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Determination of Pre-Service Elementary Science Teachers' Knowledge Level About Greenhouse Effect

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ABSTRACT

The aim of this study is to determine pre-service elementary science teachers' knowledge level about greenhouse effect. In the study, the questionnaire of 36 items was applied to 319 pre-service elementary science teachers by using scanning model. Percentage (%), frequency (f) and single factor variance analysis were done by using SPSS statistical package program for the data gained from the application. As a result of the analysis it was stated that the students have some misconceptions about greenhouse effect and that there was not a significant difference among the pre-service elementary science teachers' knowledge level about greenhouse effect according to their grade level.

Key Words: Pre-service elementary science teachers, Greenhouse effect, Knowledge level.

Fen Bilgisi Öğretmen Adaylarının Sera Etkisi Hakkındaki Bilgi Düzeylerinin Saptanması

ÖZET

Bu araştırma ile Fen Bilgisi öğretmen adaylarının sera etkisi hakkındaki bilgi düzeylerinin saptanması amaçlanmıştır. Araştırmada tarama modeli kullanılarak 36 ifadeden oluşan anket 319 Fen Bilgisi öğretmen adayına uygulanmıştır. Uygulamadan elde edilen verilere SPSS istatistik paket programı kullanılarak yüzde (%), frekans (f) ve tek faktörlü varyans analizi yapılmıştır. Analizler sonucunda öğrencilerin sera etkisi ile ilgili bazı yanlış kavramalarının olduğu ve Fen Bilgisi öğretmen adaylarının sera etkisi hakkındaki bilgi düzeyleri arasında, sınıf seviyelerine göre anlamlı bir fark olmadığı saptanmıştır.

Anahtar Sözcükler: Fen bilgisi öğretmen adayları, Sera etkisi, Bilgi düzeyi.

INTRODUCTION

As a result of the increase of some gases existing in the atmosphere and called "greenhouse gases", caused by different activities of human beings, the process of artificial increase of the heat in the parts of atmosphere close to the earth and the solid part of the earth is called global warming. Global warming occurs as a result of the increase of the fact called greenhouse effect (Çepel, 2003; McKinney and Schoch, 2003). The greenhouse gases which play a role in global warming are carbon dioxide, chlorofluorocarbon (CFCs) and the other halocarbons, methane, nitrogen oxides and the water vapour (Çepel, 2003; Kuterdem, Onacak and Evirgen, 1996).

When the structure of atmosphere is analysed, it is understood that dry air consists of 78% nitrogen gas, about 21% oxygen gas and about 0,9% argon gas. The 0,1% portion of atmosphere is formed by those greenhouse gases. Although they have a small portion as percentage, the enormous effect of those gases on the earth should not be underestimated (Uzmen, 2007).

Because of the resemblance to the heating event in the greenhouses, it is called greenhouse effect. While the glass structures in the greenhouses permit the entrance of sunrays, they do not permit the entrance of reflex infrared radiation and they cause heating. Even on a cold winter day, the inside of the greenhouse can be hot as long as the Sun shines (Chiras, 2001). Greenhouse effect is not a problem; on the contrary, it is an effect which

help us exist. If the earth did not have this effect, the average temperature of the earth would be about -17°C (Bush, 2003; McKinney and Schoch, 2003).

Excessive and unconscious use of natural sources, the increase in fossil fuel consumption and population growth along with environmental problems has become the most important problems which threaten the life of human beings. It is possible to say that human being has a crucial role in the damage of environment (Yeşiltaş, 2009). The aim should be the balanced use of natural sources and the progress in industry. In order to be able to settle down this thinking, it is necessary to give an effective environmental training to the human being who is in interaction with the environment (Arslan, 2008). Environment training studies including different environmental problems such as greenhouse effect, ozone layer, air pollution, biological diversity are done in the world and in our country in order to determine the young people and children's knowledge level about the basic concepts of environment, ecosystem and its function and structure (Ayvaz, 1998; Boyes and Stanisstreet, 1992, 1999; Dove, 1996; Syibo, 1995). These studies aim to determine the misconceptions and knowledge levels.

The aim of this study is to determine pre-service elementary science teachers' knowledge level about greenhouse effect which is a part of the global environmental problem.

METHOD

Participants

319 pre-service elementary science teachers, 89 of whom were from the first grade, 90 of whom were from the second grade, 71 of whom were from the third grade and 69 of whom were from the fourth grade studying at Ondokuz Mayıs University Science department attended to the research.

