ORIGINAL ARTICLE

The Effect of Informal Learning Environment on Learning Wastes and Recycling: The Case of Glass Bead Atelier

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***Abstract**: Informal learning supports formal education by facilitating students' learning and helping them to expand their knowledge outside the classroom. This paper explores the impact of informal learning environments on learning outcomes. This study aims to answer the question 'How does the use of informal learning environments within the scope of formal learning affect students' academic achievement and their views on this learning environment?' Fort is purpose, students were taken to Atelier of Making of Glass Artand Beads in the process of teaching the acquisition of "Explains the importance of recycling and recovery" in the 8th grade Environmental Education and Climate Change course. This trip was made in the exploration phase of the 4E teaching model, one of the student-based models of the constructivist approach. At the end of the learning process, the effect of teaching the acquisition in an informal learning environment on students' academic achievement and students' opinions about this environment were examined. A mixed design was adopted in the study. The students participating in the study were selected from a public school in small district of one of the metropole city in Turkiye through purposive-judgmental sampling. Two of the 8th grade classes in the school were randomly selected and 60 students were included in the study, one of which was the experimental group (29) and the other was the control group (31). The Recycling and Recovery Achievement test was used for quantitative data and 6 open-ended questions about informal learning environment were used for qualitative data. Mann-Whitney U test was used to analyze quantitative data and*

descriptive analysis was used to analyze qualitative data. As a result of the analyses, it was concluded that the Recycling and Recovery achievement mean scores of the experimental group students were higher than the control group, and this result was supported by the positive opinions of the students about the informal learning environment.

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Introduction

Human beings continue to learn and teach throughout their lives. These processes do not only take place at school; information stimuli can appear anywhere at any time. Information can be transferred from friends, family, visual or written media (Türkmen, 2010). What important thing is here that the learner actively internalizes the stimulus. In fact, the most effective learning is the learning that the learner actively experiences and is involved in the process. In this context, it is recommended to use teaching models such as learning cycle, 4E, 5E, 7E, which are based on constructivist learning approach and developed in a way to enable students to use scientific thinking skills by doing in the teaching and learning process (Bıyıklı & Yağcı, 2014). These models increase the learner's motivation and curiosity to learn and cause the learner to exhibit scientific behaviors in the process, as well as creative and critical thinking, metacognitive thinking, improvement in scientific process skills and positive attitudes towards learning scientific subjects (Singer & Moscovici, 2008). Another factor that causes these positive gains in the learner is the learning environment. Research suggests that informal learning environments are the most appropriate environment in which students play a more active role(Dawson, 2014; Demirel & Özcan, 2020; Görecek Baybars, 2017; Hacker & Miller, 2016; Katırcıoğlu, 2019; King & Howard, 2014; Sellmann & Bogner, 2013; Stocklmayer, Rennie & Gilbert, 2010).

It is argued that by establishing a mutually reinforcing link between formal learning and informal learning in schools, students can move away from memorizing information and access information on their own. In addition, individual and peer inquiry in informal learning environments is thought to increase learning (Hung, Lee & Lim, 2012). With the understanding of sustainability in education coming to the forefront in today's education, the view that education cannot be limited to school environments has come to the fore (Brown, 2019; King & Howard, 2014). In addition, it is seen that the lessons taught in informal learning environments increase children's interest in science, and they want to choose science-related courses in their future education life and even progress in science-related fields in their career choices (Bonnette, Crowly, & Shunn, 2019).

At this point, it is seen that many studies have been conducted in our country on informal education and its effect on learning. Such as, Türkmen (2018) revealed in his study that the trip to the Natural History Museum for the 5th grade "Fossils" subject increased the academic achievement of the students, and that the students conducted research together like scientists and provided a high learning motivation. Metin and Bozdoğan (2020) stated that the planetarium trip in the exploration phase of the 5E model within the scope of the 7th grade "Earth and the Universe" subject caused a significant

increase in students' academic achievement, interest level and motivation. Özcan and Kara (2024) stated that informal learning experiences within the scope of the 8th grade "Wastes and Recycling" subject increased student achievement and had positive effects on students' acceptance of informal learning environments.

