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Reflections of Local Learning Environments on Secondary School Students: The Wastewater Treatment Plant+

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ABSTRACT The purpose of the current study is to reveal the reflections of the Köyceğiz Wastewater Treatment Plant (WTP) field trip planned within the context of the unit "Domestic Waste and Recycling" and the activities carried out concerning this trip on middle school students in Turkey. This research was conducted based on the semi-mixed method using a single-group pretest-posttest quasi-experimental design. The quantified data were collected using open-ended questions about domestic waste and recycling, while the qualitative data were collected through semi-structured interviews. Twenty-seven middle school students (17 females, 10 males) participated in the study selected by convenience sampling method. According to the study's quantitative findings, the field trip to the wastewater treatment plant made the students realize the wastes produced at home, recyclable materials, the importance of recycling, and the contributions of wastewater treatment plants to the country's economy and nature. On the other hand, the quantitative findings indicate that this trip helped the students develop more eco-centric behaviors (Protection of biodiversity, Protection of nature, and Protection of resources, etc.). Moreover, the contributions made by the field trip structured within environmental education to the students could be gathered under the following headings: sustainability, personal, and cognitive.

Keywords Environmental education, local environment, wastewater treatment plant, outdoor school learning environments, informal learning.

1. INTRODUCTION

While the world has the potential to quickly meet the basic needs of the people living on it (food, drink, etc.), it is not capable of meeting all the desires and ambitions of human beings forever because the endless ambitions and desires of human beings cause an excessive burden on nature, causing the natural resources of future generations to be exhausted completely (Gül, 2013). With the United Nations Conference on the Human Environment held in Stockholm in 1972, countries came to a consensus on the solution to the problem. Thus, "environmental education" started taking shape (United Nations Conference on the Human Environment, 1972). Environmental education at school aims to foster the knowledge, skills, and awareness of individuals about the environment and environmental problems, to ensure that students are sensitive to natural, historical, and cultural values by developing their environmental awareness, and to develop students' responsibility for voluntary participation in the solutions to environmental problems (Fraser, Gupta & Krasny, 2015; US EPA, 1990). Environmental education occurs theoretically in the classroom and through activities carried out in various environments outside the school. However, the existing research has shown that environmental education taking place in outdoor school environments gives more successful results than the other because environmental education conducted in outdoor school environments is seen as one of the most critical learning tools of our age, as it increases the interaction of students with nature and improves their learning by allowing them to gain skills such as research, exploration, observation and interpretation (Dieser & Bogner, 2016). Arnold, Cohen & Warner (2009) remarked that children's being in a natural environment is important not only for having fun and having a good time, but also for the development of empathy skills. On the other hand, it has been revealed in

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the literature that environmental education using outdoor school learning environments makes significant contributions to the education of science literate individuals by improving students' awareness and knowledge of the region where they live, interest in science, science career planning, and social life skills (Fu & Liu, 2017; Sennes, Gombert-Courvoisier, Ribeyre & Felonneau, 2012). Dieser & Bogner (2016) conducted a study on the participation of primary school students in an outdoor school environment based on activities with the theme of conversation of species and characteristics of an ecological forest. They observed essential developments in the students' knowledge and feelings about various environmental issues. These learning environments enable students to recognize problems more efficiently, offer solutions, and make effective decisions by involving them in the learning environment more effectively (Pan & Hsu, 2020), leading to students' attainment of real-life experiences.

A good example of this is the Koh Yao Noi Project in Thailand; the project aims to prepare citizens for real life using environmental and skill education suitable for the marine culture of the region (Walter, 2009). Moreover, Scribner-MacLean & Kennedy (2007) and Kisiel (2006) stated that field trips have positive effects, such as attracting students' interest in science and increasing their knowledge and motivation by offering formal and informal learning environments. Cwikla, Lasalle & Wilner (2009) stated that the inclusion of 8th-grade students interested in science into outdoor school learning environments aroused ambition and desire in students to have a career in science. Thus, it can be said that environmental education through field trips can be inspiring and stimulating for students. In addition, out-of-class learning environments improve students' social relations with each other, increase the retention of the learned information and contribute to understanding the logic behind the information (Larsen, Walsh & Myers, 2017).

In the relevant literature, it has been reported that outdoor school learning environments contribute not only to the development of students' affective characteristics, such as interest in science, career planning, and empathy towards the local environment, but also to developing their cognitive skills. For example, Finn, Yan & McİnnIs (2018) carried out outdoor science and physical activities under science and mathematics education, healthy living, environmental education, and teamwork in an outdoor learning environment with students every morning for five weeks. The results showed that outdoor school learning environments improved students' learning of science concepts and scientific inquiry skills. Rios & Brewer (2014) explained this by stating that when students are provided with learning environments that offer them learning opportunities outside the classroom, they show more commitment to and participation in lessons, which is reflected in their academic achievement. On the other hand, it is noted that the relationship between schooling and local environmental knowledge is either low or negative (Reyes-Garcia et. al, 2010; Quinlan & Quinlan, 2007). In other words, school and school-related activities do not contribute positively to individuals' local environmental knowledge.

When the literature is reviewed, it is seen that the benefits of environmental education outside the school for students can be listed as observing and exploring nature, developing empathy skills by establishing an emotional bond with nature, raising awareness of the local environment, increasing interest in and motivation towards science, and consequently increasing academic achievement. In addition, it can be said that it contributes to the development of scientific and hands-on experience and the shaping of a professional career in science.

