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The Relationship between Pre-service Teachers' Awareness Levels of Electromagnetic Pollution and other Environmental Problems

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ABSTRACT

Purpose: The purpose of this study is to find out the relationship between the awareness level of preservice science teachers' conscious use of technological devices, which cause electromagnetic pollution, and their awareness level of related environmental problems. **Research Methods**: In this study, a mixed design method was used. A relational screening model was used to collect quantitative data. The phenomenological method, which includes defining and interpreting individuals' perception and perspective related to a phenomenon, was used to collect qualitative data. While selecting participants, purposeful sampling was used. Seventy-six preservice science teachers took part in the quantitative part of this study in Ankara, Turkey. In the qualitative part of the study, seven female and eight male preservice teachers were chosen out of the seven-six on a volunteer basis. Three data collection tools were used. **Findings**: The findings obtained from the research show that there is no remarkable difference among preservice science teachers' awareness levels of electromagnetic pollution depending on the gender variable. Then, it was concluded that students who had taken environmental science courses had higher levels of awareness compared to those who had not. With another sub-problem, it was seen that there is no relationship between preservice teachers' awareness levels of conscious use of technological devices causing electromagnetic pollution and their awareness levels of environmental problems. **Implications for Research and Practice**: Preservice science teachers are less sensitive to electromagnetic pollution than other types of pollutions. Future studies could investigate why students think that they are less sensitive to electromagnetic pollution.

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Introduction

In this age, though developments in science and technology increase societal standards of living, they lead to destruction or changes in many things. Environmental issues includes overuse or misuse of natural resources; corruption caused by pollution in fundamental physical elements of nature such as water, air and soil; nature's loss of ability to dispose of wastes; and misuse of natural resources. Thus, there exists a corruption that is ecologically intolerable (Kislalioglu & Berkes, 2007; Yildiz, Sipahioglu & Yilmaz, 2008; Guven & İnce Aka, 2009). These problems, which could be considered as unimportant early on, go beyond being a single country's problem and threaten the world. Environmental problems arise from changes to the relationship between the natural environment and living beings. The elements that cause these changes are the use of fossil fuels, destruction of forests, and production and use of various chemical materials and agricultural activities on large fields (Turner, Kasperson, Meyer, Dow & Golding, 1991). People have used natural resources and not allowed them to renew themselves. They have harmed nature without considering themselves as a part of it and thus gave rise to many environmental problems (Caldarelli, 2004). Environmental problems are mostly considered to include water, air, noise or soil pollution by scientists (Arkis, 1992; Dogan, 1993; Tican, 1996; Page, 2000; Yilmaz, Morgil, Aktug & Gobekli, 2002; Solange & Trufen, 2004; Oznur, 2008; Sevinc, 2009; Bozkurt, 2011). However, as a natural result of living in a technological age, electromagnetism, which pollutes and impairs the quality of both the environment and our lives, can also be regarded as a kind of pollution. Electromagnetic pollution can be categorized as man-made and natural. Our world is surrounded by a statical electromagnetic area between 25-65μT (Feychting, Ahlbom & Kheifets, 2005). Natural electromagnetic pollution has been in the air as a part of natural world since the very beginning of life. Whereas this kind of pollution can be controlled by a conscious society, it can pose a great threat if necessary actions are not taken.

Unlike other kinds of pollution, electromagnetic pollution is invisible and its effects do not come into sight for a long time. For this reason, necessary precautions cannot be taken. On the other hand, man-made electromagnetic pollution is a result of technological devices. Primary technological devices which contribute electromagnetic pollution are radio and television transmitters, radiophones, microwave ovens, photocopiers, cell phones, wireless modems, hair dryers, laptops and radio stations (Altun, 2001; Demir, 2005; Balmori, 2006; Chakraborty, 2007; Erdogan, 2007; İnce, 2007; Moulton Howe, 2008; Uygunol & Durduran, 2008; Balmori, 2009; Uygunol & Durduran, 2009; Greenberg, 2010).

