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The Impact of Visiting a Recycling Facility on Students' Meaningful Learning

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ABSTRACT

The use of informal learning environments in teaching is an inevitable reality. Students create a schema in their mind by using the 5 senses and experiencing. In this study, 7th-grade students were taken to one of the Recycling facilities as part of the exploration phase of the Learning Cycle teaching model to teach the science subject of Domestic Waste and Recycling. Comparison Group Pre-test/Post-test of the quasi-experimental design was used as a research method in the study. The visit to the Recycling Facility has a crucial effect on the reason for this difference in the academic achievements of the students. The qualitative data showed that students have positive feelings, have a great time, enjoying collaborating with their friends. Thus they prefer to be taught in an informal learning environment. Learning in informal environments has more positive effects than learning at school. The reasons are students can actively question and discuss with friends, and reach information through exploration and/or the guidance of experts during the field trip. Thus students have meaningfully learned at cognitive and affective levels.

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1. INTRODUCTION

The integration of informal learning environments into formal education is one of the changes in the perspective of education in recent times. Today, while raising scientifically literate individuals in science education, firstly, to increase the scientific knowledge of the students, secondly, to enable them to realize the emergence of this knowledge and what the factors affecting this process are (Rumjaun et al., 2022), and then to use scientific knowledge in every stage of life, are the purpose of educating next generations (Boeve-De Pauw et al., 2022; Dron & Anderson, 2022; Fick & Arias, 2022). In line with the second purpose, it is also important for students to understand how scientists use scientific research methods in the process of producing scientific knowledge, how they form their arguments, and how they put forward their claims as a result.

Unfortunately, not all scientific knowledge is accepted directly by the society. Some information causes divisions and debates in society and this reduces the usability of the information. These types of issues make it debatable because of the lack of information of individuals or because they do not accept the existing information for some reason. Visits to informal learning environments help individuals learn science concepts meaningfully and contextually. People who participate in field trips as part of their learning experience show that they have learned the scientific concepts in the course content meaningfully (Morag & Tal, 2012). It is easier to learn scientific knowledge during field trips than in the classroom, and students learn more about that subject because scientific knowledge is constructed in the minds of students on a contextual basis (Rumjaun et al., 2022). Some studies show that participants not only think learning is fun on field trips but also enjoy learning more in the classroom (Tal, 2012; Türkmen, 2018).

Scientific studies say that some conditions must be fulfilled so that students can learn at a higher level in informal environments. First of all, the field trip planning should be planned in 3 parts; before the trip, during the trip, and after the trip.

Before the trip, teachers perform administrative and academic preparation in this process. In the administrative preparation, teachers must first inform the school administration and obtain the necessary permissions, then the same process should be done for each student's parents. The purpose of the visit, the name of the visiting place, the time of leaving and returning to the school, and any necessary information such as entrance fee, transportation info, special clothing, and physiological needs such as food and beverage, should be written on the permission forms. For this process to be carried out properly if the place to visit is an institutional structure, it is necessary to contact the authorized persons and get information about the institution environment and available time for visitors, and even the teacher may need to visit the place before to get to know the place better. For example, the teacher may visit the informal learning environment to see and make decisions about potential hazards for students. This previous visit facilitates the teacher's academic planning. The academic preparation part begins with the selection of the ideal informal environment for the scientific knowledge to be taught. If the teachers make these choices together with their colleagues in the first weeks of school, the process proceeds more easily. Two different approaches stand out in the academic planning of the teacher. The first and general approach is to be taught science knowledge in the classroom and then to reinforce the knowledge by making a field visit. The other is the planning of learning to take place entirely during the trip. In terms of academic success, learning during the trip is at a higher level. The planning here is student-centered, where students conduct research like scientists and aim to reach scientific knowledge from the data they have obtained. In this process, the teacher prepares

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worksheets containing many different techniques and puts the students in a problem situation, and enables them to solve the problem by doing research. If it is prepared as a group activity, students will help each other to use their scientific process skills and, as a result, learn meaningfully.

