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The Impact of Out-Of-School Learning Environments on the Academic Success of Students in Terms of Science Education: Hydroelectric Power Plant Trip Case Study*

Research Article

Mustafa BULBUL[1], Serif Ali DEGIRMENCAY[2]

[1]*Giresun University, İnstitute of Science, Giresun, Turkey,* ORCID: 0000-0002-4464-3804

[2]*Giresun University, Facultyof Education, Department of Mathematics and Science* Eeducation, Giresun, Turkey, ORCID: 0000 0003 1528 7406

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ABSTRACT

This study is conducted to identify the impact on learning of a planned trip to a hydroelectric power plant, which is among the informal learning environments. The experimental method with pretest-posttest control group, which is one of the quasi-experimental research designs, is used in this study. 37 eighth grade students are included in the study in total, which was carried out in the academic year of 2015-2016. 19 of the students were in the experimental group and 18 of them were in the control group. Academic success test on the "Electricity in Our Life" subject developed by the researchers is used to derive the data. The measurement tool prepared consists of 21 questions and its KR-21 reliability coefficient is 0.82. In this study, Mann Whitney U and Wilcoxon Test are used to analyze the data. As a result of the study, it is concluded that there is a significant difference between the pre-test academic success scores and post-test academic success scores of the students participating in the trip in favor of the post-test.

Keywords:

Primary Education, Informal Learning with Trips, Formal Learning Trip, School Trip, Hydroelectric Power Plant

Introduction

During the period when education was not institutionalized as it is in recent years, it was a phenomenon where people shared information with each other or tried to teach by showing to each other. Education has a more institutional structure today and is being defined as the process of intentionally making a desired change in the individual's behavior through his own life (Erturk, 1972). Education ensures that individuals are able to

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Corresponding author's address: Giresun University
Telephone: +905434096109
e-mail: serifali.degirmencay@giresun.edu.tr

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follow the developing and rapidly changing information and thus have qualified knowledge. As a result, an individual who has education becomes different. The reason for such differentiation is the knowledge, skill, attitude and values acquired. Schools have a significant part in terms of education. However education is not only carried out in schools (Fidan, 2012).

Education consists of two parts. The first part is formal education, which is carried out according to a specific plan within the framework of predetermined goals, and the second part is informal education, which takes place spontaneously within life. Informal learning can be defined as learning that occurs outside the classroom/school (Lacin Simsek, 2011). Although formal education is so important as it is pre-planned and acted according to a certain purpose, it is observed that the permanence increases when it is supported with informal education environments (Balkan Chopper & Atabek Yigit 2010; Chin, 2004). There is a realistic link between formal and informal education. One of the important aspects of informal education is observation and imitation. Observation in informal environments is very important in science education (Fidan, 2012). That is because most cases and events are easier to learn with observable concrete activities. Informal educational environments used in science education are science centers, zoo, botanical park, forest lands, libraries, aquariums, and nature centers (Bozdogan, 2007).

Subjects of science classes include many events we encounter in daily life. However, the abstraction of these subjects intimidates the students and as a result, reduces learning. Students' capability to reflect the abstract concepts of science to daily life can provide meaningful learning by embodying science education.

Learning dimension takes place at every stage of our lives. In these days, where information production and access are much easier, we can create a learning situation within every moment of our lives . Effective use of out-of-school learning environments in science education as an embodying step can make students' learning more permanent by observing, doing and living (Lacin Simsek, 2011). Besides, learning includes emotional elements as well (Falk & Dierking, 1997). Museums are one of the most important out-of-school settings among the informal educational environments that provide concrete observation in learning abstract subjects. Museums are learning environments in which children are able to develop positive attitudes towards science (Barshinger & Ann, 1998; Livingstone et al., 2001; Rapp, 2005). And science museums have great importance in science education. When school trips to museums, and activities and materials during the trip coincide with the education given at school, it ensures better science education (Cox-Petersen et al. 2003; Guisasola, Morentin & Zuza, 2005). It is important for permanent learning that formal education provided in the school coincide with the informal education carried out in informal environments. For instance, trips and activities regarding science museums should be planned. Planned activities that coincide with the subjects taught should be designed in order for informal environments to contribute to science education. The procedures before the trips, during the trips and after the trips should be well-planned (Guven et al. 2004). The importance of informal learning in informal educational environments has recently increased with the use of settings such as museums, zoos and botanical gardens and aquariums as educational environments and by associating these with the subjects in the curriculum. It is considered that these informal environments will provide wide opportunities in terms of science curriculum learning outcomes in science education.

