

# Recycling Awareness Education: Its Impact on Knowledge Levels of Science Teacher Candidates\*

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## **Abstract**

The study was carried out to determine the impact of waste recycling education given to Science Teacher candidates for sustainable improvement of their knowledge levels about waste and recycling. The study was designed according to the single group pretest-posttest experimental design in line with the main purpose of the study. The sample of the study consists of 30 volunteer Science Teacher candidates studying in 3rd and 4th grade in Science Teaching Department of Faculty of Education. Recycling Knowledge Test developed by the researcher was used as a data collection tool in the study. Within the scope of the study, 30 Science Teacher candidates were educated for 10 weeks. Pre-test and post-tests were applied to teacher candidates before and after the course. In the study, the data obtained from the Recycling Knowledge Test was analyzed by content analysis. As a result of the study, it has been seen that knowledge levels of Science Teacher candidates on recycling have increased and that teacher candidates' behaviors towards recycling changed positively.

**Keywords:** Science Teacher candidate, waste, recycling, sustainable development.

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## **Introduction**

Waste has come out to be a very important environmental problem in cities with high population density along with the population increase, fast and unplanned urbanization. The problems related to the increasing amount of waste show the importance of waste management aiming at production and consumption with very little waste or no waste at all (BSTB, 2014). Insufficient importance placed on waste management, irregular disposal of garbage to nearby settlements, disposal on soil and in water sources threatens the health of nature and environment. For this reason, it is necessary to collect, transport, store the waste and then to make them harmless by 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 pest, bad smell from waste, and soil contamination as waste get mixed with soil by forming a carcinogenic substance (Keleş, 2007). Considering all these, reuse, recovery and recycling, known as 3R, come to the forefront in reducing the amount of waste which becomes an important environmental problem.

Waste management, which aims to prevent rapid depletion of natural resources and to prevent the threat posed by the waste to the environment and human health, and to turn them into an economic value, constitutes the basis for sustainable development, which has become the most important policy target and which has been adopted throughout

the World (BSTB, 2014). Sustainable development, a concept indicating the responsibilities of people to the nature, to each other and to future generations (Baumgärtner & Quaas, 2010), is also a planning and management process of competing with the world markets economically, meeting the basic needs of people appropriately, raising the prosperity level and quality of living without ignoring future generations and it is also socially fair, preventive, protective, remedial and supportive for natural systems (Whistler, 2007).

Sustainable development aims at balancing ecology, meeting needs, economic development and responsibility to future generations (Çepik, 2015) and at this point sustainable environmental education comes up. At the United Nations Rio Summit, where environmental issues are addressed, it has been decided to use the phrase of "Environmental Education for Sustainable Development" instead of "Environmental Education" (Tilbury, 1995; UNESCO, 1992).

An individual who is aware that he is a part of the ecosystem within the scope of sustainability, will come to a point where he will achieve his social and economic development and show respect to nature. (Okur Berberoğlu & Uygun, 2013). With the environmental education for sustainable development based on a holistic view, the individual handles environmental issues not only in terms of biological and physical aspects but also in economic, social, political, cultural and historical aspects. Individuals who take responsibility for their behaviors and take an active role in environmental problems need to have a holistic view (Tilbury, 1995).

Sustainable environmental education which is an interdisciplinary approach aiming at improving the knowledge and skills needed for a sustainable future, is crucial in enhancing quality of living by changing views of people and making the world a safer and healthier place (Keleş, 2007). Finding permanent solutions to shape the fate of the World and humanbeings in struggle with increasing environmental problems is only possible with societies that turn the concept of 'sustainability' which is only created through a sustainable environmental education into a philosophy of life. This demonstrates the importance of sustainable environmental education.

Considering that the main cause of environmental problems is societies with weak environmental consciousness; it is a gospel truth that teachers, one of the most important elements of the environmental education and the system of education, have a vital role in raising generations who act with the awareness of sustainability. Taking into account that teachers influence societies, they are role models for the raising generations, and that they have an active role in shaping today's World and the future, it is very important for future teachers to have adequate knowledge of waste and recycling and to become aware of these issues. In this context, it is aimed to determine the effect of recycling education given to Science Teacher candidates for sustainable development on their knowledge levels about waste and recycling. The study carried out to raise individuals who adopt the concept of sustainability, design their life with this understanding, have sense of responsibility and ability for empath to hand down a livable world and who are aware of the fact that the environmental problems are global and that unconscious behaviors affect all societies and not also today but also our future may be threatened is thought to be important.

## **Methodology**

### *Study Design*

The study was designed according to one group pretest-posttest experimental design in line with main purpose of the study. In one group pretest-posttest experimental design, one group posttest design is developed by adding a pretest 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).

### *Sample of the Study*

The sample of the study consists of 30 volunteer Science Teacher candidates who are studying in the 3rd and 4th grade in the Science Teaching Department of Faculty of Education. The sample selection in the study was made using the maximum variation sampling method (Yıldırım & Şimşek 2011) 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 the subject of the study to the maximum extent (Yıldırım & Şimşek, 2011).

### *Education Process and Data Collection Tool*

Within the scope of the study, 30 Science Teacher candidates have been educated for 10 weeks. The Recycling Knowledge Test developed by researchers was applied to teacher candidates as pre-test and post-test before and after the course.

Activities conducted with teacher candidates within the scope of the education and the content of these activities are given in Schema 1.

