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Determination of Science Students' Awareness on Waste Management

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ABSTRACT In this research, it was aimed to determine science students' awareness on waste management. Eleven students studying in the first year of the Science Education Department participated in the research. The screening model was used in the research. The data were collected through scientific newspapers prepared in line with the Scientific Newspaper Preparation Instruction within the Scope of Waste Management. In the five sections of the instruction, students were asked to prepare scientific newspapers that they will support with written explanations and drawings on recovery, reuse, recycling, plastic bag usage, and zero waste within waste management. The data were analyzed by using content analysis. As a result of the research, it was understood that a significant part of the students was aware of the effects of education, research, and project activities on recovery, reuse, recycling, plastic bag usage, and zero waste practices within the scope of waste management, and the place and importance of the individual in waste management. On the other hand, it was understood that most of the students were not aware of the basis of waste management practices as the waste types, the separation of wastes at the source in accordance to their types, and throwing the wastes into the appropriate waste bin for their types.

Keywords Sustainability, Waste Management, Awareness, Scientific Newspaper, Science Student

1. INTRODUCTION

Waste is defined as any substance or material thrown, left, or obligatory discarded to the environment by the producer or the person in possession (URL). If it is appropriately managed, waste has an economic value (Muljaningsih & Galuh, 2018). So much so that many countries consider waste as material and energy (Cucchiella, D'Adamo & Gastaldi, 2017). Once the waste composition is known, strategies for separation, collection, and treatment alternatives such as recycling and composting can be determined. This situation allows that waste is being removed from landfills (Nolasco et al., 2021). Otherwise, the negative effects of the waste will occur. In this respect, waste causes various problems such as health problems, bad smells, fire hazards, atmosphere, soil, water, and visual pollution, together with social and economic losses (Dharmasiri, 2019).

Waste is a serious problem for air, water, and soil. As a result of the burning of trash stored in open areas, toxic gases are released, such as carbon dioxide and carbon monoxide, which cause health problems. Waste pollutes water by falling into rivers and puddles; at the same time, it causes an increase in the fly and mouse population. The physical properties of the soil change, and the growth of plants are adversely affected. In addition, trashes cause a decrease in the aesthetic value of the environment and the disappearance of the landscape (Dharmasiri, 2019). Considering all these factors, waste should be seen as a cultural problem affecting life. To minimize the negative effects of this problem on the environment, waste should be appropriately managed (Naria, Nasution & Santi, 2018).

Waste management covers the activities of preventing the formation of waste, reduction at the source, reuse, separating according to its characteristic and type, accumulating, collecting, temporary storage, transportation, intermediate storage, recycling, recovery including energy, disposal, monitoring after disposal processes, control and inspection (URL). Waste management is a long process that is creative and full of opportunities. In this process, waste should not be considered a problem but a resource that society will benefit from (Kumar & Kumar, 2020). A five-step process is followed in waste management (Figure 1). The first preferred step in this process is preventing waste. Then,

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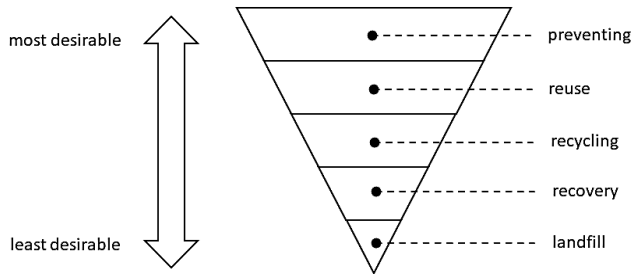


Figure 1 Waste management hierarchy (Cucchiella, D'Adamo, & Gastaldi, 2014)

preventing waste is followed by reuse, recycling, recovery including energy, and safe disposal is applied as the last step. Benefits obtained from the regular implementation of the waste management process are preventing greenhouse gas emissions, reducing pollutants, energy-saving, conservation of resources, new employment opportunities, and developing green technologies (Cucchiella, D'Adamo & Gastaldi, 2014).

The 3R (reduce, reuse, and recycle) rule is one of the most effective methods implemented in waste management (Naria, Nasution & Santi, 2018). This rule comes to the fore in reducing waste, which has become a significant environmental problem (Aksan & Çelikler, 2019). In the integrated waste management system, following the approaches covered by the 3R rule, reducing wastes at the source, reusing, and recycling; then, incineration, and final disposal processes are carried out close to the waste source (Asteria & Haryanto, 2021). However, 3R activities face a significant obstacle if society's awareness of separating or classifying waste is low (Muljaningsih & Galuh, 2018).

Reusing waste for another purpose or in a different way is called reuse. People can reuse many materials such as plastic bags, furniture, toys etc. and repair some broken materials they use. They may also sell to others or give to charity. Additionally, recycling is when waste is reshaped and converted into raw materials that can create a new product (Dharmasiri, 2019). The first step in implementing waste material recycling plans is the proper implementation. Therefore, a household waste recycling program should be followed when considering the environmental, economic, and social effects of recycling (Almasi et al., 2019; Asteria & Haryanto, 2021). So much so that Harman & Çelikler (2016) determined that most of the pre-service science teachers had sufficient awareness of the meaning, necessity, and purpose of recycling. In contrast, their understanding of recyclable waste was not enough.

Waste is a result of human activities. Every human activity produces waste. The type of waste depends on the types of materials that people consume, and waste management cannot be separated from people's lifestyles (Muljaningsih & Galuh, 2018). Lack of waste management, which is a direct result of human activity, is one of the main problems of modern civilization that has emerged from the contemporary lifestyle (Kumar & Kumar, 2020). The 3R rule is widely accepted in waste management to solve the waste problem. In addition to this rule, responsibility is also important in promoting waste management behaviors (Minelgaitė & Liobikienė, 2019). In an ideal world, everyone should be conscious of managing waste appropriately, as everyone is responsible for environmental issues, including waste management (Ampofo, 2020; Dharmasiri, 2019). In support of this, Aksan, Çelikler & Yenikalaycı (2019) pointed out that science students have a high awareness of recycling, and individuals with a high level of recycling awareness will be more likely to show recycling behavior.

Environmental knowledge is the key to a clean and sustainable environment. Lack or absence of funding, lack of educated teachers, insufficient knowledge, awareness, practice, and interest are obstacles to environmental sustainability. However, these obstacles can be overcome in schools. So much so that schools create appropriate curricula to promote sustainability through practice, awareness, and participation. This situation leads to sustainable development and cleaner and greener production (Debrah, Vidal & Dinis, 2021). On the other hand, a lack of individual awareness and environmental knowledge weakens waste management practices, causing permanent problems for future generations (Ampofo, 2020). Wrong waste management pollutes the air, water, and soil, and these pollutants create severe risks to biodiversity and human health. Therefore, everyone needs to participate and provide support (Kumar & Kumar, 2020). Consequently, sustainable waste management should concern everyone (Gusti, 2016). Sustainability is a concept that includes the appropriate use of natural resources and processing wastes with proper methods (Triguero, Alvarez-Aledo & Cuerva, 2016). Waste reduction and correct waste management are significant for sustainable environmental management. This situation reduces landfill use (Cucchiella, D'Adamo & Gastaldi, 2014) and protects environment-human health and environmental quality (Cucchiella, D'Adamo & Gastaldi, 2014; Fagnani & Guimaraes, 2017; Gusti, 2016).

Waste management is beneficial in terms of economically and socially. With waste management, natural resources are protected, and employment is created (Fagnani & Guimaraes, 2017). In addition, improvement of environmental aesthetics, prevention of environmental pollution, and reduction of disease transmission routes can be provided (Naria, Nasution & Santi, 2018). In this context, waste management practices are also at the center of innovative sustainable campus programs and activities (Ifegbesan, Ogunyemi & Rampedi, 2017). These activities should be related to cognitive, emotional, and psychomotor areas. Students should have knowledge and attitude on waste management and display this knowledge

and perspectives with their behaviors (Muljaningsih & Galuh, 2018).