1.1. Local Knowledge for Environmental Education

It is stated that student-centered, innovative approaches based on learning through field observations and learning by doing and experiencing should be adopted during environmental education (Amahmid, Guamri, Yazidi, Razoki, Rassou, Rakibi Knini & Ouardi, 2019). These approaches it is aimed at more conscious training individuals (Sennes, Gombert-Courvoisier, Ribeyre & Felonneau, 2012), able to establish links with the place they live (Fisman, 2005) and develop positive behaviors towards the environment (Teksoz & Sahin, 2012) because of the way individuals live their lives has a positive or negative effect on the environment they live in. This means individuals have some, albeit limited, control over the environment (Sennes, Gombert-Courvoisier, Ribeyre & Felonneau, 2012). Because it is believed that water and water management, seen as an essential socio-scientific issue today, needs technical and regulatory measures and behavioral support in society and can only be overcome in this way (WWAP, 2012), on the other hand, it is stated that the local environment should be taught in environmental education so that individuals can develop empathy and behavior (Fisman, 2005). Amahmid et al. (2019) stated that field trips in their local environment are the best way to improve the relationship between children and the natural world. In this way, children's awareness of their local environment will be increased by gaining information about their environment. In the literature, various instructional designs or theories have been developed to help individuals learn about the environment in which they live. One of these is "local environment learning" (Jose, Patrick & Moseley, 2017), which is based on the principle of decreasing the time spent inactively by students and providing them with opportunities to get to know their local environment through activities motivating for students to learn about environmental issues. Another approach, "residential outdoor environmental education" by Mullenbach, Andrejewski & Mowen (2019), on the

other hand, includes activities spanning more than one day based on discovering nature in the local area and establishing organic connections with it. Walter (2009), on the other hand, aims to educate individuals on the island of Koh Yao Noi, located in the south of Thailand, where the economy, food, and tourism sectors are based on sea and seafood, through environmental education by the region's culture. The Koh Yao Noi Project education program consists of different sections, including aquaculture, wild fisheries, oceanography, culture, and agriculture. From this point of view, the education required for the region's people to know where they live and to act more consciously can be given outside the school based on local knowledge (Fisman, 2005; Sennes, Gombert-Courvoisier, Ribeyre & Felonneau, 2012).

When the relevant literature is reviewed, it is seen that museums (Tenenbaum, To & Wormald, 2015), space centers (Sören & Frède, 2016), science-arts centers (Friedman & Worden, 2016), energy parks (Bozdoğan, 2016), national parks (Çetin, 2014; Whitesell, 2016), factories, botanical and animal gardens (Mazor, 2011; Scott & Matthews, 2011) have been used as outdoor school learning environments. These environments can be seen as real-life reflections of theoretical contents such as earth science, physics, astronomy, chemical industry, and biodiversity, as seen in the school environment. Thus, individuals can see the equivalent of the theoretical information they have acquired in formal education outside the school and in the right place.

It is thought that it would be appropriate to emphasize the issues of domestic waste, recycling, and water conservation within the scope of outdoor school learning environments in environmental education because water scarcity is seen as a global problem facing our age (Amahmid et al., 2019; Fu & Liu, 2017). When the relevant studies are examined, it is seen that the number of studies, including field trips to WTP, is minimal, and these few studies have been conducted at university level and mainly with the participation of students from chemistry departments of universities (Forest & Rayne, 2009). In this context, it is considered that environmental education in a WTP, which is one of the important steps of recycling in the immediate environment, should be included in applications of environmental education starting from lower grades and in different outdoor school learning environments.

1.2. Wastewater Treatment Plants as a Place for Field Trips

Water is an indispensable resource for the continuation of human life and for meeting human needs. In this respect, humans take care of the resources they need to survive. Increasing water demand and misuse of water in recent years have also accelerated the decrease of water resources and the increase in wastewater (Meneses, Pasqualino & Castells, 2010; Polat, 2012). For this reason, it is aimed to eliminate water problems to some extent by making the wastewater emerging after agricultural, industrial, and domestic uses reusable (Aküzüm, Çakmak & Gökalp, 2010) because water scarcity is seen as a global problem facing our age (Amahmid et al. 2019; Fu & Liu, 2017).

In places where humans live, water is removed through sewage as wastewater after being used. Since waste waters contain pathogenic microorganisms such as bacteria, protozoa, viruses, and dissolved/non-dissolved organic and inorganic substances, their appearance may be different, and their odor may be disturbing. For this reason, its direct release to nature may cause irreversible adverse effects such as eutrophication on the environment (Mainstone & Parr, 2002; Minareci, Öztürk & Minareci, 2004).

Wastewater treatment plants are units where the harmful effects of wastewater generated due to different uses are minimized or where these waters are converted into reusable water. In this respect, a WTP prevents the pollution of rivers, lakes, and ground waters and constitutes the water source required for city cleaning, construction, agricultural irrigation, and firefighting (Meneses et al., 2010; Polat, 2012). The Köyceğiz Wastewater Treatment Plant is an important facility in terms of its location because Köyceğiz is a county located within the borders of the province of Mugla in the southwest of Turkey. The region is in an essential position regarding biodiversity and agricultural and greenhouse production due to its mild climate and rich ground/surface waters. Agricultural chemicals containing nitrate and phosphate are frequently used in the region, especially in greenhouse production (Ayrancı, 2011). In addition, having a high annual rainfall regime may make it more possible for these chemicals to penetrate the water ecosystem through rainwater drainage. This may threaten many valuable endemic species of the region, such as the Anatolian Liquidambar orientalis, by bringing about factors that cause eutrophication (Republic of Turkey Ministry of Agriculture and Forestry, 2007: 60-65). Therefore, a WTP in the region is of great importance.

The consciousness of the fact that water, which is of vital importance for life, can be recycled through WTP should be raised in individuals from a young age because the recycling and reuse of water is vital to prevent water scarcity from being experienced in the future to some extent (Fu & Liu, 2017). On the other hand, it has been revealed that individuals have prejudices and negative perceptions about recycled water (Chen, 2015) and that these waters are unusable and unsafe (Rozin, 2015). In this context, it is thought that it is essential for wastewater treatment plants to be involved in environmental education so that individuals have correct knowledge about water recycling and can eliminate their prejudices about recycled water.

