was found that the prospective teachers had misconceptions as they gave answers such as *"… more acid rain will occur in result of global warming…”* (S=47%, SS=56%) and *"… skin cancer might increase as more sunlight will land on the earth as a result of global warming…”* (S=46%, SS=38%).

In question 5, which sought the option that cannot be a solution for global warming, it was seen that the prospective teachers marked the options that can be solution for global

warming like "recycling paper more" (S = 19%, SS = 48%), "generating electricity from renewable energy sources" (S=16%, SS=15%) and "using less sprays like deodorant, etc. containing chlorofluorocarbons (CFC)" instead of choosing the correct option of "using the unleaded gas". It was observed that the prospective teachers in both groups responded incorrectly by selecting especially the option of "recycling more paper", and that they *chose "…recycling is only about cutting trees…"* (S=56%, SS=54%) as the reason for their answers.

In question 6, which addressed the measures to be taken to stop the global warming, the prospective teachers chose "imposing restrictions on chemical wastes discharged to rivers by factories" (S=21%, SS=33%), "not building nucler power plants" (S=18%, SS=26%) and "limiting the use of pesticides in agricultural activities" (S=14%, SS=7%) options instead of choosing the option of "promoting reforestation campaigns". When the reasons about the answers of the prospective teachers were examined, it was seen that both groups were concentrated on the "a" and "d" options. It was observed that the prospective teachers have expressed wrong opinions such as that *"…nuclear energy use is not environmentally friendly…"* (S=41%, SS=42%), and that *"…pollution of rivers can harm the ecosystem…"* (S=31%, SS=42%) could cause global warming.

The misconceptions of the prospective science and social studies teachers about the greenhouse effect were discussed comparatively and are shown in Table 5.

Table 5.

Comparison of misconceptions of the prospective science and social studies teachers about greenhouse effect

Question No	Science (n=229)								Social Studies (n=212)							
	MC		LK		L-LC		SK		MC		LK		L-LC		SK	
	f	%	f	%	f	%	f	%	f	%	f	%	f	%	f	%
3	47	21	25	11	38	16	119	52	75	35	33	16	21	11	81	38
4	143	62	25	11	18	8	43	19	144	68	42	20	4	2	22	10

Items about the misconceptions about greenhouse effect were the Questions 3 and 4. While in Question 3, the definition of the greenhouse effect was asked, in Question 4, the benefits and harmof the greenhouse effect were questioned. When Table 5 is examined, it is seen that the prospective social studies teachers had more misconceptions in both items.

In the 3rd question, where the definition of greenhouse effect was questioned, it was observed that both groups, especially the prospective science teachers (52%) had a high level of scientific knowledge (SK). However, when it was examined in terms of misconceptions, it was seen that the prospective social studies teachers (35%) had higher misconceptions than the prospective science teachers had (21%). In the fourth question where the benefits and harm of the greenhouse effect was questioned, it was seen that the prospective teachers in both groups had misconceptions at high rate. In fact, it was observed that 68% of the prospective teachers had misconceptions about the benefits or harm of greenhouse effect andthe prospective science teachers had misconceptions about that in the rate of 62%.

The prospective teachers were asked to give justifications of their answers about the greenhouse effect and the results were examined comparatively. The findings are presented in Table 6.

Table 6.

Reasons for the misconceptions of the prospective science and social studies teachers about greenhouse effect

Question No	Option	Science				Social Studies				Option	Question No
		Tier 1 (Answer)		Tier 2 (Reason)		Tier 1 (Answer)		Tier 2 (Reason)			
		f	%	*f*	%	*f*	%	*f*	%		
3 (n_1=229, n_2=47)	a	190*	83*	23	49	142*	67*	38	51	a	3 (n_1=212, n_2=75)
	b	10	4	14**	30**	17	8	12**	16**	b	
	c	29	13	10	21	53	25	25	33	c	
4 (n_1=229, n_2=143)	a	3	1	2	1	3	1	20	14	a	4 (n_1=212, n_2=144)
	b	140	61	76**	54**	164	78	11**	8**	b	
	c	87*	38*	5	3	42*	20*	4	2	c	
	d	0	0	60	42	3	1	109	76	d	

n_1: Prospective teachers who answered Tier 1, n_2: Prospective teachers with misconceptions, * correct answer, ** correct justification

In the 3rd question where the definition of greenhouse effect was asked, it was seen that the prospective teachers have described it as as “an unnatural process” (S=4%, SS=8%) and as “a process that increases only because of human activities and develops depending on CO2 concentration” (S=13%, SS=25%) instead of "absorbing the rays reflected from the earth by various gases in the atmosphere". When the reasons of the prospective teachers who gave incorrect answers by giving these definitions were examined, it was found that the prospective teachers in both groups focused on the options “a” and “c". It was also observed that the prospective teachers expressed their opinions such as the greenhouse effect “… is developed only depending on the CO2 intensity…” (S=49%, SS=51%) and "…is an artificial process that emerged after the industrial revolution…” (S=21%, SS=33%).

In question 4, where the benefits and harm of the greenhouse effect was questioned, the prospective teachers gave the wrong answers by choosing the options of “beneficial” (S = 1%, SS = 1%), “harmful” (S = 61%, SS = 78%) and “ineffective” (SS= 1%) instead of choosing the correct option “both beneficial and harmful”. Both groups of the prospective teachers indicated that “...greenhouse effect leads to ozone depletion...” (S=42%, SS=76%) as a justification for the wrong options mentioned.

The prospective science and social studies teachers' misconceptions about ozone depletion were discussed comparatively and are presented in Table 7.

