

# The Effect of the SCAMPER Technique in Raising Awareness Regarding the Collection and Utilization of Solid Waste

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## Abstract

The aim of this study was to determine the effect of the SCAMPER technique in raising awareness among science students regarding the collection and utilization of solid waste. The participants included a total of 65 third-year students. According to the study results, the science students described schools and visual media as their main source of information regarding the collection and utilization of solid waste. Following the application of the SCAMPER technique, the students described that they will recycle all solid waste except for organic waste, and that, if available, they would dispose each type of waste in different recycling containers.

**Keywords:** SCAMPER technique, solid waste, awareness, science student

## 1. Introduction

Due to the rapid increase in population and living standards worldwide, natural resources are being consumed at increasingly faster rates to meet mankind's increasing demands and needs. Parallel to this development, the amount of solid waste generated, especially in highly populated areas of Turkey, has increased considerably. Failure to utilize this waste is likely to trigger severe environmental problems and to adversely affect human life from an environmental, economic, and health standpoint. For this reason, ensuring the collection and utilization of solid waste is extremely important for sustainability.

The term "solid waste" refers to all forms of substances and materials that are formed as a result of domestic, commercial, and industrial activities (Igbinomwanhia & Ohwovoriole 2009), and does not contain any fluids or liquids (TÇSV 1991; Güler & Çobanoğlu 1996). Failing to sort and collect wastes such as glass, plastic, paper, and metal at their source, in order to reuse and utilize them, leads to pollution, which in turn results in economic losses (Topbaş *et al.* 1998; Yılmaz & Özdil 1999). Solid wastes that are not suitably stored and/or which are randomly and irregularly dumped into landfills create environments that are suitable for pathogenic microorganisms (Ertürk 1994). Improperly stored solid wastes will lead to visual pollution, malodors, and air, water and soil pollution. Solid wastes can potentially result in methane gas explosions due to the entrapment and compression of methane in landfills (Çepel 1992). Thus, the effective participation of the individuals is important for protecting the environment, for preventing pollution, and for rehabilitating the environment wherever necessary (Ünlü 1995). Without the effective and active participation of individuals, it would not be possible to resolve the environmental problems associated with solid wastes (Keleş, Metin & Sancak 2005). Individuals have an important task and responsibility in reducing the amount of solid waste produced, in properly sorting solid waste, and in ensuring that solid waste is recycled. These tasks and responsibilities can only be fulfilled by individuals who are aware and knowledgeable of environmental issues, and of the problems presented by solid waste. Education is essential for raising conscious, sensitive, and aware individuals (Karatekin 2013), and for ensuring the active participation of individuals to the implementation of systems involving the sorting of waste at their source (Yücel 1997). To ensure the active participation of individuals, it is necessary to both foster their creativity and raise their awareness regarding the subject.

Although creativity tends to differ from one individual to another, no individual can be considered to lack creativity; what matters the most, in this context, is finding a way to elicit and develop this characteristic, which more or less exists in all individuals (Majid, Tan & Soh 2003). As a type of brainstorming method, SCAMPER is a practical and entertaining teaching technique that promotes creative thinking. Developed by Robert F. Elberle, SCAMPER involves the development of thought process sequences regarding an object or subject. In this technique, individuals are required to consider a single object, and to then find ways to change or improve that object through brainstorming (Glenn 1997).

The SCAMPER technique not only provides a framework for students to freely use their creative thinking, but also recommends systematic and practical approaches to ensure different, creative and original thinking (Glenn 1997). The education provided regarding solid waste by using the SCAMPER technique will provide science students the necessary skills for creative problem solving; this, in turn, will allow them to be raised as individuals who can contribute to sustainable growth, and who possess the necessary awareness regarding the collection and utilization of solid waste. This study aimed to investigate the effect of the SCAMPER technique in raising awareness regarding the collection and utilization of solid waste. In this context, the SCAMPER technique will serve as a creative platform for science students to propound new and different ideas.

## 2. Methodology of Research

This study was based on using the SCAMPER technique to raise awareness regarding a socio-scientific issue, namely the collection and utilization of solid waste. In accordance with the main purpose of the study, a single sample, pretest-posttest study design was developed and used.

### 2.1 Study group

The study participants included a total 65 science students enrolled in the Faculty of Education, Department of Science Teaching of a public university in Turkey. The participating science students included third-year students.

The demographic characteristics of the students who constituted the study group is provided in Table 1.