The Ministry of National Education in Turkey included various WTP and wastewater treatment objectives in the

2018 science curriculum developed for middle school students (MoNE, 2018). Some of these objectives are as follows; "Distinguishes the domestic waste that can be recycled from the domestic waste that cannot be recycled", and "Thinks about the ways of recycling for the effective use of resources". Considering these objectives, a thematic field trip was planned in the current study.

In a wastewater treatment plant-themed field trip, students can make meaningful connections between science, technology, society, and environment because, with such facilities, students can have the opportunity to observe on-site scientific and technological methods such as decomposition of wastewater and treatment with aerobic and anaerobic digestion and to understand that the plant contributes to the protection of the ecosystem in the region by seeing the difference between the water entering and leaving the facility. Two different social contributions of the Köyceğiz WTP can be mentioned. One can be shown as the irrigation of citrus orchards grown in the agricultural areas around the plant, and the other as the preservation of the Köyceğiz Lake ecosystem, which serves people socially and professionally for a more extended period. The on-site observation of a facility that makes such a multi-faceted contribution to the local environment can be transformed into a beneficial learning experience to raise awareness of sustainable development in students. In this context, although it is thought that field trips to WTP will have many positive effects on students' cognitive, affective, and behavioral development, there are no studies in which field trips are conducted at the secondary school level in the literature. In this respect, the current study is believed to shed light on issues such as how WTP can be used for field trips, what can be encountered in the process, and what may be needed for future research. Considering both the lack of studies on WTP and the emphasis on the subject in the science curriculum, it is hoped that the current study will contribute to the literature. The current study aims to determine the effects of the field trip to the Köyceğiz WTP planned within the context of the unit "Domestic Waste and Recycling" and the accompanying activities on 7th-grade students' environmental knowledge and learning about the subject of "Domestic Waste and Recycling" and to reveal the students' opinions about the field trip. To this end, answers to the following research questions were sought:

1. Is the Koycegiz Wastewater Treatment Plant field trip effective on the students' "Domestic Waste and Recycling" acquisitions?
2. What are the students' opinions about the field trip to the Köyceğiz Wastewater Treatment Plant?

2. METHOD

2.1. Research model

This current study was conducted by using the semi-mixed method. Semi-mixed designs are designs in which two types of data (quantitative and qualitative) are collected. Still, the connection between these two types of data is little or no in presenting the findings and interpretations (Teddlie & Tashakkori, 2009). In the current study, the quantified data were collected using open-ended questions about domestic waste and recycling, while the qualitative data were collected through the semi-

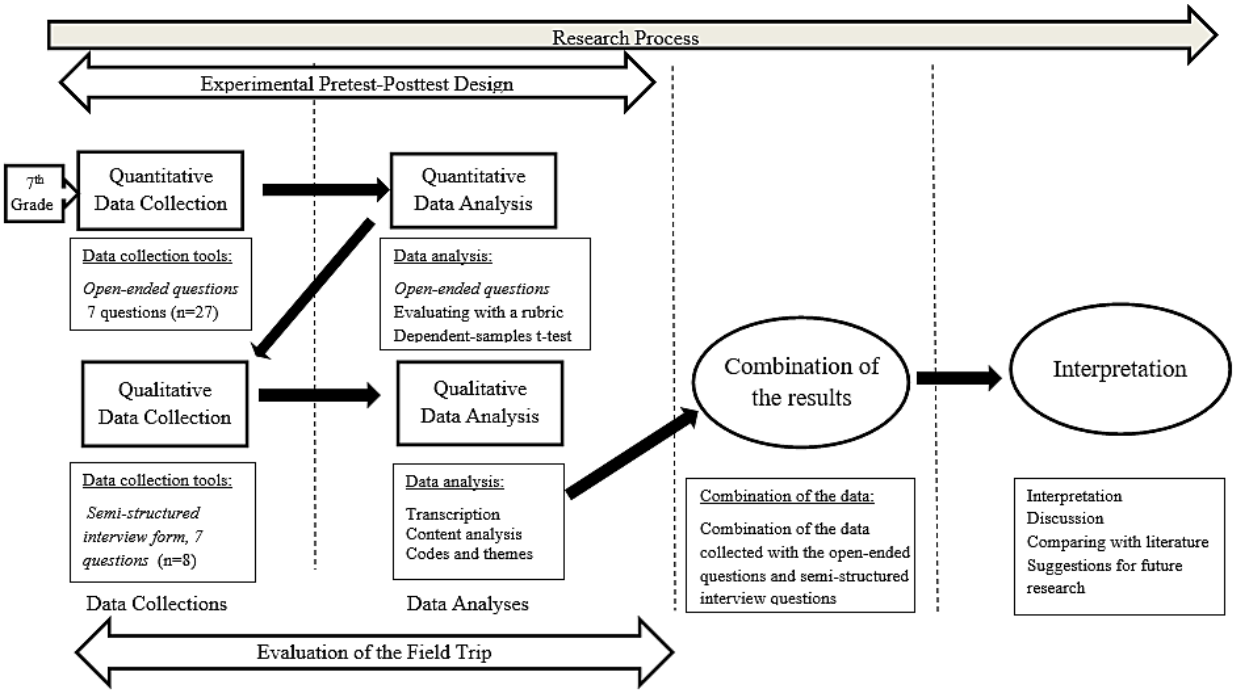

Figure 1 Resecarch design

structured interview technique. The research design of the current study is given in Figure 1.