Although electromagnetic waves are not visible or easily perceptible, their effects can be detected. For this reason, damages of electromagnetic waves on people cannot be noticed easily. If electromagnetic pollution were like noise pollution, we could protect ourselves by leaving the environment or removing the item that makes the noise. However, when electromagnetic pollution is heavy in an atmosphere, it cannot be perceived by the five senses. That is why electromagnetic pollution can only be noticed when its effects appear on people's health. Electromagnetic pollution's effects

change according to the electromagnetic field's frequency, intensity, distance and, most importantly, duration (Ermol, 2008). Electromagnetic pollution has two kinds of effects on people's health. The first includes short-term effects such as tiredness, headache, eye burning, eye pain, weakness and dizziness. The latter, on the other hand, is a long-term effect (Sandstrom et al., 1998). In addition, when the literature was reviewed, it was noticed that electromagnetic pollution can have certain biological effects such as insomnia, feeling sleepy during the day, resentment and constant restlessness, which cause exclusion from society (Mann & Roschke, 1996; Borbely Huber, Graf, Fuchs, Gallmann & Achermann, 1999; Krause, Sillanmaki, Koivisto, Haggqvist, Saarela, Revonsuo, Laine & Hamalainen, 2000). The electromagnetic waves also effect molecules, chemical bonds, cells and the body protection mechanism of the human body (Graham, Cook, Cohen & Gerkovich, 1994; Kang Lee, Seo, Sung, Chung, Lee, Suh & Chi, 1997). Researchers have worked on the melatonin hormone because it is both a very important antioxidant and a cancer inhibitor. Moreover, it has a great impact on human psychology. The melatonin hormone is released through the pineal gland, which is a magnetic organ consisting of magnetic crystals in the center of the head. The pineal gland is very sensitive to magnetic energy and melatonin is released at night when the earth's magnetic field is active. However, the pineal gland's activity decreases if factors disturbing the balance between the human body and the magnetic field are in the air. These spoiling factors are chemical contaminators, communication frequencies and signals coming from electrical power transmitters (Bold, Toros & Sen 2003). Even though melatonin levels change from person to person, it is released at the highest level between 23.00 and 05.00 at night. It was ascertained that 20 minutes every day, five days a week and three weeks of exposure to 40 Hz electromagnetic field decreases the concentration of melatonin (Karasek, Woldanska-Okonska, Czernicki, Zylinska & Swietoslawski, 1998). Experiments on animals have also suggested that a low-intensity electromagnetic field has certain biological effects such as changing hormone and enzyme levels, inhibiting the movement of chemicals on tissues (Dincer, 2000; Bold, Toros & Sen, 2003; Taktak, Tiryakioglu & Yılmaz, 2005) and triggering cancer (GarajVrhovac, Fucic & Horvat, 1992; Moulder & Foster, 1995). Just the same, studies have shown that pregnant women who are exposed to electromagnetic field for long times have difficulty in giving birth (London et al., 1991) and that electromagnetic waves have adverse effects on growth and development (Ermol, 2008). Studies have shown that electromagnetic waves are more dangerous if exposure is long, but in low-doses than if they are short but in high-doses (Berman, Carter & House, 1982; Berman, Quinn & Zarro, 1991). Electromagnetic pollution has negative influences both on people and the natural environment. Open fields with high electromagnetic pollution affect bird populations badly. In Spain, antennas were located in the ''Compo Grande'' park, and its bird population decreased. Between 1997 and 2007, 3 species out of 14 left the region. In the same way, insects and bees were exposed to electromagnetic waves, which led to colonial immigration (Balmori, 2009). Most researchers have conducted studies on the adverse effects of electromagnetic pollution on people's health while emphasizing the necessary actions to be taken to protect themselves from

electromagnetic pollution (London, Thomas, Bowman, Sobel, Cheng & Peters, 1991; Durusoy, Hassoy, Karababa & Ozkurt, 2011; Sarigoz, Karakus & Irak, 2012; Kaya Gulagiz, Goz & Kavak, 2016). This means that it is very significant to make people aware of electromagnetic pollution, which is an environmental problem, especially in a technological age. From the literature review it is obvious that electromagnetic pollution has not yet been considered an environmental problem (Arkis, 1992; Dogan, 1993; Tican, 1996; Page, 2000; Yılmaz, Morgil, Aktug & Gobekli, 2002; Solange & Trufen, 2004; Oznur, 2008; Sevinc, 2009; Bozkurt, 2011). However, as a result of living in an age of technology, electromagnetic pollution is unfortunately one of the most important environmental problems we face. Within this context, the purpose of this study is to find out the relationship between the awareness level of preservice science teachers' conscious use of technological devices that cause electromagnetic pollution and their awareness level of environmental problems.