Separation of waste is essential as the waste produced causes many problems. Waste separation should be done within the scope of waste management at the sources such as homes, markets, or industries to ensure recycling (Dharmasiri, 2019). The biggest obstacle to recycling is the lack of a system for separate collection of wastes in many countries (Tulebayeva, Yergobek, Pestunova, Mottaeva & Sapakova, 2020). Waste management at the source is the basis of waste management at the household level. The education to be provided can increase knowledge, environmental awareness, practical knowledge and improve the understanding of household waste management (Asteria & Haryanto, 2021). It is necessary to raise the awareness of individuals so that separate collection of waste becomes a part of daily life at school, at home, and in the community. Teachers are a key factor in providing this awareness (Rada et al., 2016). Considering that societies that have poor environmental awareness are the leading cause of ecological problems, it is a fact that environmental education and teachers, one of the most important elements of the education system, have a vital role in raising generations that act with sustainability awareness (Aksan & Çelikler, 2019). Practical education to transform waste into valuable products improves students' environmental understanding. Waste processing should be integrated with school and extracurricular activities and frequently applied to correct students' ecological awareness (Nizaar, Sukirno, Djukri, Muhardini & Mas'ad, 2020). Waste management practices can reduce environmental pollution and waste-related diseases. It can also improve the reuse, recycling, and recovery of waste materials (Fredrick, Oonyu & Sentongo, 2018).

Education is essential in raising people's awareness about environmental protection to ensure waste management (Muljaningsih & Galuh, 2018; Tulebayeva et al., 2020). Education is used to gain knowledge, change attitudes and develop skills in the direction of resources, including waste management (Fredrick, Oonyu & Sentongo, 2018). Education, a significant and simple way to solve the waste problem, leads to increasing environmental awareness and planning appropriate solutions for sustainable development (Przydatek, 2019). Fredrick, Oonyu & Sentongo (2018) revealed that public education improves waste management practices in the city. Early education ensures future generations contribute to sustainable waste management practices (Zainu & Songip, 2017). Therefore, it is essential to disseminate waste management education starting from kindergarten. In this context, each individual's waste management roles and responsibilities should be appropriately communicated and given a directive. In this way, responsible citizens who manage waste as a resource and create zero or less waste in the future can be raised while applying the 3R rule (Dharmasiri, 2019). The concept of zero waste and recycling activities are important universal gains to shape the future of countries and leave a cleaner environment for future generations (Bulut, 2020). However, the amount of waste produced continues to increase without consumers' conscious decisions about reducing, reusing, and recycling (Zainu & Songip, 2017). Ampofo (2020) determined that high school students, teachers, and administration were worried about waste disposal. When the studies about the effectiveness of environmental education and practices on waste management are examined, Liao & Li (2019) revealed that environmental education is essential to ensure that high school students have the necessary knowledge and positive attitudes towards separating solid wastes. Similarly, as a result of their studies, Nizaar et al. (2020) revealed that the waste processing activity carried out by using the 3R rule was also effective in students' environmental awareness.

When the studies about the knowledge, attitude, and behavior on waste management are examined, Gusti (2016), in his study with primary school students, showed that knowledge of sustainable waste management with attitudes towards sustainable waste management; moreover, knowledge and attitudes towards sustainable waste management with the intention of sustainable waste management behavior were also related. Similarly, Molina & Catan (2021) determined that senior high school students had sufficient knowledge about solid waste management and did the correct practices. However, as a result of the study conducted by Desa, Kadir & Yusooff (2012), it was determined that first-year university students showed correct behaviors regarding solid waste management. On the other hand, Almasi et al. (2019) found that participants' knowledge and attitudes about reduction at the source, separation, and recycling were high, but the correct practice was low. In addition, nearly half of the participants stated that they were not satisfied with the waste collection services. In support of this, Baba, Güneş-Şen & Aydın (2018) examined the public's opinions on solid waste management, and they found that most of the participants were not satisfied with the waste management in the country.

Teachers are expected to educate students to manage waste according to the 3R rule to increase respect for the environment (Nizaar et al., 2020). Recycling education in schools within qualified environmental education will be effective throughout individuals' lives. In this context, curriculum, teaching environments, and textbooks significantly affect the teaching of recycling within the scope of environmental education by well-appointed teachers (Aksan & Çelikler, 2019). Education and awareness are the critical factors in reducing waste (Zainu & Songip, 2017). Education and awareness on waste and waste management are becoming increasingly important from a global resource management perspective (Kumar &

Kumar, 2020). The knowledge and awareness obtained from education are highly effective in environmental activities and human behaviors. Waste management education starts at school and affects individuals at home (Dharmasiri, 2019). Primary school students' sustainable waste management behavior will provide role models for their families and society (Gusti, 2016).

Formal education for sustainable development is essential at all levels of education. Teachers who have the correct knowledge, attitudes, skills, and innovation are required for better environmental sustainability or waste management sustainability education. However, most teachers do not have applied solid waste management or ecological knowledge negatively affects the students' environmental knowledge and attitudes toward solid waste management. In addition, teachers' attitudes in environmental education related to waste management are very important in the education they will give to students (Debrah, Vidal & Dinis, 2021). Considering that teachers affect societies, are role models for the growing generations, and have active roles in shaping today's world and its future, pre-service teachers should have knowledge and awareness on waste and recycling. For this reason, pre-service teachers in all programs should be informed through various educational activities and courses during their university education. In addition, scientific activities such as conferences, symposiums, and panels on waste and recycling should be organized in universities. In this way, the increase in the knowledge and awareness levels of the pre-service teachers will positively affect their attitudes and behaviors (Aksan & Çelikler, 2019).

Protecting the environment can be emphasized by encouraging society to reduce waste generation through awareness programs. Awareness programs can improve attitudes towards waste management and provide new business opportunities. Higher education institutions play an important role in giving environmental education to students. Thus, postgraduate students can explore career opportunities in solid waste management (reduction, reuse, and recycling as an alternative to disposal) (Al-Khatib, Kontogianni, Al-Sari & Al Rajabi, 2018). When the studies on the importance of waste management awareness are examined, Bulut (2020) revealed most teachers thought that children in preschool education gained insufficient understanding about zero waste and recycling. Teachers stated that they wanted to gain awareness about zero waste and recycling in preschool education undergraduate programs for reasons such as contributing to the country's economy, raising children's awareness at an early age, protecting nature and the environment, saving the country's natural resources and protecting all living things in the background. At the same time, Aksan & Çelikler (2019) found that awareness education increased the pre-service science teachers' knowledge level about recycling and positively changed their behavior towards recycling.

The research aimed to determine the science students' awareness on waste management. In this context, answers to the following sub-questions of research were sought.

1. What is the science students' awareness on recovery?
2. What is the science students' awareness on reuse?
3. What is the science students' awareness on recycling?
4. What is the science students' awareness on plastic bag usage?
5. What is the science students' awareness on zero waste?

2. METHOD

2.1 Research Model

The screening model was used in the research. Screening is a research model that aims to examine a situation such as an event, individual, or object in its original form without changing and affecting it (Karasar, 2020, p. 109).

2.2 Research Group

Eleven students (nine female, two male) studying in the Science Education Department of a state university in Turkey in the spring semester of 2019-2020 voluntarily participated in the research.

2.3 Data Collection

The data were collected through scientific newspapers prepared in line with the Scientific Newspaper Preparation Instruction within the Scope of Waste Management. Researchers designed instruction. First, the current science course curriculum (Ministry of National Education [MoNE], 2018) and the national and international literature were examined to prepare the instruction. Then, a control list was designed to evaluate the statements' suitability to be included in the instruction, the adequacy of the power to represent the subject, and the content validity. Concepts involved within the scope of waste management in the control list are given in Figure 2.