2.2. Study Group

A total of 27 (17 females, 10 males) seventh-grade students, selecting the convenience sampling method, attending a middle school in the city of Muğla in Turkey, were selected as the study group. The students were informed about the field trip, and the parents' consent was obtained with the help of the school administration.

2.3. Data Collection Tools

Open-ended Questions

A total of 7 open-ended questions were developed to reveal students' opinions about Domestic Waste and Recycling. The open-ended questions asked to the students were formed in line with the views of three experts in the field of science and a science teacher with 12 years of teaching experience and doing a Ph.D. within the context of content validity. The open-ended questions were designed to reveal whether the students know what the wastes produced at their homes are, whether they know the ways of producing less waste, whether they know which materials can be recycled, and what they know about the contributions of WTP to the country and nature. The qualitative findings obtained through the open-ended questions were quantified based on a rubric assigning scores to the student's responses varying between 0 and 3. Thus, qualitative data was quantified. Intercoder consistency was checked to establish the reliability of the quantification operation.

2.4. Semi-structured Interview Form

In the qualitative dimension of the current study, a semi-structured form consisting of 7 open-ended questions was developed to understand what the 7th-grade students think about the field trip to the Köyceğiz WTP and the accompanying activities. These questions aimed to reveal the students' opinions about the field trip in more detail. Before the interviews with the students, the interview form was piloted on 2 students to check the comprehensibility of the interview questions and determine the approximate time to be allocated to an interview. With the students' consent, the interviews were tape-recorded. Then the interviews lasting for 20 minutes on average were conducted with 8 students who were selected on the basis of the scientificity of their responses to the open-ended questions (2 students giving highly scientific responses, 2 students giving poorly scientific responses and 4 students giving moderately scientific responses).

2.5. Procedure

In order to conduct the field trip with the theme of "Koycegiz WTP and Recycling" with the 7th-grade students in a planned and programmed manner, the field trip was planned to consist of three stages: before the trip, during the trip, and after the trip (DeWitt & Osborne, 2007).

Before the Field Trip

Before the field trip, the researchers made preliminary preparations by visiting the Koycegiz WTP. In addition, information was received from the concerned authorities in the plant to determine the current state of the plant, how it could be related to science, and the connection of this field trip with domestic waste and recycling. These preliminary preparations were vital for the good structuring of the field trip so that the trip's objectives could be achieved. A week before the field trip, the open-ended questions were administered to the students as a pretest. Then, the students were informed about the Koycegiz WTP and the activities to be conducted within the context of this field trip.

During the Field Trip

The field trip stage was carried out in four phases. In the first phase, the students were introduced to the facility in the command center; in the second phase, the students traveled around that facility; in the third stage, the related activities were conducted, and in the last phase, a discussion environment was created to make a general evaluation of the trip.

The students were gathered in the facility command center in the first phase. Here, the students were informed about the aim of the plant, the establishment process of the plant, the importance of the plant, and the contributions of the plant to Koycegiz and Koycegiz Lake by the facility officer. The facility officer explained in the command center that wastewater treatment plants ensure that wastewater is released to nature in a way that does not harm nature. He also mentioned that the valuable underground waters of Koycegiz district were polluted before the plant was activated, that significant pollution occurred in Koycegiz Lake that partial eutrophication occurred in some parts of the lake, and that, therefore, living organisms were exposed to various threats or even died.

In the second phase, after leaving the command center, the group went to where the mechanical treatment, the first stage of wastewater treatment, takes place. The facility officer explained that the large particles mixed into the wastewater from the city were mechanically treated at this point. The water purified from large particles is transferred to the 4 meter-high pools, the second stage of the treatment. This is the point where the chemical treatment starts. The facility officer stated that at this stage, the goal is to remove the oils or nutrients in the wastewater using microorganisms. Special importance was attached to breaking up the oil; removing it from the water was the most challenging treatment process. Thus, the student was drawn to why waste oil should not be poured into the sink. The water carried to the third stage is kept for a certain period. The particulate matter is precipitated in this process, and clear water is collected at the top. The sediment accumulated in the bottom layer is carried to the

last stage for drying. In the last stage, the water cleaned on the upper surface is discharged to Koycegiz Lake.

In the third phase, the students, in groups of 3 and 4, conducted "Filtration of Dirty Water, Recycling of Paper, Design from Recycled Materials" in the park, some of which were built with recycled materials near the plant. In the activity "Filtration of Dirty Water", students were guided to establish a mechanism for filtration by using plastic bottles, soil, large and small pebbles, coal, and cotton through the instructions. Then, the filtration of the dirty water was observed. In the activity "Recycling of Paper", the used newspaper papers were kept in water for a while and kneaded into pulp. Then, the pulp was shaped and left to dry. In the activity "Design from Recycled Materials", the students were asked to transform household wastes from their homes into a design they could use in their daily lives. The students were expected to use their creativity in this activity, so no restriction was imposed.

Following the activities conducted in the fourth phase, the students were allowed to walk around the park, some of which were built with 100% recycled materials. In addition, the red Californian worms (Eisenia foetida) raised by the researcher were introduced to the students, and discussions were made about their contribution to recycling by producing fertilizers from the domestic wastes they consume. Finally, a discussion environment was created to allow the students to make a general evaluation of the trip.

After the Field Trip

The open-ended questions were administered to the students as a posttest nearly ten days after the field trip. Moreover, interviews lasting for 20 minutes on average were conducted with 8 students within two days, 4 students each day.

2.6. Data Analysis

The collected data was analyzed using the SPSS 24 program package. The upper limit of the margin of error in the interpretation of the analysis results was accepted as 0.05. A rubric was prepared for the content analysis of the student's responses to the open-ended questions. This rubric was developed by seeking the opinions of two field experts involved in the research process. The content analysis was carried out by two experts, one of whom was the researcher of the current study. According to this rubric, each question is evaluated with values between 0 and 3 depending on the answers given by the students. The total score of 7 questions gives an idea of the student's knowledge of the wastewater treatment plant. The correlation between the scores the two experts gave for the same question was calculated using the correlation analysis to check the consistency between the coders (Table 1).

