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RESEARCH ARTICLE

Creating Awareness of Pre-Service Science Teachers for Sustainable Development about Waste Recycling*

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Abstract

The research has been carried out with the purpose of raising pre-service science teacher' awareness of waste recycling in terms of sustainable development and determining the effect of the education given on the level of pre-service teacher' awareness of waste and recycling. The research sample consists of 30 volunteer pre-service science teachers studying at the Faculty of Education in a university located in the North of Turkey. Recycling Awareness Scale developed by the researcher has been used as a data collection tool in the research. The awareness scale developed before and after the training has been applied as pre-test and post-test to pre-service science teachers. The data acquired from the Recycling Awareness Scale in the study has been analyzed as percent (%) and frequency (f). T test analysis has been performed for the related samples to determine whether there is a significant difference between pre-test and post-test scores of pre-service science teachers' awareness scale. As a result of the research, it has been seen that 10-week training has increased awareness of pre-service science teachers.

Keywords: Recycling, waste, sustainable development, awareness.

Introduction

Increasing needs of people and increasing consumption along with the rapidly increasing world population, the tendency to increase the quality of life and the unconscious destruction of nature cause decrease of natural resources and degradation of natural balance. As a result, human beings face with environmental problems that threaten the whole world.

Waste has emerged as a very important environmental problem in the cities with high population density along with increasing population, fast and unplanned urbanization. The problems related to increasing waste show the importance of waste management aiming at production and consumption with little or no waste (BSTB, 2014). Insufficient importance placed on waste management, irregular disposal of garbage to nearby settlements, on soil and water sources threatens health of nature and environment. For this reason, it is necessary to collect, transport, store the waste and then to make them harmless after putting them to good use. The waste generated by human activities causes a number of dangerous problems such as storage problem, contamination of surface and ground water, reproduction of various pests, bad smell from waste, pollution of soil as they get mixed with soil by forming carcinogenic substance (Keleş, 2007). Considering all these, reuse, recovery and recycling, known as 3R, come to the forefront in reducing the amount of waste that becomes an important environmental problem.

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Recycling is of vital importance to leave a livable world to the next generations. For this reason, diffusion of recycling by getting transformed into behavior in societies is only possible through consciousness and awareness of individuals on recycling. Awareness plays an important role in recognizing the need for fighting with environmental problems, understanding how much individuals know about environmental problems, and how much of it they implement or make effort to implement (Malkoç, 2011).

Societies with environmental awareness consist of individuals who have knowledge of the environmental and natural wealth, who are aware of the sustainability of this wealth and who take action in this regard and play a role in taking measures (Hungerford & Volk, 1990; Sander, Jelemenska & Kattmann, 2006). The use of the environmental and natural wealth and raising individuals who have a sense of sustainability is only possible through the teachers with knowledge about sustainability, with awareness to turn sustainability into behavior, and environmental education that enables the forming of environmental knowledge and the development of responsibility starting from primary school (Lord, 1999; Moseley, Reinke & Bootout, 2002; Slingsby & Baker, 2003). It is seen how important environmental education is if the main cause of environmental problems is thought to be societies composed of individuals who are not environmentally conscious enough. This shows that the teachers, who are the most important elements of the education system, have a vital role in raising sustainability conscious generations. In this context, the purpose of this research is to raise consciousness of pre-service science teachers on recycling of waste for sustainable development and to determine the effect of pre-service teachers on the level of awareness of waste and recycling. For this reason, it is important to raise awareness of pre-service teachers who will raise next generations on waste and recycling, which constitute the topic of this research, to prevent and solve the environmental problems that waste may cause and to contribute to the growth of generations with sustainable consciousness.

Methodology

Research Design

The research was designed according to one group pre-test-post-test experimental design in line with its main purpose. In one group pre-test-post-test experimental design, one group post-test design is developed by adding a pre-test to measure the dependent variable without intervening in participants. Such studies are considered to be a good way of fulfilling the purpose of the research in terms of both being able to see and document the change in performance, as well as being easy to understand and use (Christensen, Johnson & Turner, 2015).

Research Sample

The sample of the study consists of 30 volunteer pre-service science teachers studying in the department of Science Teaching of Faculty of Education at 3rd and 4th grades in a state university in the North of Turkey. The sample selection in the study has been made using the maximum variation sampling method, which takes into consideration that individuals have similar characteristics. The purpose of the maximum variation sampling method is to create a small sample and to reflect the diversity of individuals who are suitable for research in this sample to the maximum extent (Yıldırım, & Şimşek, 2011).

Data Collection Tool

Within the scope of the research, 30 pre-service science teachers have been trained for 10 weeks. The Recycling Awareness Scale developed by Aksan and Çelikler (2017) has been applied as pre-test and post-test before and after the training to pre-service teachers. The "Recycling Awareness Scale" used in the study consists of 48 articles and 10 factors of "Environmental", "Educational", "Economic", "Administrative", "Legal", "Susceptibility", "Media", "Protection of resources", "Features of recycled products" and "Biological".

Data Analysis

Recycling Awareness Scale has been used to collect data in the study. Analysis of the obtained data has been performed by SPSS statistical program. Responses to the articles of awareness scale in the survey have been analyzed as percent (%) and frequency (f). T test analysis has been conducted on pre-service science teachers for the related samples to determine whether there is a significant difference between pre-test and post-test scores of the awareness scale.

Validity of the Research

Research validity is an important concept in terms of all research types and it expresses the correctness or reality of the inferences made by the findings of the research (Christensen, Johnson & Turner, 2015).