Sub-problems for the study are as follows:

1. Is there a remarkable difference between the awareness level of preservice science teachers' conscious use of technological devices and their awareness level of environmental problems depending on the gender variable?
2. Is there a remarkable difference between the awareness level of preservice science teachers' conscious use of technological devices that cause electromagnetic pollution and their awareness level of environmental problems depending on their taking an ''environmental science'' course?
3. What kind of a relationship is there between the awareness level of preservice science teachers' conscious use of technological devices that cause electromagnetic pollution and their level of awareness of environmental problems?
4. What do science teachers think about electromagnetic pollution?

Method

In this part of the article, the research model, data collection techniques used in the study, implementation stages of the study and the data analysis process will be explained.

Research Design

In this study, which aims to discover the relationship between the awareness level of preservice science teachers' conscious use of technological devices that cause electromagnetic pollution and their level of awareness for environmental problems, a mixed design method was used. In this method, both qualitative and quantitative data were collected and evaluated together to find an answer to the study's problem questions (Punch, 2005; Nagy & Biber, 2010). The advantage of a mixed design is that it helps researchers to understand the problem clearly because it uses quantitative and qualitative approaches at the same time (Creswell & Clark, 2007). This study was regulated according to a method enriched with mixed design types. First, quantitative data were collected, and then qualitative data were collected to support them. Relational screening model was used to collect quantitative data. In this model,

the existence and degree of two or more variables are attempted to be defined (Karasar, 2000). The phenomenological method, which includes defining and interpreting individuals' perception and perspective related to a phenomenon, was used to collect qualitative data (Yildirim & Simsek, 2008). An interview technique was used to define preservice teachers' individual perceptions. Interview is a kind of data collection tool to discover individuals' feelings and attitudes toward a case (Kus, 2003; Ekiz, 2009).

Research Sample

Seventy-six preservice science teachers, of whom 45 are female and 31 are male, took part in the quantitative part of this study. They studied at a state university in Ankara in the 2012–2013 spring term. While selecting participants, purposeful sampling was used, which helps to find individuals that serve the purpose of the study and who are easily accessible by researchers (Cohen, Manion & Morrison, 2007). In the qualitative part of the study, seven female and eight male preservice teachers were chosen out of the 76 on a volunteer basis.

Research Instrument and Procedure

Three data collection tools were used to find answers to problems and sub-problems of the study. As a first data collection tool, the Awareness Scale for use of certain technological devices that cause electromagnetic pollution, which had been developed by Koklukaya and Selvi (2015), was used. The scale is a 5-point Likert scale and consists of four parts: ''totally agree,'' ''agree,'' ''neither agree nor disagree,'' "disagree'' and ''totally disagree.'' The scale is composed of three dimensions and 24 items. The alpha reliability coefficient of the scale is .93. As a second data collection tool, the Awareness Scale for Environmental Problems, which had been developed by Guven and Aydogdu (2012), was used. The scale is a 3-point Likert scale and consists of three parts: ''yes,'' ''no idea'' and ''no.'' The scale is composed of 6 factors and 44 items. The alpha reliability coefficient of the scale is .90. Lastly, the semi-structured interview form, which was prepared by the researchers, is composed of four open-ended questions. Two science assistant professors gave their opinions while preparing the interview form. The questions are as follows:

1. Have you ever heard of electromagnetic pollution?
2. How does electromagnetic pollution appear?
3. Which electronic devices that cause electromagnetic pollution do you use most?
4. If you evaluate yourself about environmental problems and electromagnetic pollution, how many points do you give yourself from 1 to 10?

Data Analysis

In the data analysis part of the study, the SPSS 15 program was used. The Kolmogorov–Smirnov test was used to determine whether the quantitative data has normal distribution. Then, an independent t-test was used to find preservice science teachers' awareness levels of electromagnetic pollution depending on gender and taking ''environmental science'' course variables. Lastly, the Pearson correlation test

was used to find the relationship between preservice teachers' awareness levels of their use of devices that cause electromagnetic pollution and their awareness levels of environmental problems. In the qualitative data analysis, the content analysis method was used. Interviews with preservice teachers were recorded with their permission, and their expressions were not modified. Then, the recordings were posted on a computer and put in writing. Finally, the latter data were analyzed by using a content analysis method.