Lecturing	•A lecture was held on wastes and recycling by using question-answer discussion methods with teacher candidates.
Slogan Contest	•A slogan contest was organized about recycling. Winner of the contest was rewarded.
Interview	•An interview was carried out with a lecturer from the engineering faculty, Department of Environmental Engineering of a Turkish University.
Technical trip	•A technical trip was organized to the recycling plant.
Place waste battery boxes and banners	•Waste battery boxes and banners were placed by teacher candidates at various points of the Faculty of Education and brochures were distributed to the students studying at the Faculty of Education.
Seminar	•A seminar was given on waste batteries and recycling by a specialist in this field.
Preparation of poster	•Teacher candidates were informed of banner preparation and they were asked to prepare a banner about recycling.
Preparation of model	•Teacher candidates were asked to prepare a model on wastes and recycling.
Preparation of worksheet	•Teacher candidates were asked to prepare worksheets on wastes and recycling.
Public Spot Contest	•A public spot contest was organized about recycling. Winner teacher candidates were rewarded.

*Schema 1. Activities and their content*

### Data Analysis

In the study, the data obtained from the Waste and Recycling Knowledge Test was analyzed with the content analysis. Content analysis is expressed as reduction and interpretation of any qualitative data to determine basic consistency and meanings by taking bulky qualitative material (Patton, 2014). Content analysis is conducted in order to reach concepts and relations that can explain the collected data. Content analysis is important in ensuring that similar data is organized within the framework of specific concepts and themes and in facilitating understanding of the data by readers (Yıldırım & Şimşek, 2011). The qualitative data obtained was examined in detail and the prevalence of data was determined by determining common themes. The obtained data was tabulated within the framework of the specified themes. Names of the teacher candidates were kept secret and they were coded as “F<sub>1</sub>, F<sub>2</sub>...F<sub>n</sub>” for the data obtained and the quotations of their answers to the questions are given in findings section.

### Findings

The frequency of Science Teacher candidates' answers to the question of “*When did you first hear about the concept of recycling?*” taking place in the Waste and Recycling Knowledge Test are given in Table 1.

Table 1.

*Frequency of teacher candidates' answer to the sources of recycling concept where they have first heard about recycling*

The first source of the concept of recycling	Answer Frequency (f)
School	24
Media	4
Internet	1
Family	1

When Table 1 is examined, it is seen that most of the teacher candidates have first heard about the concept of recycling from schools and some other from the media.

The pre-test and post-test results of the frequency of answers given by Science Teacher candidates to the question of “*How often do you use recycle boxes?*” are given in Table 2.

Table 2.

*The pre-test and post-test results regarding the frequency of using recycle boxes*

The frequency of using recycle boxes	Pre-test	Post-test
	Answer Frequency (f)	
Always	2	6
Frequently	6	15
Sometimes	11	9
Very little	9	0
I do not use.	2	0

When Table 2 is examined, it has been determined that in the pre-test most of the teacher candidates gave the answer of ‘sometimes’ and ‘rarely’ to the frequency of using

recycle boxes; whereas in the post-test they answered as "mostly" and "sometimes". Moreover, it seems that none of the teacher candidates answered as 'rarely' and 'never'.

The pre-test and post-test results of the answers given by Science Teacher candidates to the question of "What products do you throw into the recycle boxes?" are given in Table 3.

Table 3.

*The pre-test and post-test results of the frequency of throwing things into recycle boxes*

Recycled waste in recycling boxes	Pre-test	Post-test
	Answer Frequency (f)	
Paper / Cardboard	29	30
Plastic	27	30
Glass	20	30
Battery	15	30
Composite	8	29
Metal	9	28

When Table 3 is examined, it has been determined that frequency of throwing recycling products into the recycle boxes increased compared to the pre-test.

Pre-test and post-test results of the frequency of answers given by Science Teacher candidates to the question of "Are you willing to pay more money for recyclable products?" are given in Table 4.

Table 4.

*Pre-test and post-test results of being willing to pay more money for recyclable products*

Payment Request	Pre-test	Post-test
	Answer Frequency (f)	
Yes	20	25
No	10	5

When Table 4 is examined, it has been determined that most of the teacher candidates stated they can pay more money to recyclable products; however this rate increased in the post-test.

Pre-test and post-test results of the frequency of the answers given by teacher candidates to the question of "Are you willing to pay more for the recyclable products? Please explain the reason of your answer" are given in Table 5.

Table 5.

*Pre-test and post-test results of the reason for teacher candidates' desire for paying money*

Answer	The reason for their desire to pay money	Pre-test	Post-test
		Answer Frequency (f)	
Yes	Protecting the nature	2	25
	Contributing to the national economy	2	21
	Saving energy	1	20

	Conservation of natural resources	2	19
	Preventing environmental pollution	6	15
	Reducing the need for raw materials	2	13
	Enhancing sustainable development	0	6
	Raising quality of living	0	1
No	I do not want to pay more	3	0
	We pay enough for taxes	1	0

When Table 5 is examined, it has determined that in the pre-test the vast majority of the teacher candidates respond positively for paying more for recyclable products in order to prevent environmental pollution. Teacher candidates who respond negatively indicate that they do not want to pay more and that they are already paying enough for taxes. In the post-test, the vast majority of teacher candidates responded positively to pay more money to recyclable products in order to protect the nature, to contribute to the national economy, to save energy, to conserve natural resources and to prevent environmental pollution. It is noteworthy that there is no candidate having responded negatively in the post-test.

Below are some examples of direct quotations from teacher candidates' answers to the reasons for being willing to pay more for the recyclable products in the pre-test.

- F<sub>11</sub>: *We can minimize the harm of the waste to the nature by using recyclable products*  
 F<sub>13</sub>: *I think we benefit from recyclable products. Above all, I do not even care about the money because it prevents environmental pollution.*  
 F<sub>23</sub>: *I don't want to pay more than its first price.*

Below are some examples of direct quotations from teacher candidates' answers to the reasons for being willing to pay more for recyclable products in the post-test.