Table 1. The Percentage Distribution of Certain Demographic Characteristics of the Study Group

Factor	Classification	Study Group %
Gender	Female	84,6
	Male	15,4
Age (Years)	20-21	92,3
	22-23	7,7
Type of graduate school	High school	72,3
	Anatolian high school etc.	27,7
Mother's education level	Primary school	61,5
	Secondary school	24,6
	High school	10,8
	Undergraduate	3,1
Father's education level	Primary school	33,8
	Secondary school	15,4
	High school	20,0
	Undergraduate	30,8
Student's shelter in place	Detached house	7,7
	Apartment	43,1
	Student dormitory	49,2
Student's monthly expense	...<750tl	15,4
	750-1000tl	43,1
	...>1000tl	41,5
Courses with regarding the environment	High school	9,2
	University	75,4
	High school and university	15,4
The students' sources of knowledge regarding solid wastes	School	69,2
	TV	20,0
	Family	7,7
	Newspaper	3,1
The views regarding the number of containers	Adequate	47,7
	Not adequate	52,3
The distance of containers to the students' location of residence	... ≥ 1km (very far)	6,2
	500m-1km (far)	13,8
	250m-500m (close)	15,4
	... ≤ 250m (very close)	60,0
	Have no idea	4,6

1. The large majority of the students were female.
2. Although most of the students were graduates from regular high schools, some of them were also graduates from teacher high schools – particularly Anatolian teacher high schools.
3. While the large majority of the students' parents were elementary school graduates, the ratio of university graduate fathers was higher than the ratio of university graduate mothers.
4. The students resided either in apartment flats or in student dormitories. Most of the students in the study group resided in student dormitories, while most of the students in the control group resided in apartment flats.
5. The large majority of the students had monthly expenses equal to or greater than 750 TL.
6. Only a few students received classes in high school that covered environment-related subjects; most of the students attended such classes during university.
7. Most of the students described school and TV as their source of information regarding solid waste.
8. More than half of the students were not satisfied with the size and number of containers.
9. Although there were containers nearby ( $\leq 250$  m) in most of the locations where the students resided, it was also noted that there were no containers in some of the locations where the students lived.

## 2.2 Implementation

The SCAMPER technique was implemented for eight total hours over a period of four weeks. Prior to implementing the SCAMPER technique, a two-hour preliminary implementation was performed in order to familiarize the students with the technique, to provide them with information about the technique and its steps, and to demonstrate how the technique will be used in class. Afterwards, the student wrote the steps of the SCAMPER technique on the board, implemented each one of these steps, and then proposed their own ideas regarding solid waste.

The steps of the SCAMPER technique, the purpose of each step, and the questions to which students sought answers at each step can be listed as follows.

### 1. *Substitute:*

The purpose of this step is to interchange the object or person being considered with a different object or person (which will serve as its replacement) (Glenn 1997).

- What should be done to convert solid waste into other materials and reuse them?
- What processes should be applied on solid waste such that they may be reused?

### 2. *Combine:*

The purpose of this step of the technique is to bring together and combine different objects (Glenn 1997).

- Which solid waste can be disposed together in the same container?
- What would happen if solid waste were disposed together in the same container with organic waste?

### 3. *Adapt:*

This purpose of this step is to adapt the object under consideration to different situations or uses (Glenn 1997).

- Do you think that solid waste can be utilized without recycling?
- Would you use products obtained from the recycling of solid waste?

### 4. *Modify, Minify, Magnify:*

This step involves changing the form of the original object by reducing or increasing its size, by changing its quality, by rendering it lighter or heavier, and/or by reducing or increasing its speed (Glenn 1997).

- Does the recycling and reutilization of paper, cardboard, glass, metal, and plastic waste alter their shape?
- Does the recycling and reutilization of paper, cardboard, glass, metal, and plastic waste change their quality?

### 5. *Put to other uses:*

This step involves discussing the use of the object under consideration for purposes, and also at locations, that differ from was originally intended (Glenn 1997).

- In order to protect trees and raw materials sources, what could be done by whom to ensure the reutilization of paper, cardboard, glass, metal, and plastic waste?
- How could means and methods such as public announcements, posters, visual media, etc... be used effectively to ensure the recycling of paper, cardboard, glass, metal, and plastic waste?

### 6. *Eliminate:*

This step involves fully or partially removing a certain feature or section of the object that is the subject of the brainstorming (Glenn 1997).

- How will the environment be affected if waste is not collected?
- Are taxes necessary for ensuring the collection and utilization of waste?

### 7. *Reverse:*

In the final step of the technique, the current state of the object will be considered, and then the object or its characteristics will be reorganized or inverted (Glenn 1997).