Results

Results Related to Quantitative Data

In this part, findings gathered from sub-problems of the study were presented as tables. Firstly, data were tested whether they have normal distribution or not to find which test to use. For this reason, normality test was applied. The results are shown on Table 1.

Table 1

Kolmogorov-Smirnov Test Results

	ASTEP	ASEI
Kolmogorov- Smirnov (Sig)	,069	,079

According to the results on Table-1, it can be seen that data have normal distribution. For that reason, parametric tests were decided to use (Buyukozturk, 2007).

Firstly, independent samples t-test was used for analysis of preservice teachers' scores for the sub-problem ''Is there a remarkable difference among preservice teachers' awareness level of using devices which cause electromagnetic pollution according to the gender variable?''

Table 2

Preservice Teachers' Awareness Level of Electromagnetic Pollution According to the Gender Variable

Gender	*n*	*M*	*Sd*	*df*	*t*	*p*
Female	45	93.15	9.32	74	0.73	.46
Male	31	91.48	10.41			

As it can be seen on Table-2, there isn't any remarkable difference among students' level of awareness of conscious use of technological devices according to the gender variable [$t(74) = 0.73$, $p>.05$].

Secondly, independent samples t-test was used for analysis of preservice teachers' scores for the sub-problem "Is there a remarkable difference among preservice teachers' awareness level of using devices which cause electromagnetic pollution according to taking environmental science course?"

Table 3

Preservice Teachers' Awareness Level of Electromagnetic Pollution According to Taking ''Environmental Science'' Course

Environmental course	N	M	Sd	df	t	p
Take course	38	94.89	8.01	74	2.22	.029
Not take course	38	90.05	10.78			

Scores of preservice teachers who took this course (M= 94.89, std. dev = 8.01) were higher than those who didn't (M= 90.05, std. dev. = 10.78). There is a remarkable difference between scores [t (74) = 2.22, p< .05].

Thirdly, Pearson correlation test was used to analyze teachers' scores for the sub problem "what kind of a relationship is there between preservice teachers' awareness level of conscious use of technological devices which cause electromagnetic pollution and other environmental problems?"

Table 4

Correlation Test Results

		Awareness Scale for Environmental Problems
Awareness Scale for use of some technological devices which causes electromagnetic Pollution	r	.003
	p	.978
	n	76

As it can be seen on Table-4, the correlation coefficient between preservice teachers' scores for their awareness level of conscious use of technological devices which cause electromagnetic pollution and other environmental problems is .003. This means that there isn't a remarkable relationship between preservice teachers' awareness level of conscious use of technological devices which cause electromagnetic pollution and their awareness level of other environmental problems (r= .003, p>.05).

Results Related to Qualitative Data

Lastly, researchers interviewed with preservice teachers to find an answer to the question '' What are the teachers' views on electromagnetic pollution?'' Students were asked some open-ended questions.

Firstly, preservice teachers were asked ''Have you ever heard of ''electromagnetic pollution'' concept before ?'' and 4 preservice teachers said ''no'' while 11 of them expressed that they had heard the concept before. Frequency differences of preservice teachers' answers were shown on Table-5.

Table 5

Preservice Teachers' Answers to the Question "Have You Ever Heard of Electromagnetic Pollution Concept Before?"

Have you ever heard of electromagnetic pollution?	Yes	No
	11	4

Then, preservice science teachers asked about how electromagnetic pollution appears. Their answers were on Table-6.

Table 6

Frequency and Percentage of Preservice Teachers' Answers to the Question ''How Does Electromagnetic Pollution Appear?''