In the five sections of the instruction, students were asked to prepare scientific newspapers that they will support with written explanations and drawings on recovery, reuse, recycling, plastic bag usage, and zero waste

Figure 2 Concepts involved within the scope of waste management

within waste management. There are three stages in each section of the instruction. After completing each step, the students were asked to put an X in the parenthesis ( ) near the relevant stage. These stages are:
Stage-1: Provide information about recovery by supporting written explanations and drawings. ( )
Stage-2: Write an example from the news you have heard/read from the media about recovery. ( )
Stage-3: Write your thoughts about recovery. ( )
Similarly, three-stage instruction was followed for reuse, recycling, plastic bag usage, and zero waste.

The ability of the statements in the instruction to determine the students' awareness on waste management, including the concepts of recovery, reuse, recycling, plastic bag usage, and zero waste. Whether any expressions needed correction that were not understood or that were not necessary and whether they were appropriate for the level of the students were examined by two faculty members whose fields were science education and chemistry education.

2.4 Data Collection Process

During the data collection process, separate tables were prepared for eleven students. The Scientific Newspaper Preparation Instruction within the Scope of Waste Management, five stapled white A4 papers, and 12 colors of dry pencils was put on the tables for individually used materials by students. One student sat at each table. Students were given 60 minutes to follow the instruction and prepare scientific newspapers.

2.5 Data Analysis

The data sheets were numbered for each student in the data analysis, and the written explanations and drawings on the data sheets were transferred to the computer in their raw form. Within the scope of the research, the written explanations and drawings of the students were analyzed using content analysis.

The data of written explanations and drawings in scientific newspapers prepared by students were analyzed separately by two science education researchers to ensure validity and reliability. First, codes and categories were created by using content analysis by two researchers. Then they were compared and arranged. Finally, comparisons were made between coders to ensure the reliability of coding. The reliability between the two independent coders was calculated by using the formula Agreement=[Number of Agreements/(Number of Disagreements+Number of Agreements)x100] (Miles & Huberman, 1994) and found as 81.4%. However, expert opinion was received on the suitability of the categories and codes.

To ensure external validity, two researchers presented the raw data in categories by coding to make a detailed description. In addition, direct quotations from the students' written explanations and examples of their drawings were provided with the number given to each student's datasheet.

Ethics Committee approval was obtained for this research (Turkey, Ondokuz Mayıs University, Social Sciences and Humanities Research Ethics Committee, 28.02.2020, 2020/115).

3. FINDINGS

The slogans in the prepared scientific newspapers about recovery, reuse, recycling, plastic bag usage, and zero waste within the scope of waste management by students are given in Table 1.

When Table 1 is examined, it is seen that students write more slogans about recycling, plastic bag usage, and zero waste than recovery and reuse.

3.1 Findings of Science Students' Awareness on Recovery

Students' written explanations and drawings in the prepared scientific newspapers about recovery are analyzed and given in Table 2.

When Table 2 is examined, it is seen that explanations and drawings in the prepared scientific newspapers about recovery mainly were concentrated on the resource type, sustainable consumption behavior, educational activities and effects, project activities and effects, cooperation, and solidarity.

One student (S_5) drew attention to negative situations in terms of sustainable consumption behavior with expressions such as excessive water use, leaving taps open, and not being able to prevent excessive water use. In addition, a student (S_4) drew without writing an explanation, and two students (S_1, S_6) did not prepare a scientific newspaper page about recovery.

Some examples of students' written explanations are given below.

"Both wear and sell… In this article, we will present the idea of an association to you. I am sure that it will be a great idea for life. The members of the recovery association put forward this idea at first, then they developed and presented this idea and tried to reach an agreement with some companies. In this idea, we put a machine in certain places. We throw our clothes and shoes that we do not wear, worn out or shrinking, into this machine, and discounts are applied for you in some branded stores. This idea is first being thought of in big cities. It is being considered in Istanbul, Ankara, and Izmir. If it holds, it will probably spread everywhere, and I think it is a good idea and that such ideas will develop and be beneficial for our country. If it is agreed and resolved, I will announce it to you in this newspaper. With love ..." (S_2)

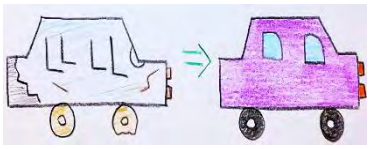
"Every day, we run a lot of water for everything. Even while standing by the sinks, the taps are on. This situation is terrible. We need to, but we cannot prevent it. Therefore, it would be a very logical approach to clean the running water and make it reusable." (S_5)

Table 1 Slogans in the prepared scientific newspapers by students

	Slogans	Student number
Recovery	Both wear and sell…	S_2
	No losing, keep winning. We continue to win.	S_8
Reuse	Why are we cutting down trees?	S_2
	Reuse the water.	S_4
	The municipality cares about reuse!	S_6
	Don't worry about single-use! Now, you can use it again! Do you know these? Don't be sad that it's over!	S_8
Recycling	Let's recycle and not go back! Let's recycle and get back to life!	S_1
	Give your signature so that everything transforms. Think ahead, recycle!!!	S_2
	Recycling is everywhere.	S_4
	Recycle if you want to live! All children are experiencing report card excitement. I recycle for more books, for my future.	S_5
	Throw into the recycle, don't be trash.	S_6
	We renew nature!	S_8
	Don't throw which on your hand to the ground; recycle it…	S_{10}
	Support recycling by throwing your books into the waste bins or through schools.	S_{11}
Plastic bag usage	Plastic bag case! Plastic bags are killing! No to the false glare.	S_1
	Should the plastic bag necessarily enter the house?	S_2
	Plastic bags do not disappear.	S_4
	Now, the plastic bags are 25 krş. Is the string shopping bag coming again?	S_5
	Let's recycle; let's not pollute nature.	S_6
	Was there a plastic bag in the past? No to the plastic bag! Yes to the string shopping bag! Long live the string shopping bags!	S_8
	We don't want a plastic bag.	S_{10}
	"Plastic bags do not disappear in nature." We should be aware of plastic bag usage!	S_{11}
Zero waste	Let's not drown in the water which we drink!	S_1
	Zero waste for my country... "Make zero waste, get."	S_2
	Clean nature, clean future.	S_3
	Bread is labor, don't throw it into the trash.	S_4
	Bread in Africa. Please, don't be indifferent, don't throw it away!	S_5
	Our world is getting better with zero waste.	S_7
	We couldn't bear to throw. Zero waste, double energy!	S_8
	"An important step for zero waste in the dormitory."	S_9
	I want a world without waste.	S_{10}

S_2: Collecting different materials in the separate waste bin, giving a discount voucher to be used on clothes or shoes in return for the materials placed in the waste bin

S_5: The water flowing from the faucet to the sink is cleaned and purified with a cleaner and purifier and reaches the faucet again with the pipe



S_{10}: Repairing and renewing a scrap vehicle with a flat tire

Figure 3 Some examples of drawings in the prepared scientific newspapers about recovery by students

"The old collected materials are recovered by the municipality and distributed to the needy again. Thanks to the recovery, support was provided to many families. Thanks to the recovery of old materials by the people, they found many owners again. I think that recovery supports many families in need. This is a very nice and healthy project.

We can take a step in this regard, and we should raise awareness of everyone." (S_{11})

Some examples of drawings in the prepared scientific newspapers about recovery by students are given in Figure 3.

3.2 Findings of Science Students' Awareness on Reuse

Students' written explanations and drawings in the prepared scientific newspapers about reuse are analyzed and given in Table 3.

In Table 3, it is seen that explanations and drawings in the prepared scientific newspapers about reuse were mostly concentrated on resource type and sustainable consumption behavior.