- F<sub>23</sub>: *In the production phase, operations are less than reproduction. It provides energy saving and financial saving.*  
 F<sub>25</sub>: *I buy these products to contribute to the national economy, to reduce the need for raw materials, and to live in a better environment.*  
 F<sub>27</sub>: *Because I would contribute to the national economy this way. It also saves energy and raw material.*

The pre-test results of the frequency of the answers given by Science Teacher candidates to the question of "What is Waste?" are given in Table 6.

Table 6.

*Pre-test results for the concept of waste*

Waste	Answer Frequency (f)
Used material	14
Waste material	4
Garbage	3
Recyclable material	2
A material which is used and left to the nature	2
Non-recyclable material	1
Used material	1
Unused harmful material	1
Unnecessary material	1
Recyclable object	1
Non-beneficial products	1
Environmentally hazardous materials	1
Non-recyclable materials	1

When Table 6 is examined, it has been determined that the concept of waste was defined as used materials by most of the teacher candidates. It has been determined that some of the teacher candidates define it as waste, garbage, recyclable material and a material used and thrown out to the nature.

Examples of direct quotations of teacher candidates' answers to the concept of waste in the pre-test are given below.

*F<sub>11</sub>: Wastes are the used products which lost their function, but they can be reused as a usable raw material.*

*F<sub>24</sub>: Used materials which cannot be used again are called waste.*

*F<sub>29</sub>: Waste is the residual materials from the products we use.*

The post-test results of the frequency of teacher candidates' answers to the question of "What is Waste?" are given in Table 7.

Table 7.

*Post-test results for the concept of waste*

Waste	Answer Frequency (f)
Expired materials	27
Recyclable materials	20
Material generated by domestic commercial industrial process, which is no longer usable by the consumer	15
Materials that can be recycled as a result of physical and chemical processes	10
Non-useful part of materials	1
Debris	1

When Table 7 is examined, it is seen that in the post-test most of teacher candidates define the concept of waste as expired and recyclable materials. Half of the teacher candidates has been determined to define the concept of waste as materials generated by domestic commercial industrial process and which is no longer usable by the consumer.

Examples of direct quotations of teacher candidates' answers to the concept of waste in the post-test are given below.

*F<sub>3</sub>: Materials which are generated by domestic commercial industrial process and which are thought to be expired. They need to be thrown away from the environment and people for social benefits.*

*F<sub>11</sub>: Materials of our daily life that can be recycled as a result of chemical processes after we use them.*

*F<sub>6</sub>: Materials which are used up by people and which can be recycled are called waste.*

Pre-test results of the frequency of teacher candidates' answers to the question of "What are the types of wastes?" are given in Table 8.

Table 8.

*Pre-test results for the types of wastes*

<b>Types of Wastes</b>	<b>Answer Frequency (f)</b>
Plastic	16
Glass	16
Paper	13
Metal	13
Cardboard	11
Battery	9
Composite	8
Domestic waste	6
Medical waste	5
Packing wastes	4
Waste oil	3
Industrial waste	2
Hazardous waste	2
Food waste	1
Chemical waste	1
Garbage	1

When Table 8 is examined, it has been determined that most of teacher candidates expressed types of waste as plastic, glass, paper, metal and cartonboard wastes.

The post-test results of the frequency of teacher candidates' answers to the question of "What are the types of wastes?" are given in Table 9.

Table 9.

*Post-test results for the types of waste*

<b>Types of Waste</b>	<b>Answer Frequency (f)</b>
Packing wastes	30
Medical waste	28
Hazardous waste	27
Domestic waste	27
Industrial waste	21
Organic waste	1
Chemical waste	1

When Table 9 is examined, it has been determined that all teacher candidates express packaging waste and most of the teacher candidates express medical waste, hazardous waste, domestic waste and industrial waste as types of waste.

Pre-test results of the frequency of teacher candidates' answers to the concept of recycling are given in Table 10.

Table 10.

*Pre-test results for the concept of recycling*

Recycling	Answer Frequency (f)
Recycling of Wastes	15
Operations to be done to reuse waste materials	10
Restituting waste materials	9
Renewal of waste materials	1
Reverting the product back to its original state	1
Recycling of the non-domestic waste	1

When Table 10 is examined, it has been determined that half of the teacher candidates defined the concept of recycling as recycling them to reuse the waste. And some of the teacher candidates have been determined to define recycling as operations to be done to reuse the waste materials and to revert them back to their original state.

Examples of direct quotations to the teacher candidates' answers to the concept of recycling in the pre-test are given below.

*F<sub>6</sub>: It is the process of recycling of the unused waste.*

*F<sub>24</sub>: Subjecting such products as cartonboard, plastic, glass, paper, battery and metal to a process to reuse them.*

*F<sub>27</sub>: Reproducing a material by subjecting them to some processes.*

The post-test results of the frequency of teacher candidates' answers to the question of "What is recycling?" are given in Table 11.

Table 11.

*Post-test results for the concept of recycling*

Recycling	Answer Frequency (f)
Conversion of waste materials to new materials through various physical or chemical processes	22
Processing waste through chemical and physical methods to reuse them.	5
The process of recycling materials	1
Bringing used materials into the nature	1
Collecting and processing the used waste	1

When Table 11 is examined, it is seen that large majority of the teacher candidates define the concept of recycling as conversion of waste materials to new materials for reuse through various physical or chemical processes.

Examples to direct quotations of teacher candidates' answers to the concept of recycling in the post-test are given below.