	Code	Themes	Frequency
How does electromagnetic pollution appear?	Sun S_1,S_3,S_{14}, S_{12}	Naturally	4
	Moon S_1,S_3,S_{12}		3
	Planet S_{11},S_7,S_{12}		3
	Galaxy S_{12}		1
	Telephone, S_3, S_4,S_5, S_6, S_7, S_{15}, S_{14}	With technology	7
	Computer S_3, S_4,S_5, S_6		4
	Base station S_3, S_4		2
	Walkie talky S_3		1
	Microwave oven S_7		1
	Battery S_3		1

Students' answers to the question were ''it appears naturally'' and '' it is a result of technology''. Some of the teachers expressed that electromagnetic pollution develops out of the sun, moon, planets and galaxy. The others think that mobile phones, computers, radio stations, transmitters and batteries cause electromagnetic pollution. Following statements belong to the students:

S3: "*I have just heard of electromagnetic pollution. I have done some research on the internet. Electromagnetic waves are always with us because of the sun and the moon, but we increase it intentionally in our environment. We do it with radio stations, cell phones and computers, I guess. As technology develops we will have more difficulty, I think.*"

S4: "*In my view, electromagnetic pollution is a result of radio stations which we always see on TV. Apart from this, computers contribute it a lot.*"

Then, preservice teachers were asked which technological devices which cause electromagnetic pollution they use most. From most used to less used, students' answers were as following.

Table 7

Technological Devices Which Preservice Teachers Use Most

Devices which produce Electromagnetic pollution	Frequency
Mobile phone	13
Television	10
Notebook	8
Tablet computer	8
Wireless modem	8
Hair dryer	5
Microwave oven	4
Radio	3

As it can be seen on Table-7 students use mobile phones most. Television, notebook, tablet computer, wireless modem, hair dryer, microwave oven follow it. They use radio least.

S15: "*My cell phone is always with me expect the time I sleep. It is the most important one for me. My computer is also irreplaceable for me because I always do my homework or use social media.*"

S2: "*I love having a blow dry, so hair dryer is the one I use most. I don't use other devices so often except my cell phone.*"

Then, students were asked ''How many points do you give yourself from 1 to 10, when you evaluate yourself in terms of environmental problems and electromagnetic pollution?''. Their answers are on Table-8.

Table 8

Self-Evaluation of Preservice Teachers about Environmental Problems and Electromagnetic Pollution

Self-evaluation of electromagnetic pollution				Self-evaluation of environmental problems			
	Score	Preservice teachers	Frequency		Score	Preservice teachers	Frequency
	10	-	-		10	S_3	1
	9	S_3	1		9	S_4, S_{13}, S_{14}, S_{15}	4
	8	-	-		8	S_5, S_8, S_9, S_{10}	4
	7	-	-		7	S_1, S_2, S_6, S_7, S_{11}	5
	6	S_4,S_8,S_{12}	3		6	S_{12}	1
	5	S_1,S_5, S_{13}, S_{14}, S_{15}	5		5	-	-
	4	S_2,S_7, S_9, S_{10}, S_{11}	5		4	-	-
	3	S_6	1		3	-	-
	2	-	-		2	-	-
	1	-	-		1	-	-
Mean Score		*5*		*Mean Score*		*7.93*	

As it can be seen on Table-8, preservice science teachers think that they are more sensitive to environmental problems compared to electromagnetic pollution. Preservice science teachers' average score for environmental problems is 7.93 while their score for electromagnetic pollution is 5.

Discussion and Conclusion

The aim of this study is to find the relationship between awareness level of preservice science teachers' about conscious use of technological devices and their awareness level of environmental problems. When body of literature about electromagnetic pollution is reviewed it was seen that there are a lot of studies on it. First of all, there exist some studies on how electromagnetic pollution appears and in which part of life and to what extend electromagnetic waves exist on engineering field (Onal, 2005; Erdogan, 2007; Ince, 2007; Moulton Howe, 2008; Uygunol & Durduran, 2009). On the other hand, we can find studies on how electromagnetic pollution affects living organisms on healthcare field (GarajVrhovac, Fucic & Horvat, 1992; Moulder & Foster, 1995; Dincer, 2000; Bold, Toros & Sen, 2003; Saunders, 2003; Taktak, Tiryakioglu &Yilmaz, 2005; Aksoy, 2006; Vasistha & Garg, 2016; Shekoohi Shooli, Mortazavi, Jarideh, Nematollahii, Yousefi, Haghani, Mortazavi & Shojaei-fard, 2016). However, in educational field there are very few studies on electromagnetic pollution. In this study, first of all, it was seen that there isn't a remarkable difference among preservice teachers' awareness level of conscious use of technological devices which cause electromagnetic pollution depending on the gender variable. When we analyze Household Information Technologies Use Studies (2011), it is clear that at all age groups men use computer and internet more than women do Greengard (2008), on the other hand, researched why women use cell phones less than men do and he found that women think that they are not competent enough to use cell phones. Also Yalcin and Okur (2014) were determined electromagnetic field awareness development of participants who take part of an environmental education based on ecopedagogy. According to the researchers it is identified that the participants' awareness is developed throughout the education. Contrary to this study, Koklukaya (2013) confirmed in his research that girls use technological devices which cause electromagnetic pollution more consciously. Similarly, Kenar, Turgut and Gokalp (2014) found that female preservice teachers have higher awareness level of electromagnetic pollution compared to male preservice teachers. Then, taking ''environmental science'' course variable was examined and it was seen that preservice teacher who took this course had higher awareness level of conscious use of technological devices which cause electromagnetic pollution. Similarly, Denis and Genc (2007) stated that students who took this course had higher knowledge of environment compared to those who didn't. In the same way, it was determined that participants who took Environmental Science course have higher level of attitude and values for environment (Sahin, Cerrah, Saka & Sahin, 2004; Kilic, 2007; Yalcin & Okur, 2014; Aydin & Aykac, 2016). Nevertheless, other studies suggest that this variable didn't make a remarkable difference among participants (Denis & Genc, 2007; Ozdemir & Yapıcı, 2010). With the next sub-problem, it was found that there isn't a relationship