In addition, there are many study results showing that learning experiences offered to students in informal learning environments increase success in "recycling, waste control and environmental education" (Görcek Baybars, 2017; Türkmen, 2023). Dori and Tal (2020) mentioned the potential of projects carried out in informal learning environments in raising students' awareness of environmental issues and stated that these projects encourage students to take an active role in the decision-making process and participate in environmental activities. In our country, the main purpose of the Environmental Education and Climate Change course, which was included as a course in the primary education curriculum in the 2023-2024 academic year, is to raise individuals who play an active role in environmental problems and to enable permanent learning in this regard. In addition, there are special objectives such as providing opportunities for students to experience environmental problems closely and to produce solutions to these problems through trips to informal learning environments in their immediate surroundings (Ministry of National Education, 2022).

The aim of this study is to investigate the effect of teaching the "Wastes and Recycling" topic of the 8th grade environmental education and climate change course in Nazarköy Glass Bead Workshop, which is an informal learning environment, on students' academic achievement and to learn students' thoughts about this learning environment. Izmir Nazarköy Glass Bead Atelier has been producing glass ornaments and evil eye beads in Nazar Boncuğu furnaces since 1950. Many different items are produced with the skill of the masters from glass that melts at an average temperature of 800-1200 degrees. The craftsmen, who spend 10-12 hours a day in front of the fire, color the melted glass with substances such as cobalt, copper oxide, opaque and lead. Then they shape the melted glass with specially made mercury steel rods coming out of the furnace. In the atelier excursion programs, students have the chance to get information by visiting the bead furnaces, ask questions to the masters while watching the production and make applications themselves.

For this purpose, the 8th grade Environmental Education and Climate Change lesson "Wastes and Recycling" was taught using the 4E teaching model. The 4E teaching model consists of four successive phases: Exploration, Explanation, Extension, and Evaluation. The first phase, Exploration, is the step where students have extensive experience with the concepts to be taught. Teachers ask questions to guide students' thinking and interpretation of the concepts. Students collect data using scientific process

skills. In the second phase, the Explanation step, students make inferences based on the data they collect and reach scientific knowledge with teacher guidance. The third phase, Expansion, involves students applying what they have learned to new and different situations and making connections with life. The last phase, Evaluation, involves evaluations that are intertwined with the process. The teacher questions students' learning and identifies possible deficiencies (Özmen, 2008).

This study, in the context of the selected informal learning environment, is important in terms of students having knowledge about the recycling of glass, which they frequently encounter as waste in daily life, making glass production practically in the glass bead atelier, looking at the concept of waste in their environment from a different perspective and making the use of waste for various purposes into action.

Method

In this study, mixed research method was used. The reason for using mixed models is the principle of Complementarity as defined by Greene, Caracelli and Graham (1989). Because Complementarity reason is qualitative and quantitative data were used together to help the researcher fully understand the research problem and explain the result clearly. Explanatory design from mixed methods was used in this study. First, quantitative data were collected. In the quantitative dimension of the study, a quasi-experimental model with pre-test post-test control group was used to investigate the effect of informal learning environment on student achievement, and the data collected were compared and analyzed in SPSS Program. Then, in the qualitative dimension of the research, a case study was conducted in which students' ideas and opinions about informal learning environments were taken. In this way, after comparing student achievements, student opinions about the learning environment were obtained (Büyüköztürk et al., 2011)

Study Group

As the research study group, a public school in small district of one of the metropole city in Turkiye was determined by purposive sampling. Of the 6 randomly selected branches, one experimental group consisted of 29 students and the other control group consisted of 31 students.

Data Instruments

Within the scope of the 8th grade "Environmental Education and Climate Change" course, the researchers developed an achievement test containing 15 multiple-choice questions related to the outcome "Explains the

importance of recycling and recovery in terms of sustainable development". The developed test was examined by 2 academicians and 3 field teachers in order to get expert opinion before the pre-application and necessary arrangements were made and applied. In the pre-application, 5 items with low discrimination index were removed. The Cronbach α reliability coefficient of the remaining 10-item multiple-choice achievement test was calculated as 0.70. As a result of the item analysis of the questions constituting the test, the average difficulty index of the test was calculated as 0.74 and the discrimination index as 0.47. Thanks to these steps, it is believed that the achievement test developed will have an inclusive and harmonious relationship with the learning outcome content (Akbulut & Çepni, 2013).