*F<sub>5</sub>: It means the conversion of material or materials used by people to different materials for reuse through various physical or chemical processes.*

*F<sub>16</sub>: Processing recyclable materials that can be reused.*

*F<sub>27</sub>: Bringing used materials into the nature again.*

Pre-test results of the frequency of teacher candidates' answers to the question of "What is recovery" are given in Table 12.

Table 12.

*Pre-test results for the concept of recovery*

Recovery	Answer Frequency (f)
Reusing the recycled materials	8
Recycled materials that come into existence as a new product	7
Making a product useful	1
Getting an existing thing back	1
Recyclable material	1
<b>No answer</b>	<b>13</b>

When Table 12 is examined, it has been seen that nearly half of the teacher candidates in the pre-test could not give any answer, whereas most of the teacher candidates who answered the question defined the concept of recovery as reuse of recycled materials and as recycled materials that come into existence as a new product.

Examples to the direct quotations of teacher candidates' answers to the concept or recovery in the pre-test are given below.

*F<sub>2</sub>: Recovery is turning recycled materials into their original form again.*

*F<sub>8</sub>: After a new product is used, it becomes waste, and it is the process of bringing this waste back to the market through recycling. In other words, the use of a product more than once is recovery.*

*F<sub>28</sub>: Recyclable materials.*

The post-test results of the frequency of teacher candidates' answers to the question of "What is recovery?" are given in Table 13.

Table 13.

*Post-test results for the concept of recovery*

Recovery	Answer Frequency (f)
Reuse of waste materials after being recycled	20
Reuse of solid wastes through physical and chemical processes and producing primary or secondary products.	4
Conversion of materials to reusable material or to a different material after recycling	3
It covers recovery and recycling	1
Putting wastes on the market as primary or secondary products through physical, chemical and biological methods	1
<b>No answer</b>	<b>1</b>

When Table 13 is examined, it has been determined that majority of the teacher candidates defined the concept of recovery as reuse of waste materials after being recycled. Moreover, it has also been seen that some of the teacher candidates define recovery as producing primary and secondary products or a different material from solid wastes using physical and chemical processes.

Examples to direct quotation of teacher candidates' answers to the concept of recovery in the post-test are given below.

*F<sub>1</sub>: Reuse of recyclable materials are called recovery.*

*F<sub>2</sub>: Reuse of solid wastes through physical and chemical processes and production of primary and secondary raw materials.*

*F<sub>14</sub>: Reuse of waste materials.*

The pre-test results of the frequency of Science Teacher candidates' answers to the question of "What is Reuse?" are given in Table 14.

Table 14.

*Pre-test results for the concept of reuse*

Reuse	Answer Frequency (f)
Reuse of recycled products	13
Reuse of materials without being processed	5
Reuse of a used material	4
Reuse of a waste as the same material thanks to recycling	1
Reuse of a products without being subject to more than one process	1
<b>No answer</b>	<b>6</b>

When Table 14 is examined, it has been determined that some of the teacher candidates could not give any answer and that majority of the teacher candidates who could give an answer defined the concept of reuse as use of recycled products.

Examples to direct quotations of teacher candidates' answers to the concept of reuse in the pre-test are given below.

*F<sub>5</sub>: Reuse of the materials used as a result of recycling.*

*F<sub>15</sub>: Recycled products come up as new products. This means reuse.*

*F<sub>28</sub>: Use of recycled products.*

The post-test results of the frequency of Science Teacher candidates' answers to the question of "What is Reuse?" are given in Table 15.

Table 15.

*Post-test results for the concept of reuse*

Reuse	Answer Frequency (f)
Reuse as re-evaluation/re-use of used materials	20
Re-use of materials after being subject to physical processes without any chemical process.	15

When Table 15 is examined, it has been determined that all teacher candidates gave answers in the post-test and they defined the concept of reuse as re-evaluation/re-use of used materials and as re-use of materials after being subject to physical processes without any chemical process.

Examples to direct quotations of teacher candidates' answers to the concept of reuse in the post- test are given below.

*F<sub>17</sub>: For example; making window box from plastic boxes.*

*F<sub>20</sub>: Reuse of nonusable material without making any change on it.*

*F<sub>30</sub>: Reuse of a material without any need for physical or chemical processes.*

Pre-test results of the frequency of Science Teacher candidates' answers to the question of "What are the benefits of recycling of wastes?" are given in Table 16.

Table 16.

*Pre-test results for the benefits of recycling*

<b>Benefits of Recycling</b>	<b>Answer Frequency (f)</b>
Prevents environmental pollution	20
Contributes to the economy	4
Conserves the nature and living creatures	3
Conserves natural resources	2
Prevents waste of raw material	2
Saves energy	2
Natural cycle does not get harmed.	1

When Table 16 is examined, it has been determined that most of the teacher candidates are of the opinion that recycling will prevent environmental pollution.

Examples to direct quotations of teacher candidates' answers to the benefits of the recycling of wastes in the pre-test are given below.

- F<sub>22</sub>:** *Used wastes are brought into use again through recycling and it saves production cost. At the same time, environmental pollution is avoided by sending wastes to recycling.*
- F<sub>14</sub>:** *It reduces use of raw materials considerably. It is ensured that the environment gets clean. It saves energy.*
- F<sub>30</sub>:** *Prevents environmental pollution. Contributes to economy of the country. Instils feeling of responsibility and sensitivity to people.*

The post-test results of the frequency of Science Teacher candidates' to the question of "What are the benefits of recycling of wastes?" are given in Table 17.

Table 17.