It can be said that the results of the content analyses made by a field expert other than the researcher and the researcher adhering to the rubrics are consistent and compatible. In cases where the evaluations did not agree, the relevant answers were determined by consensus after the joint evaluation of the researcher and the other field experts. The normality analysis was conducted on the final quantified data. Normality analysis was tested using the

Table 1 Correlation analysis emerging as a result of the evaluation of the open-ended questions by two different researchers

				Researcher (Expert 1)													
				*Q1		Q2		Q3		Q4		Q 5		Q6a		Q6b	
				p	Sig	p	Sig	p	Sig	p	Sig	p	Sig	p	Sig	p	Sig
Pretest	**Expert 2**	Q1	p	**,87***													
			Sig.		**,00**												
		Q2	p			**,85***											
			Sig.				**,00**										
		Q3	p					**,87***									
			Sig.						**,00**								
		Q4	p							**,71***							
			Sig.								**,00**						
		Q5	p									**,74***					
			Sig.										**,00**				
		Q6a	p											**,82***			
			Sig.												**,00**		
		Q6b	p													**,75***	
			Sig.														**,00**
			Sig.												**,03**		
		Q6b	p													**,60***	
			Sig.														**,00**

*Question: Q

Table 1 Correlation analysis emerging as a result of the evaluation of the open-ended questions by two different researchers (*Continued*)

				Researcher (Expert 1)													
				*Q1		Q2		Q3		Q4		Q 5		Q6a		Q6b	
				p	Sig	p	Sig	p	Sig	p	Sig	p	Sig	p	Sig	p	Sig
Posttest	Expert 2	Q1	p	**,87***													
			Sig.		**,00**												
		Q2	p			**,82***											
			Sig.				**,00**										
		Q3	p					**,93***									
			Sig.						**,00**								
		Q4	p							**,82***							
			Sig.								**,00**						
		Q5	p									**,55***					
			Sig.										**,00**				
		Q6a	p											**,43***			
			Sig.												**,03**		
		Q6b	p													**,60***	
			Sig.														**,00**

*Question: Q

Shapiro-Wilks test since 27 students participated in the research. According to the analysis, the Shapiro-Wilks test result was 0.28 for the pretest and 0.22 for the posttest. Thus, it was assumed that the data was distributed normally, and parametric statistical methods were used in the study. A dependent samples t-test was used to compare the groups' pretest and posttest mean scores in this connection.

The audio recordings of each interview with the students were transcribed by a person independent of the researcher. The transcribed statements were categorized into themes based on the students' responses. To establish the reliability of the coding, the pretest and posttest responses of 8 students randomly selected from the sample group were coded again nearly one year after the first coding, and the consistency between the first coding and second coding was calculated as proposed by Miles & Huberman (1994) and found to be 80%. In this way, the students' general views of the subject were revealed.

3. FINDINGS

Here, the findings from the students' responses to the open-ended and semi-structured interview questions are presented.

3.1. Findings related to the First Research Question

The findings from the student's responses to the open-ended questions are given in Table 2.

It is seen that the responses given to the questions in the posttest are more scientific than the responses given to the questions in the pretest. Although the scores obtained for questions 2 and 5 were found to be higher in favor of the posttest, this difference is not significant. On the other hand, the scores obtained for question 1 [t(52)=-2.308, p<.05], question 3 [t(52)= -4.818, p<.05], question 4 [t(52)=-2.463, p<.05], question 6a [t(52)=-2.916, p<.05] and question 6b [t(52)=-2.190, p<.05] were found to be significantly higher in favor of the posttest. The graph comparing the scores obtained from evaluating the responses to the open-ended questions is given in Figure 2.

Table 2 Scores obtained from the responses to the open-ended questions

Question		N	$\bar{X}$	S	T	sd	p
1	Pretest	27	1.77	.506	-2.308	52	*.025*
	Posttest	27	2.14	.662			
2	Pretest	27	1.07	.729	-1.343	52	.185
	Posttest	27	1.37	.883			
3	Pretest	27	1.63	.629	-4.818	52	*.000*
	Posttest	27	2.37	.492			
4	Pretest	27	1.48	.849	-2.463	52	*.017*
	Posttest	27	2.04	.807			
5	Pretest	27	1.29	.608	-1.843	52	.071
	Posttest	27	1.59	.572			
6a	Pretest	27	1.04	.649	-2.916	52	*.005*
	Posttest	27	1.59	.747			
6b	Pretest	27	.88	.577	-2.190	52	*.033*
	Posttest	27	1.30	.775			

The first question was asked to determine whether the students knew what waste was generated in their houses. While the students' mean score taken for the responses given to this question in the pretest was calculated to be 1.77, it was found to be 2.14 in the posttest. This finding shows that there is a significant difference between the pretest and posttest mean scores [t(52)=-2.308, p<.05].

With the second question, the students were asked what should be done to reduce the great amount of waste generated at home. With this question, the students were expected to come up with solutions to make it possible to

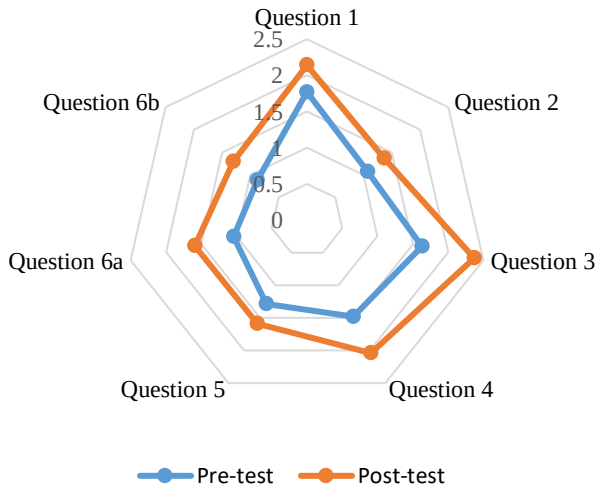

Figure 2 Graph showing the comparison of the pretest-posttest scores obtained for the responses given to the open-ended questions

reduce the amount of waste generated at home. However, these results show that although the field trip and the associating activities enabled the students to create more solutions, this difference is not significant [t(52)= -1,343, p>.05].