Constructivist learning theory forms the basis of primary education curriculums that were reorganized in 2004. Constructivist approach deems that every knowledge learned prepares the ground for the next one. Constructivist learning is a process of linking existing and new learning outcomes and integrating every new information with existing ones. Constructivism is not about accumulating and memorizing information, it is about thinking and analyzing it (Sasan, 2002). It is important that students are able to use what they have learned at school in out-of-school learning environments. In addition, moving science education out of school can offer much more opportunities. In literature, there are various terms used for out of school learning environments such as "out of school science", "free-choice learning", "lifelong science learning", and "science learning in everyday life" (Dierking et al., 2003). In our country, year-end trips are considered as informal environments. Since the trips do not coincide with the curriculum, they are seen as situations that are perceived only as a moment of entertainment and time spending, not as a learning environment. That being said, new researches reveal that it is more important to plan trips organized according to the objectives associated with the curriculum and assessing whether learning has taken place.

This study was carried out to show that planning the activities to be carried out before, during and after the trip will have an effect on the academic success of the students when the trips to out-of-school learning environments are associated with the curriculum.

Method

Research Model

This research was conducted based on an experimental method with pretest-posttest control groups which is one of the quasi-experimental designs. The effect of the experiment is tested by a study carried out on the experimental group and the control group in this design. Measurements of the groups related to the dependent variable are obtained by using the same measurement tools and applying them to the same group as a pre-test and then a post-test. The significance of the difference between the pretest and posttest results of the group in the design is determined. The symbolic appearance of the design is as shown in Table 1 (Buyukozturk et al., 2017).

Table 1. Experimental and Control Groups Pretest - Posttest Experimental Design

Group	Pre-Test	Procedure	Post-Test
D	O_1	X_1	O_2
K	O_3	X_2	O_4

D: Experimental group

K: Control Group

X_1: Independent Variable Level (Trip to Hydroelectric Power Plant)

X_2: Independent Variable Level (Education in Classroom)

O_1: Pretest Application

O_2: Posttest Application

O_3: Pretest Application

O_4: Posttest Application

Experimental and control groups are determined by random method in this study. "Hydroelectric power plant trip" is defined as the independent variable of the experimental design. Dependent variable is tested with academic success test.

During the study, in-class practices were carried out in the control group in accordance with the science curriculum flow. In the experimental group, an out-of-school learning environment was established and a trip was organized to that environment and science curriculum was followed. Experimental and control groups are subjected to the success test before the process. The same academic success test has been applied to both groups at the end of the process as well. The impact of the planned trip in the out-of-school learning environment on student's success has been demonstrated with statistical results.

In the experimental design used in this research, the independent variable whose impact on the experimental group was examined was "Giresun Tirebolu Aslancik Hydroelectric Power Plant Trip".

Academic success test results were examined in order to determine the effect of independent variable on dependent variables (academic success). The experimental design of the research is given in Table 2.

Table 2. Experimental Design of the Research

Groups	Pre-tests	Practices	Post-Test
Experimental group	Academic Success Test	Giresun Tirebolu Aslancık Hydroelectric Power Plant Trip	Academic Success Test
Control Group	Academic Success Test	Curriculum In-Classroom Practices	Academic Success Test

Study Group

A total of 37 eighth grade students attending to a secondary school of Tirebolu district of Giresun province in the 2015-2016 academic year were included in the study. The distribution of students to experimental and control groups is provided in Table 3.