During the trip: After entering the informal learning environment, the students are informed about what to do and begin to fulfill their duties. Students behave like scientists and make research to be able to solve problems given by their teacher. In this process, children collect data from exhibitions, interactive activities, video shows, etc. that the environment offers to students. When necessary, students can also ask questions to the experts and/or staff, working in the informal environment. At the end of the trip, the students interpret the information they have obtained throughout the process with their groupmates.

Post-trip: In the classroom, a follow-up activity should be held after the visit, usually in the next lesson. The follow-up activity usually begins by brainstorming about what students saw or enjoyed during the visit. They together analyze the collected information or examples and the teacher may ask questions to guide students in their analysis (Asrifan et al., 2020; Rumjaun et al., 2022; Türkmen, 2010). Afterward, the teacher summarizes the scientific knowledge with the students. Finally, this knowledge needs to be tested by the students to make sense of it. As a result of the test, the knowledge level of the children is determined and if there are misconceptions, it is determined.

With the research, the reasons why the teachers who teach by using informal learning environments could not achieve the desired result were determined. Barriers to successful field trips for teaching purposes, transportation, teacher's lack of training and experience, school program and teachers' ability to prepare, lack of support from school administration, heavy school curriculum, students' attitudes and behaviors, teachers' inability to associate potential informal environments with the curriculum, seasonal conditions, defined as economic problems (Ateşkan & Lane, 2016; Behrendt & Franklin, 2014; Kisiel, 2014). To avoid these problems, teachers should know that the results depend on the science context, students' interest, motivation, prior knowledge, and experience. Teachers should not forget these reasons and should make their lesson plans by remembering them. Although the learning process in the classroom and the informal environment are the same, there may be a difference in learning outcomes (Rennie, 2014; Staus & Falk, 2017). Learning that takes place informal environment should be driven essentially by the student's interests and requirements. If the field trip plan was made to these requirements, students easier understand science concepts and have unforgettable experiences. At the same time, students' knowledge climbs to a higher level and encourages further learning related to other disciplines areas (Behrendt & Franklin, 2014; Darling-Hammond et al., 2020). Visits to informal environments such as science centers, museums, aquariums, and zoos provide precious motivational opportunities for students to learn science concepts and impact student learning (Dawson, 2014; Schwan et al., 2014; Yildirim, 2020).

To have a successful student-centered field trip process, some conditions must be formed in the informal environment (Hanafin et al., 2014). During the trip, students should have a good time and find it fun, participate in the process voluntarily, be able to use their decision-making skills, and go through the process with hands-on activities. Moreover, students should be provided with time flexibility, and the process should be open-ended without following any order problem-solving skills while they are solving problems (Turkmen, 2010). Bultitude & Sardo (2012) explained how activities in informal environments affect the success of the participants and defined 3 main elements that contribute to the success of the participants in

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science activities in informal environments. (1) The informality of the surroundings: It increases the confidence of the students and enables them to participate actively in the activities, communicate easily with the scientists in the environment, and ask questions comfortably. (2) The involvement of 'real' scientists: Those who see scientists as scary or distant from themselves start to enjoy the activities when they get in touch with scientists. In addition, participants, who think that science is difficult, realize that they can learn more easily when they interact with the scientist. (3) The opportunity to re-engage participants with scientific concepts: Students or adults who encounter the concepts they learned at school again on field trips can make sense of the concepts more easily by realizing how useful they can be for them. It is seen that learning becomes easier and success can increase when suitable conditions are created. Having awareness-raising activities in informal learning environments can facilitate the learning of visitors (Turkmen, 2018).