Data Collecting Tools

In order to determine the pre-service elementary science teachers' knowledge level about greenhouse effect survey model, one of the quantitative research techniques was used. A questionnaire of 36 items and 3 parts was used in the research (Boyes, Chuckran and Stannisstreet, 1993; Boyes and Stannisstreet, 1992, 1993). The questionnaire used by Boyes et al was translated into Turkish by the researches and content validity of the questionnaire was approved by the specialists. Pilot study of the scale translated into Turkish was applied to 93 prospective teachers receiving

education in the department of science. Data obtained from the application was analysed and unperceived and missed expressions were revised and corrected. Croanbach Alpha reliabililty coefficient of 36 expressions related to greenhouse effect was calculated as 0,892. The first part of the questionnaire includes statements about the possible problems as a result of the increase of greenhouse effect; the second part includes statements about the possible factors which may cause the increase of greenhouse effect and the third part includes statements about the decrease of the greenhouse effect and each part has 12 statements. The answers of the statements were designed according to the 5 pieces Likert type grading. According to this, the answers that the students gave to the statements were; "I am sure this is right", "I think this is right", "I have no idea" "I think this is wrong" and "I am sure this is wrong".

Data Analysis

The analysis of the data collected from the answers to the statements in the questionnaire that 319 pre-service elementary science teachers attended was determined as percentage and frequency values by using SPSS statistical package program. Findings are given in Table 1, 2 and 3. In order to determine if there is a significant difference, according to the grade levels, among the pre-service elementary science teachers' knowledge level about greenhouse effect, single factor variance analysis, a parametric test, for unrelated samples (One-Way-Anova) was used and the findings are shown in Table 4.

FINDINGS and EXPLANATION

The percentage (%) and frequency (f) values of pre-service elementary science teachers' answers to the items in the questionnaire are given in table 1, 2 and 3.

The percent (%) and frequency (f) distribution of the responses of pre-service elementary science teachers to the items in part 1 of the survey regarding the problems stemming from the increase in the greenhouse effect is provided in Table 1.

Table 1: Percentage (%) and Frequency (f) Distribution of the Pre-Service Elementary Science Teachers' Answers to the Items about the Possible Problems As A Result of Greenhouse Effect

Items	I am sure this is right		I think this is right		I have no idea		I think this is wrong		I am sure this is wrong	
	f	**%**	**f**	**%**	**f**	**%**	**f**	**%**	**f**	**%**
1. If the greenhouse effect gets bigger the earth will get hotter,	176	55,2	112	35,1	26	8,2	5	1,6	-	-
2. If the greenhouse effect gets bigger more people will get food poisoning,	62	19,4	145	45,5	90	28,2	21	6,6	1	0,3
3. If the greenhouse effect gets bigger there will be more flooding,	99	31,0	113	35,4	77	24,1	27	8,5	3	0,9
4. If the greenhouse effect gets bigger more fish will be poisoned in rivers,	111	34,8	127	39,8	70	21,9	10	3,1	1	0,3
5. If the greenhouse effect gets bigger more people will get skin cancer,	147	46,1	126	39,5	43	13,5	3	0,9	-	-
6. If the greenhouse effect gets bigger some of our tap (drinking) water will become unsafe to drink,	123	38,6	135	42,3	45	14,1	13	4,1	3	0,9
7. If the greenhouse effect gets bigger there will be more "bugs" and "pests" on crops,	82	25,7	119	37,3	78	24,5	34	10,7	6	1,9
8. If the greenhouse effect gets bigger there will be changes in the world's weather,	163	51,1	126	39,5	23	7,2	4	1,3	3	0,9
9. If the greenhouse effect gets bigger more people will die of heart attacks,	63	19,7	101	31,7	118	37,0	16	5,0	21	6,6
10. If the greenhouse effect gets bigger there will be more deserts in the world,	161	50,5	104	32,6	41	12,9	11	3,4	2	0,6
11. If the greenhouse effect gets bigger some of the ice at the North and South Poles will melt,	149	46,7	107	33,5	47	14,7	9	2,8	7	2,2
12. If the greenhouse effect gets bigger there will be more earthquakes,	30	9,4	57	17,9	159	49,8	41	12,9	32	10,0

When we analyse Table 1; it is seen that most of the students came to the conclusion that the Earth will become hotter as a result of the increase of greenhouse effect (90,3%). Similarly, many students correctly associated the increase of greenhouse effect with changes in the earth climate (90,6%) and glacier melting (80,2%). Besides, there is a parallelism between the increase of greenhouse effect and more flooding (66,4%). Most of the students agree that the increase of greenhouse effect has an effect on the increase in the number of the deserts (83,1%). While the students who showed the correctness of their knowledge by accepting the increase of bug species and agricultural pests as a result of the increase of greenhouse effect are 63,0%, 24,5% of them stated that they have no idea.