Table 7.

Comparison of misconceptions of the prospective science and social studies teachers about ozone depletion

Question No	Science (n=229)								Social Studies (n=212)							
	MC		LK		L-LC		SK		MC		LK		L-LC		SK	
	f	%	*f*	%	*f*	%	*f*	%	*f*	%	*f*	%	*f*	%	*f*	%
7	45	20	18	8	18	8	148	64	76	36	14	7	9	4	113	53
8	63	28	39	17	16	7	111	48	115	54	54	26	6	3	37	17
9	129	56	55	24	9	4	36	16	136	64	46	22	2	1	28	13
10	64	28	14	6	24	10	127	56	122	58	39	17	8	4	43	21

Items about the function, cause, consequence and precautions to be taken related to the ozone layer were the 7th, 8th, 9th and 10th questions. When Table 7 is examined, it is seen that the prospective social studies teachers had more misconceptions than the prospective science teachers had in all questions. Especially in questions 7, 8 and 10, it was seen that the difference between the error rate of the two groups widened.

In the 7th question, where the function of the ozone layer was questioned, it was found out that 36% of the prospective social studies teachers had misconceptions while the prospective science teachers had misconceptions in the rate of 20%. Similarly, in the 8th question in which the reasons for the ozone depletion were questioned, it was seen that the prospective social studies teachers had almost twice as much misconceptions compared to the prospective science teachers (S=28%, SS=54%). In the question 9 where the consequences of the ozone depletion were questioned, it was found that the error rate between the groups was close to each other (S=56%, SS=64%). Finally, in the 10th question which focused on how to stop ozone depletion, it was observed that the ratio of misconceptions for the prospective social studies teachers was more than twice the rate of misconceptions of the prospective science teachers (S=28%, SS=58%).

The justifications for the answers given by the prospective teachers about the ozone depletion were examined comparatively, and they are presented in Table 8.

Table 8.

The prospective science and social studies teachers' justifications that belong to misconceptions about ozone depletion

Question No	*Option*	*Science*				*Social Studies*				*Option*	*Question No*
		Tier 1 (Answer)		*Tier 2 (Reason)*		*Tier 1 (Reason)*		*Tier 2 (Reason)*			
		f	*%*	*f*	*%*	*f*	*%*	*f*	*%*		
7 (n_1=229, n_2=45)	a	21	9	6**	13**	40	19	3**	4**	a	7 (n_1=212, n_2=76)
	b	178*	78*	20	45	137*	65*	51	67	b	
	c	30	13	19	42	35	16	22	29	c	
8 (n_1=229, n_2=63)	a	35	15	3	5	47	22	15	13	a	8 (n_1=212, n_2=115)
	b	30	13	21	34	68	32	31	27	b	
	c	14	6	7**	11**	17	8	6**	5**	c	
	d	22	10	26	41	28	14	47	41	d	
	e	128*	56*	6	9	52*	24*	16	14	e	
9 (n_1=229, n_2=129)	a	68	30	80	62	56	26	83	62	a	9 (n_1=212, n_2=136)
	b	11	5	18**	14**	18	9	18**	13**	b	
	c	48	21	4	3	42	20	5	3	c	
	d	102*	44*	27	21	96*	45*	30	22	d	
10 (n_1=229, n_2=64)	a	13	6	38	59	24	11	75	62	a	10 (n_1=212, n_2=122)
	b	60	26	16	25	129	61	33	27	b	
	c	156*	68*	10**	16**	59*	28*	14**	11**	c	

n_1: Prospective teachers who answered tier 1, n_2: Prospective teachers with misconceptions, * correct answer, ** correct justification

In the 7th question where the function of ozone layer was asked, it was seen that the prospective teachers in both groups had the same misconception. It was observed that while prospective teachers were expected to choose the option of "it filters ultraviolet rays from the Sun", they gave wrong answers by choosing the options "it protects the world from acid rains" (S=9%, SS=19%) and "it makes the world habitable by keeping its temperature stable" (S=13%, SS=16%). When the justifications of the prospective teachers were examined, it was seen that they focused on the options of "...by keeping

the sun's rays out of the atmosphere, it makes the world heat habitable…" (S=45%, SS=67%) and "...the ozone layer acts as a shield to prevent acid rain from reaching the surface of the earth…" (S=42%, SS=29%).

In the 8th question where the reasons for the ozone depletion were asked, it was found out that the prospective science and social studies teachers gave wrong answers by choosing "carbon dioxide (CO2)" (S=15%, SS=22%), "greenhouse effect" (S=13%, SS=32%), "nuclear power plants" (S=6%, SS=8%) and "carbon monoxide (CO)" (S=10%, SS=14%) instead of giving the correct answer "products containing chlorofluorocarbon (CFC)". When the rationale of the prospective teachers was examined, it was seen that the prospective teachers in both groups focused on similar justifications (options b and d). It was observed that the prospective teachers expressed their reasons about ozone ldepletion as "…the greenhouse effect increases the global warming and damages the ozone layer…" (S=41%, SS=41%) and "…the pollutant and destructive effect of carbon dioxide (CO2) on earth…" (S=34%, SS=27%)".

In question 9, where the consequences of ozone depletion were asked, it was found that the prospective teachers gave the wrong answers by choosing the options such as "increasing in floods" (S=30%, SS=26%), "arrival of more solar radiation to the atmosphere" (S=21%, SS=20%) and "air leakage from atmosphere to space" (S=5%, SS=9%) instead of choosing the correct option "increase in cases of skin cancer and cataracts". When the the prospective teachers' justifications were examined, it was seen that the prospective teachers in both groups claimed that with ozone depletion, "…glaciers in Polar region can melt…" (S=62%, SS=62%) and "...more sunlight can reach the atmosphere…" (S=21%, SS=22%).