Table 3. Numerical Properties of Research Group Students

Groups	Number of Students	Female	Male
Experimental	19	11	8
Control	18	10	8

Data Collection Tools and Analysis

In order to investigate the impact of using hydroelectric power plants, which is one of the informal learning environments, in science education on the learning of 8th grade students, "Electricity in Our Life - Academic Success Test" has been prepared. While the test was being developed, the "Academic Success Test Question Pool", which consisted of 30 multiple-choice questions related to the learning outcomes of the electricity in our life unit, which is within the 8th Grade Science Curriculum, is presented to obtain expert opinion. In order to confirm the validity of the questions, the opinions of the two science experts were asked and as a result of the feedbacks, the "Academic Success Test Question Pool" was finalized. Then, in order to confirm the reliability of the questions and to identify the questions of the actual test application, 127 ninth grade students were asked these questions. The reason for doing this with 9th grade students is that they graduated from the eighth grade and have achieved the learning outcomes.

The academic success test question pool specification table is presented below.

Table 4. Specification Table

Learning Outcome	Knowledge	Comprehension	Application	Analysis	Total
1.1. The student realizes that a coil with current acts like a rod magnet.	S1 S2 S4	S3			4
1.2. The student creates an electromagnet and finds its poles by making use of the current's flow direction.		S5 S6			2
1.3. The student discovers by experimenting that the magnetic effect occurring in the center of the coil with current changes based on the current passing through the coil and the number of turns of the coil.			S7		1
1.4. The student investigates and presents the use				S8 S9	2

of magnetic effect of electric current in daily life (FTTC-5, BSB-32).				
1.5. The student realizes that electrical energy turns into motion energy.		S10		1
1.6. The student discovers by experimenting that the movement of a rod magnet generates electric current (BSB-30,31).			S12 S13	2
1.7. The student realizes that motion energy turns into electrical energy.	S14 S15 S17 S18 S19 S20	S11 S21 S16		9
1.8. The student researches on and presents how electrical energy is produced in power plants.	S22 S27 S28 S29 S30	S23 S24	S25 S26	9

As a result of the item analysis of the data obtained in the reliability confirmation, the non-qualified questions 6, 8, 9, 10, 13, 15, 21, 23, and 24 were removed from the question pool and KR-20 reliability coefficient was calculated as 0.84, and KR-21 reliability coefficient was calculated as 0.82. A 21-question success test is used in the research, the validity and reliability of which was calculated. The data obtained from the academic success test applied to the experimental and control groups were analyzed with the non-parametric Mann Whitney U and Wilcoxon Test since the experimental and control group had less than 30 students (Buyukozturk et al., 2017).

Findings

1. Findings Regarding Pretest Scores of Students Participated to a Hydroelectric Power Plant Trip and Students who were taught the subjects in Classroom Environment

It was examined to see whether there is a significant difference between the pre-test scores of the experimental and control groups and the results are given in Table 5.

Table 5. Pretest statistics of students in experimental and control groups

Group	Measurement	n	Average of Ranks	Rank Total	U	P
D	O_1	19	17.95	341.00	151	,541
K	O_2	18	20.11	362.00		

Upon analyzing the table above, it is seen that there is no significant difference between the academic success test pretest scores of the experimental group students and the academic success test pretest scores of the control group students ($U = 151$, $p > .05$).

This means that the experimental and control groups are identical in terms of the prerequisites of the academic success test learning area regarding the learning outcomes of the electrical unit. Bases on the row average, the readiness levels of the control group students are relatively better than the experimental group. However, the said difference was not statistically significant.

2. Findings Regarding Posttest Scores of Students Participated to a Hydroelectric Power Plant Trip and Students who were taught the subjects in Classroom Environment

The results of the test which was conducted in order to determine whether there is a significant difference between the posttest scores of the experimental and control groups are given in Table 6.