A student (S_2) drew attention to a situation that is not appropriate for the category of individual responsibility with the statement that using paper without thinking of felled trees. Two students highlighted the effect of reuse on life with the statements that the cutting down of trees poses a problem for our country and the world (S_2), the depletion of resources is bringing the end of humanity day by day (S_5); one student emphasized the effect of reuse on natural resources with the statements that millions of trees are cut down, and trees are in danger (S_2). However, a student's (S_8) statement contradicts the nature of reuse by expressing the scientists' studies on disposable materials. Also, a student (S_1) did not prepare a scientific newspaper page about reuse.

Table 2 Written explanations and drawings in the prepared scientific newspapers about recovery by students

Category	Codes	f
Resource type	Trees	1
	Wastewater	1
	Used clothes and shoes	1
	Used materials	1
	Scrap car	1
Waste bin	Clothes	1
	Unspecified waste type	1
Separation at the source	Recovery machines	1
	Recycling bins	1
Sustainable consumption behavior	Wasting water*	3
	Walking to close distances	1
	Conscious use of oxygen, time, and money	1
Educational activities and effects	News about generating solutions for wastage	1
	News about recovery projects	1
	Using the newspaper for the announcement	1
	Organizing book reading days	1
	Raising awareness of people	1
Project activities and effects	Implementation in big cities first	1
	Reusing wastewater by cleaning	1
	Reusing the car with recovery	1
	Nature conservation	1
	Beautiful and healthy	1
	Beneficial for the country	1
Authorized institution/organization activities and effects	Recovery association - Generating and developing an idea	1
	Municipality - Recovery	1
Cooperation and solidarity	Giving recovered materials to the needy	2
	Giving their old materials by people	1
	Agreement between the recovery association and other companies	1
	People working together	1
Strengthening natural resources	Tree planting days	1
	Increasing the number of trees recovered to life	1
Encourage and widespread effect	Shop discount for used clothes and shoes given to machines	1
	Acceptance and widespread of the recovery idea	1
Effect on emotional state	Peaceful	1
	Surprising	1

**negative*

Table 3 Written explanations and drawings in the prepared scientific newspapers about reuse by students

Category	Codes	f
Resource type	Used and leftover materials	3
	Paper, book, notebook	1
	Clothes, shoes, toys, bag	1
	Wastewater	1
	Broken mirror	1
	General	1
Waste bin	Clothes	1
Sustainable consumption behaviour	Making a wall mirror from the broken mirror of the cabinet	1
	Designing new products from used and leftover materials	1
	Reusing materials over and over	1
	Preventing the used materials from being thrown away	1
	Exchange a reading book with a new one	1
	Preventing wastage	1
	Preventing water wastage	1
	Generations who reuse	1
Individual responsibility	Sensitive people	1
	Paper usage without thinking of felled trees*	1
Educational activities and effects	Learning that some materials are reusable	1
	Seeing a reuse example on the website	1
	Seeing a reuse example with peer observation	1
	Primary school students doing a study	1
Research activities and effects	Scientists' method suggestions to prevent tree cutting	1
	Scientists' studies on disposable materials*	1
	The invention of the machine that reproduces worn clothes	1
	The invention of the machine that reproduces used notebooks and pens	1
Authorized institution/organization activities	Municipality - Collecting used materials and offering to reuse	1
	Municipality - Putting a clothes collection box in each district	1
Solidarity	Helping those in need	1
Effect on life and natural resources	A national and global problem - Felling of trees*	2
	Trees are in danger*	1
	Day-to-day depletion of resources and the end of humanity*	1
Functionality	Beneficial	1
	Nice	1
Encourage and widespread effect	Supporting studies about reuse	1
	Reuse is a common method today	1
Effect on the emotional state	Feeling happy due to the news about the done studies	1
	Adding color to life by newly designed products	1

**negative*

Some examples of students' written explanations are given below.

"Instead of throwing away the finished towel papers in the house, the woman designed something from them. My friend made an owl for homework. She had some leftover materials, and instead of throwing them away, she made cloudy pillows for her nephew. I think that we can do something with them and add color to our lives instead of discarding the leftover materials." (S_3)

"The municipality cares about reuse! The municipality offers the materials for the second user with the clothes collection boxes in each district. Besides clothes, toys, bags, and shoes are also collected in these boxes. It was good work to prevent new materials from being thrown away and help those in need. I invite everyone to be sensitive about this issue." (S_6)

"Primary school students did a study called reuse. A student made a wall mirror using a broken cabinet mirror and said that he would gift the mirror to his mother. We need generations who reuse, not destroy." (S_{10})

Some examples of drawings in the prepared scientific newspapers about reuse by students are given in Figure 4.

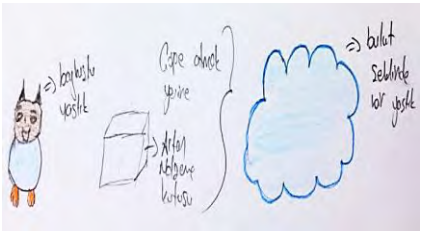
3.3 Findings of Science Students' Awareness on Recycling

Students' written explanations and drawings in the prepared scientific newspapers about recycling are analyzed and given in Table 4.

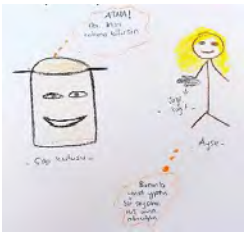
Table 4 Written explanations and drawings in the prepared scientific newspapers about recycling by students

Category	Codes	f
Resource type	Paper	3
	Paper, book	1
	Paper, plastic, glass, metal	1
	Paper, plastic, glass, battery	1
	Book	1
	Waste oil	1
	General	1
	General (Recyclable)	1
Waste bin	Unspecified waste type	2
	Paper, plastic, glass	1
	Paper, plastic, glass, battery	1
Separation at the source	Separating household wastes (paper, plastic, metal, glass)	1
	Campaign - Placing waste oil collection boxes in cities	1
Symbols highlighting waste management	Recycling symbol	4
Sustainable consumption behavior	Throwing wastes into the recycling bin	1
	Throwing recyclable wastes into the recycling bins	1
	Recycling used books to prevent wasting book	1
	Recycling takes the country away from reuse*	1
Individual responsibility	Sensitivity	3
	Sensitivity towards the waste oil collection campaign	1
	Making an effort to beautify the environment	1
Educational activities and effects	Seeing the consequences of recycling and being mindful	1
	Gaining awareness on wastes	1
	Gaining awareness on recycling	1
	Obtaining information about the paper recycling from the website	1
	Raising public awareness	1
Project activities and effects	Doing a project about reducing the used materials' effect on nature	1
	High school students doing a study	1
	Changing the life of a disabled person with a gained wheelchair within the scope of the project	1
Cooperation	Bringing household wastes by everybody on weekends	1
	Donating books and notebooks by school for recycling	1
Effect on life and natural resources	Preventing tree cutting by paper recycling	4
	Healthy creatures	2
	Increasing life expectancy	1
	The most important thing in our life	1
	Preventing recyclable wastes from becoming trash	1
	A clean world	1
	Resource abundance	1
	The end of the world is coming*	2
	Increase in tree cutting due to non-recyclable papers*	2
	Having trouble finding a resource in the future*	1
	The effect of waste on nature*	1
The importance of natural resources	Trees produce oxygen	1
	Trees contribute to a happy nature	1
Encourage and widespread effect	Contributing to recycling	2
	Increasing support for paper wastes recycling	1
	Implementation of paper recycling in many metropolitan cities	1
	Increasing recycling in the world	1
Effect on emotional state	Adding colour to life	1
	Joy	1

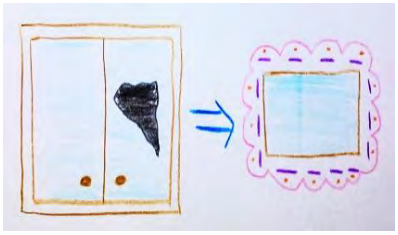
**negative*



S_3: Instead of throwing the leftover materials into the trash, collect them in the box and use them to make a pillow



S_5: Reuse wax paper used in food making instead of throwing it into the trash



S_{10}: Making a framed small wall mirror from the mirror of the broken cabinet door

Figure 4 Some examples of drawings in the prepared scientific newspapers about reuse by students

S_1: The relationship between paper usage and cutting down trees

S_3: The separated waste bins according to their types (plastic, glass, paper)

S_7: Instead of separating the wastes according to their types and throwing them into the appropriate recycling bin, throwing the waste into the same trash bucket without separating them *(inappropriate drawing)*

Figure 5 Some examples of drawings in the prepared scientific newspapers about recycling by students

In Table 4, it is seen that explanations and drawings in the prepared scientific newspapers about recycling mainly were concentrated on resource type and effect on life and natural resources.