It is seen that 64,9% of the students came to a wrong conclusion by saying "I think this is right" for the statement that when the greenhouse effect increases, more people will get food poisoning. Besides, 28,2% of the students stated that they have no idea. That the increase of the greenhouse effect will cause water pollution which harms for the fish (74,6%), makes drinking water supplies unsafe to drink (80,9%) and results in more deaths due to heart attacks (51,4%) was regarded as true answers by the students. That 85,6 % of the students stated that more people will get skin cancer as a result of the increase in greenhouse effect has shown that most of the students have misconceptions. While 49,8% of the students stated that they have no idea for the statement saying that there will be more earthquakes as a result of the increase of greenhouse effect, 27,3% establish a wrong association by saying that it is true.

The percent (%) and frequency (f) distribution of the responses of pre-service elementary science teachers to the items in part 2 of the survey regarding the agents that may cause an increase in the greenhouse effect is provided in Table 2.

Table 2: Percentage (%) and Frequency (f) Distribution of the Pre-Service Elementary Science Teachers' Answers to the Items about the Possible Factors Which May Make the Greenhouse Effect Worse

Items	I am sure this is right		I think this is right		I have no idea		I think this is wrong		I am sure this is wrong	
	f	**%**	**f**	**%**	**f**	**%**	**f**	**%**	**f**	**%**
13. The Greenhouse Effect is increased by rubbish dumped in rivers and streams	67	21,0	105	32,9	86	27,0	38	11,9	23	7,2
14. The Greenhouse Effect is increased because too many of the sun's rays get to the earth	84	26,3	108	33,9	60	18,8	44	13,8	23	7,2
15. The Greenhouse Effect is increased by too much carbon dioxide in the air	100	31,3	125	39,2	68	2,3	12	3,8	14	4,4
16. The Greenhouse Effect is increased by too much ozone near the ground	61	19,1	85	26,6	105	32,9	39	12,2	29	9,1
17. The Greenhouse Effect is increased by too much litter in the streets	54	16,9	102	32,0	89	27,9	47	14,7	27	8,5
18. The Greenhouse Effect is increased by gas from rotting waste	77	24,1	153	48,0	66	20,7	20	6,3	3	0,9
19. The Greenhouse Effect is increased by radioactive waste from nuclear power stations	88	27,6	110	34,5	83	26,0	18	5,6	20	6,3
20. The Greenhouse Effect is increased by the raise in the amount of acid in the rain	65	20,4	113	35,4	87	27,3	30	9,4	24	7,5
21. The Greenhouse Effect is increased by CFC gas from spray cans	122	38,2	112	35,1	57	17,9	15	4,7	13	4,1
22. The Greenhouse Effect is increased by gas which comes from artificial fertilisers	106	33,2	139	43,6	61	19,1	12	3,8	1	0,3
23. The Greenhouse Effect is increased by thinning of the ozone layer	108	33,9	101	31,7	64	20,1	17	5,3	29	9,1
24. The Greenhouse Effect is increased because the sun rays cannot escape from the earth	119	37,3	102	32,0	85	26,6	11	3,4	2	0,6

When we analyse Table 2, we see that most of the students (70,2%) who stated "I think this is right" said that the greenhouse effect is made worse as a result of sun rays' getting more to the earth. That the sun rays cannot escape from the earth makes greenhouse effect worse is stated by 69,3% of the students while 26,6% of them has not stated an idea. Most of the students correctly stated that gas from decomposed waste (72,1%), the increase of CO_2 gas in the air (70,5%), CFCs gas in spray cans (73,3%) and gas from artificial fertilisers (76,8%) make greenhouse effect worse. While 65,6% of the students came to a wrong conclusion by accepting the statement that the thinning of the ozone layer makes greenhouse effect worse, 20,1% of them stated that they have no idea. Besides, while 45,7% of the students came to a wrong conclusion by stating that too much ozone near the ground makes greenhouse effect worse, 32,9 of them stated that they have no idea for the same statement.

