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

**NOVELTY**

This study is considered to be original in terms of being an example of how to make any field trip to the wastewater treatment plant, determining the reflections of the environmental Wastewater Treatment Plant field trip on the students and using the wastewater treatment plants within the scope of local environmental education.

# 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 in relation to this trip on middle school students in Turkey. This research was conducted on the basis of the semi-mixed method by using the single-group pretest-posttest quasi experimental design. The quantified data were collected by using domestic waste and recycling open-ended questions while the qualitative data were collected through the semi-structured interview technique. A total of 27 middle school students (17 females, 10 males) participated in the study. According to the quantitative findings of the study, the field trip to the wastewater treatment plant made the students realize the wastes produced at homes, recyclable materials, importance of recycling and contributions of wastewater treatment plants to the economy of the country and nature. The quantitative findings on the other hand indicate that this trip helped the students develop more eco-centric behaviours. 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 easily 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 excessive burden on nature, causing the natural resources of future generations to be exhausted completely (Gul, 2013). With the United Nations Conference on the Human Environment held in Stockholm in 1972, countries came to a consensus on the solution of the problem and thus the phenomenon of "environmental education" started to take shape (United Nations Conference on the Human Environment, 1973). 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 and Krasny, 2015; US EPA, 1990). Environmental education takes place both 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 important 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, and 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 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 and Liu, 2017; Sennes et al.2012). Dieser and Bogner (2016) conducted a study with 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 and observed important developments in the students' knowledge and feelings about various environmental issues. These learning environments enable students to recognize problems more easily, to offer solutions to these problems and to make effective decisions by involving them in the learning environment more effectively (Pan and Hsu, 2020), which leads to attainment of real life experiences by students. A good example of this is the Koh Yao Noi Project in Thailand; with the project, it is aimed to prepare citizens for real life by means of an environmental and skill education suitable for the marine culture that the region has (Walter, 2009). Moreover, Scribner-MacLean and 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 and 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 the social relations of students with each other, increase the retention of the learned information and contribute to the understanding of the logic behind the information (Larsen, Walsh and Myers, 2017).

In the relevant literature, it has been reported that outdoor school learning environments contribute not only to the development of affective characteristics of students such as interest in science, career planning and empathy towards the local environment, but also to the development of their cognitive skills. For example Finn, Yan, and Mcİnnis (2018) carried outdoor science and physical activities under the themes of science and mathematics education, healthy living, environmental education and teamwork in an outdoor school learning environment with students every morning for 5 weeks. The results showed that outdoor school learning environments improved the learning of science concepts and scientific inquiry skills of students. Rios and 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 and this 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, Knightly, Ruiz-Mallen, Fuentes-Pelaez, Demps, Huanca and Martinez-Rodrigez, 2010; Quinlan and 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 professional career in science.

* 1. **Local Knowledge for Environmental Education**

It is stated that student-centred, 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 and Ouardi, 2019). With these approaches, it is aimed to train individuals who are more conscious (Sennes et al. 2012), able to establish links with the place they live (Fisman, 2005) and develop positive behaviours towards the environment (Teksoz and Sahin, 2012) because the way individuals live their lives has a positive or negative effect on the environment they live in. This means that individuals have some, albeit limited, control on the environment (Sennes et al. 2012). Because it is believed that water and water management, which is seen as an important socio-scientific issue today, needs not only technical and regulatory measures but also behavioural support in the 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 in order for individuals to develop empathy and behaviour (Fisman, 2005). Amahmid, et al. (2019) stated that the best way to improve the relationship between children and the natural world is field trips in their local environment. In this way, children’s awareness of their local environment will be increased by gaining information about the environment they live in. In the literature, various instructional designs or theories have been developed to help individuals to learn the environment in which they live. One of these is “local environment learning” (Jose, Patrick and 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 named as “residential outdoor environmental education” by Mullenbach, Andrejewski and 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 an environmental education in accordance with the culture of the region. The education program named as the Koh Yao Noi Project is consisted of different sections called Aquaculture, Wildfisheries, Oceanography, Culture and Agriculture. From this point of view, the education required for the people of the region to know where they live and to act more consciously can be given outside the school based on local knowledge (Fisman, 2005; Sennes et al.2012).