The third question was asked to determine to what extent the students know which of the following: car tires, plastic bottles, batteries, bags, newspapers, vegetable and fruit residues, concrete and metal materials that are frequently used in daily life, are recyclable and which are non-recyclable. The mean score from the responses to this question in the pretest was 1.67, while it was 2.37 in the posttest. There is a significant difference between the pretest and posttest mean scores in favor of the posttest [t(52)=-4,818, p<.05]. In this regard, the students learned that the redundant concrete blocks are used to harden the foundations of the new buildings after they have been broken into smaller pieces, the used tires are used for the grounds of parks, running tracks, and some sports areas after undergoing some processes, and finally, they learned that they could create fertilizer for vegetables or fruit trees by composting household food waste as a result of the field trip and activities they were involved in.

The fourth question asked the students to learn what they think about recycling means and why recycling is necessary. The mean score taken from the students' responses to this question in the pretest was calculated to be 1.48. It was found to be 2.04 in the posttest. The posttest mean score was found to be significantly higher than the pretest mean score [t(52)= -2,463, p<.05].

The fifth question aimed to learn the students' opinions about which of the wastes generated at homes can be recycled and which cannot be recycled. Before and after the field trip, the students could write which of the wastes generated at homes could be recycled. Although the difference found between the pretest and posttest mean scores is not significant [t(52)= -1,843, p>.05], it can be said that the field trip and the activities the students participated in enabled them to give more examples of recyclable materials from among the domestic wastes.

Questions 6a and 6b were asked to learn about the students' knowledge and thoughts on the contributions of WTP to our country and nature. The mean score calculated for the students' responses to this question regarding the contributions of the WTP to our country was found to be 1.04 in the pretest and 1.59 in the posttest. Thus, there is a significant difference between the mean scores of the students' responses given to question 6a in favor of the posttest [t(52)=-2.916, p<.05]. On the other hand, the mean score of the student's responses to the question related to the contributions of WTP to nature was calculated to be 0.88 in the pretest, while it was calculated to be 1.30 in the posttest. Thus, there is a significant difference between the pretest and posttest mean scores of the student's responses to question 6b in favor of the posttest [t(52)=-2.190, p<.05].

3.2. Findings related to the Second Research Question

The findings were obtained from the semi-structured interviews with eight students to answer the second research question, "What are the students' opinions about the field trip to the Koycegiz WTP?".

Students' Opinions about the Field Trip

The students' opinions were asked about the field trip made to the Koycegiz WTP, and they were gathered under the headings affective and cognitive. The students defined the field trip as beautiful and enjoyable in the affective dimension and useful and informative in the cognitive dimension. Moreover, the large control panel through which the plant is managed and the operation mechanism of the plant were shown to be factors making them like the trip by the students. On the other hand, the dog farm located next to the plant, activities conducted outside the classroom (picnic park), and the time spent with friends were shown to be factors that made students like the field trip in the affective dimension.

Willingness for Field Trips and Its Reasons

The students were asked whether they would like to participate in other field trips related to the science course subjects. All the students interviewed stated they would like to participate in such field trips. Three of these students were observed to be much more willing to participate in such field trips than the others. Another question was asked of the students to understand the reasons for this willingness. The analysis of the student's responses to this question revealed that the students would like to participate in more field trips because such trips are informative, learned information is more permanent, and such field trips are enjoyable.

Benefits of the Field Trip

The students were asked to determine their views on the benefits of the thematic field trip to the Koycegiz WTP. All the students interviewed think that the field trip was beneficial for them. In light of the data collected from the students, the benefits of the field trip were subsumed under the sub-themes of career awareness, information about the plant, learning methods and techniques, and effects on behavior. The students found the trip beneficial as they believe that they gained information about the selection of a profession and the people working in the plant within the context of the sub-theme of career awareness and as they believe that they gained information about the operation of the plant within the context of the sub-theme of information about the plant. On the other hand, within the context of the sub-theme of learning methods and techniques, students think that as the field trip increases their level of readiness, more meaningful learning will occur while the subject is being taught in the classroom. Within the sub-theme of effects on behavior, some students think that the field trip was helpful to them as it motivated them to economize. In contrast, others think that the field trip was helpful to them as it helped them to gain some positive behaviors such as not throwing recyclable materials into garbage but into special containers, informing individuals around about recycling, and not spilling used oil into sinks.

Benefits of Wastewater Treatment Plants for Our Country and Nature

The students' opinions about the benefits of WTP to our country were subsumed under the sub-themes of sustainability, economy, irrigation, and recycling. Within the context of the sub-theme of sustainability, students think that WTPs benefit our country as they allow less resource use and more savings. Students also stated that WTP would contribute to our country's economic development. On the other hand, within the sub-theme of irrigation, students think that wastewater treatment can contribute to the irrigation of agricultural areas. Finally, within the sub-theme of recycling, students believe that discharge of the wastewater after being treated can reduce the pollution caused by wastewaters in nature and eliminate the elements that can threaten plant, animal, and human health.