In the qualitative part of the mixed design research, interview questions consisting of 6 open-ended questions that the students would answer at the school after the trip were organized in line with same experts' opinions and applied and evaluated after the content validity was ensured.

Data Collection Process

The place chosen for the trip was a place that the researcher had visited before, and it was found to be associated with the selected outcome since all stages such as the production of evil eye beads from waste glass, the supply and transformation of these wastes were within the scope of workshop activities. During this visit, a pre-trip interview was made with the atelier staff who would help the students, and a lesson plan was prepared accordingly by obtaining the necessary information such as day, time, environment, and materials used. The necessary permissions were obtained from the school and parents before the trip and then the trip plan was created. The achievement test developed by the researchers was applied to the experimental and control groups as a pre-test before the exploration phase of 4E. In the lesson, the control group students performed the exploration phase of 4E in the classroom, while the experimental group students performed it in Nazarköy Glass Bead Atelier. While the control group students were shown pictures related to the subject in order for the students to reach scientific knowledge in the exploration phase, the experimental group students were asked 5 research questions prepared before the trip (**Table 1**). These research questions are:

1. What are the important points to be considered in the reprocessing of glass?
2. What kind of materials are preferred as raw materials in bead making and what are the reasons for this?
3. Where are these materials sourced from? How do the atelier staffs collect these materials?

Table 1. Data Collection Process

	Exploration	Explanation	Expansion	Evaluation
Experiment Group	* Pre-Test, * Research, * Bead Atelier * 2 Hours	* Scientific Knowledge * Classroom *1 Hours	* Preparing Materials & Posters * Classroom *2 Hours	*Subject Repetition * Post-Test, * 6 Interview Questions * Classroom *3 Hours
Control Group	* Pre-Test, * Research, * Classroom * 2 Hours	* Scientific Knowledge * Classroom *1 Hours	* Preparing Materials & Posters * Classroom *2 Hours	*Subject Repetition * Post-Test * Classroom *2 Hours

4. List the process of making evil eye beads?
5. What is the importance of evil eye bead making, which is one of the important examples of artistic transformation, in terms of the environment you live in?

In this way, the students were enabled to take an active role in the process, while the teacher's observations and guidance helped them to realize the concepts related to the subject. In the control group, in the Exploration phase of the lesson, concept realization was carried out in the classroom environment with questions and visual materials. Then, in both the experimental and control groups, the Explanation, Expansion and Evaluation phases were applied in the classroom environment. The Explanation and Expansion phases lasted two class hours each in both groups. In the explanation step of the experimental group, the students organize the data obtained from the previous step, that is, the research questions they answered during the trip, with the help of the teacher and present them to the class and interpret the findings they have collected. The teacher gives the scientific equivalents of these concepts while the students construct the concepts and topics with their own words. In the explanation step of the control group, this process proceeds through the student inferences made about the visuals (waste bins, waste collection facilities, etc.) shown in the discovery step. In the Expansion phase, students in both groups designed materials and posters using recycled materials. In this step, which was carried out as a group work, both recycling materials were used and posters were prepared to draw attention to this issue in the school environment and raise awareness. Thus, students had the opportunity to transfer what they learnt to a different situation. The Evaluation phase lasted 2 hours and the test was applied as a post-test to both groups and the subject was repeated. In addition, 6 interview questions were given to the experimental group as written form before the new topic was introduced. Then the students were asked to answer the questions in one

Table 2. Comparison of Achievement Pre-Test Scores Between Experimental and Control Groups.

Test	Group	N	Mean	Mean rank	Sum of rank	Mann Whitney U	Z	p
Pre-test	Experiment group	29	74.83	30.17	875	440	-0.14	0.886
	Control group	31	75.48	30.81	955			

class hour. In total, the research lasted 8 lessons in the experimental group and 7 lessons in the control group.