- Would you be able to perform the tasks of the municipality by yourself?
- What type of measures and regulations are necessary for ensuring the efficient utilization of solid waste?

### 2.3 Data collection and analysis

To determine the level of awareness of the participating science students regarding the collection and utilization of solid waste, eight of the questions developed and structured by El-Hoz (2009) were employed as a pre-test at the beginning of the study, and as a post-test at the end of the study. The data obtained during the study were analyzed as frequency (f) and percentage (%).

## 3. Results of Research

To determine the level of awareness of science students regarding the collection and utilization of solid waste, the questions listed below were asked. The answers and results that were obtained are also provided below next to their corresponding questions.

1. The percentage and frequency of the pretest-posttest answers provided by the students to the question, “Where do you dispose of the following municipal waste?” are shown in Table 2-7.

a) *Organic wastes (e.g. vegetable peels, food leftovers, etc.)*

Prior to the implementation of the SCAMPER technique, the large majority of the students threw organic waste into trash cans, while some of the students threw them into recycling containers. Following the implementation of the SCAMPER technique, it was noted the number of students who threw organic waste into trash cans increased, while the number of students who threw them into recycling containers decreased. This indicated that the students gained awareness regarding the content of organic waste, and fact that this waste should not be thrown in recycling containers (Table 2).

Table 2. The Percentage and Frequency Distribution of the Pretest-Posttest Answers Provided by the Students Regarding the Type of Containers in Which They Disposed Organic Waste

	Pre-test		Post-test	
	f	%	f	%
in trash cans	54	83,1	60	92,3
to animals	3	4,6	4	6,2
to recycle	8	12,3	1	1,5
<b>Total</b>	<b>65</b>	<b>100</b>	<b>65</b>	<b>100</b>

b) *Plastics (e.g. shopping plastic bags, etc.)*

Prior to the implementation of the SCAMPER technique, the large majority of the students threw plastic waste into trash cans, while only a few students threw them into recycling containers. Following the implementation of the SCAMPER technique, it was noted the number of students who threw plastic waste into trash cans decreased, while the number of students who threw them into plastic waste containers increased (Table 3).

Table 3. The Percentage and Frequency Distribution of the Pretest-Posttest Answers Provided by the Students Regarding the Type of Containers in Which They Disposed Plastics

	Pre-test		Post-test	
	f	%	f	%
to recycle	17	26,2	21	32,3
to recycle (in containers for plastics)	5	7,7	23	35,4
in trash cans	37	56,9	21	32,3
to recycle or in trash cans	6	9,2	-	-
<b>Total</b>	<b>65</b>	<b>100</b>	<b>65</b>	<b>100</b>

c) *Cardboard, empty boxes*

Prior to the implementation of the SCAMPER technique, nearly half of the students threw cardboard boxes into trash cans, while the other half threw them into recycling containers. Following the implementation of the SCAMPER technique, the number of students who threw cardboard boxes into trash cans decreased, while the number of students who threw them into recycling containers increased (Table 4).

Table 4. The Percentage and Frequency Distribution of the Pretest-Posttest Answers Provided by the Students Regarding the Type of Containers in Which They Disposed Cardboard Boxes

	Pre-test		Post-test	
	f	%	f	%
to recycle	23	35,42	24	36,9
to recycle (in containers for paper)	7	10,8	28	43,1

in trash cans	<b>34</b>	52,28	13	20,0
to recycle or in trash cans	1	1,5	-	-
<b>Total</b>	<b>65</b>	<b>100</b>	<b>65</b>	<b>100</b>

*d) Empty cans*

Prior to the implementation of the SCAMPER technique, a large portion of the students threw empty cans into trash cans. Following the implementation of the SCAMPER technique, the number of students who threw empty cans into trash cans decreased, while the number of students who threw them into recycling containers, and especially into metal waste containers, increased (Table 5).

Table 5. The Percentage and Frequency Distribution of the Pretest-Posttest Answers Provided by the Students Regarding the Type of Containers in Which They Disposed Empty Cans

	Pre-test		Post-test	
	f	%	f	%
to recycle	13	20,0	<b>20</b>	30,8
to recycle (in containers for metal)	4	6,2	<b>24</b>	36,9
in trash cans	<b>48</b>	73,8	21	32,3
<b>Total</b>	<b>65</b>	<b>100</b>	<b>65</b>	<b>100</b>

*e) Bottles*

Prior to the implementation of the SCAMPER technique, nearly half of the students threw glass into trash cans, while the other half threw them into recycling containers. Following the implementation of the SCAMPER technique, the number of students who threw glass into trash cans decreased, while the number of students who threw them into recycling containers, and especially into glass waste containers, increased (Table 6).