*Post-test results for benefits of recycling*

<b>Benefits of Recycling</b>	<b>Answer Frequency (f)</b>
Prevents environmental pollution	19
Contributes to economy	18
Saves energy	18
Conserves the nature	17
Prevents waste of raw materials	17
Natural resources are conserved	15
Reduces bad smell	10
Reduces storage space	10
Reduces dependency on foreign countries	9
Prevents visual pollution	9
Conserves forests	6
Provides new working areas	6
Reduces greenhouse effect	6
Reduces soil pollution	5
Reduces air pollution	4
Reduces water pollution	4

It is an investment on the future	3
Reduces effects of global warming	3
Reduces amount of wastes	2
Reduces health problems	2
Keeps balance of the ecosystem	1
Reduces methane gas explosions	1

When Table 17 is examined, it has been determined that most of the teacher candidates state benefits of recycling of waste as prevention of environmental pollution, contribution to economy and energy saving, protection of nature, prevention of waste of raw materials and conservation of natural resources.

Examples to direct quotations of teacher candidates' answers to the benefits of the recycling of wastes in the post-test are given below.

*F<sub>11</sub>: Contributes to the nature, reduces methane gas explosions, and it is environmentally friendly. Conserves our forests and our mineral deposits, reduces the greenhouse effect, global warming, soil pollution and prevents bad smells.*

*F<sub>12</sub>: Contributes to economy, prevents cutting trees, provides saving, reduces environmental pollution and protects the nature. We don't depend on foreign countries. We have a new production area with recycling.*

*F<sub>19</sub>: Recycling, energy saving, smaller garbage dumps, reduces environmental pollution, contributes to economy, reduces bad smell, resolves visual pollution, reduces amount of garbage.*

The pre-test results of the frequency of Science Teacher candidates' answers to the question of "What are the harms of the recycling of wastes?" are given in Table 18.

Table 18.

*Pre-test results for harms of recycling*

Harms of Recycling	Answer Frequency (f)
Costs too much	5
Risky for health	3
No harm	3
Causes air pollution	2
Product quality is lower compared to its original quality	1
Causes pollution of the nature	1
Reduces quality of living	1
Harms living creatures	1
Disturbs the balance of the nature	1
Harms the atmosphere	1
<b>No answer</b>	<b>14</b>

When Table 18 is examined, it is seen that nearly half of teacher candidates cannot give answer to the harms of waste recycling. Majority of the teacher candidates who could give an answer stated potential harms of waste recycling as being too costly, risky for health and causes air pollution.

Examples to direct quotations of teacher candidates' answers to the harms of waste recycling in the pre-test are given below.

*F<sub>3</sub>: I do not have any information about this. However it might be high cost and air pollution.*

*F<sub>18</sub>: I think it may be harmful for health.*

*F<sub>25</sub>: I don't think it is harmful.*

It has been determined that in the post-test, Science Teacher candidates expressed recycling of wastes as harmless for the question of "What are the harms of waste recycling?".

Examples to direct quotations of teacher candidates' answers to the harms of waste recycling in the post-test are given below.

F<sub>16</sub>: *I don't think it is harmful at all.*

F<sub>5</sub>: *I am of opinion that it would be more harmful if we did not recycle wastes.*

Pre-test and post-test results of frequency of Science Teacher candidates' answers to the question of, "What are the authorized institutions for recycling in Turkey?" are given in Table 19.

Table 19.

*Pre-test and post-tests results for Turkey's authorized institutions for recycling*

Turkey's Authorized Institutions for Recycling	Pre-test	Post-test
	Answer	Frequency (f)
ÇEVKO	3	30
TAP	0	30
DOÇEV	0	11
TURMEPA	0	8
İSTAÇ	0	6
T.R. Ministry of Environment and Urbanization	2	4
Municipalities	3	3
Civil society organizations	1	0
Recycling Facilities	1	0
<b>No Answer</b>	<b>25</b>	<b>0</b>

When Table 19 is examined, it is seen that majority of teacher candidates could not answer the question of Turkey's authorized institutions for Recycling in pre-test; in the post-test all teacher candidates gave answer and all teacher candidates answered this question as TAP and ÇEVKO.

The pre-test and post-test results of frequency of teacher candidates' answers to the question of "What are the authorized institutions for Recycling in city centers?" are given in Table 20.

Table 20.

*Pre-test and post-test results for the authorized institutions for recycling in city centers*

Authorized Institutions for Recycling in City Centers	Pre-test	Post-test
	Answer	Frequency (f)
Municipalities	16	30
Recycling Facilities	0	3
Charity/foundations	0	2
Environmental Health Institutions	1	0
T.R. Ministry of Environment and Urbanization	1	0
<b>No Answer</b>	<b>13</b>	<b>0</b>

When Table 20 is examined, it has been determined that more than half of the teacher candidates answered the question of 'authorized institutions for recycling in city centers' as municipalities; while nearly half of the teacher candidates could not give any answer.

In the post-test, it has been seen that all teacher candidates answered this question as municipalities and there was no candidate who could not answer.

The pre-test and post-test results for the frequency of teacher candidates' answers to the question of "Please write down the meaning of symbols" are given in Table 21.

Table 21.

*Pre-test and post-test results for meaning of symbols*

No	Symbol	Pre-test	Answer Frequency (f)	Post-test	Answer Frequency (f)
1		Recycling Symbol	24	Recycling Symbol	30
		No answer	6		
2		Recycling Symbol	5	Products made of recycled material	30
		Made from recycling	4		
		No answer	21		
3		ÇEVKO	4	Green Dot	18
		No answer	26	ÇEVKO	12
4		Conversion percentage	1	Symbol showing to what percentage the product can be recycled	28
		No answer	29	Recycling percentage	2
5		No answer	30	Compostable product	27
				No answer	3
6		No answer	30	Bio-hazard symbol	28
				Medical Waste	2

When Table 21 is examined, it has been determined that in the pre-test and post-test teacher candidates' answer frequency and correct answer rate for meaning of symbols increased. In addition, it has been seen that all teacher candidates could not answer meanings of some symbols in the pre-test and that nearly all teacher candidates answered them in the post-test.