When the relevant literature is reviewed, it is seen that museums (Tenenbaum, To & Wormald, 2015), space centres (Sören & Frède, 2016), science-arts centres (Friedman and Worden, 2016), energy parks (Bozdoğan, 2016), national parks (Çetin, 2014; Whitesell, 2016), factories, botanical and animal gardens (Mazor, 2011; Scott and 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 seen in the school environment. Thus, individuals have the opportunity to 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 and Liu, 2017). When the relevant studies are examined, it is seen that the number of studies including field trips to WTP is very small and these few studies have been conducted at university level and mostly with the participation of students from chemistry departments of universities (Forest and 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 environment education starting from lower grades and in different outdoor school learning environments.

* 1. **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, human beings take care of this resource that 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 and 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 and Gökalp, 2010) because water scarcity is seen as a global problem facing our age (Amahmid, et al. 2019; Fu and Liu, 2017).

In places where human beings live, after being used, water is removed through sewage as waste water. 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 odour may be disturbing. For this reason, its direct release to nature may cause irreversible negative effects such as eutrophication on the environment (Mainstone and Parr, 2002; Minareci, Öztürk and Minareci, 2004).

Wastewater treatment plants are units where the harmful effects of wastewater generated as a result of 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 also constitutes the source of water 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 important position in terms of both 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 into 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, the existence of 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 to be experienced in the future to some extent (Fu and 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 very important for wastewater treatment plants to be involved in environmental education in order for individuals to have correct knowledge about water recycling and to eliminate their prejudices about recycled water.

The Ministry of National Education in Turkey included various objectives related to WTP and treatment of wastewater 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”, “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 of them can be shown as 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 longer period of time. The on-site observation of a facility that makes such a multi-faceted contribution to the local environment can be transformed into a very beneficial learning experience in order 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 the cognitive, affective and behavioural development of students, there are no studies in which field trips are conducted at 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. In the current study, it is aimed 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’ acquisitions on the subject of “Domestic Waste and Recycling”?

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, qualitative) are collected but the amount of connection between these two types of data is little or none in the presentation of the findings and interpretations (Teddlie and Tashakkori, 2009). In the current study, the quantified data were collected by using domestic waste and recycling open-ended questions while the qualitative data were collected through the semistructured 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 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 consents of the parents were gained with the help of school administration.

**2.3. Data Collection Tools**

***2.3.1. Open-ended Questions***

A total of 7 open-ended questions were developed to elicit 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 having 12-year teaching experience and doing a PhD within the context of content validity. The open-ended questions were designed to elicit information about 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 on the basis of a rubric assigning scores to the responses of the students varying between 0 and 3. Intercoder consistency was checked to establish the reliability of the quantification operation.

**Figure 1.**

*Research Design*



**2.4. Semi-structured Interview Form**

In the qualitative dimension of the current study, a semi-structured form consisted 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. Through these questions, it was aimed to elicit the students’ opinions about the field trip in more detail. Prior to the interviews with the students, the interview form was piloted on 2 students to check the comprehensibility of the interview questions and to 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 be consisted of three stages; before the trip, during the trip and after the trip (DeWitt & Osborne, 2007).

***2.5.1. Before the Field Trip***

Before the field trip, preliminary preparations were made by the researchers 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 of vital importance for the good structuring of the field trip so that the objectives of the trip 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.

***2.5.2. During the Field Trip***

The during the field trip stage was carried out in four phases. In the first phase, the students were introduced to the facility in the command centre; in the second phase, the students travelled 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.