Internal Validity of the Research

Internal validity, defined as correctness of cause and effect inferences made by the researcher, is related to the level of justifying and explaining that the change in the independent variable on the participants leads to the change in the dependent variable. Internal validity is to provide measurable changes that can be observed in dependent variables and caused only by the independent variable (Christensen, Johnson & Turner, 2015). The research has been completed with 30 science teachers who have been determined initially and loss of experimental subjects during the study have not affected the internal validity.

In time-dependent studies, it is possible that life of experimental subjects changes outside of experiments depending on the change or maturation between experimental practices (Büyüköztürk et al., 2016). In this context, it can be said that because the Awareness Training given to the pre-service teachers lasts 10 weeks, life of pre-service teachers outside of training might influence their awareness level.

External Validity of the Research

The external validity of the research is defined as the generalization level of the research results depending on other individuals, groups, environments, interventions, outcomes and time. External validity is a kind of inference process and involves forming comprehensive sentences only based on limited information (Christensen, Johnson & Turner, 2015). The fact that the research group consists of 30 pre-service science teachers indicates that the results obtained have a limited generalization and they are generalizable only for groups with the same characteristics.

Findings

The frequency and percentage distributions of the pre-test and post-test results of the answers given by pre-service science teachers for the items in the "Environmental" factor of the Recycling Awareness Scale are given in Table 1.

Table 1.

The frequency and percentage distributions of the answers given by pre-service teachers to the items related to "Environmental" factor of the scale

Items	*Type of test*	*CA*		*A*		*NAND*		*D*		*CD*	
		f	*%*	*f*	*%*	*f*	*%*	*f*	*%*	*f*	*%*
Recycling reduces environmental pollution.	**Pre-test**	17	**56.7**	9	30.0	3	10.0	0	0	1	3.3
	Post-test	20	**66.7**	10	33.3	0	0	0	0	0	0
Recycling slows down global warming.	**Pre-test**	17	**56.7**	8	26.7	3	10.0	0	0	2	6.7
	Post-test	21	**70.0**	9	30.0	0	0	0	0	0	0
Recycling does not solve the problem of waste.	**Pre-test**	16	**53.3**	10	33.3	2	6.7	1	3.3	1	3.3
	Post-test	20	**66.7**	9	30.0	1	3.3	0	0	0	0
Recycling prevents bad odours.	**Pre-test**	12	**40.0**	9	30.0	8	26.7	1	3.3	0	0
	Post-test	17	**56.7**	12	40.0	0	0	0	0	1	3.3
Recycling does not change the greenhouse effect.	**Pre-test**	0	0	2	6.7	2	6.7	17	**56.7**	9	30.0
	Post-test	0	0	0	0	0	0	9	30.0	21	**70.0**
Recycling prevents visual pollution.	**Pre-test**	9	30.0	19	**63.3**	1	3.3	1	3.3	0	0
	Post-test	10	33.3	20	**70.0**	0	0	0	0	0	0
Recycling has no effect on soil pollution.	**Pre-test**	0	0	4	13.3	12	**40.0**	6	20.0	8	26.7
	Post-test	0	0	0	0	0	0	7	23.3	23	**76.7**
Recycling increases air pollution.	**Pre-test**	1	3.3	5	16.7	5	16.7	12	**40.0**	7	23.3
	Post-test	0	0	0	0	0	0	17	**56.7**	13	**43.3**
Recycling helps prevent water pollution.	**Pre-test**	1	3.3	4	13.3	5	16.7	17	**56.7**	3	10.0
	Post-test	12	**40.0**	16	**53.3**	2	6.7	0	0	0	0

***(CA:** Certainly Agree, **A:** Agree, **NAND:** Neither Agree Nor Disagree, **D:** Disagree, **CD:** Certainly Disagree)*

When the pre-test results of the answers given by the pre-service teachers are examined; while 56.7% of the candidates definitely agree that recycling of waste will abate environmental pollution, 10.0% has been determined to be doubtful. In addition, while pre-service teachers definitely agree that recycling will slow down global warming (56.7%) it will not eliminate the garbage problem (53.3%), it will prevent bed smell (40.0%), it has been determined that they do not agree it will not make any difference on greenhouse effect (56.7%), and air pollution will increase (40.0%). Pre-service teachers have been found to be doubtful that recycling will abate soil pollution (40.0%), and they agree that image pollution (63.3%) and water pollution (53.3%) will be prevented. 10.0% has been determined to be doubtful. In addition, while pre-service teachers definitely agree that recycling will slow down global warming (56.7%) it will not eliminate the garbage problem (53.3%), it will prevent bed smell (40.0%), it has been determined that they do not agree it will not make any difference on greenhouse effect (56.7%), and air pollution will increase (40.0%). Pre-service teachers have been found to be doubtful that recycling will abate soil pollution (40.0%), and they agree that image pollution (63.3%) and water pollution (53.3%) will be prevented.

When the post-test results of the answers given by the pre-service teachers are examined; while candidates definitely agree that recycling of waste would abate environmental pollution (66.7%), global warming would slow down (70.0%) and it will stink (56.7%); it is seen that they agreed water pollution might be prevented (53.3%), visual pollution might be prevented (70%). It has been determined that there are pre-service teachers who do not agree that recycling of waste would not make any difference on greenhouse effect (70%), not abate soil pollution (76.7%) and air pollution would increase with recycling (43.3%).

The frequency and percentage distributions of the pre-test and post-test results of answers given by pre-service teachers for the items in the “Educational” factor of the Recycling Awareness Scale are given in Table 2.

Table 2.