Pre-test and post test results of frequency of Science Teacher candidates' answer to the question of "What are the recyclable wastes? Please mark" are given in Table 22.

Table 22.

*Pre-test and post-test results for recyclable wastes*

Recyclable Wastes	Pre-test	Post-test
	Answer	Frequency
	(f)	
Paper/Cartonboard	30	30
Plastic	30	30
Glass	29	30
Battery	25	30
Composite	17	30
Vehicle tire	16	29
Elektronic waste	11	29
Medical waste	10	29
Waste oil	22	27
Metal	18	27
Accumulator	6	25
Concrete	4	25
Organic waste	9	24
Engine oil	5	24
X-ray film	4	22

When Table 22 is examined, it has been determined that all teacher candidates expressed paper/cartonboard, plastic and most of teacher candidates expressed glass, battery and waste oil, metal and vehicle tire as recyclable wastes. In the post-test, it has been determined that all of the teacher candidates expressed paper/cartonboard, composite, plastic, battery and glass as recyclable waste. It has been seen that the frequency of teacher candidates' answers to recyclable wastes has increased considerably in the post- test.

Pre-test results of frequency of Science Teacher candidates' answers to the question of "What can be the reasons why recycling is not common? Please prioritize starting from 1" are given in Table 23.

Table 23.

*Pre-test results on the reasons why recycling is not common and reasons' order of importance*

Reasons why recycling is not common	Answer Frequency (f)	Order of importance
Individuals do not know recycling	15	1
Recyclable wastes are not known	11	2
Recyclable wastes cannot be distinguished	6	3
Individuals do not think recycling is important	6	4
Individuals do not think recycling has an effect on protection of the nature	6	5
There are few recycle boxes	6	6
Seperation of wastes take too much time	4	7
Recycling is thought to be costly	7	8
There are few recycling plants	7	9
Recycle boxes are not thrown out regularly	9	10
Recycle boxes do not attract attention in terms of their color and shape	11	11

Recycle boxes are too small	9	12
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When Table 23 is examined, it is seen that considering prioritization of teacher candidates in the pre-test, the fact that individuals do not know recycling and recyclable are top 2 criteria; while the fact that recycle boxes are not attractive in terms of color and shape are the last 2 criteria.

The post test results of the frequency of Science Teacher candidates' answers to the question of "What can be the reasons why recycling is not common? Please prioritize starting from 1" are given in table 24.

Table 24.

*Post-test results on the reasons why recycling is not common and reasons' order of importance*

Reasons why recycling is not common	Answer Frequency (f)	Order of importance
Individuals do not know recycling	13	1
Recyclable wastes cannot be distinguished	11	2
Recyclable wastes are not known	9	3
Individuals do not think recycling has an effect on protection of the nature	4	4
Individuals do not think recycling is important	4	5
Separation of wastes take too much time	4	6
There are few recycle boxes	6	7
Recycling is thought to be costly	8	8
There are few recycling plants	6	9
Recycle boxes are not thrown out regularly	6	10
Recycle boxes do not attract attention in terms of their color and shape	6	11
Recycle boxes are too small	10	12

When Table 24 is examined, the fact that individuals do not know recycling and that recyclable products cannot be separated are top 2 criteria for teacher candidates; while the small sizes of the recycle boxes is in the last rank.

Pre-test and post-test results of Science Teacher candidates' answers to the question "What color bags and boxes are used for wastes?" are given in Table 25.

Table 25.

*Pre-test and post-test results for colors of bags*

Colors	Types of Wastes							
	Medical waste		Packing wastes		Domestic waste		Hazardous waste	
	Pre-Test	Post-Test	Pre-Test	Post-Test	Pre-Test	Post-Test	Pre-Test	Post-Test
	f	f	f	f	f	f	f	f
Red	0	17	1	0	0	0	9	17
Yellow	4	6	2	1	0	0	0	13
Blue	4	1	2	29	8	1	0	0
Black	4	1	0	0	2	29	6	0
Grey	1	1	1	0	0	0	0	0
Green	1	0	1	0	5	0	0	0
White	4	0	1	0	2	0	0	0
Orange	0	0	2	0	0	0	0	0

When Table 25 is examined, it has been determined that in the pre-test, answer frequency of teacher candidates is low and majority of teachers who answered indicated yellow, blue, white and black for medical wastes, yellow, blue and orange for packaging wastes; blue and green for domestic wastes, red and black colors for hazardous wastes. In the post-test, the answer frequency of teacher candidates increased considerably and majority of teacher candidates indicated red and yellow for medical wastes; blue for packaging wastes, black for domestic wastes, and red and yellow colors for hazardous wastes.

## Results and Discussion

In the study, it has been determined that most of the teacher candidates stated that the first source where they heard the concept of recycling for the first time is school. Few teacher candidates stated it as media, internet and family. Similar results have been found in the research conducted by Harman and Çelikler (2016).

The recycling education to be given at schools within the context of a qualified environmental education will be effective throughout individuals' life. In this context, teaching programs, teaching environments and textbooks have great impact on teaching recycling within the scope of the environmental education to be given by well appointed teachers. The study conducted by Çimen and Yılmaz (2012) reveals that the most important sources of information for primary school students on recycling are teachers and textbooks, and this result shows the effect of school, teacher, curriculum and textbooks.