In question 10, what can be done to stop ozone depletion was asked. Instead of choosing the the option "we should not use sprays contain chlorofluorocarbon (CFC) like deodorant", the prospective teachers chose wrongoptions such as "we should use public transport" (S=6%, SS=11%), and "we need to place filters on factory chimneys and exhausts" (S=26%, SS=61%). It was seen that the prospective teachers chose the opinions of "... factory wastes will deplete ozone layer…" (S=59%, SS=62%) and "…decreasement of CO2 production will stop ozone depletion…" (S=25%, SS=27%) as the reasons for their answers.

The misconceptions of the prospective science and social studies teachers about acid rain were examined in a comparative way and are presented in Table 9.

Table 9.

Comparison of the the prospective science and social studies teachers` misconceptions about acid rain

Question No	Science (n=229)								Social Studies (n=212)							
	MC		LK		L-LC		SK		MC		LK		L-LC		SK	
	f	%	f	%	f	%	f	%	f	%	f	%	f	%	f	%
11	80	35	69	30	35	15	45	20	88	42	76	36	11	5	37	17
12	81	35	62	27	16	7	70	31	120	57	55	26	6	3	31	14
13	97	43	42	18	26	11	64	28	110	52	55	26	10	5	37	17

Items related to misconceptions about acid rain were the 11th, 12th and 13th questions. In parallel with the other dimensions, it was noted that the prospective social studies teachers had more misconceptions than the prospective science teachers had.

In the 11th question which was posed for the correct answer about acid rains, it was found out that the two groups had a misconception at a close rate. In fact, it was seen that 35% of the prospective science teachers had misconceptions while 36% of the prospective social studies teachers had such misconceptions. In the 12th question in which the consequences of acid rains were questioned, it was seen that the rate of misconceptions among the groups increased as the prospective social studies teachers had more. As a matter of fact, while misconceptions were observed in 35% of the prospective science teachers, it was observed in 57% of the prospective social studies teachers. In the 13th question, which is the last question of the test, the precautions that can be taken against acid rains were questioned. Similar statistical results were observed here and it was observed that the prospective social studies teachers had more misconceptions about the precautions that could be taken against acid rain compared to the prospective science teachers (S=43%, SS=52%).

The justifications for the answers of the prospective teachers about acid rains were examined comparatively, and are presented in Table 10.

Table 10.

The prospective science and social studies teachers' misconceptions about acid rain

Question No	*Option*	*Science*				*Social Studies*				*Option*	*Question No*
		Tier 1 (Answer)		*Tier 2 (Reason)*		*Tier 1 (Answer)*		*Tier 2 (Reason)*			
		f	*%*	*f*	*%*	*f*	*%*	*f*	*%*		
11 (n_1=229, n_2=80)	a	125	55	17	21	99	47	30	34	a	11 (n_1=212, n_2=88)
	b	90*	39*	26	33	75*	35*	21	24	b	
	c	14	6	7	9	38	18	19	21	c	
	d	-	-	30**	37**	-	-	18**	21**	d	
12 (n_1=229, n_2=81)	a	16	7	28	35	23	11	74	62	a	12 (n_1=212, n_2=120)
	b	22	10	3	4	36	17	8	7	b	
	c	128*	56*	7	9	74*	35*	16	13	c	
	d	6	3	2	2	7	3	4	3	d	
	e	57	24	41**	50**	72	34	18**	15**	e	
13 (n_1=229, n_2=97)	a	58	25	34	35	97	46	56	51	a	13 (n_1=212, n_2=110)
	b	116*	51*	6	6	62	29	44	40	b	
	c	55	24	57**	59**	53	25	10**	9**	c	

n_1: Prospective teachers who answered tier 1, n_2: Prospective teachers with misconceptions, * correct answer, ** correct justification

In the 11th question where the correct statement about acid rains was asked, it was observed that the prospective teachers gave the wrong answer by choosing the options that "acid rain occurs with the accumulation of methane (CH_4) in the atmosphere" (S=55%, SS=47%) and "ozone depletion causes acid rain" (S=6%, SS=18%) instead of choosing the correct option, which is "it is formed as a result of the wastes generated by the burning of fossil fuels mixed into the water cycle". When the justification of the prospective teachers were examined, it was seen that the prospective teachers in both groups presented their opinions as *"...contribution of chlorofluorocarbons to the formation of acid rain..." (S=21%, SS=34%)* and *"...causing of harmful gases (CH_4) that are in waste collection areas to acid rain..."* (S=33%, SS=24%).

In the 12th question where the consequences of the acid rains were asked, the prospective teachers gave incorrect answers by choosing the options of “ozone depletion” (S=7%, SS=11%), “increasing global warming” (S=10%, SS=17%), and "burning everything it touches” (S=24%, SS=34%) instead the correct option of "damaging buildings, busts and historical buildings”. Likewise, the rationale of the prospective teachers was examined and it was observed that the prospective teachers in both groups focused especially on the option *"... because acid rain is acidic, it burns everything it comes into contact with..."* (S=35%, SS=62%).