In the first phase, the students were gathered in the facility command centre. Here, the students were informed about the aim of the plant, the establishment process of the plant, the importance of the plant, the contributions of the plant to Koycegiz and Koycegiz Lake by the facility officer. The facility officer explained in the command centre that wastewater treatment plants ensure that wastewater is released to the nature in a way that does not harm the 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 centre, the group went to the place where the mechanical treatment, which is the first stage of waste water treatment, takes place. The facility officer gave information that the large particles mixed into the wastewater coming from the city were mechanically treated at this point. The water that is purified from large particles is transferred to the 4 meter-high pools, which is the second stage of the treatment. This is the point where the chemical treatment starts. The facility officer stated that at this stage, it is aimed to remove the oils or nutrients in the wastewater by using microorganisms. Special importance was attached to the fact that in the process of breaking up the oil and removing it from the water is the most difficult part of the treatment process and thus, the students’ attention was drawn to the reason why waste oil should not be poured into the sink. The water carried to the third stage is kept for a certain period of time. In this process, the particulate matters existing in the water are precipitated and clear water is collected at the top. The precipitate 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 activities called "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 the filtration of dirty water by using plastic bottles, soil, large and small pebbles, coal and cotton through the instructions given to them. 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 use household wastes from their homes to transform them into a design that they could use in their daily lives. In this activity, the students were expected to use their own creativity, 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.

***2.5.3. After the Field Trip***

Nearly 10 days after the field trip, the open-ended questions were administered to the students as a posttest. Moreover, interviews lasting for 20 minutes on average were conducted with a total of 8 students within two days; 4 students each day.

**2.6. Data Analysis**

The analysis of the collected data was made in 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 to be used in the content analysis of the students’ responses to the open-ended questions. This rubric was developed by seeking the opinions of two field experts involved in the research process as well. The content analysis was carried out by two different experts, one of whom was the researcher of the current study. The correlation between the scores given by the two experts for the same question was calculated by using the correlation analysis to check the consistency between the coders (Table 1).

Table 1.

*Correlation Analysis Emerging as a result of the Evaluation of the Open-ended Questions by Two Different Researchers*

|  |  |  |  |
| --- | --- | --- | --- |
| **Pretest** |  |  | **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 |
|  **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** |
|  |  |  | **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

It can be said that the results of the content analyses made by a field expert other than the researcher and the researcher by adhering to the rubrics are consistent and compatible with each other. In cases where the evaluations did not agree, the relevant answers were determined after the joint evaluation of the researcher and the other field expert by consensus. The normality test was conducted on the quantified data. According to the result of the analysis, the result of the Kolmogorov-Smirnov test was found to be 0.2. Thus, it was assumed that the data distributed normally and parametric statistical methods were used in the study. In this connection, dependent samples t-test was used to compare the pretest and posttest mean scores of the groups.

The audio recordings of each interview made with the students were transcribed by a person independent of the researcher. The transcribed statements were categorized into themes on the basis of the responses of the students. In order 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 and Huberman (1994) and found to be 80%. In this way, the students’ general views of the subject were elicited.

# Result and Discussion

Here the findings obtained from the students’ responses given to the open-ended questions and from the semi-structured interview questions are presented.

* 1. **Findings related to the First Research Question**

The findings obtained from the students’ responses to the open-ended questions are given in Table 2.

Table 2.

*Scores Obtained from the Responses to the Open-ended Questions*

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| Question |  | N |  | S | T | sd | p |
| 1 | PretestPosttest | 2727 | 1.772.14 | .506.662 | -2.308 | 52 | *.025* |
| 2 | PretestPosttest | 2727 | 1.071.37 | .729.883 | -1.343 | 52 | .185 |
| 3 | PretestPosttest | 2727 | 1.632.37 | .629.492 | -4.818 | 52 | *.000* |
| 4 | PretestPosttest | 2727 | 1.482.04 | .849.807 | -2.463 | 52 | *.017* |
| 5 | PretestPosttest | 2727 | 1.291.59 | .608.572 | -1.843 | 52 | .071 |
| 6a | PretestPosttest | 2727 | 1.041.59 | .649.747 | -2.916 | 52 | *.005* |
| 6b | PretestPosttest | 2727 | .881.30 | .577.775 | -2.190 | 52 | *.033* |

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 the questions 2 and 5 were found to be higher in favour of the posttest, this difference is not significant. On the other hand, the scores obtained for the 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 favour of the posttest. The graph comparing the scores obtained from the evaluation of the responses to the open-ended questions is given in Figure 2.