A student (S_6) drew attention to a situation that would not be appropriate for sustainable consumption behavior with the statement that recycling takes the country away from reuse. Although some students expressed the effect of not recycling on natural resources as having difficulties in finding resources to use in the future (S_5), tree cutting for used and discarded papers (S_1), and not recycling paper will increase tree cutting (S_1). Regarding the used materials' effects on nature (S_8), two students stated the impact of not recycling on life as the world's end is coming (S_1, S_5).

Some examples of students' written explanations are given below.

"Let's throw our trash into the recycling bin and add color to life. I read on a web page that the paper wastes we throw away are transformed instead of tree cutting again. This practice has been implemented in many metropolitan cities. More trees, cleaner air, and, moreover, a happier nature. Throw your wastes into the recycling bins, and add color to life." (S_3)

"You can save recyclable everything from being trash by throwing them into the recycling bins! Everything thrown into the recycling suspends our country away from reuse. For example, the papers we do not throw into the trash and recycle prevent the trees from dying. Throw it into the recycling; it isn't trash. With a campaign launched, oil collection boxes for recycling were made and placed in certain parts of the cities. People are already extremely sensitive." (S_6)

"We can contribute to recycling by separating the trashes in our home as paper-plastic-metal-glass. Contribution to recycling plays an important role in changing people's lives." (S_9)

Some examples of drawings in the prepared scientific newspapers about recycling by students are given in Figure 5.

3.4 Findings of Science Students' Awareness on Plastic Bag Usage

Students' written explanations and drawings in the prepared scientific newspapers about plastic bag usage are analyzed and given in Table 5.

In Table 5, it is seen that explanations and drawings in the prepared scientific newspapers about plastic bag usage mainly were concentrated on the effect on life and natural resources.

Some students drew attention to situations that were not appropriate for the category of individual responsibility with the expressions such as the insensitivity of people (S_4), people buying insistently (S_2), reaction to the increase in the plastic bag price (S_8), unnecessary grouching of lazy people about environmental problems (S_8). On the other hand, some students emphasized the widespread of plastic bags usage with their negative expressions, such as its use is increasing day by day (S_8, S_{11}), rising in usage with the

Table 5 Written explanations and drawings in the prepared scientific newspapers about plastic bag usage by students

Category	Codes	f
Waste bin	Unspecified waste type	1
Symbols highlighting waste management	Recycling symbol	1
Sustainable consumption behavior	Throwing wastes into the recycling bins	1
	Protecting the living space	1
Individual responsibility	Insensitivity of people*	1
	Buying plastic bags by people insistently*	1
	Reaction to the price hike on the plastic bag*	1
	Unnecessary grouching despite irresponsibility*	1
Educational activities	Getting information from the news	1
	Unconsciousness of public*	1
Research activities	Doing research of university students	1
Effect on life and natural resources	Staying long in nature*	7
	Harming to the environment*	4
	Harming to the living things*	3
	Causing visual pollution*	1
	Reduction of natural habitat*	1
	Increasing in waters turning into swamp*	1
	Causing global warming*	1
	Causing the extinction of the Caretta Caretta*	1
	An increasing number of fish striking the shore*	1
	Being affected humanity by the harm to nature*	1
Widespread effect	Increasing in usage day by day*	2
	Increasing in usage with the increase in shopping*	1
	Being everywhere*	1
	Quickly covering the world*	1
Preferred reason	Easy to use	1
	Economic	1
	Needed in daily life	1
Deterrent practices and effects	Decreasing in plastic bag usage with pricing	4
	Pricing	3
	Raising awareness of people with pricing	1
	Cloth bag or string shopping bag usage with pricing	1
	Tendency to cloth bag usage with pricing	1
Solution offers	Preferring cardboard/cloth ones	3
	Disuse	2
	Plastic bag usage can be destroyed in nature	1
	Making and using our own string shopping bag	1
	The usefulness of string shopping bag usage	1

**negative*

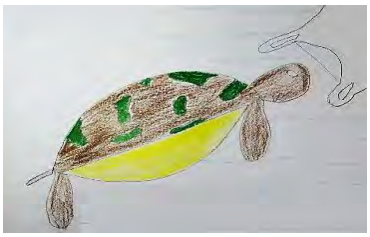
increase in shopping (S_5), being everywhere (S_8), quickly covering the world (S_1). One student (S_2) established a relationship between the unconsciousness of public and educational activities.

Seven students (S_1, S_2, S_3, S_4, S_5, S_{10}, S_{11}) stayed long, three students (S_3, S_4, S_8) harming to the environment, and some students caused environmental pollution (S_8), causing visual pollution (S_1), decreasing in natural habitats (S_1), increasing in water turning into a swamp (S_1) and causing global warming (S_8). In addition, some students mentioned the negative effects of plastic bag usage on life. For example, three students (S_1, S_2, S_{11}) harm the living things, some of the students cause the extinction of Caretta Caretta (S_9), increasing in the fish that hit the shore (S_1), and humanity will see the harm to nature (S_5). In addition, it was observed that a student (S_7) did not prepare a scientific newspaper page about plastic bag usage.

Some examples of students' written explanations are given below.

S_1: Giving harm to the world through plastic bag usage

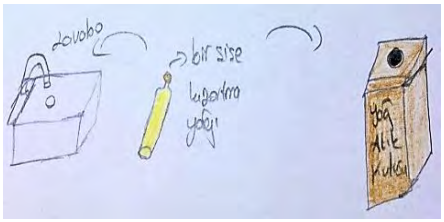
S_3: Comparison of the future that awaits individuals using cloth bag and plastic bag



S_9: The danger of Caretta Caretta's extinction with the threw plastic bags into the water

Figure 6 Some examples of drawings in the prepared scientific newspapers about plastic bag usage by students

S_2: Separating and disposing of wastes according to their type and obtaining food and drink in return



S_3: Pouring waste oil into the waste oil box instead of pouring it into the sink

S_4: Preventing bread wastage

Figure 7 Some examples of drawings in the prepared scientific newspapers about zero waste by students

"Plastic bag case! Another blow to the decreasing natural habitat comes from plastic bags daily. Plastic bags are killing! According to the information obtained as a result of long research, plastic bags, which can be destroyed in nature in close to a thousand years, cause visual pollution and threaten the lives of many living things. The fish that hit the shore and the waters that turned into swamps increased to a level frightening. Most of us turn to plastic bags saying that they are easy to use and economical. But this false glare should not mislead us. If every person in the world uses one plastic bag a day and leaves it to nature, we will have difficulty finding a space to breathe daily. The behind of false glare is dark. Let's protect our world, our living space. No to false glare." (S_1)

"Plastic bags or every plastic item are materials that take a very long time to disappear. It has much harm to the environment. Plastic bags do not disappear. It is awful that people are insensitive to this situation while it takes more than centuries for a plastic bag to disappear. The pricing of plastic bags raises people's awareness of this situation." (S_4)

"One of the reasons for the extinction of Caretta Caretta is plastic bag usage. We can prevent such problems by increasing cloth bag usage instead of plastic bag." (S_9)

Some examples of drawings in the prepared scientific newspapers about plastic bag usage by students are given in Figure 6.