Table 6.Posttest statistics of students in experimental and control groups

Group	Measurement	n	Average of Ranks	Rank Total	U	P
D	O_3	19	23.79	452.00	80	,005
K	O_4	18	13.94	251.00		

When the results indicated in Table 6 are analyzed, it is seen that the average rank score (23.79) of the academic success test post-test scores of the experimental group students is higher than the average rank score (13.94) of the control group students' academic success test post-test scores. The group with lower average is the group with the highest number of lowest scores (Field, 2009). It is also seen from the table that this situation is statistically significant, which results in favor of the experimental group ($U = 80$, $p < .05$). Analyzing the data obtained from the tables, it is seen that there is a significant difference between the two groups. However, it is understood from the table that the participants of the trip were more successful. When we analyze based on the value of $P < 0.05$, it is seen that the students participated in the trip were successful. The first sub-problem of the research is defined as follows: "Is the hydroelectric power plant trip effective in terms of gaining the learning outcomes of electricity in our life unit?" To this end, descriptive statistics between the pretest-posttest scores obtained from the measurements related to the dependent variable were calculated. The descriptive statistics for the comparison of the pretest-posttest scores of the experimental group are given in Table 7.

Table 7. Descriptive Statistics Regarding the Comparison of Pretest-Posttest Scores of Students

	n	Average	Standard Deviation	Lowest	Highest
Pretest	19	10.105	2.90	4.00	15.00
Posttest	18	17.842	2.00	13.00	20.00

Upon examining Table 7, itis seen that the post-test averages of the students are higher than their pre-test averages. It is also seen that the standard deviation of the posttest is less than the standard deviation of the pretest when the standard deviations of the pretest and posttest are compared. The comparison of the lowest and highest scores of the students shows that the lowest score in the pretest is 4, the lowest score n the posttest is 13, the highest score in the pretest is 15 and the highest score in the posttest is 20. When thefindings within Table 4.3.1. are interpreted, it is fair to say that there is a difference in favor of the students' post-test scores. The test results were compared with the Wilcoxon signed rank test, which is one of the non-parametric tests, in order to determine the significance of this difference. Non-parametric tests are methods that do not contain any distribution assumptions and do not assume anything about the underlying distribution. The Wilcoxon signed-ranks test is used to determine the significance of a difference between the scores of two related measurements and it is assumed that the two variables are not spaced or proportional and the data is not normally distributed. This test is suitable to be used in cases where the study group has less than 30 subjects (Buyukozturk, 2017). The results of the Wilcoxon signed-rank test used to compare the pretest and posttests are presented inTable8.

Table 8. Wilcoxon Signed Rank Test Results Regarding the Comparison of Pretest-Posttest Scores of Students

Variables		n	Average of Ranks	Rank Total	Z	P
Academic Success Test	Negative Rank	0	.00	.00		
	Positive Rank	19	9.50	171.00	3.731	.000
	Equal	0				
	Total	19				

When the Wilcoxon signed rank test results (Table 4.3.2.) are analyzed, it is concluded that there is a significant difference between the pre-test academic success scores and post-test academic success scores of the students in favor of the post-test ($Z=3.731$; $p=.000<.05$). Accordingly, it can be said that the trip to the hydroelectric power plant has an effect on the students' electric unit learning outcomes.

Discussion and Conclusion

Researchers have observed an increase in the academic success of students as a result of trips to science centers which are among the out-of-school learning environments (Bozdogan and Yalcin 2006; Bozdogan, 2007). Zoos, such as science centers, are also among the most used out-of-school learning environments. Studies conducted in this field reveal that out-of-school learning creates a significant difference in academic success (Braund & Reiss, 2006; Bozdogan & Yalcin, 2006; Falk & Adelman, 2003; Ramey-Gassert, 1997).

It is observed in the results of the trips to other informal educational environments (such as science centers, museums, botanic parks, aquariums, planetariums, etc.) other than zoos that students' success is positively affected by these environments as well (Bozdogan, 2007; Bozdogan, 2009; Bozdogan and Yalcin, 2006; Demirbas, 2005; Erim, 2005; Sahin and Saglamer Yazgan, 2013; Sahan, 2005; Tortop, 2007; Yardimci, 2009; Yavuz and Balkan Kiyici, 2012a).