In literature, many studies are confirming how positive effects informal environments. Randler et al. (2007) stated that the provision of structured education programs in zoos as informal education environments can affect students learning positively. Patrick et al. (2013) revealed how pre-service teachers developed their skills by visiting zoos, revealed how we can use botanical gardens as a learning environment and an educational facility (Sanders et al., 2022). Bozdoğan et al. (2015) showed that a well-planned trip can achieve its goals. It has been also observed that there are positive effects in the research applied by integrating field trips related to environmental problems in the field. Kortland (as cited in Cenk & Yalman, 2022) declared that students' understanding of the waste issue changed a little after the lessons, and this was not at a desirable level. His explanation for this result is the lack of interaction between student and teacher, and teaching materials. Said et al. (2003) studied with teachers about environmental issues. They found that almost half of the teachers were unable to correctly answer the underlying causes of the waste problem. Since the waste problem was the lowest concern among the environmental problems of the participants, they did not have enough information about solving, such as reducing, reusing, and recycling, this problem. Öcal (2022) studied with preservice social science teachers to determine their awareness and sensitivity towards the subject of recycling. After teaching the subject, she took their pre-service social science teachers to 3 recycling facilities. After the field trips, pre-service social studies teachers' attitudes and behaviors towards the recycling issues are considerably changed. Çalış & Ergül (2015) studied with preservice science teachers to determine their views on waste pollution. They found that preservice science teachers don't know enough knowledge about waste pollution and its damage to nature and human health. Harman & Çeliker (2018) studied with the preservice science teacher to determine their opinions on the collection, separation, and recycling of solid wastes. They found that preservice science teachers have enough knowledge about recycling solid wastes and how to use separate recycling containers for each type of solid waste, and are generally aware of recycling and reutilizing the material of packages. Aksan & Çeliker (2019) studied with the preservice science teachers to determine how the impact of waste recycling education on their knowledge levels about waste and recycling. They found that preservice science teachers' knowledge levels on recycling have increased and their' behaviors towards recycling changed positively. Bulut (2020) studied with preschool teachers to determine young kids' awareness of zero-waste and teachers' thoughts about how to teach recycling activities. He found that kids' awareness level of zero-waste and recycling was not enough. Most of the pre-school teachers declared that the if education environment should have been colored and enriched with the use of visual materials and educational games, kids' awareness level of that can arise. The learning process

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has to be more enjoyable and more suitable for the kids' levels of development. Despite the great contributions of field trips, it is seen that there are not enough field trips in our country, and although they are made, they are not carried out with student-centered approaches (Bozdoğan et al., 2015, Türkmen 2016; 2018).

For this study, the scientific concept of "recycling", which is one of the social-scientific issues, was chosen. Limited natural resources, global population, and climate threats have brought the concept of recycling to the fore in science. The big international organization's declarations, like United Nations 2030 sustainability goals, Europe Union 2030 framework, the Paris Agreement for Climate Change, Europe Union Waste Directives, etc., have paved the way for the adoption of the circular economy model (reduce-reuse-recycle). Governments had to take crucial efforts to solve these problems, limited natural resources, the global population, and climate threats. Many countries have formal waste collection systems to save manufacturing time and energy requirements and reduce production costs. Unfortunately, this solution is not being spread around the world. Although the solution is very clear and obvious, people, unfortunately, cannot prevent this environmental problem. The first solution is to make people aware of the issue then other solutions come. For this purpose, we took our students to a private recycling facility to raise awareness about recycling, show how the process works, and make them realize its social benefits at the end of the process. The private recycling facility, as an informal learning environment used in the study, was established in 1974. Its priority is to recover/recycle waste. The facility, which buys and sells approximately 30,000 tons of scrap annually, aims to be one of the companies in EU standards. In this recycling facility, scrap products are recycled in 5 different categories: metal, plastic, electronics, glass, and paper.

Studies examining the effects of visiting a recycling facility, which is one of the informal learning environments that facilitate learning, are limited in the literature. Based on this shortcoming, it was decided to conduct this study which aims to investigate the effect on the learning of the 7th grade "Domestic Waste and Recycling" science subject, which is taught with the Learning Cycle teaching model in the Recycling Facility.