3.5 Findings of Science Students' Awareness on Zero Waste

Students' written explanations and drawings in the prepared scientific newspapers about zero waste are analyzed and given in Table 6.

In Table 6, it is seen that explanations and drawings in the prepared scientific newspapers on zero waste are concentrated educational activities and the effect on life and natural resources.

One student (S_5) drew attention to a situation that would not be appropriate for sustainable consumption behavior. The expressions were taking more bread than needed and throwing the bread into the trash. The same student (S_5) described a negative approach to individual responsibility with the word as people who have good living conditions do not know the value of what they have. Some students also gave negative expressions such as harming nature by pouring waste oil into the sink (S_3), the formation of a new continent from the accumulated trash in the world (S_5), and the starvation to death of people who cannot find bread (S_5). One student (S_{11}) stated that zero waste practices are not common today. Also, a student (S_6) did not prepare a scientific newspaper page about zero waste.

Some examples of students' written explanations are given below.

"She read that some cities had started a zero waste project on the internet. Instead of pouring oils into sinks and harming nature, they collected and recycled them with a zero waste project. Thanks to this project, water pollution, and many pollutions did not occur. This means that nature is cleaner. Nice thing. Pure nature means a clean future." (S_3)

Table 6 Written explanations and drawings in the prepared scientific newspapers about zero waste by students

Category	Codes	f
Resource type	Water bottles	1
	Waste oil	1
	Paper, plastic, glass	1
	Household wastes, plastic, glass	1
Waste bin	Waste oil	1
	Household wastes, plastic, glass	1
	Paper, plastic, glass	1
	Paper, plastic, glass, metal	1
Sustainable consumption behavior	Respect the bread	1
	Don't waste bread	1
	Prevention of wasting in the country	1
	Buying more bread than you need*	1
	Throwing the bread into the trash*	1
Individual responsibility	Coming up with a solution by people	1
	Good individual contribution	1
	People with good living conditions do not know the value*	1
Educational activities	Raising people's awareness on waste reduction	1
	Demonstrate waste reduction in practice	1
	Planning major activities	1
	Informing people about zero waste	1
	Raising awareness of people about zero waste	1
	Talking about the zero waste issue everywhere	1
	Seeing a slogan about zero waste on social media	1
	Get information about the cities where the zero waste project was initiated from the website	1
	Inspirational news for people	1
Project activities	Collecting household wastes in waste pipes in homes	1
	Recycling bins in dormitories (paper, glass, plastic, metal)	1
	Recycling of waste oil	1
Effect on life and natural resources	Preventing water and environmental pollution	4
	Approaching the possibility of a world without waste	1
	Harming to the environment by pouring waste oil into the sink*	1
	The formation of a new continent from the accumulated trash in the world *	1
	The starvation to death of people who cannot find bread*	1
Economic development	Building a school - The economic value of trashed bread	1
	Building a school - Income from recovery water bottles	1
	Energy-saving - Recycling of household wastes	1
Separating wastes and encourage	Machine separating wastes according to their types (paper, plastic, glass)	1
	Machine giving food and drink in exchange for waste	1
Widespread effect	Not being common zero waste practices today*	1

**negative*

"A new continent has emerged from the trash in the world. Lots of people are starving. S/he cannot find food or bread. Although our situations and living conditions are so good, we do not know the value of what we have. We buy more bread than we can eat. We throw out the rest. Do you think it's a beautiful thing? According to the research, 100.000 new schools can be built with the bread thrown into the trash in our country... Bread in Africa. Again, bread was the last word of a child before s/he died. We lost an angel of hunger again. How are we going to account for this? Please don't be indifferent, don't throw!" (S_5)

"No waste will pollute our world anymore. Big steps are planned to be taken about zero waste in the coming days. A neighborhood headman in Turkey informed the whole neighborhood about zero waste. In my opinion, zero waste is one of the best things we can do. I also think that everyone should be conscious about zero waste, and zero waste should be explained everywhere in the streets and buses." (S_{11})

Some examples of drawings in the prepared scientific newspapers about zero waste by students are given in Figure 7.

Table 7 Unscientific explanations, drawings, and reasons for not being scientifically appropriate in scientific newspapers

	Unscientific explanations and drawings	Reasons for not being scientifically appropriate
Recovery	Recovering the person who quit smoking back to life (S_3)	Establishing a relationship between recovery from smoking and human life
	A happy life awaits people who quit smoking (S_3)	
	Reinforcing the learned information not to forget (S_7)	Establishing a relationship between recovery and ensuring the permanence of the learned information
Reuse	Obtaining new and clean pages from used school books in paper mills (S_7)	Being a practice within the scope of recycling
	Obtaining fertilizers from organic wastes (S_9)	Being a practice within the scope of composting
	Throwing the caps and labels of pet bottles into separate containers (S_{11})	Being a practice within the scope of recycling
Recycling	Throwing wastes into the same trash bucket (S_7)	It is necessary to separate the wastes according to their types and throw them into the appropriate recycling bin
	Putting trash buckets in every neighborhood (S_8)	It is necessary not to throw waste into the trash buckets for recycling
	Collecting household wastes in trash buckets (S_8)	Since it is possible to recycle household wastes, it is necessary not to be thrown them into the trash buckets
	Opening shops producing from wastes in the neighborhoods (S_8)	Being a practice within the scope of reuse
Plastic bag usage	Being too lazy to throw it into the trash, the plastic bags next to the trash bin (S_8)	It is necessary to throw the plastic bags into the recycling bin
Zero waste	Putting the waste collected separately in household, plastic, and glass waste bins into the same machine for recycling (S_8)	It is necessary that the waste collected separately in household, plastic, and glass waste bins are put into separate recycling machines in accordance with their types.
	Throwing trashes on the grounds instead of trash buckets (S_8)	It was expressed as trash, whereas it should be expressed as waste. It was expressed as a trash bucket, whereas it should be expressed as a recycle bin.
	Finding a solution to the disposal of trash on the ground (S_8)	It was expressed as trash, whereas it should be expressed as waste.
	Trash types: Food leftovers, glass bottles, underused clothes, etc. (S_8)	Expressing the recyclable and reusable waste types as trash types

Unscientific explanations, drawings, and reasons for not being scientifically appropriate in the prepared scientific newspapers by students are given in Table 7.

4. DISCUSSION

In the research, eight students prepared scientific newspapers about waste management (recovery, reuse, recycling, plastic bag usage, and zero waste). However, S_1 did not prepare a scientific newspaper page about recovery and reuse; S_6 did not prepare a scientific page about recovery and zero waste; S_7 did not prepare a scientific newspaper page about plastic bag usage.

As a result of the research, it was understood that a significant part of the students was aware of the effects of education, research, and project activities on recovery, reuse, recycling, plastic bag usage, and zero waste practices within the scope of waste management, and the place and importance of the individual in waste management. On the other hand, it was understood that most of the students were not aware of waste types that are the basis of waste management practices, the separation of wastes at the source in accordance to their types, and throwing the wastes into the appropriate waste bin for their types. Similarly, it was determined that university students had recycling awareness in specific areas. Still, they did not have recycling awareness in many places, and they performed recycling at a minimum level in practice (Ak & Genç, 2018). Furthermore, Harman, Aksan & Çelikler (2015) determined that first-year science students' mental recycling models were limited. On the other hand, Aksan, Çelikler & Yenikalaycı (2019) determined that first-year science students' awareness on recycling was high. In this

direction, they stated that individuals with heightened awareness of recycling would be more likely to show recycling behavior. Similarly, Pamuk & Kahriman-Pamuk (2019) determined that pre-service teachers' recycling intentions and behaviors differ according to the recycling opportunities on the campus where they study and, the place where they lived as children, and they currently live.