Table 6. The Percentage and Frequency Distribution of the Pretest-Posttest Answers Provided by the Students Regarding the Type of Containers in Which They Disposed Glass Bottles

	Pre-test		Post-test	
	f	%	f	%
to recycle	20	30,8	<b>29</b>	44,6
to recycle (in containers for glass)	11	16,9	<b>18</b>	27,7
in trash cans	<b>34</b>	52,3	18	27,7
<b>Total</b>	<b>65</b>	<b>100</b>	<b>65</b>	<b>100</b>

*f) Scrap metal*

Prior to the implementation of the SCAMPER technique, a large portion of the students threw scrap metal into trash cans. Following the implementation of the SCAMPER technique, the number of students who threw scrap metal into trash cans decreased, while the number of students who threw them into recycling containers, and especially into metal waste, increased. In addition, it was observed both in the pretest and posttest that a number of students sold scrap metals to metal collectors for cash (Table 7).

Table 7. The Percentage and Frequency Distribution of the Pretest-Posttest Answers Provided by the Students Regarding the Type of Containers in Which They Disposed Scrap Metal

	Pre-test		Post-test	
	f	%	f	%
to recycle	15	23,1	<b>18</b>	27,7
to recycle (in containers for metal)	-	-	<b>20</b>	30,8
in trash cans	<b>39</b>	60,0	19	29,2
to junk collectors	11	16,9	8	12,3
<b>Total</b>	<b>65</b>	<b>100</b>	<b>65</b>	<b>100</b>

Based on the study results, it was determined that some of the students contributed to recycling by throwing waste separately into plastic, paper, glass, and metal waste containers (Table 3-7). This indicated that the SCAMPER technique enabled the students to develop their creative thinking skills and to think differently, thus allowing them to gain an awareness regarding the importance of separately collecting and disposing this waste. This awareness among students also reflected their realization that the separation of waste facilitated the activities of both municipalities and private waste collection and utilization companies.

2. The percentage distribution of the pretest-posttest answers provided by the students to the question, “Do you sort your solid waste?” is shown in Figure 1.

Following the implementation of the SCAMPER technique, an increase was observed in the number of students who sorted solid waste. This was possibly due to the realization by the students of the importance of sorting solid waste.

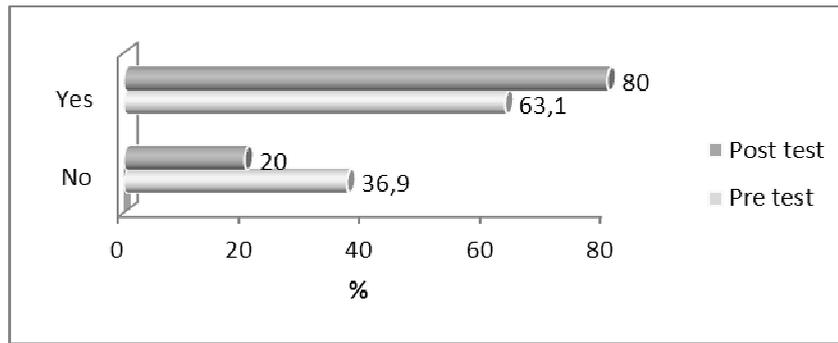


Figure 1. The Percentage Distribution of Students Who Sorted Their Solid Wastes

An evaluation of Table 8 indicates that, prior to the implementation of SCAMPER, the main reason why the students sorted waste was their knowledge of its benefits, as well as their view that sorting waste would contribute to recycling and the reduction of environmental problems. Following the implementation of SCAMPER, recycling was the main reason mentioned by the students for performing sorting. In addition to this, composite waste was mentioned by the students as another reason why they performed sorting, which indicated their knowledge regarding composite solid waste.

Table 8. The Frequency Distribution of the Pretest and Posttest Answers Provided by the Students Regarding Their Reasons for Sorting Solid Waste

	Pre-test f	Post-test f
1-Because I see others doing it.	1	-
2-I know that sorting could be useful.	42	48
2a-For recycling	38	53
2b-For compost	-	5
3- I know that sorting will reduce environmental problems.	25	30
4-I have seen it in the news.		
4a-TV	13	8
4b-Radio	1	-
4c-Newspaper	7	3
5-I see neighbours doing it that is why I do it.	1	-
6-I don't see any use for sorting my waste.	13	15

An evaluation of Table 9 shows that although the students were knowledgeable about sorting waste prior to the implementation of the SCAMPER technique, many expressed that they were unable to sort due to the lack/absence of containers near the places they lived. The number of students who expressed such views decreased following the implementation of the technique. Students who initially did not know how to sort, who thought that sorting would not make a difference, and who did not spend time sorting despite being knowledgeable about it abandoned such attitudes and thoughts regarding sorting following the implementation of the technique, which allowed them to gain an awareness on how sorting is performed and to act more sensitively on this subject.