2. METHODOLOGY

Comparison Group Pre-test/Post-test *of* the quasi-experimental design was applied as a research method in this study. Because participants are not randomly assigned. Quasi-experimental designs are most likely to be conducted to interpret the effectiveness of an educational intervention. The symbolic representation of the design is given in Table 1.

Tabel 1. Pre-test *Post-test comparison group* quasi-experimental design

Pre-test	Group	Intervention	Post-test
Q1	E	X	O2
Q1	C		O2

The convenience sampling method was chosen to select the study group consisting of seventh-grade students studying in a secondary school. One class was randomly assigned as the experimental group, including 33 students, and the other class as the control group, including 28 students.

In this study, the Domestic Waste and Recycling Achievement Test, consisting of 16 multiple choice questions, was the data collection instrument. In the development process of the

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Recycling Achievement Test, (1) Item Formation Phase, (2) Application for Expert Opinion Phase, (3) Applying Pilot Phase, (4) Reliability Calculation Phase (Bozdoğan & Öztürk, 2008) were followed respectively. First, an achievement test including 20 multiple choice questions with four answer options was prepared. Then it was presented to the opinion of 2 experts. The reliability and validity calculations of the achievement test were started by re-arranging the feedback from two experts. The test was asked to answer 52 eighth-grade students in order to calculate validity and reliability. The Cronbach α reliability coefficient calculated for the Recycling Achievement Test was found to be 0.62. Next, item analysis was performed for each question. Since the item difficulty indexes of the questions and the item discrimination index of questions 2, 8, 10, and 18 were lower than 0.30, they were excluded from the test. Finally, The Cronbach α reliability coefficient was found to be 0.78. The results showed that the Recycling Achievement test can be used in terms of item difficulty and item discrimination. Moreover, before the next lesson, the experimental group students were asked 4 questions, (1) How does it feel to be taught in such environments? (2) What are the things that interest you most during the trip? (3) How is it different from the courses you teach at school? (4) Would you like to teach in such environments again? to get their thoughts about the field trip they had experienced.

In the study, a lesson plan was prepared and applied based on the Learning Cycle teaching model for both experimental and control groups. Before the beginning of the science lesson, the Recycling Achievement test was applied as a pre-test. Then, in the exploring phase of the Learning Cycle teaching model, a problem-based scenario was given to the control group. The control group students were asked to find out answers to the questions about a problem-based scenario in the use of their questioning and research skills. In the experimental group, the field trip to the recycling facility was carried out. Before going on the trip, the teacher went to the recycling facility, made preliminary investigations, and obtained the necessary information from the authorities to prepare to proper lesson plan. The suitable worksheet, including same a problem-based scenario and questions, was prepared for the students to act like a scientist during the trip. Students could observe the environment comfortably, ask questions to the experts, and touch and feel the materials. Legal documents, including information about the route of the trip, the service to be taken, the availability of the shuttle, the driver, the departure time, and the number of students to join, were prepared, and then were submitted to parents and school administration to get their permissions. During the trip, under the plan, the recycling facility expert gives general information about the facility and then the recycling process. Afterward, students wore hard hats and vests for security requirements and then toured 5 different parts of the facility. While touring the parts of the facility, the students saw which products were recycled and how. They touched and felt the difference before and after the disintegration of the shredded materials. In addition, the experts answered the questions of the students at the machines, and when necessary, the students were persuaded to reach the information through discussion with experts and teachers. Most of the exploration phase of the Learning Cycle learning model took place there, which lasted about 1.5 hours. The trip was over and went back to school. Next lesson, according to the answers obtained during the exploration phase of the Learning Cycle model, both in the recycling facility and in the classroom, scientific information about domestic waste and recycling was reached as a result of the discussions in the classroom. In the concept application phase, in both groups, visual materials and videos related to the different domestic wastes used in daily life and their recycling were shown on the smartboard, and then the

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Recycling Achievement test was applied. In the next science lesson, the teacher asked 4 open-ended questions about the field trip experiences of his students.