While 53,9% of the students stated that rubbish dumped in rivers and streams make greenhouse effect worse, 27,2% of them stated that they have no idea for the same statement. 48.9% of the students came to a wrong conclusion by stating that too much litter in the streets make greenhouse effect worse while 27,9% of them did not state an idea.

The answers given by the students as true answers concerning the radioactive pollution caused by nuclear power stations and the increase in the greenhouse effect due to the increase in the amount of the acid in the rain result from the fact that they make wrong associations between different environmental problems.

The percent (%) and frequency (f) distribution of the responses of pre-service elementary science teachers to the items in part 3 of the survey about decreasing the greenhouse effect is provided in Table 3.

Table 3: Percentage (%) and Frequency (f) Distribution of the Pre-Service Elementary Science Teachers' Answers to the Items about Decreasing Greenhouse Effect

Items	I am sure this is right		I think this is right		I have no idea		I think this is wrong		I am sure this is wrong	
	f	**%**	**f**	**%**	**f**	**%**	**f**	**%**	**f**	**%**
25. The Greenhouse Effect can be decreased by having nuclear power stations instead of coal power stations	66	20,7	103	32,3	106	33,2	34	10,7	10	3,1
26. The Greenhouse Effect can be decreased by eating healthy foods	31	9,7	96	30,1	93	29,2	82	25,7	17	5,3
27. The Greenhouse Effect can be decreased by keeping beaches clean	51	16,0	99	31,0	102	32,0	49	15,4	18	5,6
28. The Greenhouse Effect can be decreased by using unleaded petrol (gasoline)	80	25,1	123	38,6	90	28,2	25	7,8	1	0,3
29. The Greenhouse Effect can be decreased by reducing the number of nuclear bombs in the world	90	28,2	114	35,7	79	24,8	15	4,7	21	6,6
30. The Greenhouse Effect can be decreased by planting more trees in the world	130	40,8	141	44,2	31	9,7	3	0,9	14	4,4
31. The Greenhouse Effect can be decreased by producing electricity by the help of wave and wind	91	28,5	109	34,2	89	27,9	12	3,8	18	5,6
32. The Greenhouse Effect can be decreased by recycling used paper	98	30,7	148	46,4	63	19,7	7	2,2	3	0,9
33. The Greenhouse Effect can be decreased by protecting rare plants and animals	57	17,9	101	31,7	120	37,6	32	10,0	9	2,8
34. The Greenhouse Effect can be decreased by saving electricity	81	25,4	134	42,0	86	27,0	15	4,7	3	0,9
35. The Greenhouse Effect can be decreased by reducing starvation in the world	29	9,1	57	17,9	137	42,9	64	20,1	32	10,0
36. The Greenhouse Effect can be decreased by stopping excessive car using	116	36,4	141	44,2	42	13,2	10	3,1	10	3,1

In Table 3, it is said that having nuclear power stations instead of coal power stations (53,0%), generating electricity by the help of wave and wind, (62,7%), recycling used paper (77,1%), planting more trees (85,0%), saving electricity (67,4%) and stopping excessive car using (80,6%) will decrease greenhouse effect. 39,8% of the students stated ”I think this is right” 29,2% stated “I have no idea” and 31% stated “I think this is wrong” for the statement saying eating healthy food can decrease greenhouse effect.

The students who stated “I think this is right” for reducing the number of nuclear bombs in the world (63,9%), stated “I think this is wrong” for the link between nuclear pollution and greenhouse effect. 24,8% of the students stated “I have no idea”. While 49,6% of the students stated “I think this is right” for the statement saying protecting rare plants and animals decreases greenhouse effect, 37,6% of them stated “I have no idea”. 47% of the students stated” I think this is right” for the statement saying keeping beaches clean decreases greenhouse effect while 32% of them said “I have no idea”. The connections about decreasing greenhouse effect are set wrongly in both of the statements.

Because none of these factors does not decrease greenhouse effect. 63,7% of the students stated “I think this is right” for the statement that suggests using unleaded petrol (gasoline) decreases greenhouse effect and set a wrong connection. Most of the students (42,9%) stated “I have no idea” for the statement suggests reducing starvation in the world decreases greenhouse effect.

Findings from the One-Way Anova analysis which was done to determine if there is a statistical difference in the answers of the classes for greenhouse effect according to the knowledge level of the grades are given in Table 4.