between preservice teachers' awareness level of conscious use of electromagnetic devices and their awareness level of environmental problems.

Lastly, it was ascertained that most of the students had heard of electromagnetic pollution before. Similarly, Koklukaya's study (2013) supports that most of the students in high school had heard of electromagnetic pollution while it points that they couldn't explain how electromagnetic pollution appears. Participants' age can be a variable in this case. Besides, it was seen that preservice teachers use cell phones most and radios least. Turkish Statistical Institute's data (2011) supports the result of the study. Moreover, when preservice teachers evaluate themselves in terms of environmental problems they gave more points them than they do for electromagnetic pollution. This may be the result of the fact that, unlike other types, electromagnetic pollution is invisible and its results don't appear for so long.

Conclusion

In this study which defines the relationship between Awareness Level of preservice science teachers' conscious use of technological devices and environmental problems seeks answer to four sub-problems. Firstly, it was stated that there isn't a remarkable difference among preservice science teachers' awareness level of conscious use of technological devices which cause electromagnetic pollution depending on the gender variable. Then, it was concluded that students who took environmental science course had higher level of awareness when compared to those who didn't. With another sub-problem it was seen that there isn't any relationship between preservice teachers' awareness level of conscious use of technological devices which cause electromagnetic pollution and their awareness level of environmental problems. Lastly, with the help of qualitative data it was seen that 11 preservice science teachers had heard of electromagnetic pollution while 4 of them hadn't. Besides, students think that electromagnetic pollution stems from natural reasons such as the sun, the moon etc. or technological reasons such as computers, mobile phones etc. Preservice teachers stated that in all technological devices which cause electromagnetic pollution they use mobile phones most and then, television, tablet computer, wireless modem, hair dryer, microwave and radio follow it. Lastly, preservice science teachers' average score for environmental problems is 7.93 while their score for electromagnetic pollution is 5. In the light of this study, new studies to find why students think that they are less sensitive to electromagnetic pollution.

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Öğretmen Adaylarının Elektromanyetik Kirlilik ve Diğer Çevre Sorunlarına Yönelik Farkındalık Düzeyleri Arasındaki İlişki

Atıf:

Koklukaya, A. N., Guven Yildirim, E. & Selvi, M. (2017). The relationship between pre-service teachers' awareness levels of electromagnetic pollution and other environmental problems. *Eurasian Journal of Educational Research*, 67, 17-35 http://dx.doi.org/10.14689/ejer.2017.67.2