The Recycling Achievement test was administered to both groups as pre-test and post-test. The data were normally distributed and were analyzed by an independent t-test. The data were interpreted in descriptive statistics and determined whether there was a significant difference between the independent variables at the level of α = .05. Moreover, open-ended questions were analyzed with content analysis, and themes and codes were extracted to explain the data. The codes were represented by frequency and percentage calculations.

3. RESULT AND DISCUSSION

Before the beginning of the lesson, the Recycling Achievement test was used in both groups as a pre-test. The mean score of the Recycling Achievement test of the experimental group was 35.1, the control group was 34.4, and the p-value was 0.45. These results showed that there was no statistically significant difference between the experimental group and the control group before the intervention [t = .487, p>.05] (Table 2).

Table 2. t-test Results of Pre-test

	Groups	N	x̄	Sd	t	p
Pre-test	Control	28	34.4	2.50	.487	.45
	Experimental	33	35.1	2.13		

At the end of the concept application phase of the Learning Cycle model, students' achievements were measured as a post-test of the Recycling Achievement test for both groups. The mean score of the Recycling Achievement test of the experimental group was 81.2, the control group was 59.4 and the p-value was 0.016. According to the post-test results, there was a significant difference between the experimental group and the control group in favor of the experimental group [t = 2.17, p<.05] (Table 3).

Table 3. t-test results of Post-test

	Groups	N	x̄	Sd	t	p
Post-test	Control	28	59.4	12,8	2.17	.016
	Experimental	33	81.2	14.7		

When each question of the Recycling Achievement test was examined separately, none of the students in the control group could answer all the questions correctly, while all of the students in the Experimental group answered the 3rd, 9th, and 12th questions correctly. The students in the control group gave the most correct answers in questions 3, 12, and 15.

Question 3. Which of the following domestic waste materials can be recycled??
I. Paper, II. Glass, III. Metal, IV. Plastic
a) I-II, b) I-III, c) I-II-III, d) I-II-III-IV

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The questions with the least correct answers in both groups were questions 2 and 5, relating to metal recycling. Question 2 showed that students made mistakes with examples of recycled metals. Students generally preferred to mark the aluminum foil and car scrap options. The possible reason to marked these options is there are many car junkyards around us, so they may have felt that these scraps were left to rot there and aluminum foil is generally used as a kitchen material at home and thrown away. Question 5 is related to scientific institutions authorized by the Ministry of Environment and Urbanization. Students marked TAP and LASDER institutions.

> Question 2. Some of the recyclable materials are given below. How many of these substances are metal wastes?
> I. Beverage can, II. Aluminum foil, III. Oil tin, IV. Car scrap
> a)1, b) 2, c) 3, d) 4.

> Question 5. In our country, it is not one of the institutions authorized by the Ministry of Environment and Urbanization for waste control and recycling?
> a) LASDER (Tyre Manufacturers Association),
> b) TAP (Portable Battery Manufacturers and Importers Association),
> c) ÇEVKO (Environmental Protection and Packaging Waste Recovery Foundation Economic Enterprise),
> d) TÜBİTAK (Scientific and Technological Research Council)

There was a big difference between groups, especially in the rate of correct answers to questions 10 and 11 that relate to “recycling facilities” and “Compost”. The experimental group of students, learning by doing and experiencing, receiving information from the experts of the Recycling Facility, and their observations and inquiries during the field trip, may have provided to mark right answers. Moreover, the students understood that the recycling facility provides job opportunities by seeing the employees there and observed that recycling can be used to produce energy and contribution to the economy directly. For example;

> Question 10. Regarding recycling facilities;
> I. Newly established paper recycling facilities provide job opportunities.
> II. It reduces the amount of waste of products such as plastic and paper.
> III. It contributes to the economy,
> Which of the statements are true?
> a) I-II, b) I-III, c) II-III, d) I-II-III,