The students' opinions about the importance of WTP to nature were subsumed under the sub-themes of cleanliness, health, and sustainability. Within the sub-theme of cleanliness, some students think that WTP contributes to keeping lakes and nature clean. Students think they benefit from protecting human, plant, and animal health within the sub-theme of heath. Within the sub-theme of sustainability, some students think that wastewater treatment will prevent excessive exploitation of natural resources.

According to quantitative findings, students think that WTP generally has many direct and indirect benefits, such as providing water for agricultural irrigation, preventing the pollution of nature and our environment, offering healthier living conditions for living things, less exploitation of natural resources, and contributing to economic development. Also, the students said that the trip was very informative and useful for them and that their saving behavior improved due to their participation in the field trip.

4. DISCUSSION

The current study aimed to reveal the reflections of the field trip made to the Köyceğiz WTP and accompanying activities on students. Based on the research findings, it can be said that the field trip reflects students in terms of behavior, cognition, and individuality (Figure 3). As for the cognitive contributions, although the students had not studied any subject related to domestic waste and recycling before, it was seen that they gave adequate answers to some questions (Q2) in the measurement tool. The reason for this was revealed by the interviews conducted with the students. In this regard, it was seen that although the students had not studied the subject of recycling, they learned about it from informal sources such as written and visual media, recycling bins placed around, and advertisements on billboards. These results remind us once again how important it is to learn outdoor education in a way that supports science lessons. In this field trip, the students observing the process of water treatment on-site, learning about the treatment process from experts, and then participating in the learning process with hands-on activities are thought to have enabled the students to include more than one sensory organ in the learning process. All these enabled the students to gain more information about how wastewater is treated and what the stages of this treatment process are. In addition, the students' statements indicating that the field trip-based learning process is more straightforward than in-class learning concur with both student-centered teaching studies in the literature (Sören & Frède, 2016) as well as with Weimer's (2013) suggestions for providing a learning process that provides more opportunities for students to learn themselves, rather than content-based teaching.

As for the behavior contributions of this trip, they were able to develop new behaviors. Lieflander & Bogner (2014) explained such behavior changes as students' level of knowledge about the environment increases through teaching in an outdoor school learning environment. This increase fostered their positive behavior of avoiding the exploitation of nature. Kriger (1970) argued that this is because of the development of students' ability to feel empathy due to their interaction with nature. Based on the fact that each individual can control the environment in which they live their life, albeit a little (Sennes, Gombert-Courvoisier, Ribeyre & Felonneau, 2012), it can be said that WTP is very effective in environmental education because

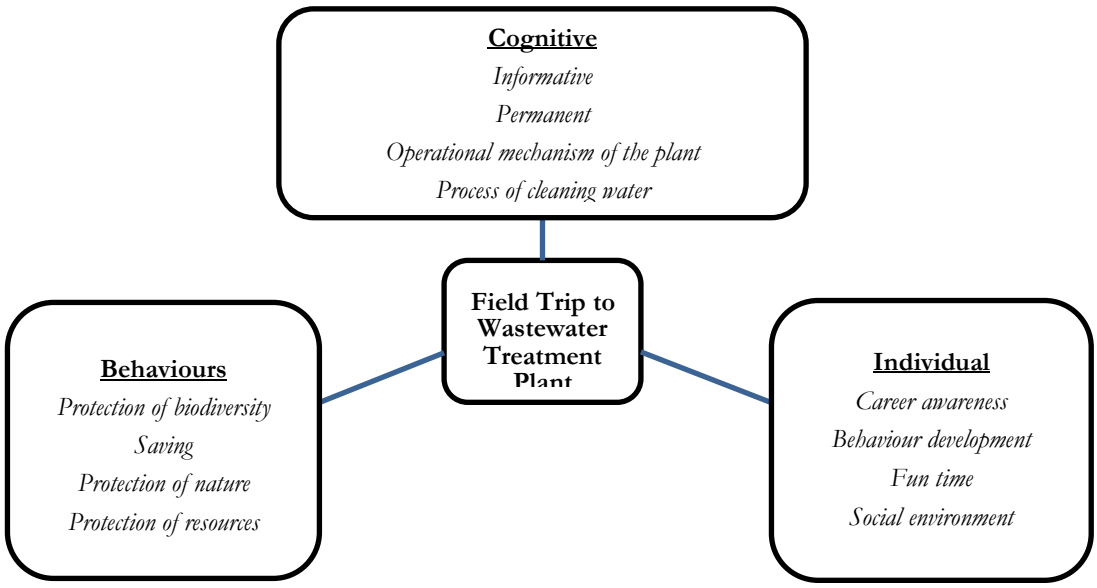

Figure 3 The model constructed regarding the reflections of a structured field trip to WTP on the student

individuals tend to reduce the oppression of the environment after visiting the plant. In addition, the reason for these behavioral changes might be because of the students' emerging desire not to cause negative effects on Koycegiz Lake, which is the center of attraction in the region where the students live, and this complies with the argument of Fishman (2005) that if students are taught the immediate environment they live in, they can develop a greater sensitivity to their immediate environment and establish connections with the environment.

As for the individual contributions of this trip, it was revealed in the current study that the students' spending time with each other for the same purpose outside the school contributed significantly to their social development. Similarly, in a study conducted by Smith, Steel & Gidlow (2010) in a school camp with 32 students between the ages of 14 and 15 in New Zealand, it was concluded that the students found the school camp entertaining and that the time spent with their friends provided socially important experiences. Palmberg & Kuru (2000) also stated that different environmental education programs (trekking, field trips, and camps) help students develop their interactions with the natural environment, environmental awareness, and social and behavioral relations in the external environment. In this connection, Crompton & Sellar (1981) also stated that outdoor school learning environments contribute to developing students' social skills and teaching in such environments should be encouraged. According to Liu & Lin (2014), discussion environments created by asking questions related to science topics in outdoor school environments improve students' critical thinking and communication skills.