Frequency and percentage distributions of pre-service teachers' answers to the “Educational” factor of the scale

Items	*Type of test*	*CA*		*A*		*NAND*		*D*		*CD*	
		f	*%*	*f*	*%*	*f*	*%*	*f*	*%*	*f*	*%*
I am not very knowledgeable about recycling.	**Pre-test**	11	36.7	16	**53.3**	2	6.7	1	3.3	0	0
	Post-test	0	0	0	0	1	3.3	12	**40.0**	17	**56.7**
Awareness should be raised in society about recycling products.	**Pre-test**	13	**43.3**	12	40.0	4	13.3	0	0	1	3.3
	Post-test	17	**56.7**	11	43.3	0	0	0	0	0	0
Education provided in schools is important in developing recycling awareness.	**Pre-test**	11	36.7	12	**40.0**	6	20.0	0	0	1	3.3
	Post-test	21	**70.0**	8	26.7	0	0	0	0	1	3.3
Consumer awareness projects are important for developing recycling awareness.	**Pre-test**	10	33.3	15	**50.0**	4	13.3	0	0	1	3.3
	Post-test	22	**73.3**	8	26.7	0	0	0	0	0	0

Societies do not have the required level of information about recycling.	**Pre-test**	6	20.0	8	26.7	13	**43.3**	3	10.0	0	0
	Post-test	16	**53.3**	11	36.7	2	6.7	0	0	1	3.3

***(CA:** Certainly Agree, **A:** Agree, **NAND:** Neither Agree Nor Disagree, **D:** Disagree, **CD:** Certainly Disagree)*

When the pre-test results of the answers given by the pre-service teachers are examined; it is seen that they definitely agree that the awareness of society needs to be raised (43.3%), and they agree that they do not have enough knowledge about recycling (53.3%), the education required for raising awareness of recycling should be given in schools (40.0%) that it is important to make consumer awareness projects on recycling (50.0%). It is also noted that there are doubtful candidates (43.3%) who are of idea that societies do not have enough knowledge on recycling.

When the post-test results of the answers given by the pre-service teachers are examined; it has been determined they absolutely do not agree that pre-service teachers do not have enough knowledge about recycling (56.7%) In addition, it has been found out that pre-service teachers absolutely agree that the awareness of society needs to be raised (56.7%), the education required for raising awareness of recycling should be given in schools (70.0%) and it is important to make consumer awareness projects on recycling (73.3%) and that societies do not have enough knowledge on recycling (53.3%).

The frequency and percentage distributions of the pre-test and post-test results of the responses given by pre-service teachers to the items in the “Economic” factor of the Recycling Awareness Scale are given in Table 3.

Table 3.

Frequency and percentage distributions of pre-service teachers' responses to the "Economic" factor of the scale

Items	*Type of test*	*CA*		*A*		*NAND*		*D*		*CD*	
		f	*%*	*f*	*%*	*f*	*%*	*f*	*%*	*f*	*%*
Recycling saves energy.	**Pre-test**	2	6.7	9	30.0	14	**46.7**	3	10.0	2	6.7
	Post-test	17	**56.7**	13	**43.3**	0	0	0	0	0	0
Widespread recycling helps decrease imports of raw materials.	**Pre-test**	13	**43.3**	15	**50.0**	2	6.7	0	0	0	0
	Post-test	19	**63.3**	11	36.7	0	0	0	0	0	0
Products made of recycled materials contribute to economic development.	**Pre-test**	3	10.0	15	**50.0**	6	20.0	5	16.7	1	3.3
	Post-test	17	**56.7**	13	**43.3**	0	0	0	0	0	0
Recycling industry creates jobs for people.	**Pre-test**	2	6.7	5	16.7	17	**56.7**	5	16.7	1	3.3
	Post-test	18	**60.0**	12	40.0	0	0	0	0	0	0
Investing in recycling industry makes economic sense.	**Pre-test**	2	6.7	9	30.0	15	**50.0**	3	10.0	1	3.3
	Post-test	19	**63.3**	11	36.7	0	0	0	0	0	0

*(**CA:** Certainly Agree, **A:** Agree, **NAND:** Neither Agree Nor Disagree, **D:** Disagree, **CD:** Certainly Disagree)*

When the pre-test results of the answers given by the pre-service teachers are examined; it is seen that candidates agree that the import of raw materials from abroad will decrease as recycling becomes prevalent (50.0%) and the products produced from recycled materials will contribute to the economy (50.0%). In addition, it has been determined that pre-service teachers doubt that energy will be saved along with the recycling of waste 46.7%), recycling sector will provide people with new job opportunities (56.7%) and recycling sector is an efficient economic investment (50.0%).

According to the post-test results of the answers given by pre-service teachers, it is seen that candidates definitely agree that energy will be saved along with the recycling (56.7%), the import of raw materials from abroad will decrease as recycling becomes prevalent (63.3%), and the products produced from recycled materials will contribute to the economy (56.7%), and recycling sector is an efficient economic investment (63.3%).

The frequency and percentage distributions of the pre-test and post-test results of answers given by pre-service teachers for the items in the "Administrative" factor of the Recycling Awareness Scale are given in Table 4.

Table 4.