Data Analysis

For the analysis of the quantitative data, firstly, a normal distribution test was performed on the achievement test data before the comparison of the experimental and control groups before and after the application. Accordingly, it was concluded that the achievement test data did not show normal distribution in line with the analysis values of the Shapiro-Wilk test ($W = 0.821$, $p < 0.05$). For this reason, it was decided to use the nonparametric Mann-Whitney U test to compare the data obtained from the achievement test. Content analysis was used to analyze qualitative data. In content analysis, the data were first coded, themes were created, codes and themes were organized, and the findings were defined and interpreted.

Findings

In line with the analysis of the data, the findings are presented under two headings.

Findings from the Achievement Test

It was applied as a pre-test to determine the achievement status of the students in the two groups before the lesson and the data obtained were analyzed by Mann-Whitney U test. According to the Mann-Whitney U test results, it was found that there was no statistically significant difference between the experimental and control groups in the achievement test scores of waste and recycling before the lesson. It was concluded that the mean values of the two groups in terms of achievement (experiment group; 74.83, control group; 75.48) were in the same range ($U = 440$, $p > 0.05$) (**Table 2**).

Based on these results, the achievement test was applied as a post-test to determine whether there was a difference in the level of academic achievement between the experimental group and the control group after the

Table 3. Comparison of Achievement Post-Test Scores Between Experimental and Control Groups.

Test	Group	N	Mean	Mean rank	Sum of rank	Mann Whitney U	Z	p
Post-test	Experiment group	29	87.24	35.64	1033.5	300.5	-2.26	0.024
	Control group	31	80.00	25.69	796.5			

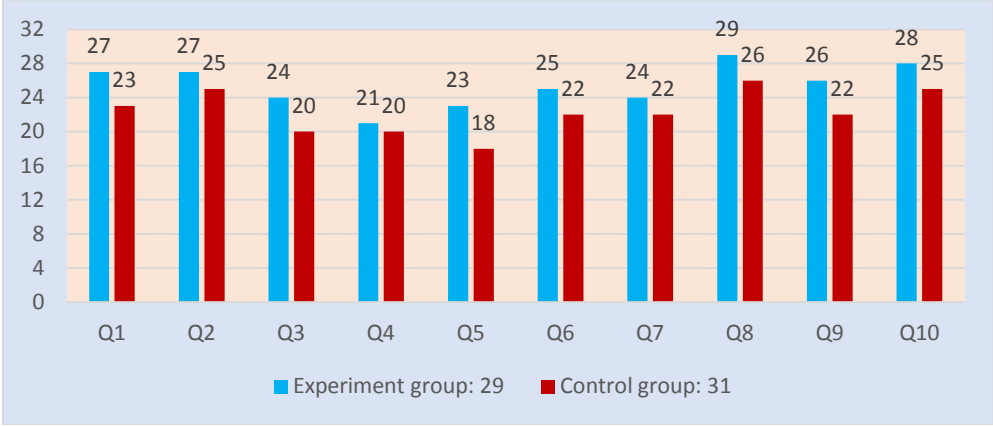

Figure 1: Achievement Test Correct Answer Frequencies.

application. The academic achievement of the students increased for both groups after the applications. While the mean value of academic achievement of the experimental group students increased from 74.83 to 87.24, the mean value of academic achievement of the control group students increased from 75.48 to 80.0. According to the results of the Mann Whitney U test, there was a statistically significant difference in the academic achievement post-test scores between the experimental and control groups ($U = 300.5$, $p < 0.05$) (**Table 3**).

The statistically significant difference was in favor of the experimental group. In other words, the subject taught using the informal learning environment had a significant effect on students' academic achievement in a more positive direction than the course taught in the classroom (**Figure 1**).

When the achievement test questions were analyzed separately, all students of the experimental group answered the 8th question correctly, while all students of the control group could not answer this question correctly, but it was the most correctly answered question of the group.

Similarly, in the experimental group, the most correctly answered questions were 1. question (27 students), 2. question (27 students) and 10. question (28 students), while in the control group, the most correctly answered questions were 2. and 10. questions. These findings show that the learning environment was used effectively in the learning of scientific knowledge in both groups, but in the experimental group, the glass making process observed in the informal environment made a difference in favor of the students. For example;

Question 8: Which of the following wastes can be recycled completely?