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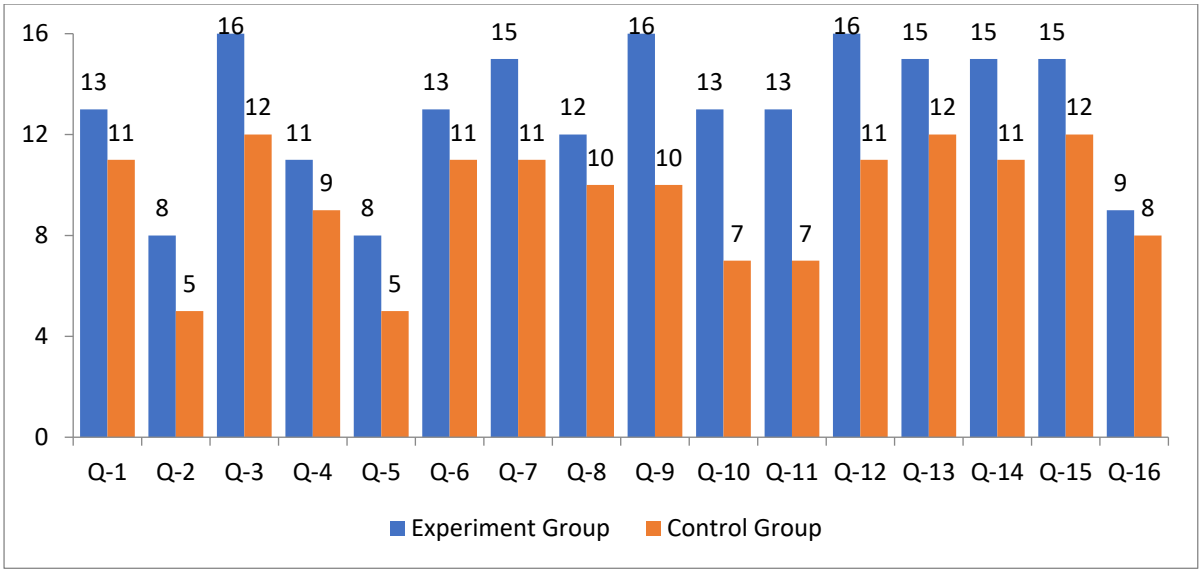

Figure 1. Results of Groups' Recycling Achievement test

When the findings of four open-ended questions about the learning environment are examined question by question, the first question was "How does it feel to be taught in such environments?" The experimental group students' answers were gathered under 7 codes. The highest code was *fun* (34.7%) and the lowest codes were *boring* (%1.4) and *don't know* (%1.4). These results showed that students generally were having a great time. Maybe only one negative thought was their tiredness (Table 4).

Table 4. Students' thoughts about Learning in the Recycling Facility

Codes	**Fun**	**Excitement**	**Tired**	**More socialization**	**More Freedom**	**Boring**	**Don't know**
Frequency	25	18	12	9	8	1	1
%	34.7	24.3	16.2	12.2	10.8	1.4	1.4

A few student thoughts on the theme of Learning in the Recycling Facility are given below.

> S3: I had a lot of fun and I think I learned new things. I saw interesting and exciting things, which made me happy
> S30: I had a very good time, and it's nice to do something together with my friends, but I have to say that it was tiring.
> S22: I think it's a very boring environment, I can't listen and write enough.

The second question was What are the things that interest you most during the trip? The responses were categorized into 5 codes, huge machines (%31.5), amazing process (%24.4), workers (%19.5), noise (%13.4), and mess (%12.2). The structure and operation of the recycling facility were the most important features that remained in the minds of the students during the field trip. Additionally, the fact that the recycling facility was a bit messy and noisy due to the workload did not escape the attention of the children (Table 5).