Table 9. Frequency Distribution of the Pretest-Posttest Answers Provided by the Students Regarding Their Reasons for not Separating Solid Waste

	Pre-test f	Post-test f
1-I don't know about it.	7	-
2-I know about it but there is no waste container nearby.	20	13
3-I know about, there is a container nearby, but I don't have time to sort.	4	-
4-I don't think it makes a difference to sort.	3	-

**3.** The percentage distribution of the pretest-posttest answers provided by the students to the question, “Would you be willing to separate compostable materials?” is shown in Figure 2.

Prior to the implementation of the SCAMPER technique, the students generally appeared to be unwilling sort of compostable materials. This was possibly because the students did not know what type of materials these were, and because they had insufficient knowledge regarding the subject. The data obtained following the implementation of the SCAMPER technique showed that the large majority of the students were willing to sort compostable materials.

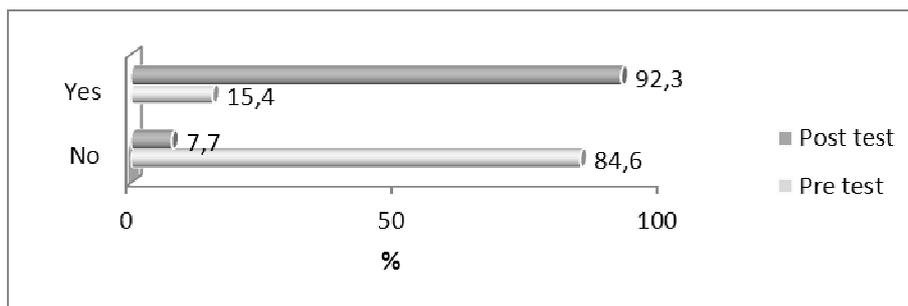


Figure 2. The Percentage Distribution of Students Who Separated Compostable Materials

4. The frequency distribution of the pretest-posttest answers provided by the students to the question, “**What do you think should be done to encourage you more to start sorting or avoid dumping? Explain:**” is shown in Table 10.

Prior to the implementation of the SCAMPER technique, the students expressed that in order to promote sorting, public institutions should inform society by organizing seminars and panels, make separate containers for organic and solid waste available, and broadcast public announcements on TV and radio regarding the sorting of solid waste. However, after the implementation of the SCAMPER technique, the number of students who expressed these thoughts decreased, and an increasing number of students described the necessity to provide classes in schools and organize projects regarding the sorting of organic and solid waste. This finding is very important in that it emphasizes the importance of the tasks and responsibilities in promoting waste sorting. The classes provided by educational institutions and the projects that will be performed with the participation of students will be very beneficial and important for raising awareness.

Table 10. The Frequency Distribution of the Students’ Pretest-Posttest Answers Regarding the Promotion of Sorting

	Pre-test f	Post-test f
Public institutions could organize seminars and panels in order to raise social awareness about sorting	53	28
Increase the number of containers	12	12
Provide different containers for organic and solid wastes	23	17
Perform public service announcements on television and radio regarding the sorting of organic and solid wastes	14	12
Use rewards in order to encourage the collection and sorting of organic and solid wastes in separate containers	11	8
To encourage the separate collection of trash and solid wastes by using posters and brochures	5	3
Ensure the regular collection of waste by municipalities	8	1
Provide separate trash bags to allow the sorting of different wastes at their source	2	1
Provide courses in schools regarding the separation of organic and solid wastes	4	22
Organize school projects regarding the separation of organic and solid wastes	1	9

5. The frequency distribution of the pretest-posttest answers provided by the students to the question, “**How do you feel about the current situation of solid waste disposal, dumping, sorting, etc...? Explain:**” is shown in Table 11.

Although the majority of the students expressed, prior to the implementation of the SCAMPER technique, that the current activities regarding the collection, sorting and processing of solid waste was sufficient, an increasing number of students expressed following the implementation of the SCAMPER technique that the current activities were not sufficient. At the same time, the number of students who were undecided on this subject increased twofold following the implementation of the technique. This result indicated an association with the increasing awareness of the students during the implementation of the SCAMPER technique, which led students to evaluate and question the current activities and situation.