Frequency and percentage distributions of pre-service teachers ' responses to the "Administrative" factor of the scale

Items	*Type of test*	*CA*		*A*		*NAND*		*D*		*CD*	
		f	*%*	*f*	*%*	*f*	*%*	*f*	*%*	*f*	*%*
Recycling methods are the same for all types of waste.	**Pre-test**	2	6.7	2	6.7	7	23.3	17	**56.7**	2	6.7
	Post-test	0	0	0	0	0	0	11	36.7	19	**63.3**
Recycling requires more space for waste storage.	**Pre-test**	0	0	1	3.3	9	30.0	18	**60.0**	2	6.7
	Post-test	1	3.3	1	3.3	4	13.3	10	**33.3**	14	**46.7**
In recycling, wastes undergo physical changes only.	**Pre-test**	1	3.3	1	3.3	12	**40.0**	13	**43.3**	3	10.0
	Post-test	0	0	0	0	0	0	5	16.7	25	**83.3**
Recycling bins need to be used more widely.	**Pre-test**	11	36.7	15	**50.0**	3	10.0	1	3.3	0	0
	Post-test	17	**56.7**	12	40.0	0	0	0	0	1	3.3
Recycling is done by municipalities and licenced firms.	**Pre-test**	0	0	5	16.7	15	**50.0**	10	33.3	0	0
	Post-test	17	**56.7**	13	43.3	0	0	0	0	0	0
The most important stage of recycling is separation at source and separate collection.	**Pre-test**	6	20.0	15	**50.0**	7	23.3	2	6.7	0	0
	Post-test	27	**90.0**	3	10.0	0	0	0	0	0	0

***(CA:** Certainly Agree, **A:** Agree, **NAND:** Neither Agree Nor Disagree, **D:** Disagree, **CD:** Certainly Disagree)*

When the pre-test results of the answers given by the pre-service teachers are examined; it has been determined that pre-service teachers do not agree that recycling methods are the same for each waste (56.7%), that with recycling more space is required for storage of waste (60.0%), and that waste does not only change physically within the recycling process (43.3%). It is seen that they agree that recycling boxes should get prevalent (50.0%) and that the most important step of the recycling process is separation at source and collecting separately (50.0%). It has been determined that they doubt that recycling activities are carried out by municipalities and licensed companies (50.0%).

According to the post-test results of the answers given by pre-service teachers, it has been found out that they definitely do not agree that recycling methods are the same for each waste (63.3%), that with recycling more space is required for storage of waste (46.7%), and that waste does not only change physically within the recycling process (83.3%). It has been determined that they definitely agree that recycling boxes should get prevalent (56.7%) and that recycling activities are carried out by municipalities and licensed companies (56.7%) and the most important step of the recycling process is separation at source and collecting separately (90.0%).

The frequency and percentage distributions of the pre-test and post-test results of the answers given by pre-service teachers for the items in the “Legal” factor of the Recycling Awareness Scale are given in Table 5.

Table 5.

Frequency and percentage distributions of pre-service teachers' responses to the “Legal” factor of the scale

Items	*Type of test*	*CA*		*A*		*NAND*		*D*		*CD*	
		f	*%*	*f*	*%*	*f*	*%*	*f*	*%*	*f*	*%*
New legislation needs to be made to encourage recycling.	**Pre-test**	3	10.0	18	**60.0**	9	30.0	0	0	0	0
	Post-test	13	**43.3**	17	**56.7**	0	0	0	0	0	0
An environmental protection tax should be introduced to encourage recycling.	**Pre-test**	5	16.7	17	**56.7**	6	20.0	2	6.7	0	0
	Post-test	16	**53.3**	12	40.0	2	6.7	0	0	0	0
Recycling facilities do not need an environmental licence to operate.	**Pre-test**	5	16.7	13	**43.3**	5	16.7	6	20.0	1	3.3
	Post-test	0	0	0	0	0	0	17	**56.7**	13	**43.3**
Governments should sign international treaties and protocols to spread recycling.	**Pre-test**	23	**76.7**	7	23.3	0	0	0	0	0	0
	Post-test	25	**83.3**	5	16.7	0	0	0	0	0	0

***(CA:** Certainly Agree, **A:** Agree, **NAND:** Neither Agree Nor Disagree, **D:** Disagree, **CD:** Certainly Disagree)*

When the pre-test results of the answers given by the pre-service teachers are examined; it has been determined that candidates agree that countries should prepare global contracts and protocols for diffusion of recycling (76.7%), the government should make legal regulations to increase recycling activities (60.0%), environmental protection tax should be collected for diffusion of recycling (56.7%) and that the plants carrying out recycling process so not need to have environmental permits or license (43.3%),

According to the post-test results of the answers given by the pre-service teachers, it has been determined that candidates agree that the government should make legal regulations to increase recycling activities (56.7%), and they definitely agree that environmental protection tax should be collected for diffusion of recycling (53.3%), countries should prepare global contracts and protocols for diffusion of recycling (83.3%).Moreover, it is also seen that candidates are of the same mind that the plants carrying out recycling process need to have environmental permits or license.

The frequency and percentage distributions of the pre-test and post-test results of answers given by pre-service teachers for the items in the " Susceptibility" factor of the Recycling Awareness Scale are given in Table 6.

Table 6.