A) Cigarette butts B) Waste oil C) Copper wire D) Glass jars

Question 2: Which of the following is a non-recyclable material?

A) Petroleum B) Plastic C) Tin cans D) Newspaper

Question 4 had the least number of correct answers in the experimental group (21 students). Among the control group students, questions 3 (20 students), 4 (20 students) and 5 (18 students) had the least number of correct answers. The reason for this may be that especially the 4th and 5th questions include the skills of establishing a relationship with daily life, supporting and interpreting the scientific concept that is aimed to be acquired, in other words, they are based on the analysis step of Bloom's cognitive taxonomy. For example;

Question 4: An electric car is an exhaust-free automobile driven by one or more electric motors using electricity stored in batteries and other energy storage devices. Which of the following statements about electric cars is incorrect?

A) The use of electric cars helps to reduce environmental problems.

B) The use of electric cars benefits the national economy in terms of sustainable development.

C) The use of electric cars is an innovative and environmentalist project in terms of economical use of resources.

D) The use of electric cars further slows down the recycling process in the country.

The question with the highest difference between the two groups in the correct answers given to the achievement test is 5th question. Although the number of correct answers of the students of the two groups was not very high in this question, the difference in favor of the experimental group (23 in the experimental group, 18 in the control group) is observed. The reason may

Table 4. Student Views on the Learning Contribution of the Field Trip.

Code	Sample	N	%
Acquiring new knowledge	S1: Yes, it did, I learned how it is done and how important recycling is.	15	50
Reinforcement of knowledge	S22: Yes, it helped me remember the transformation process of glass.	12	40
Ease of learning with practice	S14: Yes, it did, I understood the bead making process more easily when I watched it live and did it.	3	10

be that the information about the process in the question was repeated frequently by the craftsmen in the glass bead atelier.

Question 5: Which of the following is not expected to happen when recycling is done successfully in a country?

A) Since waste will decrease; environmental pollution is expected to decrease.

B) It is expected to contribute positively to the country's economy.

C) Products with reduced production costs are expected to be sold at higher prices.

D) The space required for waste storage is expected to shrink.

Findings from the Interview Questions on Informal Learning Environments

At the end of the course taught with the 4E teaching model, the students in the experimental group were given a form consisting of 6 open-ended questions to analyze their opinions about their experiences in the informal learning environment (related to the process in the Glass Bead Atelier). Firstly, the question "Did the visit to Nazarköy bead workshop contribute to your learning? Explain briefly." and all of the students expressed their positive opinions. The codes for their thoughts are "acquiring new knowledge" (50%), "reinforcement of knowledge" (40%) and "ease of learning with practice" (10%) (**Table 4**).

When the students were asked the question "How did you feel during the visit, how does it feel to teach in this way?", 86.5% of the answers were positive emotions, among which the state of being 'excited and joyful' came to the fore with 53.3%. While the percentage of expressing negative feelings was 13.5%, 50% of them expressed their thoughts about the temperature of the workshop environment and the remaining half about the working conditions of the craftsmen (**Table 5**).

When the students were asked the question "Were you able to find answers to the questions given by your teacher and/or the questions you had

Table 5. Students Emotional States in the Field Trip.

Theme	Code	Sample	N	%
Positive emotions (86.5%)	Excited and joyful	S28: It was very funny and exciting, I felt happy when I learned in this way.	16	53.3
	Willing to learn	S11: It was very nice to learn this way, let all lessons be like this.	5	16.7
	Surprising	S6: I may have been very surprised, the recycling of the beads created this feeling in me.	5	16.7
Negative emotions (13.5%)	Hot/Sweltering	S24: It was very hot inside, I felt overwhelmed by the heat.	2	6.7
	Exhausting	S13: Listening and trying to learn in a hot environment and the journey was tiring	1	3.3
	Sorrow for the hardships of the craftsmen	S7: It is very difficult for the craftsmen to work in that heat, I was upset about this situation.	1	3.3

Table 6. Students' Views on the Methods of Finding Answers to the Questions They Have in Their Minds / Questions Given by the Teacher in the Field Trip.