Table 11. The Percentage and Frequency Distribution of the Students' Pretest-Posttest Views Regarding the Current Activities for the Collection, Sorting, Processing, etc... of Solid Waste

	Pre-test		Post-test	
	f	%	f	%
I believe that current disposal, dumping and sorting activities are adequate	43	66,2	14	21,5
I believe that current disposal, dumping and sorting activities are not adequate	14	21,5	36	55,4
Undecided	8	12,3	15	23,1
<b>Total</b>	<b>65</b>	<b>100</b>	<b>65</b>	<b>100</b>

6. The percentage distribution of the students' pretest-posttest answers to the question, "Are you satisfied with the waste collection services?" is shown in Figure 3.

While more than half of the students expressed, prior to the implementation of the SCAMPER technique, that they were not satisfied with waste collection services, this ratio increased even further after the implementation of the technique. This situation was an indication of the increased questioning of current services, which was due to the students' increasing knowledge and experience regarding these services as a result of the SCAMPER technique.

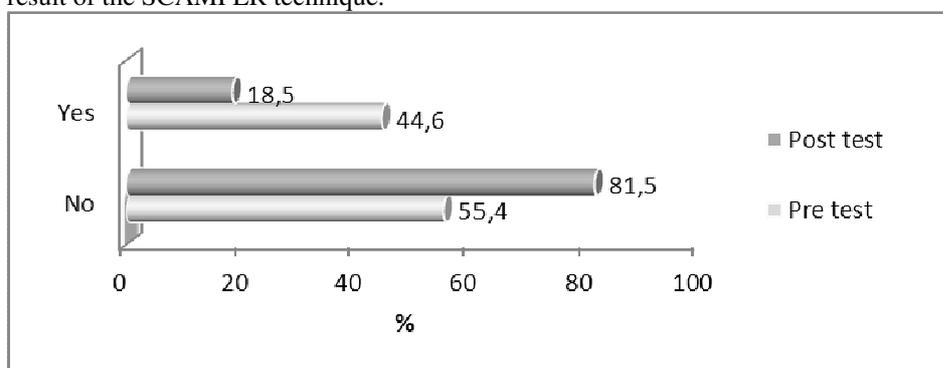


Figure 3. The Percentage Distribution of the Students Pretest and Posttest Answers' Regarding Their Level of Satisfaction with Waste Collection Services

An evaluation of Table 12 indicates that the reasons for the students' satisfaction with current waste collection services prior to the SCAMPER technique involved the regular collection of waste, and the utilization of this waste through recycling. Following the implementation of the SCAMPER technique, the number of students decreased, and the students only appeared to be satisfied with the regular collection of waste. Although some of the students expressed, prior to the implementation of the SCAMPER technique, that they were satisfied with waste collection services due to their contribution to recycling, it was noted that none of the students expressed this view following the implementation of the SCAMPER technique.

Table 12. The Frequency Distribution of the Students' Pretest and Posttest Answers Concerning Their Reasons for Being Satisfied with Waste Collection Services

	Pre-test f	Post-test f
Because they are performed regularly	18	12
Because they contribute to recycling	11	-

An evaluation of Table 13 indicates that prior to the implementation of the SCAMPER technique the reasons for the students' dissatisfaction with waste collection services included the irregular collection of waste and the limited level of importance being accorded to waste collection. Following the implementation of the SCAMPER technique, it was noted that the number of students who were dissatisfied, particularly with the lack of recycling containers, increased, as well. This result indicated the increasing awareness of the students regarding the importance of disposing waste in recycling containers in order to properly sort waste at their source.

Table 13. The Frequency Distribution of the Students' Pretest and Posttest Answers Concerning Their Reasons for Being Dissatisfied with Waste Collection Services

	Pre-test f	Post-test f
Because they are not performed regularly	20	23
Because sufficient importance is not accorded to these services	13	21
Because no recycling containers are made available	3	14

7. The percentage distribution of the pretest-posttest answers provided by the students to the question, “**Who do you think is responsible for solid waste management in the city?**” is shown in Figure 4.

Both prior to and after the implementation of the SCAMPER technique, the students expressed that municipalities are responsible for the management of solid waste. Following the implementation of the technique, a decrease was observed in the number of students who had no opinion on this subject.