In the 13th question where the precautions against acid rains were questioned, it was found that instead of marking the option of "the use of fossil fuels as energy source should be avoided”, the prospective teachers gave wrong answers choosing the options of "we must avoid behaviors that damage the ozone layer” (S=25%, SS=46%) and “carbon monoxide (CO) emissions have to be limited” (S=24%, SS=25%). When the reasons of the prospective teachers were examined, it was seen that they had asserted the opinions that *“… carbon monoxide (CO) is the main cause of acid rains…”* (S=%35, SS=%51) *and "…the ozone layer protects the world from acid rains…"* (S=%6, SS=%40).

As for the second sub-problem of the study

The knowledge levels of the prospective science and social studies teachers about atmospheric environmental problems were questioned and the differences between these two groups were compared. For this purpose, the prospective teachers' level of knowledge of global warming, greenhouse effect, ozone depletion and acid rain were examined comparatively, and the findings are presented in Table 11.

Table 11.

The comparison of the prospective science and social studies teachers' knowledge level of atmospheric environment problems

Atmospheric Environmental Problems	*Group*	*N*	$\bar{X}$	*ss*	*sd*	*t*	*p*
Global Warming	Science	229	9.13	2.79	439	2.604	0.010*
	Social Studies	212	8.43	2.82			
Greenhouse Effect	Science	229	4.82	1.76		4.543	0.000*
	Social Studies	212	4.06	1.76			
Ozone Depletion	Science	229	7.72	2.43		6.740	0.000*
	Social Studies	212	6.21	2.26			
Acid Rain	Science	229	9.70	3.01		8.532	0.000*
	Social Studies	212	7.48	2.38			
Total	Science	229	31.40	6.24		9.013	0.000*
	Social Studies	212	26.20	5.82			

** p <0.05 significant*

When the knowledge levels of the prospective science and social studies teachers about atmospheric environmental problems were compared, it was found that there was a difference between the knowledge levels of the prospective scienceteachers and the prospective social studies teachers, and this difference was in favor of the prospective science teachers ($t_{(439)}$=9.013, p<.05). When Table 3 is examined, it is seen that the prospective science teachers were more successful than the prospective social studies teachers about the subjects of global warming t (439) = 2.604, p <.05), greenhouse effect

t (439) = 4.543, p <.05), ozone depletion t (439) = 6.740) p <.05) and acid rain t (439) = 8.532, p <.05).

Discussion, Conclusion and Recommendations

When the knowledge levels of prospective science and social studiesteachers about atmospheric environmental problems were examined, it was seen that the knowledge levels of the prospective science teachers were higher than the levels of the prospective social studies teachers, and this difference was also statistically significant. It has been obsereved that this difference gives similar results in each atmosphere-related environmental problem (i.e., global warming, greenhouse effect, ozone depletion and acid rain). Hobson (1993) states that ozone depletion, which is one of the atmospheric environmental problems, is a science subject that is compatible with the basic subjects in biology, chemistry, geology and physics. In this respect, the field of science is highlighted for dealing with environmental problems in general and ozone depletion in particular. Observation of a significant difference in terms of knowledge in favor of prospective science teachers might have been due to this situation. In addition, in their studies conducted to examine misconceptions of prospective elementary school teachers about the ozone layer, Topsakal & Kara (2009) founded that the prospective science teachers correctly answered questions more than the prospective social studies teachers. The results of this study are in line with those of Topsakal & Kara's (2009) outcomes.

In their research with university students on the greenhouse effect, Groves & Pugh (1999) stated that science-based subjects had relatively more scores compared to educational subjects, but there was no significant difference among the scores within educational subjects. Although this situation does not show similarity with the results of the study, the fact that the science-based departments receive more scores on this issue shows that environmental problems are more relevant in the content of science. Because in order greenhouse effect to be known, preliminary knowledge on the subjects and concepts such as greenhouse gases, infrared, ultraviolet rays, short-wavelength light, long-wavelength light, heat, temperature is required. When these subjects and concepts are examined, it is seen that they are more related to science in terms of the content. In addition to the environmental science courses, prospective science teachers have courses on also these subjects and concepts. As a result, a significant difference in favor of the prospective science teachers might occur due to this situation.

Besides the knowledge levels of the prospective teachers, misconceptions about atmospheric environmental problems (i.e., global warming, greenhouse effect, ozone depletion, acid rains) were also found out in this study. The identification and elimination of these misconceptions, which constitute an obstacle for effective environmental education, will also lead to effective planning of the learning environments in the future (Bozkurt & Cansüngü, 2002; Ürey, Şahin & Şahin, 2011). For this reason, if the misconceptions of the prospective teachers are reflected in the learning environments, the same misconceptions may also occur in the students these prospective teachers will train. This will probably affect the learning in both current and advanced periods in an adverse way.

In the present study, it was found that both the prospective science and social studies teachers had misconceptions about global warming, which is one of the environmental problems caused by atmosphere also are misconceptions of. These misconceptions are generally in connection with the causes, consequences and prevention of global warming. When the reasons were examined, it was seen that the ratio of those who gave incorrect answers due to ozone depletion was close to each other in the prospective science and social studies teachers and these rates were above 40%. It is presented in

other studies that such misconception is common among prospective teachers. In the studies in which prospective teachers' understanding levels of greenhouse gases and global warming concepts were investigated (Bahar & Aydın, 2002; Ürey, Şahin & Şahin, 2011), and their perception of global warming were examined (Bozdoğan, 2009), the prospective teachers stated that ozone depletion was the cause of global warming. Ural, Ercan & Bilen (2017) stated that the prospective science teachers had the same misconceptions in their research in which they identified misconceptions about carbon cycle and global warming. Şenel & Güngör (2009) also pointed out that some of the prospective teachers stated that global warming is the result of ozone depletion.