Frequency and percentage distributions of pre-service teachers' responses to the "Susceptibility" factor of the scale

Items	*Type of test*	*CA*		*A*		*NAND*		*D*		*CD*	
		f	*%*	*f*	*%*	*f*	*%*	*f*	*%*	*f*	*%*
People do not care to separate their waste.	**Pre-test**	0	0	20	**66.7**	5	16.7	5	16.7	0	0
	Post-test	23	**76.7**	7	23.3	0	0	0	0	0	0
I take care to use recycling bins.	**Pre-test**	0	0	0	0	3	10.0	4	13.3	23	**76.7**
	Post-test	21	**70.0**	9	30.0	0	0	0	0	0	0
I prefer recyclable products when i am shopping.	**Pre-test**	0	0	0	0	0	0	10	33.3	20	**66.7**
	Post-test	0	0	23	**76.7**	1	3.3	6	20.0	0	0
People do not care to use recycling bins.	**Pre-test**	9	30.0	12	**40.0**	7	23.3	2	6.7	0	0
	Post-test	17	**56.7**	13	**43.3**	0	0	0	0	0	0
I separate my waste at home.	**Pre-test**	0	0	0	0	0	0	19	**63.3**	11	36.7
	Post-test	20	**66.7**	10	33.3	0	0	0	0	0	0

***(CA:** Certainly Agree, **A:** Agree, **NAND:** Neither Agree Nor Disagree, **D:** Disagree, **CD:** Certainly Disagree)*

When the pre-test results of the answers given by the pre-service teachers are examined; it is seen that they agree that people do not place importance on throwing away their garbage by separating the waste (66.7%) and using recycling boxes (40.0%). While stating they absolutely do not agree that they do not make a point of throwing the waste into the recycling box (76.7%), they prefer to buy recyclable products (66.7%), they state that they do not agree that people make a point of waste sorting at their houses (63.3%).

According to the post-test results of the answers given by pre-service teachers, they have stated that they definitely agree that people do not place importance on throwing away their garbage by separating the waste (76.7%) and using recycling boxes (56.7%). Moreover, they have stated that they definitely agree that that they do make a point of throwing the waste into the recycling box (70.0%) and they sort the waste at home (76.7%).

The frequency and percentage distributions of the pre-test and post-test results of the answers given by pre-service teachers for the items in the "Media" factor of the Recycling Awareness Scale are given in Table 7.

Table 7.

Frequency and percentage distributions of pre-service teachers' responses to the "Media" factor of the scale

Items	*Type of test*	*CA*		*A*		*NAND*		*D*		*CD*	
		f	*%*	*f*	*%*	*f*	*%*	*f*	*%*	*f*	*%*
There should be public campaigns to raise awareness in society about recycling.	**Pre-test**	5	16.7	9	30.0	11	**36.7**	5	16.7	0	0
	Post-test	19	**63.7**	11	36.7	0	0	0	0	0	0
It is important to use the media to raise social awareness about recycling.	**Pre-test**	11	36.7	13	**43.3**	6	20.0	0	0	0	0
	Post-test	18	**60.0**	12	40.0	0	0	0	0	0	0
There should be news and other programmes in the media about waste and recycling.	**Pre-test**	5	16.7	15	**50.0**	8	26.7	2	6.7	0	0
	Post-test	21	**70.0**	9	30.0	0	0	0	0	0	0

***(CA:** Certainly Agree, **A:** Agree, **NAND:** Neither Agree Nor Disagree, **D:** Disagree, **CD:** Certainly Disagree)*

When the pre-test results of the answers given by the pre-service teachers are examined; it has been determined that while candidates doubt that public service announcements should be prepared to raise awareness of recycling within the society (36.6%), they agree that the use of media in raising awareness of recycling is important (43.3%) and that news and programs related to the waste and recycling should be made within media (50.0%).

According to the post-test results of the answers given by the pre-service teachers, it has been determined that they agree definitely agree that public service announcements should be prepared to raise awareness of recycling within the society (63.7%), it is important to use media in raising awareness of recycling (60.0%) and that news and programs related to the waste and recycling should be made within media (70.0%).

The frequency and percentage distributions of pre-test and post-test results of answers given by pre-service teachers for the items in the "Protection of resources" factor of the Recycling Awareness Scale are given in Table 8.

Table 8.

Frequency and percentage distributions of pre-service teachers' responses to the "Protection of resources" factor of the scale

Items	*Type of test*	*CA*		*A*		*NAND*		*D*		*CD*	
		f	*%*	*f*	*%*	*f*	*%*	*f*	*%*	*f*	*%*
Recycling prevents wasting raw materials.	**Pre-test**	8	26.7	15	**50.0**	4	13.3	3	10.0	0	0
	Post-test	18	**60.0**	12	40.0	0	0	0	0	0	0
Recycling means efficient use of natural resources.	**Pre-test**	13	**43.3**	12	40.0	2	6.7	3	10.0	0	0
	Post-test	13	**43.3**	15	**50.0**	1	3.3	1	3.3	0	0
Recycling prevents depletion of mineral resources.	**Pre-test**	14	**46.7**	13	**43.3**	1	3.3	2	6.7	0	0
	Post-test	17	**56.7**	13	**43.3**	0	0	0	0	0	0
Recycling protects forests.	**Pre-test**	14	46.7	15	**50.0**	1	3.3	0	0	0	0
	Post-test	28	**93.3**	2	6.7	0	0	0	0	0	0

***(CA:** Certainly Agree, **A:** Agree, **NAND:** Neither Agree Nor Disagree, **D:** Disagree, **CD:** Certainly Disagree)*

When the pre-test results of the answers given by the pre-service teachers are examined; it has been determined that the candidates definitely agree that recycling will prevent depletion of mineral deposits (46.7%) and it will ensure efficient use of natural resources (43.3%); and they agree that it will provide protection of forests (50.0%) and prevent waste of raw materials (50.0%).

According to the post-test results of answers given by pre-service teachers; it has been determined that they definitely agree that recycling will prevent depletion of mineral deposits (56.7%) and waste of raw materials (60.0%) and provide protection of forests (93.3%), and they agree that it will ensure efficient use of natural resources (50.0%)

The frequency and percentage distributions of the pre-test and post-test results of the answers given by pre-service teachers for the items in the "Features of recycled product" factor of the Recycling Awareness Scale are given in Table 9.