Table 4: The One-Way ANOVA Results of the Greenhouse Effect Success Points

Variance Source	Squares Total	sd	Squares Avarage	F	p
Among groups	353,070	3	117,690	0,363	0,780
In groups	102184,50	315	324,395		
Total	102537,57	318			

As it is seen in Table 4, there is not a significant difference in knowledge level about greenhouse effect of the pre-service elementary science teachers who attend at 1st, 2nd, 3rd and 4th grades ($F_{(3,315)} = 0,363$; $p > 0,05$).

SUGGESTION and RESULT

When we analysed the answers to the statements about the problems which may occur as a result of the increase in greenhouse effect, it is seen that pre-service elementary science teachers have enough knowledge to make connection among the facts that the heat of the earth would raise, there would be more flooding, the climate of the earth would change, there would be more desertification and the glacier in the north and the south hemispheres would melt. In the study agreement by Boyes and Stanisstreet (1992) it is seen that almost all of the undergraduate students think that as the greenhouse effect increases, there will be more flooding.

It is also seen that pre-service elementary science teachers have the knowledge that CO_2 is the most common greenhouse gas and an increase in its amount in the air will also increase the greenhouse effect and that CFCs and gases from artificial fertilisers and decomposed wastes increases greenhouse effect. In the study held by Boyes and Stanisstreet (1992) it is stated that most of the undergraduate students consider CO_2 as a greenhouse gas, whereas in the study held by Kılınç et al., (2008) most of the high school students consider CO_2 as a greenhouse gas.

Pre-service elementary science teachers stated the need for using nuclear power stations, planting more trees, producing electricity by the help of wave and wind, providing recycling of paper, stopping electricity waste and excessive car using in the statements about the factors which decrease greenhouse effect. In the study held by Boyes and Stanisstreet (1992) it is seen that most of the students think that planting trees and using recycled paper are the factors which may decrease the rise in greenhouse effect. In the same study it is seen that most of the students think that there will be a decrease in greenhouse effect by less use of vehicles and producing electricity with renewable energy. These results support the findings obtained from our study.

With this study, it is determined that pre-service elementary science teachers have some faulty concepts like there will be more earthquakes and more people will get skin cancer as a result of the increase of greenhouse effect. In the study held by Boyes and Stanisstreet (1998) the perception of 13-14 year-old students on the increase in skin cancer and global environmental events is studied and it is seen that many students confuse the behaviour of heat rays (infrared rays) and ultraviolet rays and they think that greenhouse effect is responsible for the increase in skin cancer.

It is seen that pre-service elementary science teachers have faulty concepts like, as a result of the increase in radioactive pollution and acid

rains, greenhouse effect will increase. Besides, it is confirmed that students have faulty concepts about the reasons and the results of different environmental problems like the rise in the amount of ozone and thinning of the ozone layer will increase greenhouse effect. According to the results of the study held by Boyes and Stannisstreet (1997) it is seen that most of the students think that the holes in the ozone layer cause greenhouse effect.

The statement suggested by the students that using unleaded petrol will decrease greenhouse effect shows that pre-service elementary science teachers have faulty concepts regarding the case. In the study held by Boyes and Stanisstreet (1992), undergraduate students at 1st grade have faulty concepts on the fact that using unleaded petrol will decrease global warming.

These faulty concepts are stated in many studies (Bahar and Aydın, 2002; Boyes and Stanisstreet, 1992, 1993; Bozkurt and Cansüngü, 2002; Daniel, Stanisstreet and Boyes, 2004; Darçın, Bozkurt and Hamalosmanoğlu, 2006; Dove, 1996; Groves and Pugh, 1999; Jeffries, Stanisstreet and Boyes, 2001; Khalid, 2003; Selvi and Yıldız, 2009).

According to the Results

In Undergraduate Program in Science Teaching Department, greenhouse effect is studied in "special subjects in chemistry lesson" which is studied in the fifth term and in ecology lesson. In order to make a true connection between greenhouse effect and different environment problems and to avoid faulty concepts, a more meaningful and permanent learning should be provided by using student-centred methods and techniques in explanation of greenhouse effect.

Suitable teaching activities can be planned after the level of readiness of the pre-service elementary science teachers is determined.

Studies on determining the reasons of faulty concepts detected in the pre-service elementary science teachers can be done.

Faulty concepts on greenhouse effect which is an important environment problem can be determined by doing this study which was previously done with the pre-service elementary science teachers, with science teachers and suitable education activities can be planned to correct them.

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