Ozet

Problem Durumu: Çağımızda bilim ve teknolojinin sürekli gelişmesi; toplumun yaşam standartlarım arttırırken çevrede pek çok şeyin yok olmasına veya değişim geçirmesine neden olmaktadır. Bu tür değişimler çevre sorunlarını meydana getirmektedir. Teknoloji çağında yaşamamızın bir sonucu olarak elektromanyetik

kirlikte çevremizi ve sağlığımızı etkileyen onemli çevre sorunlarından birisi haline gelmiştir. Elektromanyetik dalgalar gozle gorülmez ve kolaylıkla hissedilmez fakat sonuçları saptanabilir. Bu sebeple elektromanyetik dalgaların insan sağlığına verdiği zararlar da ne yazık ki fark edilmemektedir. Elektromanyetik kirlilik denilen kavram orneğin gürültü kirliliği gibi olsaydı, kulağımızı rahatsız eden bir gürültü esnasında ya o ortamı terk ederek ya da gürültü kaynağını ortadan kaldırılarak bu kirlilikten korunmak mümkün olabilirdi. Ancak elektromanyetik kirliliğin bir ortamda fazla olduğunu algılayacak bir duyu maalesef yoktur. Bu sebeple elektromanyetik kirlilik, ancak insan sağlığı üzerindeki sonuçları ortaya çıktığında fark edilebilir. Elektromanyetik kirliliğin varlığı şiddeti mühendislik alanında yapılan çalışmalarla, canlılar üzerine olan etkileri ise tıp alanında yapılan çalışmalarla ortaya konulmuştur. Ancak alanyazın incelendiğinde toplumun elektromanyetik kirlilik üzerine farkındalık düzeyini inceleyen geliştiren çalışmaların az olduğu belirlenmiş, bu çalışma bu anlamda alanyazına katkı sağlayarak ileride toplumu şekillendirecek olan bireylerin yetişmesine katkı sağlayacak oğretmen adaylarının elektromanyetik kirlilik ve çevre sorunlarına yonelik farkındalık düzeyleri ile ilişkisini incelemektedir.

Araştırmanın Amacı: Bu çalışma ile fen bilgisi oğretmen adaylarının elektromanyetik kirliliğe sebep olan teknolojik cihazların bilinçli kullanımına ilişkin farkındalık düzeyleri ile çevre sorunlarına yonelik farkındalık düzeyleri arasındaki ilişkinin belirlenmesi amaçlanmaktadır.

Araştırmanın Yontemi: Fen bilgisi oğretmen adaylarının elektromanyetik kirliliğe sebep olan teknolojik cihazların bilinçli kullanımına ilişkin farkındalık düzeyleri ile çevre sorunlarına yonelik farkındalık düzeyleri arasındaki ilişkinin belirlenmesi amacıyla yapılan bu çalışmada karma desen kullanılmıştır. Bu araştırma karma desen türlerinden zenginleştirilmiş yonteme gore düzenlenmiştir. Oncelikle nicel veriler toplamış daha sonra nitel veriler toplanarak nicel verilerin desteklenmesi sağlanmıştır. Araştırmanın nicel verilerinin elde edilmesinde ilişkisel tarama modeli, nitel verilerin elde edilmesinde ise fenomenolojik yontem kullanılmıştır. Bu araştırmanın nicel bolümünde 2012-2013 eğitim oğretim yılında bahar doneminde Ankara ilinde bir devlet üniversitesinde oğrenim gormekte olan 45 kız 31 erkek olmak üzere 76 fen bilgisi oğretmen adayı yer almaktadır. Araştırmada veri toplama aracı olarak iki adet farkındalık olçeği ve gorüşme soruları kullanılmıştır. Araştırmanın nicel verileri SPSS programı ile analiz edilmiştir. Nicel verilerin analizinde, Kolmogorov-Smirnov testi, ilişkisiz orneklemler t- testi ve Pearson korelasyon testi kullanılmıştır. Nitel veriler ise içerik analizi yontemi ile analiz edilmiştir.

Araştırmanın Bulguları: İlk olarak, oğretmen adaylarının elektromanyetik kirliliğe sebep olan teknolojik cihazların bilinçli kullanımına ilişkin farkındalık düzeyleri arasında cinsiyete gore istatistiksel olarak anlamlı bir fark çıkmamıştır [t (74)=0.73, p>.05]. Daha sonra "Çevre Bilimi" dersini alan oğretmen adaylarının elektromanyetik kirliliğe sebep olan bazı teknolojik cihazların bilinçli kullanımına ilişkin farkındalık düzeyleri "Çevre Bilimi" dersini almayan oğretmen adaylarının elektromanyetik kirliliğe sebep olan teknolojik cihazların bilinçli kullanımına ilişkin farkındalık düzeyleri ile karşılaştırılmıştır. Dersi alan oğretmen adaylarının