Table 9.

Frequency and percentage distributions of pre-service teachers' responses to the "Features of recycled products" factor of the scale

Items	*Type of test*	*CA*		*A*		*NAND*		*D*		*CD*	
		f	*%*	*f*	*%*	*f*	*%*	*f*	*%*	*f*	*%*
Products made of recycled materials are not high-quality.	**Pre-test**	10	**33.3**	2	6.7	10	**33.3**	1	3.3	7	23.3
	Post-test	0	0	1	3.3	3	10.0	12	**40.0**	14	**46.7**
Products made of recycled materials are not durable.	**Pre-test**	8	26.7	19	**63.3**	2	6.7	1	3.3	0	0
	Post-test	0	0	2	6.7	2	6.7	10	33.3	16	**53.3**
Products made of recycled materials are expensive.	**Pre-test**	0	0	0	0	15	**50.0**	8	26.7	7	23.3
	Post-test	0	0	0	0	2	6.7	13	**43.3**	15	**50.0**
Recycled goods are products made of recycled materials.	**Pre-test**	6	20.0	18	**60.0**	6	20.0	0	0	0	0
	Post-test	23	**76.7**	7	23.3	0	0	0	0	0	0

***(CA:** Certainly Agree, **A:** Agree, **NAND:** Neither Agree Nor Disagree, **D:** Disagree, **CD:** Certainly Disagree)*

When the pre-test results of the answers given by the pre-service teachers are examined; it has been seen that candidates definitely do not agree that the products produced from the recycled materials are of good quality (33.3%) and they do not agree that they are long lasting (63.3%). Furthermore, it has been determined that there are some pre-service teachers who doubt recycled products are more likely to be expensive (50.0%) and not high quality (33.3%). It has been determined that pre-service teachers indicate that recycled products are the products produced after the waste is evaluated and transformed to a new product (60.0%).

According to the post-test results of the answers given by pre-service teachers, it has been determined that candidates definitely agreed that products produced from the recycled materials are of good quality (46.7%) and long lasting (53.3%). Furthermore, it has been determined that candidates definitely do not agree that recycled products are more likely to be expensive (50.0%). And it has been determined that candidates definitely agree that recycled products are the products produced after the waste is evaluated and transformed to a new product (76.7%).

The frequency and percentage distributions of the pre-test and post-test results of answers given by pre-service teachers for the items in the "Biological" factor of the Recycling Awareness Scale are given in Table 10.

Table 10.

Frequency and percentage distributions of pre-service teachers' responses to the "Biological" factor of the scale

Items	*Type of test*	*CA*		*A*		*NAND*		*D*		*CD*	
		f	*%*	*f*	*%*	*f*	*%*	*f*	*%*	*f*	*%*
Recycling helps microorganisms proliferate.	**Pre-test**	2	6.7	3	10.0	4	13.3	15	**50.0**	6	20.0
	Post-test	0	0	0	0	0	0	8	26.7	22	**73.3**
Recycling protects life.	**Pre-test**	0	0	2	6.7	11	36.7	16	**53.3**	1	3.3
	Post-test	20	**66.7**	10	33.3	0	0	0	0	0	0
Using recycled products is not safe for health.	**Pre-test**	10	33.3	17	**56.7**	3	10.0	0	0	0	0
	Post-test	0	0	0	0	3	10.0	8	26.7	19	**63.3**

***(CA:** Certainly Agree, **A:** Agree, **NAND:** Neither Agree Nor Disagree, **D:** Disagree, **CD:** Certainly Disagree)*

When the pre-test results of the answers given by the pre-service teachers are examined; it has been determined that candidates do not agree that reproduction of microorganisms will increase with recycling (50.0%) and recycling will protect life of living things and they agree that the use of recycled products is not safe for health (56.7%).

According to the post-test results of the answers given by pre-service teachers, it has been determined that candidates definitely do not agree that reproduction of microorganisms will increase with recycling (73.3%) and that the use of recycled products is not safe for health (63.3%) and they agree that recycling will protect life of living things (66.7%).

When the Shapiro-Wilk results have been analyzed to determine the distributions of the scores of the pre-service teachers from the whole awareness scale in the pre-test and the post-test, the scores of the pre-test ($p = .580$, $p < .05$) and the scores of the post-test ($p = .120$, $p < .05$) show normal distribution.

Dependent t-test has been conducted to determine whether pre-test and post-test scores of awareness levels of pre-service teachers in terms of factors of the awareness scale and the awareness scale as a whole differ. Table 11 shows the comparison of pre-test and post-test scores from both general Recycling Awareness Scale itself and sub-dimensions of the Recycling Awareness Scale through the Dependent t Test.

Table 11.

Dependent t test results of pre-test and post-test scores of awareness levels of pre-service teachers

Factor's name	*Number of items*	*Type of test*	*N*	$\overline{X}$	*S*	*sd*	*t*	*p*
Environmental	9	**Pre-test**	30	36.1000	4.83058	29	-5.304	.000
		Post-test	30	41.3667	2.97673			
Educational	5	**Pre-test**	30	17.7000	2.96124	29	-8.704	.000
		Post-test	30	22.8000	2.23453			
Economic	5	**Pre-test**	30	17.2333	1.85106	29	-12.296	.000
		Post-test	30	23.0000	1.68154			
Administrative	6	**Pre-test**	30	21.6000	2.66005	29	-8.703	.000
		Post-test	30	27.5667	2.43088			
Legal	4	**Pre-test**	30	14.9000	1.58332	29	-8.588	.000
		Post-test	30	18.1667	1.34121			
Susceptibility	5	**Pre-test**	30	11.7333	1.31131	29	-22.355	.000
		Post-test	30	23.0333	2.39947			
Media	3	**Pre-test**	30	11.4000	1.56690	29	-6.954	.000
		Post-test	30	13.9333	1.01483			
Protection of resources	4	**Pre-test**	30	16.8333	1.93129	29	-3.525	.000
		Post-test	30	18.4333	1.25075			
Features of recycled products	4	**Pre-test**	30	14.6333	1.97368	29	-7.954	.000
		Post-test	30	17.8333	1.57750			
Biological	3	**Pre-test**	30	7.9000	1.39827	29	-18.072	.000
		Post-test	30	13.9333	1.04826			
Recycling Awareness Scale	48	**Pre-test**	30	170.0333	8.78668	29	-18.906	.000
		Post-test	30	220.0667	12.49533			