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Table 5. Interesting things in the Recycling Facility

Codes	Huge machines	Amazing process	Workers	Noise	Mess
Frequency	25	20	16	11	10
%	31.5	24.4	19.5	13.4	12.2

Some student thoughts on the theme of Interesting things in the Recycling Facility are given;

> S17: It was astonishing how huge machines in the recycling facility compacted that plastic and paper garbage and made it so tiny.
> S9: How many people are working in the recycling facility, on the one hand, they separate the chips with their hands, and on the other hand, they throw them into the big machines.
> S22: Very useful work is done in the environment, but they are dealing with noisy and messy things and also very dirty things.

The next question was How is it different from the courses you teach at school? Students liked learning in the recycling facility more than learning at school. Because their experience in the recycling facility environment shows that they are completely different from their school learning life. In particular, they see the benefits of the informal learning environment as they use their 5 senses more, get information about the profession (jobs) on-site, and the process is more fun. Only two kids thought no differences between school and informal environments (Table 6).

Table 6. Compering Learning Between School and Informal Environment

	Better learning	Touch & See	Detailed information	More fun	Difference learning method	Realize the Jobs	No difference
Frequency	27	23	17	16	10	7	2
%	26.5	22.5	16.7	15.7	9.8	6.9	1.9

Some examples of student thoughts about the theme of comparing learning environments;

> S15: I definitely choose to learn in such environments because we can really see and touch different things with our eyes, so we can see the details. Only pictures from the computer are shown at school. It's more fun here.
> S18: I prefer to learn in these types of environments because we learn by touching and seeing and I don't know that recycling is a profession. People made money from this work.

The last question was Would you like to teach in such environments again?, Majority of the experimental group of students have positive thoughts to visit and learn these types of learning environments. It was observed that only 4 students (%12.1) think neither positively

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nor negatively about which learning environments they prefer, and only 1 student (%3.1) prefers to learn at school (Table 7).

Table 7. Willingness to Learn Again in these Types of Environments Again

	Yes	Both of them OK	Doesn't matter	No
Frequency	20	8	4	1
%	60.6	24.2	12.1	3.1

Here are some thoughts from students;

> S11: I definitely prefer to learn in informal settings, because it's fun and we see so many different things that we can't see in school, and changes are nice.
> S22: It doesn't matter to me I'm working and learning everywhere

The lessons taught in the informal learning environment have more positive effects than the lessons taught at school. The difference is due to the ideal learning opportunity offered to students by informal learning environments where appropriate conditions are tried to be provided.

Many of the studies showed that if a good lesson plan is prepared; if students can actively question and discuss with friends; and if students can reach information by exploration and/or the guidance of experts during the field trip, students have meaningfully learned at cognitive and affective levels (Anderson et al., 2003; Ash, 2003; Çil et al., 2016; Griffin, 2004). Bultitude & Sardo (2012) defined the "participation of scientific experts", "comfortable atmosphere" and "direct interaction with the concepts" as factors, which were effective in the academic success of the students since these factors were fulfilled during the visit to the recycling facility.

4. CONCLUSION

In this study with this field trip, the experimental group of students increased their academic success more than the control group. They have higher success in all questions of the academic achievement test. The biggest differences between groups in questions 10 and 11 related to "recycling facilities duties" and the concept of "Compost". The possible reason students of the experiment group observe and inquire in the real environments. The part where academic success was low in both groups was that they could not remember the names or abbreviations of scientific recycling institutions. The scientific recycling institutions' names are long and really hard to memorize their abbreviations', such as LASDER (Tyre Manufacturers Association), TAP (Portable Battery Manufacturers and Importers Association), ÇEVKO (Environmental Protection and Packaging Waste Recovery Foundation Economic Enterprise), and had positive emotional feelings about learning in informal learning environments. In addition, the fact that the lessons taught in these types of environments are more entertaining, because they appeal to the 5 senses, learn and socialize with their friends, and are also informed about the professions. Thus those made them happier. The negative things to be said against learning in these types of environments are that the process is tiring and the environments visited maybe not be as clean as school and school gardens. Of course, it should not be forgotten that this view is more related to the destination. It should also be

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noted that such results were not found in learning studies conducted in institutional environments, such as museums, science centers, and aquariums.

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