On the other hand, outdoor school education can offer possibilities that allow for various career choices (Allin & Humberstone, 2006). Martin & McCullagh (2011) also argued that the outdoor school learning environment may bear the first traces of an expert's career or a profession that has just begun to mature. The students noticed the profession or duties of the people working in a WTP located in a local environment within the scope of outdoor school education, and it was stated that they could do that profession in the future. Thus, it can be said that students can be inspired in their career planning by the WTP workers or professional people (Vadala, Bixler & James, 2007) encountered where outdoor school education is performed.

In summary, after the WTP field trip, which was made with secondary school students under the theme of domestic waste and recycling, it was determined that there were some reflections on the students. These reflections, especially based on students' thoughts about the WTP, are gathered under behavior, cognitive, and individual dimensions. These dimensions support the conclusion reached by Driessnack (2009) and Rios & Brewer (2014), indicating that outdoor school learning helps students develop not only cognitively but also physically and emotionally with the experiences gained through the trip. The contributions of WTP, such as water saving, protection of natural resources, nature, and bio-diversity, can be considered to be the trip's reflections of behavior on the students and the students' raising awareness of the professions they saw in the WTP, the students' statements about the necessity of changing some of their behaviors and their socialization with their friends throughout the process can be considered to be the trip's reflections on the students. Finally, the students' acquiring information about the importance of the water in the Koycegiz district, the environmental problems experienced by Koycegiz Lake in

its history, and through which stages wastewater passes during treatment can be considered cognitive reflections of the trip on the students. These reflections are summarized in Figure 3.

The model reveals the possible reflections of a field trip made to a WTP on students about the unit "Domestic Waste and Recycling". In a structured field trip to a wastewater treatment plant, one or more of these dimensions are thought to be effective on students to varying degrees. In this respect, it is thought that a field trip based on good planning can improve students in many ways. In the literature, there are models similar to this model. In the literature, some models have been developed within the scope of environmental education in outdoor school learning environments. Morag & Tal (2012) developed a conceptual framework (FINE-Field Trip In Natural Environments) within the scope of the reflections offered by the outdoor school learning environments to students after completing the study in which they conducted activities in 22 different outdoor school learning environments. They argue that the teaching conducted by students outside the school contributes to their cognitive, affective, social, skill, and behavioral development (Finn, Yan & McInnis, 2015; 2018). Outdoor school learning creates cognitive, physical, social, literary, and artistic reflections on preschool students (Murakami, Russell & Manfra, 2017). Walter (2009) gave the environmental education necessary for the region's people to know where they live and behave more consciously in Thailand under the headings of aquaculture, wild fisheries, oceanography, culture, and agriculture. The models developed based on different outdoor school learning environments in the literature seem to have some similarities and differences from the current model. While this situation is thought to be based primarily on the environmental education targets of countries, it is partially based on the essential dynamics of regions. In the current study, based on the theory of local knowledge through outdoor school environmental education (Walter, 2009), it can be said that the field trip made to the WTP has revealed the context of sustainability as different from other models.

The WTP field trip also covered the topic of recycling, but the fact that the field trip was a treatment facility is thought to cause students to talk more about the water treatment process while expressing themselves. This may trigger the idea that field trips can sometimes suppress hands-on activities.

5. CONCLUSION

The current study aimed to reveal the reflections of the field trip made to the Köyceğiz WTP and accompanying activities on students. To this end, within the context of the Domestic Waste and Recycling unit, a thematic field trip was organized and supported by structured activities. The measurement and evaluation of the objectives determined for the current study were performed using open-ended questions. On the other hand, semi-structured interviews were conducted with eight students and analyzed through content analysis. The obtained qualitative and quantitative findings were brought together. In general, the Koycegiz WTP trip can inspire students in career planning, make essential contributions to the development of student's cognitive knowledge about water treatment and recycling, and change students' behavior to be more environmentally oriented.

The findings obtained for the first research question of the current study were derived from the study's qualitative data. From the findings obtained for the first research question, it was concluded that the field trip and activities made some contributions to the accomplishment of the objectives related to domestic wastes generated at homes, materials that can be recycled in daily life, the meaning of the concept of recycling, which it should be done and its contributions to our country and nature.

The findings obtained for the second research question of the current research were derived from the students' opinions expressed during their evaluation of the field trip. From the findings obtained for the second research question, it was concluded that the students think that, in general, WTP has many direct and indirect benefits, such as providing water for agricultural irrigation, preventing the pollution of nature and our environment, offering healthier living conditions for living things, less exploitation of natural resources and contribution to economic development. In addition, about the reflections on the trip (sustainability, cognitive, and individual), the students said that the trip was very informative and useful for them and that their saving behavior improved due to their participation in the field trip. Examples of these behavioral changes include throwing recycled materials into relevant recycling bins at home, informing people about recycling, and not spilling used oil into the sink.

Research in outdoor school learning environments is associated with many difficulties and limitations. Some suggestions have been made to researchers who will carry out similar studies or carry the current study further against the difficulties encountered during this study.

- The field trip made within the scope of the research was limited to the Koycegiz Wastewater Treatment Plant. Within the scope of environmental education given at the secondary school level, field trips are recommended to WTPs as outdoor school learning environments.
- Making field trips to WTPs is essential in raising students' awareness of water and environmental pollution in their environment. In this context, field trips should be organized by introducing students to their regions' WTP-like outdoor school learning environments.

- Researchers or science teachers who will organize field trips to WTPs within the scope of environmental education can benefit from this study's processes.
- In the learning processes experienced during the field trip to the WTP, it was observed that the students could not obtain sufficient information to discover ways to reduce waste. Thus, visiting solid waste collection centres besides wastewater treatment plants will benefit students.

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