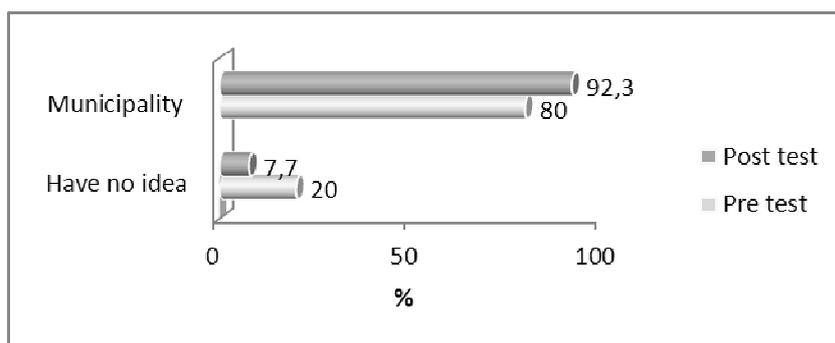


Figure 4. The Percentage Distribution of the Students' Pretest and Posttest Answers Regarding the Party Which is Responsible for Solid Waste Management within the City

8. The percentage distribution of the pretest-posttest answers provided by the students to the question, “**Would you pay a tariff for solid waste services?**” is shown in Figure 5

Both prior to and after the implementation of the SCAMPER technique, most students expressed that they are willing to pay tariffs for solid waste services. The ratio of students expressing this view increased slightly following the implementation of the technique.

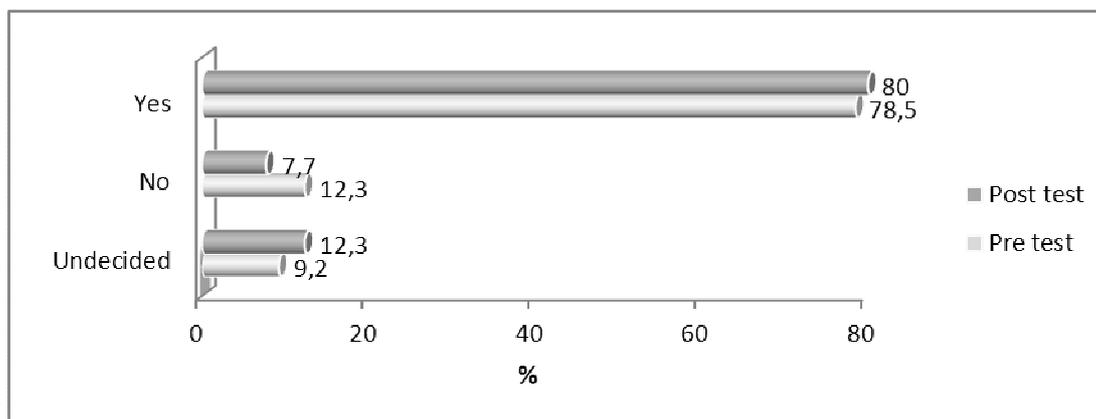


Figure 5. The Percentage Distribution of the Students' Pretest and Posttest Answers to the Question on Whether They Would Pay Tariff for Solid Waste Services

An evaluation of Table 14 indicated that prior to the implementation of the technique, the students generally expressed that they were willing to pay taxes to ensure a cleaner environment, to cover the expenses of waste-related services, to ensure a healthier life, and to receive good quality services even if their number and scope would be limited. Following the implementation of the technique, an increasing ratio of students expressed willingness to pay taxes in order to ensure a cleaner environment and to receive better services. The students who expressed following the implementation of the technique a willingness to pay taxes in order to receive better services might have said so due to an awareness that the relevant public institutions require financial support for the collection, sorting, and utilization of solid waste.

Table 14. The Frequency Distribution of the Students' Pretest and Posttest Answers Regarding Their Reasons for Paying Taxes for Waste Collection Services

	Pre-test f	Post-test f
To ensure a cleaner environment	29	25
To provide payment for the services	13	4
To ensure healthier life	12	4
To ensure the better provision of services	2	26

An evaluation of [Table 15](#) indicates that both prior to and following the implementation of the SCAMPER technique, students who were knowledgeable regarding waste collection services expressed that paying taxes for waste collection services was unnecessary, since they constituted one of the central responsibilities of municipalities. The fact that this view was expressed even more frequently after the implementation of the technique might have been associated with the increasing awareness of students, which also lead them to be more supportive of waste collection services at a personal level. In addition, although a limited number of students expressed, prior to the implementation of the technique, that they would not pay taxes for waste collection services due to the lack of trash containers in the proximity of where they lived, it was observed that the opinion of such students changed following the implementation of the technique. This observation is an important finding that indicates the effectiveness of the SCAMPER technique in developing the creative thinking and increasing the awareness of students.