Code	**Sample**	**N**	**%**
Consultation with teacher/glass craftsmen	S10: Glass craftsmen answered all my questions very well.	12	40
In-group discussion	S13: I found the answer to a question I had while talking to my friend.	8	26.6
Both of them	S30: Both craftsmen and friends helped me find answers to my questions.	10	33.4

during the field trip and what did you do for this?", the codes "Consultation with the teacher/glass craftsmen" and "In-group discussion" were reached as a result of the answers given by the students. It is seen that 10 students gave answers including both codes. The rates of these codes are presented in **Table 6**.

When the answers to the question "What were the things that interested you the most during the trip?" were examined, it was realized that some students mentioned more than one interesting situation. The most interesting situation for the students was "the bead making process" with 38.48%, the second was "the temperature of the bead furnace and the environment" with 30.76%, while "the challenging conditions of the work" and "evil eye bead looms" were the other elements that attracted the attention of 15.39% of the students (**Table 7**).

The students were asked the question "What do you think is the difference between learning with this field trip and learning in a regular classroom?" and the students' answers regarding the difference between the

Table 7. Situations That Attracted the Students' Attention During the Field Trip.

Code	Sample	N	%
The Evil bead making process	S8: I was very interested in the stages of evil bead making and the colorful bead looms.	25	38.48
The temperature of the bead furnace and the environment	S29: It was very hot, I don't know how the craftsmen endure it	20	30.76
The challenging conditions of the work	S5: It is very difficult to work in this heat	10	15.39
The evil eye bead looms	S2: The process of cooling the beads on the looms	10	15.39

Table 8. Students' Views on the Difference Between Learning by Field Trip and Learning in the Regular Classroom.

Code	Sample	N	%
Funny	S18: Learning is sometimes fun in the classroom, but not as permanent.	14	46.6
Effective and permanent	S25: It is more effective to teach in such environments	7	23.3
Contributed to scientific process skills	S25: It was nice to be free when we wanted to make observations and ask questions.	3	10
Easy learning environment	S3: Classrooms have a closed and gloomy atmosphere and I can't focus on the lesson when they are talking in class, I gathered my attention more easily outside.	3	10
Challenging learning environment	S27: The environment was warm, I could understand more easily in the classroom.	2	6.6
No difference	S30: They are all the same for me, I can learn in both.	1	3.3

two learning environments were analyzed. Accordingly, 46.6% of the students found the field trip visit "funny", 23.3% found it "effective and permanent", 10% found it "contributed to scientific process skills" and 10% found it "easy learning environment". In addition, 6.6% of the group stated that the conditions of the workshop environment were "Challenging learning environment", while only 3.3% of the group, i.e. 1 person, stated "No difference" (**Table 8**).

When the students were finally asked the question "What do you think are the negative aspects of teaching with this kind of excursion visit?", 39.3% of the students said that there were no negative aspects, while 26.4% of the students stated the "physical conditions of the learning environment (temperature, width, etc.)", 13.2% stated that the "environment was tiring (standing)", 13.2% stated the "danger of traveling (traffic)", 7.9% stated that "the aim was to have fun rather than learning" (**Table 9**).

Table 9. Student Responses Regarding the Negative Aspects of Teaching the Lesson with Field Trips.

Theme	Code	N	%
Yes	Physical conditions of the learning environment (temperature, width, etc.)	10	26.4
	Learning environment was tiring (standing)	5	13.2
	Danger of traveling (traffic)	5	13.2
	The aim was to have fun rather than learning	3	7.9
No negative opinion		15	39.3

Conclusion & Discussion

In this study, the effect of using informal learning environments on student academic achievement level and student opinions on the use of informal learning environments in teaching the concept of "Wastes and Recycling" to 8th grade students within the scope of "Environmental Education and Climate Change" unit in science course were examined.

In this context, while there was no significant difference between the pre-test academic achievement averages of both the experimental and control groups before the lesson, the post-test achievement average of the experimental group was significantly higher after the lesson, and it is seen that informal learning environment activities that support formal learning positively affect learning.