Figure 2

*Graph Showing the Comparison of the Pretest-Posttest Scores Obtained for the Responses Given to the Open-ended Questions*

The first question was asked to determine whether the students know what wastes are 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 homes. With this question, the students were expected to come up with solutions to make it possible to reduce the amount of waste generated at homes. But 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 taken from the responses given to this question in the pretest was found to be 1.67 while it was found to be 2.37 in the posttest. There is a significant difference between the pretest and posttest mean scores in favour 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 was asked the students to learn what they think about what 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].

Through the fifth question, it was aimed to learn the students’ opinions about which of the wastes generated at homes can be recycled and which of the wastes cannot be recycled. Both before and after the field trip, the students were able to 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 given to this question regarding the contributions of the WTP to our country was found to be 1.04 in the pretest while it was found to be 1.59 in the posttest. Thus, there is a significant difference between the mean scores of the students’ responses given to the question 6a in favour of the posttest [t(52)=-2.916, p<.05]. On the other hand, the mean score of the students’ 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 students’ responses to the question 6b in favour of the posttest [t(52)=-2.190, p<.05].

* 1. **Findings related to the Second Research Question**

The findings obtained from the semi-structured interviews conducted with 8 students to find an answer to the second research question “What are the students’ opinions about the field trip to the Koycegiz WTP?”.

* + 1. ***Students’ Opinions about the Field Trip***

The students’ opinions were asked about the field trip made to the Koycegiz WTP and were gathered under the headings of affective and cognitive. The students defined the field trip as both very 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 the factors making students like the field trip in the affective dimension.

* + 1. ***Willingness for Field Trips and Its Reasons***

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

* + 1. ***Benefits of the Field Trip***

The students were asked a question in order 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 behaviour. The students found the trip beneficial as they believe that they gained information about 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 increased their level of readiness, more meaningful learning will occur while the subject is being taught in the classroom. Within the context of the sub-theme of effects on behaviour, some students think that the field trip was useful to them as it motivated them to economize, some others think that the field trip was useful to them as it helped them to gain some positive behaviours such as not throwing recyclable materials into garbage but into special containers, informing individuals around about recycling and not spilling used oil into sinks.

* + 1. ***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 WTP are beneficial to our country as they allow less resource use and more saving. It was also stated by students WTP would make contributions to the economic development of our country. On the other hand, within the sub-theme of irrigation, students think that treatment of wastewater 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 contribute to the reduction of the pollution to be caused by wastewaters in nature and to the elimination of 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 contribute to keeping lakes and nature clean. Within the sub-theme of heath, students think that they have benefits in terms of protecting human, plant and animal health. Within the sub-theme of sustainability, some students think that treatment of wastewaters will contribute to the prevention of excessive exploitation of natural resources.

1. **Discussion**

In the current study, it was aimed to reveal the reflections of the field trip made to the Köyceğiz WTP and accompanying activities on students. Araştırma bulguları alan gezisinin öğrenciler üzerinde davranış, cognitive and individual açıdan yansımaları olduğu söylenebilir. 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 as a result of 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 in billboards. These results remind once again how important it is to learn out-door 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 hand-on activities is thought to have enabled the students to include more than one sensory organ in the learning process. It was seen that 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 easier than in-class learning concur with both student-centred teaching studies in the literature (Sören and 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 just content-based teaching.