In the present study, due to the association between global warming and ozone depletion and for the function of ozone layer, the prospective teachers chose the options of “more ultraviolet (UV) rays to the world than usual” and of “the direct descent of the solar rays into the earth” as reasons of global warming due to ozone depletion. At the same time, when the results of global warming were examined, the `skin cancer` option were chosen by a small number of the prospective teachers. It can be argued that the reason of this situation is due to the confusion about the results of ozone depletion. The option that there might be an increase in skin cancer, as more sunlight would land on the earth due to global warming, which the prospective teacher chose as their justification, confirms this situation. Similarly, Arslan, Çiğdemoğlu & Moseley (2012) pointed out prospective teachers' misconceptions about the relationship between global warming and skin cancer as well. Daskolia, Flogaitis & Papageorgiou (2006), in their study with prospective preschool teachers, found that the prospective teachers made an association between ozone depletion and skin cancer. There were also prospective teachers in the study who claimed that the cause of global warming was the ozone depletion.

It was observed that prospective teachers could not establish a connection to recycling in particular about the solutions for global warming. It is understood that more than half of the prospective teachers think of recycling at the point of cutting down trees. In relation to this, the prospective teachers chose the options such as to put limitations on chemical wastes discharged into rivers and on pesticide used in agricultural activities, and not to build nuclear power plants in order to stop global warming, instead of choosing the option "reforestation campaigns". In this case, it can be claimed that the prospective teachers emphasized radioactivity and factory wastes. Boyes, Chambers and Stanisstreet (1995) expressed that many of the prospective teachers pointed to radioactivity, global warming, destruction of rain forests and factory or automobile emissions as reasons of the problem of ozone depletion. Considering the common misconceptions regarding the ozone depletion and the association for global warming, it is seen that the ideas expressed for the prevention of global warming are similar to the ideas about the reasons of the ozone depletion, and that these ideas are wrong.

The definition of the concept of greenhouse effect, which is another dimension of the atmospheric environmental problems, as well was its benefits and harm were also questioned in the study. Moreover, it was observed that the prospective teachers had misconceptions about this area. Most of the prospective teachers gave the “harmful” option as their answer to the question on the benefits and harm of the greenhouse effect, and as their justficiation they stated that the greenhouse effect would lead to ozone depletion. Thus, it is seen that the skin cancer that may arise with the ozone depletion, was expressed as a result of the greenhouse effect. Topsakal & Kara (2009) stated that prospective teachers had confusion about that the greenhouse effect would lead to skin cancer. The increase of CO_2 in the atmosphere is among the causes of greenhouse effect. The fact that prospective teachers have this scientific knowledge is also found in some studies (e.g. Arsal, 2010; Papadimitriou, 2004). However, the increase in carbon dioxide (CO_2) gas in the atmosphere should not be seen as the sole cause of the greenhouse effect. In particular, the problem which the relative humidity of the

atmosphere would have on the greenhouse gases (global warming) should not be neglected (Ürey, 2018). In the study, it was found out that both prospective science and social studies teachers had misconceptions about the definition of the greenhouse effect as they described it as an artificial process that develops only based on carbon dioxide (CO_2) concentration. In a study conducted by Dove (1996), the participants stated that the greenhouse effect varied depending on the concentration of carbon dioxide (CO_2) in close percentages each other. Dove (1996) explained the reason for the fact that carbon dioxide (CO_2) gas was mentioned more among greenhouse gases and its place in environmental problems were expressed more as a result of the media. In the presentstudy, it is considered that the emphasis on carbon dioxide (CO_2) gas regarding greenhouse effect could bedue to the fact that it appears with such emphasis on both social media and other types of media which the prospective teachers have been constantly using. At the same time, the fact that carbon dioxide (CO_2) gas has a major role in this environmental problem may have caused the prospective teachers to think in this way.

The function of ozone layer as well asthe causes, consequences of and precautions agains ozone depletionare among the topics questioned in the study. In this context, it was found out that prospective science and social studies teachers had misconceptions about the function of ozone layer. There are misconceptions such as that the ozone layer will protect the earth from acid rains and it will make the world habitable by keeping the heat stable. Likewise, Pekel (2005) demonstrated that prospective scienceteachers stated that the ozone layer would provide the world to warm. The prospective teachers also indicated that ozone layer protects from acid rain at the same time. When the reasons of ozone depletion were examined, the prospective teachers in both groups chose the options of carbon dioxide (CO_2), greenhouse effect, nuclear power plants and carbon monoxide (CO) in varied percentages. Dove (1996) stated that one of the misconceptions of the prospective teachers about the ozone layer is the the sun rays come to earth because of the holes of the ozone layer and cause greenhouse effect. Topsakal & Altınöz (2010) also explained that the prospective primary schoolteachers had the opinion that ozone depletion would increase the greenhouse effect. Moreover, Khalid (2003) stated that the prospective teachers claimed that more radiation would come to the world due to the ozone depletion and thus the greenhouse effect would destroy the ozone. In the present study, when the answers given to the results of the ozone depletion were taken into consideration, it was observed that prospective teachers had similar misconceptions. As an indication of these misconceptions, the prospective teachers stated that because of ozone depletionfloods would increase, more sunlight would come to the earth, and air leakage would occur from atmosphere to space. When the reasons of the prospective teachers were examined, it was seen that the options stating due to ozone depletion, the glaciers in the poles would melt and more sunlight could reach the atmosphere were preferred. It can be claimed that such preferences and misconceptions might have been observed because of the association between the environmental problems related to ozone depletion and the concepts of layer and hole (Bahar, Bağ & Bozkurt, 2008; Papadimitriou, 2004; Ürey, Şahin & Şahin, 2011). In addition to this, while the melting of glaciers is a scientifically correct idea in terms of the consequences of global warming, it is a fundamental misconception to state that this would happen due to the ozone depletion. In the study, most of the prospective teachers argued that the glaciers would also melt if the ozone depletion happened. Once more, this thought might have been be stated by the prospective teachers because of the idea that global warming would occur as a result of the ozone depletion, which is a common misconception. Arslan, Çiğdemoğlu & Moseley (2012) stated that 12% of prospective teachers expressed that ozone depletion would be reduced by using public transport. It was claimed that this might be related to their beliefs about the destructive effect of carbon dioxide (CO_2) on the ozone layer. Moreover, in this study, the