There are many experimental studies in the literature that support this conclusion and show the positive effect of informal learning on academic achievement. Bozdoğan and Yalçın (2006) conducted an experimental study with 6th and 7th graders in the Energy Park and found that there was an increase in students' interest in science and academic achievement, and mentioned the positive effects of the tools and activities in the informal learning environment. Göğebakan (2008) states that the experience of seeing objects live and having information about them by seeing them provides the permanence of knowledge. Türkmen, Topkaç, and Atasayar Yamık (2016) took 5th grade students to Ege University Natural History Museum in the process of teaching the subject "Classification of Living Things and the Environment We Live in" within the scope of science course and concluded that informal learning environments had a positive effect on students' learning. Türkmen (2023) found in his study that the use of the Recycling Facilities in teaching 7th grade students the concepts of "household waste and recycling" increased the academic achievement of the students more than the lessons taught in the classroom. Özcan and Kara (2024) also stated that informal learning experiences on "waste and recycling" increase student

achievement by providing on-site learning, learning from experts and free learning experiences. In this context, there should be a separate course that includes topics related to Environmental Education and/or the lessons should not remain at the theoretical level in schools and should be taught in the form of field trips accompanied by questions that students can actively seek answers in order to increase the level of impact and permanence by transferring it to daily life (Güler, 2013).

After examining the student achievement levels within the scope of the study, the opinions of the students about the course taught in the informal learning environment were also taken, and in this direction, it is seen that the students primarily emphasized the positive aspects of informal activities such as fun, effective and permanent, and facilitating knowledge. While this situation is in line with the literature, there are similar studies in which students talk about the positive effects of informal learning environments. Kulalıgil (2016) states that teaching practices in informal learning environment increase students' motivation towards science learning, and the reason for this is that it attracts students' interest, arouses their curiosity, increases their willingness to learn, and reduces their anxiety about informal learning environments. The students in Demirel and Özcan's (2020) study stated that the trip to the Tropical Butterfly Garden was a very good experience that was fun, instructive, interesting and intriguing.

It is seen that students participating in informal learning activities are also negatively affected by the physical conditions of the informal learning environment such as temperature and crowd. The opinions expressed by the students in this context point to the disadvantage sub-theme of informal learning environments stated in Ocak and Korkmaz's (2018) study. In order to minimize these negativities, the conditions of the environment should be taken into consideration in the planning section and students should be provided with preliminary information about the environment (Baybars, 2017; Türkmen, 2018).

The students' consultation with experts (craftsmen) or in-group discussions while searching for answers to their research questions during the trip provided opportunities such as directing students to cooperation and supporting their scientific process skills. When the literature is examined, the importance of informal education in terms of increasing students' interaction with the environment, accessing and structuring knowledge is frequently emphasized (Açıkgöz, 2006; Dori & Tal, 2000; Öner & Güneş, 2017; Türkmen, Topkaç & Yamık, 2016). When this situation is considered in terms of environmental education, there are studies indicating that providing students with additional learning experiences in subjects such as recycling, environmental science and taking an active role in environmental issues increases success (Dere & Çinikaya, 2023).

Another striking result of the research is the students' responses in the form of acceptance of informal learning environments. As can be understood from the fact that they stated that they would like to come more often and in other lessons, it was concluded that informal learning environments are not preferred by teachers in formal education institutions despite their many positive effects. The reason for this situation may be that teachers do not prefer informal learning environments due to factors such as time, space, economic conditions, leave processes, and process dominance, as stated in Türkmen (2016).

As a result, in this study, the informal learning activities planned and applied in the Exploring phase of the 4E learning cycle made a positive difference in the academic success of the students, and it was determined that their opinions mainly included positive statements including qualities such as fun, facilitating, permanent. The fact that the students remained active in the process in a way to seek answers to the research questions within the plan in the informal learning environment enabled them to "take an active role in environmental problems", which is one of the main objectives of Environmental Education, and played an important role in increasing success.