Table 15. The Frequency Distribution of the Students' Pretest and Posttest Answers Regarding Their Reasons for not Paying Taxes for Solid Waste Services

	Pre-test f	Post-test f
Because they considered it mainly as the task and responsibility of municipalities	2	7
Because they felt that there would be no need for taxes if everyone acted responsibly regarding solid wastes	3	6
Because they are not satisfied with the currently provided services	1	-
Because there are no adequate trash containers near the places they live	3	-

#### 4. Discussion, Conclusions and Recommendations

The results of this study indicated that science students described schools as the main source for their information regarding solid waste. This finding demonstrated the importance of schools in raising of environmentally aware individuals who will contribute to the collection and utilization of solid waste. In addition, the fact that some of the students described TV as a source of information regarding solid waste demonstrated the fact that the visual media has an important role in informing and raising awareness within society. When the observation that students deemed the number of containers available as being insufficient is considered together with the observation that they were generally aware of the distance between the place they resided and these containers ([Table 1](#)), it can be seen that these students were actually sensitive and willing regarding the collection of solid waste.

Prior to the implementation of the SCAMPER technique, the large majority of the students who participated to the study described that they threw organic waste, as well as solid waste, composed of paper, glass, metal, plastic, and composite materials – generated by the packages of daily products – into trash cans. Following the implementation of the technique, an increasing number of students expressed that they disposed waste other than organic waste into recycling containers, and especially into separate containers for different types of waste if these were available. This indicated that the students were increasingly aware of the reusability of materials used in package production. The decrease in the number of students disposing organic waste into recycling containers, as well as the increase in the number of students throwing such waste into trash cans, indicated their growing awareness that the contact of organic waste with waste package materials adversely affected the recyclability of the package waste. In addition, students who learned about compostable materials during the implementation of the technique became aware that these materials were recyclable as well.

The growing awareness among students that waste sorting would contribute to recycling, and that sorting would reduce environmental problems, can be considered as an important outcome of this study. It is important to remember that natural resources are not unlimited, and careless use of these resources would eventually lead to their depletion. Students who became aware of this also realized the importance of sorting with regards to the recycling and reutilization of solid waste. Students with such an environmental awareness will contribute to a sustainable future by reducing environmental pollution through the sorting of waste at their source and the reduction of the amount of waste generated. It was observed that students who were unaware about sorting, who did not spend time for sorting, and who believed that such practices would not make a

difference tended to change their views on the subject following the implementation of the study technique.

Another important result of the study was the observation that increasing social awareness regarding the environment and recycling, especially through classes and projects provided in schools, would constitute an important investment for the future. The conscious individuals who will be thus raised will provide an economic benefit to the society through the effective recycling of solid waste and the protection of the sources of raw materials.

The students' level of dissatisfaction with waste collection services was considerable, and this level increased even further following the implementation of the SCAMPER technique. Concerning these services, the students drew attention to the fact that placing the necessary importance and emphasis on recycling first required the sorting of waste at their source. For this reason, the students considered the insufficient number of recycling containers as problematic. In addition, based on the knowledge that the regular collection of waste would reduce the amount of waste being thrown into trash cans, the students also expressed concern regarding the irregularity of waste collection. The fact that the students were willing to pay more taxes in order to receive better waste collection services demonstrated the attention they paid to this subject, as well as their awareness and sensitivity regarding the environment. It should be remembered that ensuring a better life for future generations depends heavily on our conscious, sensitive and efficient usage of the world's natural resources.

El-Hoz (2009) previously described that waste-related practices (collection, reuse, recycling) which are not designed in a manner compatible with human behavior, and which do not include the necessary adaptations, will limited the efficiency of waste sorting and recycling activities. In this study performed by implementing the SCAMPER technique, we endeavored to raise the awareness of science teachers by informing them about all waste-related processes ranging from the collection of waste to their recycling and reutilization. To ensure that science students can be raised as individuals capable of producing solutions by evaluating issues through different perspectives and approaches, it is necessary that they develop the ability to think creatively. The study results indicated that students must first learn the proper collection and utilization of waste in order to realize the importance of protecting natural resources, saving energy, contributing positively to the economy, reducing the amount of waste disposed, and leaving a good environment for future generations. Considering that the collection, sorting, and utilization of solid waste for a sustainable future will only be possible with conscious and aware individuals, conducting activities to raise awareness regarding the environment and recycling at various stages of education, starting when individuals are young children, will constitute an important investment for the future.

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