prospective teachers explained the reasons of ozone depletion through the pollutant and destructive effects of carbon dioxide (CO_2) on the world. They also suggested that the decrease in the production of CO_2 would stop the ozone depletion.

Another environmental problem caused by atmosphere and focused on in this study was acid rains. When the prospective teachers' answers for the consequences of and precautions against acid rain were investigated, it was seen that some participants stated that the accumulation of methane (CH_4) in the atmosphere would create acid rain. On the other hand, a small number of prospective teachers stated that ozone depletion would cause acid rain. This reveals that the prospective teachers perceive the ozone layer as a layer that prevents acid rain. Pabuçcu (2016) unfolds that there might be problems in understanding acid rain and its effects due to the inadequacy of prospective teachers' knowledge of chemistry. From this point of view, it can be claimed that the idea that acid burns everything that it comes into contact is due to this lack of information.

In order to prevent acid rains, prospective teachers have expressed their thoughts about avoiding ozone-layer damaging behaviors and limiting carbon monoxide (CO) emissions. Dove (1996) claimed that the prospective teachers had poor knowledge of gases responsible for acid rain because although they talked about sulfur dioxide (SO_2), nitrous oxide (NO) was mentioned very little and even instead of this, carbon monoxide (CO) was mentioned more in connection with cars.

It was observed that the prospective teachers had misconceptions about global warming, greenhouse effect, ozone depletion and acid rain, and even the causes and consequences of these problems and the precautions to be taken against these problems were expressed interchangeably in the study. Furthermore, in their justifications for the atmosphere-related environmental problems, the prospective teachers seem to have tendencies to create superficial reasons by adhering to the existing knowledge levels. Whereas, the investigation of the reasons based on the current level of knowledge in terms of solutions to the related problems is very important in terms of revealing mental perception. Bostrom, Morgan, Fischhoff & Read (1994) highlight that it can be difficult to develop solutions due to the lack of understanding of the causes of the problems and this will create problems at the point of applying those solutions. Based on the results of the research, both the prospective science and social studies teachers' misconceptions might create barriers for them to create environment-oriented learning environments and to ensure their effectiveness. Moreover, such barriers might occur in the case of their attempts to identify, solve and take precautions against environmental problems that humanity have been dealing with lately.

In the study, it was observed that the prospective social studies teachers hadmore misconceptions about atmospheric environmental problems. In the social studies program, associating science contents with environmental problems in environment-oriented courses can be effective in eliminating misconceptions. In addition, the prospective science teachers had similar misconceptions. An instructional design can be proposed in terms of causes, consequences, and precautions through a detailed content about the environmental problems that prospective teachers might experience in both programs. In particular, learning environments can be designed in which interdisciplinary association can be established on environmental problems such as greenhouse effect, global warming, ozone depletion and acid rain, which were the focus of this research. Moreover, learning environments can be enriched by using classroom discussions on these issues and current events related to environmental issues. In the present study, it was aimed to investigate the misconceptions of the prospective science and social studies teachers about atmospheric environmental problems. In future studies, prospective teachers studying other than these two programs such as pre-school education and classroom education can also be included in the study group.

References

Aksan, Z. & Çelikler, D. (2013). İlköğretim öğretmen adaylarının küresel ısınma konusundaki görüşleri. *Eskisehir Osmangazi Üniversitesi Sosyal Bilimler Dergisi,* 14(1), 49-67.

Arsal, Z. (2010). İlköğretim öğretmen adaylarının sera etkisi ile ilgili kavram yanılgıları. *Abant İzzet Baysal Üniversitesi Eğitim Fakültesi Dergisi, 9*(1), 229-240.

Arslan, H. Ö., Çiğdemoğlu, C. & Moseley, C. (2012). A three-tier diagnostic test to assess pre-service teachers' misconceptions about global warming, greenhouse effect, ozone layerdepletion, and acid rain. *International Journal of Science Education*, *34*(11), 1667-1686.

Bahar, M. & Aydın, F. (2002). Sınıf öğretmenliği öğrencilerinin sera gazları ve global ısınma ile ilgili anlama düzeyleri ve hatalı kavramları. V. Ulusal Fen Bilimleri ve Matematik Eğitimi Kongresi'nde sunulan bildiri. Eylül 2002, ODTÜ, Ankara.

Bahar, M., Bağ, H. ve Bozkurt, O. (2008). Pre-service science teachers' understandings of an environmental ıssue: ozone layer depletion. *Ekoloji, 8*(69), 51-58

Bayraç, H. N. (2014). Enerji kullanımının küresel ısınmaya etkisi ve önleyici politikalar. *Eskişehir Osmangazi Üniversitesi Sosyal Bilimler Dergisi*, *11*(2), 229-259.