The basis of waste management practices is waste types, separation of wastes at the source according to their types, and throwing the wastes into the appropriate waste bin for their classes. On the other hand, in this research, while a small number of the students gave limited examples for resource types that can be evaluated in recovery, reuse, recycling, and zero waste practices, a significant part of the students did not place waste types and waste bins according to waste types. When different studies that determined the limitation on waste types were examined, it was expressed that the recyclable waste types by limited as food waste, packaging, bottle, paper, cardboard, glass, plastic, organic waste, battery, and metal by pre-service science teachers (Harman & Yenikalaycı, 2020); paper, plastic, glass, solid waste, battery, PET, cardboard and PET bottles by pre-service science teachers (Harman & Çelikler, 2016), paper, plastic and glass by pre-service physics, chemistry and biology teachers (Demircioğlu, Demircioğlu & Yadigaroğlu, 2015), paper, glass, metal and organic matter by biology department students (Soran, Morgil, Yücel, Atav & Işık, 2000), plastic, returnable cans and coke bottles by biology department students (Soran et al., 2000) and secondary and university students (Yılmaz, Morgil, Aktuğ & Göbekli, 2002).

Science students stated waste types by limiting them to paper, plastic, glass, and battery in waste separation at the source, recyclable wastes, recycling bins, and recycling facilities (Harman, Aksan & Çelikler, 2015). Pre-service preschool teachers gave examples of recyclable products such as plastic, paper, battery, glass, and metal (Dinler, Simsar & Doğan, 2020). Pre-service science teachers stated that the wastes should be thrown into separate recycling containers for each litter and that the materials used in packaging production are recyclable (Harman & Çelikler, 2018). Gürer & Sakız (2018) determined that most adults who attended various courses in public education centers knew about the recycling of packaging wastes. Before the education based on the SCAMPER technique, science students stated that they would throw plastic, cardboard boxes, empty cans, glass bottles, and scrap metal into the trash bins and throw them into the recycling bin after the education (Çelikler & Harman, 2015). Before recycling awareness education, pre-service science teachers wrote examples for recyclable waste types like paper/cardboard and plastic (all); glass (almost all); battery, waste oil, metal, composite, vehicle tire (majority); electronic waste, medical waste, organic waste (small number) (Aksan & Çelikler, 2019).

It has been revealed that pre-service science teachers drew recycling bins for paper, plastic, glass, metal, and waste batteries in the garden and classroom for the school in their dreams; a small number of pre-service teachers drew a general recycling bin for all waste in the park and the classroom, and some of them drew trash buckets for waste (Harman, 2017). In addition, science students emphasized the recovery of solid wastes in the models that they prepared for the teaching of waste recovery; they did not use mixed wastes, although they used solid wastes such as paper, cardboard, plastic, textile, metal, and glass in almost all of the models. It was determined that the message of "reuse of solid materials/wastes for different purposes" was given in all models on recycling (Harman & Çelikler, 2015). Similarly, pre-service science teachers emphasized recovery in all of the models they prepared for teaching waste recovery besides recycling and reuse in half. All of the pre-service science teachers prepared models by using solid wastes. The models determined that the most commonly used plastic and paper/cardboard wastes, and they did not use metal and composite waste types (Aksan & Çelikler, 2018). In younger age groups, primary school first-grade students most commonly drew trash, including paper, plastic, glass, etc. about the concept of zero waste; some students drew recycling bins; a student drew battery collection boxes; a student drew separate recycling bins for paper, glass and plastic wastes, and a small number of students drew trash bin (Sönmez, 2020).

In the research, few students (S_2, S_6, S_9) drew attention to separating the sources' wastes. In this context, it was understood that the majority of the students were not aware of the waste types, the separation of the wastes at the source in accordance to their types, and throwing the wastes into the appropriate waste bin for their types. However, to ensure recycling, it is a vital requirement that waste management includes waste separation at the sources such as the home, market, or industry. Wastes should be separated as dry/wet or biologically degradable/non-degradable (Dharmasiri, 2019). Individual effort is required for waste separation behavior. Providing supportive conditions for waste separation in homes is crucial for individuals to participate in separation at the source. Therefore, local authorities, municipalities, and recycling organizations should facilitate the separate collection of household wastes (Arı & Yılmaz, 2019). Ampofo (2020) determined that there were no appropriate waste dumping areas, and the scraps were disposed of without separation in the high schools within the municipality.

Contrary to this result, it was determined that most university students separated household wastes (Gültekin, 2017), and most people tend to recycle at home (Almasi et al., 2019). Sayın & Yerli (2020) determined that gender, age, employment status, marital status, and education were influential in the household's environmental awareness of household waste. Liao & Li (2019) drew attention that

environmental education is necessary to ensure that high school students have the essential knowledge and positive attitudes toward separating solid wastes. An important part of pre-service preschool teachers stated that the obstacle to recycling is unconsciousness/ignorance, and the sensitivity of individuals can be increased through education (Dinler, Simsar & Doğan, 2020). Similarly, most pre-service science teachers stated that individuals do not know about recycling as the most important reason why recycling is not widespread. From this point, it has been said that as individuals understand the importance of recycling, their sensitivity to this issue increases. As a result, they use recycling bins by separating wastes and taking into account the colors of the recycling bins (Aksan & Çelikler, 2019).

On the other hand, Ak & Genç (2018) determined that half of the university students felt lazy to throw the trash into the recycling bins. In addition, more than half of the students stated that they do not separate and recycle waste because there is no legal sanction. They do not recycle because other people do it. They do not use recycling bins because there are people who separately collect wastes from the trash, and they see recycling as a waste of time. More than half of the students pointed out that they did not know about the markings on the recycling bins, and nearly half of them did not know what happened to the recyclable wastes.

Adequate waste management leads to health, environmental, economic, and social benefits. Activities related to waste management protect natural resources and create employment by providing positive social effects. Waste management includes establishing an appropriate treatment and rethinking production processes, minimizing waste generation, reuse, and recycling. Moreover, when wastes are appropriately managed, natural resources and energy consumption also decreases (Fagnani & Guimaraes, 2017). Global environmental risks show themselves in the scarcity of natural resources, climate change, water, air, soil pollution, and endangered biodiversity and wastes. Ecological problems and limited natural resources make a significant contribution to be reaffirmed the importance and role of waste management in developing countries. Information on waste and its effect on health and the environment requires systematic and diverse educational approaches (Kumar & Kumar, 2020).

There should be a constant urge to encourage and support awareness of effective waste management and sustainable environmental practices through education. Generally, a direct correlation has been found between poor waste management practices and a lack of environmental knowledge and awareness (Ampofo, 2020). In this context, within the scope of the research, a significant part of the students (S_2, S_3, S_5, S_7, S_8, S_9, S_{10}, S_{11}) revealed the effects of education, research and project activities and the consequences of these activities on recovery, reuse, recycling, plastic bag usage and zero waste practices with written explanations and drawings. In this direction, it was understood that the students were aware of education, research, and project activities in waste management and their effects. However, few students (S_2, S_6, S_{11}) included the activities of authorized institutions/organizations. So much, so that recycling awareness education increased the knowledge levels of pre-service teachers about recycling and positively affected their behaviors toward recycling (Aksan & Çelikler, 2019), and it has been determined that the education given to pre-service science teachers was effective in increasing their awareness (Aksan & Çelikler, 2020).