Considering that we are in the information age and that the internet is widely used by the younger generation, it is thought that the internet should be used more widely in order to raise awareness for recycling. As a matter of fact, Çimen and Yılmaz (2012) stated in their study that the internet is widely used by primary school students and that mass media is among their sources for recycling.

In the study, it has been concluded that as a result of the Awareness Education, teacher candidates use recycle boxes more frequently and that their awareness for recyclable materials has increased and that they can pay more for recycled products because their awareness for importance of recycling increased. Likewise, in their study, Kışoğlu and Yıldırım (2015) have pointed out that there is a significant difference in favor of teacher

candidates who separate wastes and throw them into recycle boxes and prefer recycled products. In addition, the results of Aydın and Kaya's (2011) study showing that high school students "sometimes" use recycle boxes support the pre-test results of this study. On the other hand, researchers indicate that the fact that recycle boxes are common and at easily accessible points is the most important factor affecting the attitudes and behaviors of individuals towards recycling (Ebreo & Vining, 2000; Hansmann et al., 2006; Schultz, Oskamp & Mainieri, 1995).

It has been determined that teacher candidates want to pay more for recycled products with the idea of conserving nature, contributing to the economy of the country, saving energy, conserving natural resources, preventing environmental pollution, reducing the need for raw materials and ensuring sustainable development. Likewise, in a study conducted by Harman and Çelikler (2016), it has been determined that Science Teacher candidates are of opinion that waste materials are harmful to the environment, thus recycling is necessary to prevent environmental pollution and depletion of raw material resources, to save energy and to contribute to the economy. In another study, Demirbağ and Güngörmüş (2012) has determined that the majority of individuals are of opinion that it is important to separate domestic waste, and that the greatest benefit of this is to the environment. Similar results have been reached in the research conducted by Öztüre (2015).

In the study, the results of the Waste and Recycling Knowledge Test; reveal that knowledge levels of teacher candidates on the concepts of waste, types of waste, recycling, recovery and reuse o, benefits and harms of waste recycling, Turkey's authorized institutions for recycling, authorized institutions for recycling in city centers, symbols and meanings of wastes and recycling, recyclable wastes and colors of bags used depending on the type of waste increased as a result of the Awareness Education. In the studies carried out in the literature with individuals at various ages and grades, it has been determined that 7th - 8th grade (Armağan, 2006) and 6th-8th grade (Çimen & Yılmaz, 2012) primary school students have enough knowledge about recycling. Çelikler, Yılmaz and Aksan (2015) indicate in their study that knowledge level influences attitudes and students studying science who have a positive attitude towards the recycling of solid wastes show this attitude as a result of having adequate level of knowledge about the subject. As a matter of fact, Vining and Ebreo (1992) emphasized that individuals with the knowledge on recycling also have high level of environmental knowledge. Likewise, Mostafa (2007) stated that individuals' knowledge on environmental issues is the most important factor affecting their environmental behaviors and sensitivity. Wright (2011) also states that the knowledge level about recycling is an important indicator of behaviours on recycling.

In the study it has been determined that teacher candidates could not define the concepts of waste, recycling, recovery and reuse at all or they made deficient and wrong definitions and they could not categorize types of wastes before the Awareness Education; whereas they made scientifically correct definitions at the end of the education and they could categorize types of wastes correctly. In the study conducted by Harman and Çelikler (2016) it has been concluded that teacher candidates restricted the types of recyclable products especially to paper, plastic and glass, and they consider the materials to be recycled within the scope of packaging wastes, however they did not mention metal and composite wastes and these results show similarity to the results obtained before the Awareness Education. Likewise, it has been determined that the secondary and university school students gave examples of plastic, returnable bottles and coke bottles (Yılmaz et al., 2002), students studying in biology department gave examples of paper, glass, metal and organic substances (Soran et al., 2000), physics, chemistry and biology teacher candidates gave examples of paper, plastic and glass for recyclable wastes (Demircioğlu, Demircioğlu & Yadigaroglu, 2015). As seen in these

studies as well, it attracts attention that paper, glass and metal packaging wastes confronted frequently in daily life are expressed more.

In the study, it has been determined that Science Teacher candidates did not have enough knowledge regarding Turkey's authorized institutions for recycling before the Awareness Education. At the end of the Awareness Education, it has been determined that teacher candidates' awareness of TAP, the only organization in our country for waste batteries; ÇEVKO, which actively works on the recovery of packaging wastes; and DOÇEV which conducts efficient studies on environmental conservation. In the study conducted by Yılmaz, Aksan and Çelikler (2016), it has been determined that Science Teacher candidates do not have any idea about the institutions and organizations in charge of collecting, recycling and disposal of waste batteries in our country and ÇEVKO, Yeşilay and TEMA are associated to recycling and disposal of waste batteries. All these results show that the institutions and organizations that conduct waste and recycling activities are not as well known in the society. In this context, it is thought that the institutions and organizations that carry out these activities should organize social activities to attract the attention of the individuals and to raise awareness. In particular, it is thought that it is important to educate students regarding institutions/organizations, their purpose and activities by distributing posters and brochures with teachers and to organize activities, competitions and campaigns that attract students and to raise awareness. As a matter of fact, in his study Mostafa (2007) states that becoming a member of environmental club and participating in environmental activities will help increase interest in the environment.