Bostrom, A., Morgan, M. G., Fischhoff, B., & Read, D. (1994). What do people know about global climate change? 1. Mental models. *Risk Analysis*, *14*(6), 959-970.

Boyes, E., Chambers, W. & Stanisstreet, M. (1995). Trainee primary teachers' ideas about the ozone layer. *Environmental Education Research*, *1*(2), 133 -145.

Bozdoğan, A. E. (2009). An investigation on Turkish prospective primary school teachers' perceptions about global warming. *World Applied Sciences Journal*, *7*(1), 43-48.

Bozkurt, O., Cansüngü, Ö. (2002). İlköğretim öğrencilerinin çevre eğitiminde sera etkisi ile ilgili kavram yanılgıları. *Hacettepe Üniversitesi Eğitim Fakültesi Dergisi, 23(3),* 67-73.

Büyüköztürk, Ş. (2011). *Sosyal bilimler için veri analizi el kitabı - istatistik, araştırma deseni, spss uygulamaları ve yorum*. Ankara: Pegem Akademi

Caleon, I. & Subramaniam, R. (2010). Development and application of a three-tier diagnostic test to assess secondary students' understanding of waves. *International Journal of Science Education, 32*(7), 939-961.

Campbell, J., Waliczek, T. M. & Zajicek, J. M. (1999). Relationship between environmental knowledge and environmental attitude of high school students. *Journal of Environmental Education*, *30*(3), 17-21.

Chiu, M. (2007). A national survey of students' conceptions of chemistry in Taiwan. *International Journal of Science Education*, *29*(4), 421-452.

Cordero, E. (2000). Misconceptions in Australian students' understanding of ozone depletion. *Critical Studies in Education, 41*(2), 85-97.

Çiğdemoğlu, C. & Arslan, H. Ö. (2017). Atmosfer ile ilgili çevre problemleri konularında kavram yanılgılarını tespit eden üç aşamalı tanı testinin Türkçeye uyarlanması. *YYÜ Eğitim Fakültesi Dergisi, 14*(1), 671-679.

Daskolia, M., Flogaitis, E. & Papageorgiou, E. (2006). Kindergarten teachers' conceptual framework on the ozone layer depletion. Exploring the associative meanings of a global environmental issue. *Journal of Science Education and Technology*, *15*(2), 168-178.

Dove, J. (1996). Student teacher understanding of the greenhouse effect, ozone layer depletion and acid rain. *Environmental Education Research*, *2*(1), 89-100.

Eroğlu, B. & Aydoğdu, M. (2016). Fen bilgisi öğretmen adaylarinin küresel isinma hakkindaki bilgi düzeylerinin belirlenmesi. *Uludağ Üniversitesi Eğitim Fakültesi Dergisi, 29* (2), 345-374 .

Gay, L. R., Mills, G. E. & Airasian, P. W. (2012). Educational research: Competencies for analysis and application. Boston: Pearson.

Goueli, S. (2003). *Environmental education in an Egyptian university: The role of teacher educators.* Unpublished PhD Dissertation, University of Alberta.

Groves, F. & Pugh, A. (1999). Elementary pre-service teacher perceptions of the greenhouse effect. *Journal of Science Education and Technology, 8*(1), 75-81.

Hobson, A. (1993). Ozone and interdisciplinary science teaching-learning to address the things that count most. *Journal of College Science Teaching, 23*(1), 33-37.

Kara, F. (2015). Knowledge level of prospective science teachers regarding formation and effects of acid rains on the environment and organisms. *International Journal of Applied Science and Technology*, *5*(4), 128-131.

Kaya, M. F. (2013). Sosyal bilgiler öğretmen adaylarının "küresel ısınma" kavramına yönelik metafor algıları. *Eastern Geographical Review,* 29, 117-133.

Khalid, T. (2003). Pre-service high school teachers' perceptions of three environmental phenomena. *Environmental Education Research*, 9, 35-50.

Milli Eğitim Bakanlığı. (2018a). S*osyal bilgiler dersi öğretim programı (İlkokul ve Ortaokul 4, 5, 6 ve 7. Sınıflar).* Ankara: MEB Yayınevi.

Milli Eğitim Bakanlığı. (2018b). *Fen bilimleri dersi öğretim programı (İlkokul ve Ortaokul 3, 4, 5, 6, 7 ve 8. Sınıflar*). Ankara: MEB Yayınevi.

Odabaşı Çimer, S., Çimer, A. & Ursavaş, N. (2011). Student teachers' conceptions about global warming and changes in their conceptions during pre-service education: A cross-sectional study, *Educational Research and Reviews*, *6*(8), 592-597.

Öztürk, T. & Zayimoğlu Öztürk, F. (2016). Sosyal bilgiler öğretim programının çevre eğitimi açısından analizi. *Kastamonu Eğitim Dergisi*, *24*(3), 1533-1550.

Pabuçcu, A. (2016). Öğretmen adaylarının asit yağmurlarıyla ilgili bilgilerinin kimya okur-yazarlığı açısından incelenmesi. *Abant İzzet Baysal Üniversitesi Eğitim Fakültesi Dergisi*, *16*(3), 961-976.

Papadimitriou, V. (2004). Prospective primary teachers' understanding of climate change, greenhouse effect, and ozone layer depletion. *Journal of Science Education and Technology*, *13*(2), 299-307.

Pekel, F. O. (2005). High school students' and trainee science teachers' perceptions of ozone layer depletion. *Journal of Baltic Science Education*, *1*(7), 12-21.

Peşman, H. & Eryılmaz, A. (2010). Development of a three-tier test to assess misconceptions about simple electric circuits. *The Journal of Educational Research, 103*, 208-222.