The highest score that pre-service teachers can get from the Recycling Awareness Scale is 240.00 and the lowest score is 48.00. The highest score from the "Environmental" subscale of the scale is 45.00, the lowest score is 9.00; The highest score from the "administrative" sub-dimension is 30.00, the lowest score is 6.00; The highest score from the "Educational", "Economical" and "Susceptibility" factor is 25.00 the lowest score is 5.00; The highest score from the "Legal", "Protection of Resources" and "Features of Recycled Products" factor is 20.00, the lowest score is 4.00; The highest score from the "Media" and "Biological" factor is 15.00 and the low$\overline{\text{est}}$ score is 3.00.

The arithmetic mean of the pre-test scores of pre-service teachers is $\bar{X}_{pre}$ = 170.0333 and the arithmetic mean of the post-test scores is $\bar{X}_{post}$ = 220.0667. When the arithmetic mean of the pre-test and post-test scores of factors of the awareness scale which are "Environmental" ($\bar{X}_{pre}$ =36.1000; $\bar{X}_{post}$ =41.3667), "Educational" ($\bar{X}_{pre}$ =17.7000; $\bar{X}_{post}$ =22.8000), "Economic" ($\bar{X}_{pre}$ =17.2333; $\bar{X}_{post}$ =23.0000), "Administrative" ($\bar{X}_{pre}$ =21.6000; $\bar{X}_{post}$ =27.5667), "Legal" ($\bar{X}_{pre}$ =14.9000; $\bar{X}_{post}$ =18.1667), "Susceptibility" ($\bar{X}_{pre}$ =11.7333; $\bar{X}_{post}$ =23.0333), "Media"($\bar{X}_{pre}$ =11.4000; $\bar{X}_{post}$ =13.9333), "Protection of Resources" ($\bar{X}_{pre}$ =16.8333; $\bar{X}_{post}$ =18.4333), "Features of Recycled Products" ($\bar{X}_{pre}$ =14.6333; $\bar{X}_{post}$ =17.8333) and "Biological" ($\bar{X}_{pre}$ =7.9000; $\bar{X}_{post}$ =13.9333) are examined, it is seen that pre-service teachers' awareness level increases in all dimensions.

It is seen that there is a statistically significant difference between the pre-test and post-test scores pre-service teachers get from the general awareness scale in favor of the post-test ($t_{(29)}$= -18.906, p< .01). It is also seen that there is a statistically significant difference between pre-test and post-test scores of factors of the awareness scale of pre-service teachers. It has been determined that this difference is significant in favor of post-test in terms of "Environmental" ($t_{(29)}$= -5.304, p< .01), "Educational" ($t_{(29)}$= -8.704, p< .01), p <.01), "Administrative" ($t_{(29)}$= -8.703, p< .01), "Legal" ($t_{(29)}$= -8.588, p< .01), "Susceptibility" ($t_{(29)}$= -22.355, p< .01), "Media" ($t_{(29)}$= -6.954, p< .01), "Protection of Resources" ($t_{(29)}$= -3.525, p< .01), and "Biological" ($t_{(29)}$= -18.072, p< .01) dimensions.

Results and Discusiion

It has been found out that there is a statistically significant difference between the pre-test and post-test scores pre-service teachers get from the general awareness scale ($t_{(29)}$= -18.906, p<.01). It has been determined that this difference is in favor of post-test. Moreover, it has also been determined that there is a significant difference between pre-test and post-test scores pre-service teachers get from factors of the awareness scale.

The results of the research reveal that the education given to pre-service teachers is effective in creating awareness. Byrne and O'Regan (2014) also point out that the purpose of environmental education is to raise awareness of young people about environmental issues and emphasize that environmental education and opportunities facilitating recycling provided to individuals will encourage individuals to recycle. Similarly, Miranda and Blanco (2010) indicate that environmental awareness is one of the most important factors influencing recycling.

It is thought that pre-service teachers' awareness about the waste and recycling issues was low before the training, because the recycling topic is not given much place within the curriculum. As a matter of fact, in the research conducted by Karatekin (2014), it has been determined that pre-service social sciences teachers have a low level of knowledge and awareness about solid waste and recycling. Again in the research conducted by Harman and Çelikler (2015), it has been determined that nearly all pre-service science teachers have enough awareness regarding meaning, necessity and purpose of recycling; however their awareness of types of waste that can be recycled is low. These surveys are similar to the result of the research conducted. In another research, it has been determined that the general, theoretical and implementation awareness of Information Technology (IT) teachers on e-waste is "moderate" (Öztüre, 2015). Again, in the research conducted by Cici, Şeker, Görgen and Deniz (2005), it is seen that the environmental awareness of pre-service teachers is good in questions regarding minimizing waste and moderate in questions regarding organic wastes and packaging.