farkındalık düzeyleri dersi almayan öğretmen adaylarından daha yüksek bulunmuştur [t (74)= 2.22, p< .05]. Daha sonra fen bilgisi öğretmen adaylarının elektromanyetik kirliliğe sebep olan teknolojik cihazların bilinçli kullanımına ilişkin farkındalıkları ile çevre sorunlarına yonelik farkındalıkları arasında bir ilişki olmadığı tespit edilmiştir (r= .003, p>.05). Nitel bulgular da ise, öğretmen adaylarının büyük bir kısmının elektromanyetik kirlilik kavramını daha once duydukları belirlenmiştir. Öğretmen adaylarının bir kısmı, elektromanyetik kirliliğin güneş, ay, gezegenler ve galaksiden kaynaklı olarak var olduğunu diğer bir kısmı ise, bilgisayar, baz istasyonu, telsizler ve pillerden kaynaklı olarak var olduğunu belirtmişlerdir. Öğretmen adayları elektromanyetik kirliliğe sebep olan teknolojik cihazlardan en fazla cep telefonlarını kullandıkları daha sonra sırasıyla, televizyon, dizüstü bilgisayar, tablet bilgisayar, kablosuz modem, saç kurutma makinası, mikrodalga fırın kullandıklarını belirtmişlerdir. Son olarak öğretmen adaylarının elektromanyetik kirliliğe ilişkin olarak kendilerini daha az duyarlı olarak nitelendirdikleri belirlenirken, çevre sorunlarına yonelik olarak kendilerini daha duyarlı olarak nitelendirdikleri ortaya çıkmıştır.

Araştırmanın Sonuçları ve Oneriler: Fen bilgisi öğretmen adaylarının elektromanyetik kirliliğe sebep olan teknolojik cihazların bilinçli kullanımına ilişkin farkındalık düzeyleri ile çevre sorunlarına yonelik farkındalık düzeyleri arasındaki ilişkinin belirlendiği bu çalışmada dort alt probleme cevap aranmıştır. İlk olarak fen bilgisi öğretmen adaylarının elektromanyetik kirliliğe sebep olan teknolojik cihazların bilinçli kullanımına ilişkin farkındalık düzeyleri arasında cinsiyet değişkenine gore anlamlı bir fak olmadığı sonucuna ulaşılmıştır. Daha sonra "çevre bilimi" dersini alan fen bilgisi öğretmen adaylarının elektromanyetik kirliliğe sebep olan teknolojik cihazların bilinçli kullanımına ilişkin farkındalık düzeylerinin dersi almayanlara gore daha yüksek olduğu belirlenmiştir. Bir sonraki alt problemle fen bilgisi öğretmen adaylarının elektromanyetik kirliliğe sebep olan bazı teknolojik cihazların bilinçli kullanımına ilişkin farkındalık düzeyleri ile çevre sorunlarına yonelik farkındalık düzeyleri arasında bir ilişki olmadığı tespit edilmiştir. Son olarak nitel verilerle fen bilgisi öğretmen adaylarının 11'inin elektromanyetik kirlilik kavramını daha onceden duyduğu 4'ünün ise duymadığı sonucuna ulaşılmıştır. Bununla birlikte öğretmen adaylarının elektromanyetik kirliliğin doğal(güneş, ay…) ve teknoloji (bilgisayar, telefon…) ile olmak üzere iki şekilde oluştuğunu düşündükleri belirlenmiştir. Öğretmen adayları elektromanyetik kirlilik oluşturan cihazlardan en sık cep telefonu olmak üzere sırasıyla televizyon, dizüstü bilgisayar, tablet bilgisayar, kablosuz modem, saç kurutma makinası, mikrodalga fırın ve radyoyu kullandıklarını belirtmişlerdir. Son olarak çevre sorunlarına yonelik öğretmen adaylarının oz değerlendirme puan ortalamalarının 7,93 olduğu ancak elektromanyetik kirliliğe ilişkin öğretmen adaylarının oz değerlendirme puan ortalamalarının 5 olduğu sonucuna ulaşılmıştır.

Anahtar Sozcükler: Farkındalık olçeği, elektromanyetik sorunlar, çevre kirliliği, teknoloji.