As for the behaviour contributions of this trip enabled to develop new behaviors. While Lieflander and Bogner (2014) explained such changes of behaviours as students' level of knowledge about the environment increased through teaching in an outdoor school learning environment, and this increase fostered their positive behaviour of avoiding the exploitation of nature Kriger (1970) argued that this is because of the development of students’ ability to feel empathy as a result of their interaction with nature. Based on the fact that each individual can control the environment in which he/she lives with his/her life, albeit a little (Sennes et al.2012), it can be said that WTP is very effective in environmental education because individuals exhibit a tendency to reduce the oppression on the environment after visiting the plant. In addition, the reason for these behavioural changes might be because of the students’ emerging desire not to cause negative effects on Koycegiz Lake, which is the centre of attraction in the region where the students live, and this is in compliance 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 with 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, and 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 and Jari Kuru (2000) also stated that different environmental education programs (trekking, field trips and camps) help students develop their interactions with the natural environment, their environmental awareness, and their social and behavioural relations in the external environment. In this connection, Crompton and Sellar (2010) also stated that as outdoor school learning environments contribute to the development of students' social skills, teaching in such environments should be encouraged. According to Liu and Lin (2014), discussion environments created by asking questions related to science topics in outdoor school environments improve students' critical thinking skills as well as communication skills. On the other hand, outdoor school education can offer possibilities that allow for a wide variety of career choices (Allin and Humberstone, 2006). Martin and 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 profession or duties of the people working in a WTP located local environment within the scope of outdoor school education were noticed by the students 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 both the workers in WTP or professional people (Vadala, Bixler and James, 2007) encountered where the 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 the dimensions of behavior, cognitive and individual. These dimensions support the conclusion reached by Driessnack (2009) and Rios and 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, and protection of natural resources, nature and bio-diversity can be considered to be the trip’s reflections of behavioural 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 behaviours and their socialization with their friends throughout the process can be considered to be the trip’s individual reflections on the students. Finally, the students’ acquiring information about the importance of the water in the Koycegiz district, environmental problems experienced by Koycegiz Lake in its history and through which stages wastewater passes during treatment can be considered to be cognitive reflections of the trip on the students. These reflections are summarized in Figure 3.

**Field Trip to Wastewater Treatment Plant**

**Cognitive**

*Informative*

*Permanent*

*Operational mechanism of the plant*

*Process of cleaning water*

**Individual**

*Career awareness*

*Behaviour development*

*Fun time*

*Social environment*

**Behaviours**

*Protection of biodiversity*

*Saving*

*Protection of nature*

*Protection of resources*

Figure 3. The model constructed in the students’ minds through the structured field trip

The model reveals the possible reflections of a field trip made to a WTP on students in relation to 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 to be carried out on the basis of a good planning can improve students in many ways. In the literature, there are models similar to this model. In the literature, there are some models developed within the scope of environmental education in outdoor school learning environments. Morag and 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 the completion of 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 makes contributions to their cognitive, affective, social, skill and behavioural development (Finn, Yan & McInnis, 2015; 2018). Outdoor school learning creates cognitive, physical, social, literary and artistic reflections on preschool students (Murakami, Russell and Manfra, 2017). Walter (2009) gave the environmental education necessary for the people of the region to get to know the place where they live and behave more consciously in Thailand under the headings of aquaculture, wildfisheries, oceanography, culture and agriculture. The models developed on the basis of different outdoor school learning environments in the literature seem to have some similarities with 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 basic 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 process of water treatment while expressing themselves. This may trigger the idea that field trips can sometimes suppress hand-on activities.

1. **Conclusions**

In the current study, it was 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 unit Domestic Waste and Recycling, a thematic field trip was organized and it was supported with structured activities. The measurement and evaluation of the objectives determine for the current study were performed by using open-ended questions. On the other hand, semi-structured interviews were conducted with 8 students and they were analyzed through content analysis. The obtained qualitative and quantitative findings were brought together. In general, the Koycegiz WTP trip can be said to be a source of inspiration for students in career planning, and to make important contributions to the development of students’ cognitive knowledge about water treatment and recycling, and to changing students' behaviour in a more environmentally oriented way.

The findings obtained for the first research question of the current study were derived from the qualitative data of the study. 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 opinions of the students 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, in relation to the reflections of the trip on themselves (sustainability, cognitive and individual), the students that the trip was very informative and useful for them and that their behaviour of saving improved as a result of their participation in the field trip. Examples of these behavioural changes include throwing recycled materials into relevant recycling bins at home, informing people around on recycling and not spilling used oil into the sink.

Conducting a 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 will 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 secondary school level, field trips are recommended to WTPs as outdoor school learning environments.

• Making field trips to WTPs plays an important role in raising students’ awareness of water and environmental pollution in their environment. In this context, field trips should be organized by introducing students to WTP-like outdoor school learning environments in their regions.

• Researchers or science teachers who will organize field trips to WTPs within the scope of environmental education can benefit from the processes in this study.

• In the learning processes experienced during the field trip to the WTP, it was observed that the students could not reach sufficient information to discover ways to reduce waste. Thus, it will be beneficial for students to visit solid waste collection centres besides wastewater treatment plants.

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**Abbreviations**

WTP, Wastewater Treatment Plant

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