We believe that the use of student-centered methods and techniques in curriculums starting from pre-school period will be effective in creating awareness on recycling. In the study carried out by Şallı et al. (2013), it has been understood that family attended project-based teaching method is effective for children at the age of 60-72 months to realize the recycling concept, and this shows the importance of children's active participation. It is important that active involvement of the resultant learners is important in the family-based project-based learning approach in recognizing the concept of recycling of children in the group of 60-72 months old. Öztüre (2015) implies that the level of awareness of e-waste and recycling of IT teachers is low because they haven't confronted with this topic either in the education they received in university and or in their text books.

People should start raising awareness of recycling at an early age. This is because the awareness gained in pre-school and primary school periods will lead to terminal behaviors at older ages. As a matter of fact, in the study carried out by Can Yaşar, İnal, Kaya and Uyanık (2012) to determine awareness level of children on recycling it has been found out that majority of the children know the meaning of the symbol and the word of recycling. In this context, value judgments, emerging especially in this age group help children become environmentally friendly individuals by providing them with positive behaviours in recycling that contribute to sustainable development.

The obligations of media organizations for raising environmental awareness of society are stated in the Environmental Law (ÇOB, 2006). In accordance with the Environmental Law, it is obligatory radio and television programs make programs on the importance of the environment and raising environmental awareness and Turkish Radio and Television Corporation and private television channels should broadcast educational programs for at least two hours a month and this obligation is at least half an hour for radio programs (ÇOB, 2006). With at least two hours per month of private television channels, while the programs of private radio channels month at least half an hour of trainings and programs are required. In addition, according to the law, 20% of the programs must be broadcasted when rating makes a peak. As a result of this research, it is believed that other reasons why pre-service teachers do not have sufficient awareness of recycling are that institutions responsible for working on raising social awareness do not work enough, and media gives little place to news, programs, and public service announcements with this regard. Considering that the media plays an important role in the daily lives of individuals and is influential in lifelong learning, it can be said that it is efficient in raising sustainability consciousness and awareness of recycling. For this reason, it is thought that it is important to give place to programs, news, documentaries and public spots in media. As a matter of fact, in the study conducted by Mert (2006), it has been determined that high school students' sensitivity of environmental education and solid wastes varies depending on their routine of buying daily newspapers and watching ecological documentaries. Öztüre (2015) states that IT teachers' awareness level on e-waste and recycling is low, because media does not place required importance on this issue. Furthermore, in the research conducted by Yılmaz, Aksan and Çelikler (2016), it has been pointed out that sit is possible to raise awareness of individuals through visual and written media, public service announcements on waste batteries, banners and informative programs. Considering results of the research, it is thought that the media is an important tool in terms of publicizing the concept of recycling and creating social awareness, and it is thought that these issues should be given more place in the media. In addition, in today's World called Information Age, it is thought that it is also important to use the internet from information technologies in the activities of raising social awareness.

Pre-service teachers who will grow future generations should have adequate equipment for waste and recycling, one of the key environmental issues. For this reason, throughout

the university education, teachers should be informed through various educational activities by adding lessons including these topics to the curriculum for all departments. Organizing scientific events such as conferences, symposiums and panels on waste and recycling in universities is thought to be effective.

Furthermore, given the fact that teachers have a mission to influence fate of societies, it is considered important to conduct studies to determine the knowledge, attitudes, thoughts and awareness of pre-service teachers on waste and recycling, which is one of the most important environmental issues. It is thought that trainings on waste and recycling at every stage of the education, trip-observation, collaborative studying activities, awareness-raising discussions, field work to influence students' attitudes positively and comprehensive projects in colleges and universities will contribute to increasing the sensitivity for recycling.

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FEN BİLGİSİ ÖĞRETMEN ADAYLARINDA SÜRDÜRÜLEBİLİR KALKINMA İÇİN ATIKLARIN GERİ DÖNÜŞÜMÜ KONUSUNDA FARKINDALIK OLUŞTURULMASI

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Özet

Araştırma, sürdürülebilir kalkınma açısından atıkların geri dönüşümü konusunda Fen Bilgisi öğretmen adaylarında farkındalık oluşturulması ve verilen eğitiminin öğretmen adaylarının atıklar ve geri dönüşüm konusundaki farkındalık düzeylerine etkisinin belirlenmesi amacı ile yapılmıştır. Araştırmanın örneklemini, Türkiye'nin kuzeyinde bir devlet üniversitesinin Eğitim Fakültesinde öğrenim gören 30 gönüllü Fen Bilgisi öğretmen adayı oluşturmaktadır. Araştırmada veri toplama aracı olarak, araştırmacı tarafından geliştirilen Geri Dönüşüm Farkındalık Ölçeği kullanılmıştır. Eğitim öncesi ve sonrası geliştirilen farkındalık ölçeği öğretmen adaylarına ön test ve son test olarak uygulanmıştır. Araştırmada Geri Dönüşüm Farkındalık Ölçeğinden elde edilen veriler, yüzde (%) ve frekans (f) olarak analiz edilmiştir. Öğretmen adaylarına farkındalık ölçeğine ait ön test ve son test puanları arasında anlamlı düzeyde bir fark olup olmadığını tespit etmek amacıyla ilişkili örneklemler için t Test analizi yapılmıştır. Araştırma sonucunda, 10 hafta süren eğitimin Fen Bilgisi öğretmen adaylarının geri dönüşüm farkındalıklarının arttırdığını ortaya koymaktadır.

Anahtar Kelimeler: Geri dönüşüm, atık, sürdürülebilir kalkınma, farkındalık.