Furthermore, it was determined that education based on the SCAMPER technique effectively raised science students' awareness about the collection and utilization of solid wastes (Çelikler & Harman, 2015). Similarly, Akanyeti & Kazımoğlu (2019) revealed that environmental engineering students who took environmental courses had more conceptual knowledge about solid waste pollution and management. Still, the course did not positively affect students' attitudes and behaviors on issues such as throwing trash into the environment or using recycling bins. Er-Nas & Şenel-Çoruhlu (2017) emphasized that projects about the concept of sustainable development that pre-service science teachers make can increase their awareness. Ersoy-Quadır & Temiz (2017) determined that kindergarten teachers implemented environmentally-friendly activities with their students, and parents also offered environmentally friendly experiences to their children.

It is possible to develop knowledge and improve environmental practices by creating participatory and encouraging programs between families and the municipality, emphasizing the education aspect through cities (Almasi et al., 2019). Likewise, Karadağ & Acar (2020) determined that pre-service social studies teachers attending seminars, meetings, or congresses had higher awareness of environmental problems. Tosun & Demir (2018) used many activities together: creative drama techniques such as dramatization, improvisation, role-playing, multiple intelligence activities, travel-observation, game, show, music, dance, etc. in the learning-teaching process to increase the preschool children's awareness on recycling. They determined that creative drama positively affected students' features such as learning and understanding of recycling, cooperation, self-confidence, creativity, and respect for the environment and nature.

Reducing waste as much as possible by processing waste in areas close to waste sources and supporting this in terms of legal, regulatory, institutional, functional, technical, financing, and community involvement consist of integrated waste management with the 3R principle (Asteria & Haryanto, 2021). By reducing the amount of stored solid waste and waste disposal costs, saving energy and natural resources, taking into account the crucial

benefits of recycling, the knowledge and attitude of the public towards the recycling of solid waste, and the cooperation of people, and recycling programs are the first steps in the correct use of resources (Almasi et al., 2019). In the research, a significant part of the students drew attention to sustainable consumption behavior (S_1, S_2, S_3, S_4, S_5, S_6, S_7, S_8, S_{10}), individual responsibility (S_2, S_4, S_5, S_6, S_7, S_8, S_{11}), cooperation and solidarity (S_2, S_6, S_8, S_{10}, S_{11}) in recovery, reuse, recycling, plastic bag usage and zero waste practices within the scope of waste management. Also, an important part emphasized the effects of waste management on life (S_1, S_2, S_5, S_7, S_9, S_{11}) and natural resources (S_1, S_2, S_3, S_5, S_6, S_8, S_{10}, S_{11}) and its encourage and widespread effect (S_2, S_3, S_{10}, S_{11}). In this context, it was understood that the students were aware of the place and importance of the individual in waste management. Dinler, Simsar & Doğan (2020) determined that pre-service preschool teachers were sensitive and willing to recycle. However, they decided that while pre-service teachers pay more attention to recycling in the school, they pay less attention at home. Furthermore, pre-service teachers claimed that the primary purpose of recycling is to keep the environment clean, and the biggest obstacle to recycling is unconsciousness.

The primary condition for creating environmental awareness in sustainability is the effective and efficient usage of resources. Consumers are among the groups that take an active role in the consumption of these resources (Kızgın, Karaosmanoğlu, Örmeci & Taş, 2017). Ateş (2018) determined that pre-service science and social studies teachers demonstrated a sufficient level of sustainable behavior and had enough knowledge. In addition, a low level of positive correlation was determined between the sustainable consumption behaviors of individuals and their knowledge levels on sustainability. On the other hand, Şentürk (2019) found that the public was aware of the danger of e-waste, but they did not know the appropriate method to get rid of this waste. For this reason, she emphasized that informed consumers will support the recycling of electrical and electronic equipment wastes.

In the research, few students presented written explanations and drawings for the functionality of reuse (S_5, S_6) and the strengthening of natural resources (S_8, S_9). Sönmez (2020) determined that in first-grade primary school students, in the drawings about zero waste, female students mainly included the concepts of waste awareness, while male students mainly included the ideas of environmental protection. Harman & Yenikalaycı (2020) determined that pre-service science teachers' awareness of the zero waste approach was insufficient. They also found that the pre-service teachers' statements about the zero waste approach were structured based on waste management and recovery, environmental effects, savings, economy, and public awareness. Dal & Cengiz-Gökçe (2019) drew attention to the importance of integrating practices that protect raw materials and energy into life activities within the scope of the sustainability of environmental resources and the inclusion of these activities in daily life will contribute to the continuity of livable, healthy environments and landscapes.

Education is related not only to the cognitive field but also to the affective and psychomotor fields. Because, for waste management, students should pay attention to the cognitive field and behavior and skill practices (Muljaningsih & Galuh, 2018). Likewise, attitudes are related to feelings towards sustainable waste management and preconceived ideas that may lead to it (Gusti, 2016). In this context, few students presented written explanations and drawings on the effects of recovery, reuse, recycling, plastic bag usage, and zero waste practices on the emotional state of the research. In the study conducted by Bulut (2020), teachers stated that efforts to raise children's awareness of zero waste and recycling in the learning-teaching process would positively affect their social and emotional development and problem-solving skills. Karakaş & Dönel-Akgül (2020) stated that pre-service elementary school teachers with a high sense of responsibility towards the environment and respect for nature had a higher sensitivity to environmental problems.

A small number of students in their scientific newspapers wrote explanations and made drawings reflecting the evaluation of the used materials such as clothes, shoes, toys, and bags (S_2, S_6, S_8, S_{11}); prevention of water (S_4, S_5), paper/book (S_1, S_2, S_3, S_4, S_5, S_6, S_7, S_{11}) and bread wastage (S_4, S_5). Similarly, a student studying in the first grade of primary school drew a clothes collection box, and a student drew a toy collection box in social responsibility and sharing. In addition, in terms of preventing wastage, a student drew stale bread, and also, a student also emphasized giving stale bread to an animal by soaking it (Sönmez, 2020).

In the prepared scientific newspapers about the plastic bag usage by students, it was determined that most of the students focused on the effects of the plastic bag usage on life (S_1, S_2, S_5, S_9, S_{11}) and natural resources (S_1, S_2, S_3, S_4, S_5, S_8, S_{10}, S_{11}), deterrent practices for preventing the plastic bag usage and its effects (S_4, S_5, S_6, S_{10}, S_{11}). It was seen that few students were aware of this issue. Gürbüz & Yılmaz (2018) also found that awareness of the harm of plastic bags, positive attitudes toward banning plastic bags, and the malleable bag usage reduction factors was effective in the statistics department students' behavior in reducing the plastic bag usage. Besides, they stated that environmental bans could affect the intention and behavior of individuals, and individuals who favor banning plastic bags have the choice and behavior to reduce plastic bag usage.

In addition, a student (S_8) offered a solution for plastic bag usage, with the statement that everyone should make and use their string shopping bag. Similarly, in the study

conducted by Naria, Nasution & Santi (2018), students produced shopping bags from unused t-shirts.

CONCLUSION

To sum up, in the research, it became clear that a significant proportion of students were aware of the impact of education, research, and project activities on recovery, reuse, recycling, plastic bag usage, and zero waste practices within waste management, and the place and importance of humans in waste management. Unlike that, it was understood that most of the students were unaware of the basics of waste management practices such as waste types, segregating waste at the source according to type, and throwing trash into an appropriate waste bin for their type. In addition, in the research, it was concluded that the use of scientific newspapers could be an effective tool for measuring student awareness.

RECOMMENDATIONS

In line with the results obtained within the scope of the research, the following recommendations were made.

- Instead of providing superficial information on waste management in environmental education courses at different education levels, courses that provide detailed information on waste management in preschool, primary, secondary and high school could be added to the curriculum. Furthermore, scientific newspapers could be disseminated to raise awareness on waste management in addition to the curriculum.
- In order to ensure students with the opportunity to learn by doing waste management, the number of pilot schools in preschool, primary school, secondary school, and high school could be increased, and students could be supported to take part in projects more frequently.

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