Limitations

In terms of the limitations of the study, the long-term results of learning could not be evaluated because the implementation period was short. The scope of the study was limited to the subject of "Waste and Recycling" and other environmental education topics were not examined. Since the study covered a specific age group, the learning effects in different age groups were not evaluated. Finally, the findings are limited to a study conducted with students in a specific region and cannot be generalized to students in different geographical regions.

Recommendations

In line with the results of the research and limitations, the following suggestions can be made.

- Students can be given preliminary information about the informal learning environment to be visited in order to prevent possible negative feelings and situations that may arise in students about the environment.
- For an effective "teaching in informal learning environments", it is thought that teachers who will plan and implement it should be informed about pre-trip preparation, planning and post-trip evaluation, and for this purpose, environments that will

encourage teachers more should be created. In particular, in-service courses and seminars should be organized to explain the importance of making trips for teaching purposes.

- Since concepts such as recycling, recycling, waste reduction are intertwined concepts, it is thought that it is important to increase informal learning environment studies such as Glass Bead workshop in order for students to comprehend these concepts in depth and to acquire principles by associating them with daily life. However, in these environments, the information should not be transferred directly to the student, but the student should reach the information by using scientific process skills himself/herself in a way that they can be active, that is, by doing and experiencing. Without ignoring this situation, it is recommended that the environments should be organized and supported, if possible, in consultation with authorized persons.
- Research to be conducted in different informal learning environments that do not find much place in the literature from daily life (effectively and correctly matched and planned with the course curriculum) can bring a different perspective to education.

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APPENDIX

ENVIRONMENTAL ACADEMIC ACHIEVEMENT TEST

Question 1. Which of the following is the leading cause of environmental pollution?

A) Humans B) Plants C) Animals D) Inanimate beings

Question 2: Which of the following is a non-recyclable material?

A) Petroleum B) Plastic C) Tin cans D) Newspaper

Question 3. Environmental pollution poses a threat to which of the following?

A) People living in undeveloped countries

B) People living only in cities

C) Only wild animals

D) All living things on earth

Question 4: An electric car is an exhaust-free automobile driven by one or more electric motors using electricity stored in batteries and other energy storage devices. Which of the following statements about electric cars is incorrect?

A) The use of electric cars helps to reduce environmental problems.

B) The use of electric cars benefits the national economy in terms of sustainable development.

C) The use of electric cars is an innovative and environmentalist project in terms of economical use of resources.

D) The use of electric cars further slows down the recycling process in the country.

Question 5: Which of the following is not expected to happen when recycling is done successfully in a country?

A) Since waste will decrease; environmental pollution is expected to decrease.

B) It is expected to contribute positively to the country's economy.

C) Products with reduced production costs are expected to be sold at higher prices.

D) The space required for waste storage is expected to shrink.

Question 6: A group of researchers are preparing an article on the benefits of a successful recycling process. An excerpt of their paper is given below.

" With paper and derivative wastes recovered through successful recycling, approximately 4.100.000 trees can be prevented from being cut down. Similarly, 7.200.000.000.000 liters of water can be saved with recycled paper and derivative wastes. In this way ..... "

According to this, the parts left blank in the rest of the article can be filled with which of the following options?

A) Effective savings are achieved.

B) Extra energy is consumed during recycling.

C) There is a loss of quality in recycled products.

D) The need for raw materials increases.

Question 7: Which of the following is more compatible with the message intended to be conveyed in the next poster?

A) Increasing the use of raw materials by giving importance to recycling

B) Not using energy from renewable energy sources

C) Increasing activities on zero waste, conscious society and conscious consumers

D) Establishment of new industrial facilities in each city to ensure sustainable development in line with the desired plan

Question 8: Which of the following wastes can be recycled completely?

A) Cigarette butts, B) Waste oil, C) Copper wire, D) Glass jars

Question 9: Which of the following activities related to waste is different from the others?

A) Collecting and recycling electronic waste

B) Throwing old books and notebooks in the recycling bin

C) Reuse of waste glass by melting

D) Obtaining fuel from waste in an oxygen-free environment

If the sentence given below is true, mark it with D, if it is false, mark it with Y.

Question 10: (D) Recycling of wastes contributes to the national economy.