Selvi, M. (2007). *Biyoloji öğretmeni adaylarının çevre kavramları ile ilgili algılamalarının değerlendirilmesi.* Yayımlanmamış doktora tezi. Gazi Üniversitesi, Eğitim Bilimleri Enstitüsü, Ankara.

Summers, M., Kruger, C., Childs, A. & Mant, J. (2000). Primary school teachers' understanding of environmental issues: An interview study, 6(4), 293-312.

Şenel, H. & Güngör, B. (2009). Üniversite öğrencilerinin küresel ısınma hakkındaki bilgilerinin ve kavram yanılgılarının tespiti. *e-Journal of New World Sciences Academy, 4*(4), 1207-1225.

Topsakal, U. Ü. & Kara, S. (2009). İlköğretim öğretmen adaylarının ozon tabakası ile ilgili algılamaları. *Çukurova Üniversitesi Eğitim Fakültesi Dergisi*, *37*(3), 13-37.

Topsakal, Ü. U. & Altınöz, N. (2010). İlköğretim öğretmen adaylarının sera etkisi ile ilgili kavramları algılama düzeyleri. *Erzincan Üniversitesi Eğitim Fakültesi Dergisi*, *12*(1), 147-163.

Treagust, D. F. (1998). Development and use of diagnostic tests to evaluate students' misconceptions in science. *International Journal of Science Education,* 10, 159-170.

Ural, E., Ercan, O. & Bilen, K. (2017). Pre-service science teachers' misconceptions of carboncycle and global warming. *Scientific Educational Studies, 1*(1), 1-17.

Ürey, M. & Alev, N. (2010). "A" ilköğretim okulunun çevre eğitimindeki başarısının nedenlerini incelemeye yönelik bir nitel araştırma örneği. *Milli Eğitim Dergisi*, 186, 183-208.

Ürey, M. & Aydın, M. (2014). İlköğretim fen ve teknoloji programında yer alan çevre konularına yönelik bir program analizi. *e-Kafkas Eğitim Araştırmaları Dergisi*, *1*(1), 37-50.

Ürey, M., Şahin, B. & Şahin, N.F. (2011). Öğretmen adaylarının temel ekoloji kavramları ve çevre sorunları konusundaki yanılgıları. *Ege Eğitim Dergisi*, *12*(1), 22-51.

Ürey, M. (2018). Çevre eğitimi. A. Tekbıyık & G. Çakmakçı (Eds.), *Fen bilimleri öğretimi ve stem etkinlikleri (güncel öğretim programlarıyla uyumlu PISA-TIMSS soru örnekleriyle desteklenmiş uygulamalar)* (ss.323-352). Ankara: Nobel Yayın Dağıtım.

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RESEARCH ARTICLE

Fen ve Sosyal Bilimler Kökenli Öğretmen Adaylarının Atmosfer Kaynaklı Çevre Problemlerine Yönelik Bilgi Düzeyleri ve Kavram Yanılgılarının Karşılaştırılması

Mustafa ÜREY
Trabzon University, Trabzon, TURKEY

Kerem ÇOLAK
Trabzon University, Trabzon, TURKEY

Hafife BOZDEMİR YÜZBAŞIOĞLU*
Kastamonu University, Kastamonu, TURKEY

Selahattin KAYMAKCI
Kastamonu University, Kastamonu, TURKEY

Özet (Turkish Abstract of Paper)

Çalışmanın amacı, fen ve sosyal bilimler kökenli öğretmen adaylarının atmosfer kaynaklı çevre problemlerine (küresel ısınma, sera etkisi, ozon tabakasındaki incelme, asit yağmurları) yönelik bilgi düzeylerini ve kavram yanılgılarını belirlemek ve karşılaştırmaktır. Çalışma, nedensel karşılaştırma yöntemiyle yürütülmüştür. Öğretmen adaylarının seçiminde uygun örneklem seçimi kullanılmış ve katılımcıların belirlenmesinde lisans düzeyinde çevre dersi alınmış olmasına dikkat edilmiştir. Çalışmada, veri toplama aracı olarak "Atmosfer Kaynaklı Çevre Problemleri Tanı Testi (AKÇPT)" kullanılmıştır. AKÇPT 13 sorudan oluşan üç aşamalı bir testtir. Birinci aşamada çoktan seçmeli sorular, ikinci aşamada birinci aşamada verilen cevapların gerekçesi ve üçüncü aşamada ise verilen cevaptan emin olup olmama durumu sorgulanmıştır. Öğretmen adaylarından elde edilen veriler, araştırmacılar tarafından geliştirilen rubrik dikkate alınarak değerlendirilmiştir. Verilerin analizinde SPSS.20 paket programından faydalanılmıştır. Araştırma sonunda, sosyal ve fen bilimleri kökenli öğretmen adaylarının benzer kavram yanılgılarına sahip oldukları görülürken, sosyal bilimler kökenli öğretmen adaylarında kavram yanılgılarının çok daha yoğun yaşandığı tespit edilmiştir. Fen ve sosyal bilimler kökenli öğretmen adaylarının atmosfer kaynaklı çevre problemleri konusundaki bilgi düzeyleri karşılaştırıldığında ise fen bilimleri kökenli öğretmen adaylarının daha başarılı oldukları belirlenmiştir.

Anahtar Kelimeler: Fen bilimleri, sosyal bilimler, atmosfer kaynaklı çevre problemleri, öğretmen adayları.

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*** Corresponding Author E-mail: hbozdemir@kastamonu.edu.tr**