In the study, it has been determined that prior to the Awareness Education, most of the Science Teacher candidates only knew the symbol of recycling among symbols related to wastes and recycling. At the end of the education, it has been determined that knowledge level of teacher candidates on symbols showing recycling, products made of recycled materials, Green Dot, what percentage of the product can be recycled, recycling percentage symbol, compostable product, and biohazard has increased. Some teacher candidates seemed to call the symbol of Green Dot as ÇEVKO. This international symbol represents the organization of PRO-Europe Foundation and in Turkey it is given by CEVKO (URL-1). For this reason, teacher candidates think that the Green Point symbol is the ÇEVKO symbol. In their study, Harman and Çelikler (2016) state that teacher candidates have difficulty in expressing meanings of symbols on packagings except for the recycling symbol. In the study of Kalıpçı, Öztaş and Özdemir (2009) with fourth grade environmental engineer candidates and in the study of Yılmaz et al. (2002) with secondary school and university students, it has been reported that a significant part of students know the signs of recycling. Being aware of the meaning of the signs on the packaging is thought to be extremely important in terms of choosing the packaged products that can be recycled in daily life.

In the study, most of the teacher candidates associates the most important reason why recycling is not common to the fact that individuals do not know recycling. Because it is thought that as the individuals understand the importance of recycling, their sensitivity towards this issue increases and as a result they use recycle boxes by separating wastes and taking recycle boxes' colors into consideration. As a matter of fact, Kışoğlu and Yıldırım (2015) point out that individuals with interest and sensitivity towards recycling are expected to display recycling behaviors.

In the study, the results obtained after the Awareness Education reveal that the knowledge level of the teacher candidates about the recyclable wastes and bags used according to the types of wastes has increased. Particularly increased awareness of hazardous and medical wastes is thought to be a remarkable and positive result.

In the study it has been determined that prior to the Awareness Education, teacher candidates were mostly of the opinion about benefits of recycling that environmental pollution will be prevented. At the end of the education, it has been determined that teacher candidates were of opinion that environmental pollution, raw material wastage and visual pollution would be prevented, recycling would contribute to economy and save energy, the nature and natural resources would be protected, bad smells and dependency on foreign countries would be reduced, and storage areas for wastes would get smaller. It is thought that in parallel with the education and increase in their knowledge level about recycling, their environmental sensitivity increased, and they are now aware of importance of recycling for the environment. As a matter of fact, Schultz, Oskamp and Mainieri (1995) emphasize that knowing the benefits of recycling is the most important factor in showing recycling behavior.

It has been determined that prior to the Awareness Education, half of the teacher candidates could not respond to potential harms/risks of recycling, and that the teacher candidates responding to this question emphasized that recycling is too costly and risky for health. Teacher candidates are thought to be concerned about recycled products, so they display negative attitudes, which are thought to be caused by lack of knowledge. The fact that all teacher candidates stated that recycling does not have any harm at the end of the Awareness Education, shows that the education provided has a significant impact on the knowledge and awareness levels of teacher candidates for waste and recycling. The increase in knowledge and awareness levels of teacher candidates is thought to affect attitudes and behaviors of teacher candidates positively. Considering the studies on attitudes of individuals towards wastes and recycling within the literature, Yılmaz, Çelik and Arslan (2010) indicate that the increase in environmental insensitivity in individuals leads to a decline in the positive attitude towards recycling and the increase in positive attitude towards recycling leads to increase in environmental behavior. Besides, in the study carried out Karatekin and Meray (2015), it is seen that social sciences teacher candidates and in the study conducted by Kışoğlu and Yıldırım (2015) Science Teacher candidates, classroom teacher candidates and social sciences teacher candidates generally have positive attitude towards solid wastes and recycling.

Teacher candidates 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. On the other hand, 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. It is thought that the media has a big impact in terms of raising environmental and social awareness. Therefore, it is of vital importance to make television programs and to broadcast public service ad in order to raise social awareness on waste management and recycling which are important for sustainability. 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 for raising social awareness on recycling for raising societies with recycling awareness.

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# GERİ DÖNÜŞÜM FARKINDALIK EĞİTİMİ: FEN BİLGİSİ ÖĞRETMEN ADAYLARININ BİLGİ DÜZEYLERİNE ETKİSİ\*

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## Özet

Araştırma, sürdürülebilir kalkınma açısından atıkların geri dönüşümü konusunda Fen Bilgisi öğretmen adaylarına verilen eğitimin öğretmen adaylarının atıklar ve geri dönüşüm konusundaki bilgi düzeylerine etkisinin belirlenmesi amacı ile yapılmıştır. Araştırma, temel amacına uygun olarak tek grup ön test-son test deneysel desenine göre tasarlanmıştır. Araştırmanın örneklemini, Eğitim Fakültesi Fen Bilgisi Öğretmenliği Anabilim Dalı 3. ve 4. sınıfta öğrenim gören 30 gönüllü Fen Bilgisi öğretmen adayı oluşturmaktadır. Araştırmada veri toplama aracı olarak, araştırmacı tarafından geliştirilen Geri Dönüşüm Bilgi Testi kullanılmıştır. Araştırma kapsamında 30 Fen Bilgisi öğretmen adayına 10 hafta boyunca eğitim verilmiştir. Eğitim öncesi ve sonrası bilgi testi öğretmen adaylarına ön test ve son test olarak uygulanmıştır. Araştırmada Geri Dönüşüm Bilgi Testinden elde edilen veriler, içerik analizi ile analiz edilmiştir. Araştırma sonucunda, Fen Bilgisi öğretmen adaylarının geri dönüşüm konusuna yönelik bilgi seviyelerinin arttığını ve öğretmen adaylarının geri dönüşüme yönelik olumlu davranış değişikliği gösterdikleri görülmüştür.

**Anahtar Kelimeler:** Fen Bilgisi öğretmen adayı, atık, geri dönüşüm, sürdürülebilir kalkınma.