The results of this research also support the previous researches. Based on the quantitative results obtained in the research, it is seen that the planned trip to the hydroelectric power plant, which is determined as an informal education, creates a positive difference in academic success in the experimental group. According to the results, it is found out as follows: $Z = 3.731$ and $p = .000 <.05$. It is deemed appropriate to add hydroelectric power plants to be used in learning in terms of various science outcomes to the areas such as science center, museum and zoos which are among informal environments.

Other researches and their results also support the findings observed in this study. According to Turkmen (2010), educational activities carried out outside the school are an important and integral part of the learning-teaching process. Learning may occur outside the classroom setting as well. It can also occur in museums, zoos, botanical gardens, water parks, playgrounds, non-governmental organizations, youth clubs, media (radio, film, newspaper etc.) or in stadiums, hospitals etc. In line with the views of Lacin Simsek (2011), the relationship between the learning outcomes in the curriculum and informal education environments has started to increase with the introduction of museums, zoos and botanical gardens as alternative environments for education.

In the study in which the educational contribution of some informal educational environments (science centers, science museums, zoos) used in science education is analyzed, the researchers concluded that informal educational environments help the students achieve the goals of the science curriculum of schools and determined that they offer a rich learning resource to the teacher (Ramey & Gassert, 1997). Bozdogan (2007), in his research entitled "The Place of Science and Technology Museums in Science Education", investigated the science interests of 2nd grade secondary school students and the effect of trips on academic success. As a result of the data obtained in the second stage of his research, he observed that the materials and activities in the Feza Gursey Science Center and Energy Park had positive and developmental effects on students' academic interests and academic success. Ertas et al. (2011) investigated the impact of informal learning on the level of ninth grade students to establish a relationship between the "energy" concept and daily life. The students were asked questions about energy before and after the trip. As a result, the researchers found out that out-of-school scientific activities had a positive effect on students' level of understanding of energy and its association with daily life.

Considering the research examples above, although there is no hydroelectric power plant case study within these studies, as per the results of the experimental group subjected to academic achievement test, a significant difference was found according to Mann Witney U and Wilcoxcon analyzes when compared with control group and also as a result of the experimental group comparison within itself. Hydroelectric power plants can be used as out-of-school learning environments within the possibilities as well, based on the researches that mention the positive effect of informal environments on academic success. It is understood from these studies that if out-of-school environments can be diversified, and while doing this diversification, if the activities to be carried out before, during and after the trip are well determined and if its association with the curriculum is accurately ensured, it will contribute to academic success positively.

Recommendations

Suggestions Regarding Educational Practices

1- Providing practical lessons to teacher candidates about the trips to informal educational environments, and in-service training activities for teachers on duty can be provided to overcome the shortcomings in this field.

2- It will be useful to plan frequent trips related to electricity and electricity production included in the science curriculum. Lessons can be taught during these trips whenever possible. By doing so, students will have tangible experiences and will be in settings that provides more motivation to learn.

3- Science teachers should include trips to the out-of-school environments in their annual and activity plans.

4- It is important to inform the students of the trips in advance and to prepare a brochure for them in this regard.

5- Teachers should see the area to be visited in advance, be aware of the dangers in the area and take appropriate precautions.

6- Different activities can be included at certain stages of school trips.

7- It is also important that teachers have sufficient equipment related to the subject area of such trips and the application steps of the trip.

Suggestions Regarding Possible Studies

1- This research is limited to 8th grade students. Trip to a hydroelectric power station can be carried out for science courses in different educational levels.

2- Studies can be conducted to examine the effects of hydroelectric power plants on the affective characteristics of students, such as their science interests, attitudes, anxieties etc.

3- Comprehensive researches can be conducted to examine the impact of hydroelectric power plants and other informal educational environments on misconceptions.

4- In this study, it was actually thought to question the permanence of the information learned during the hydroelectric power plant trip, however since the trip was made towards the end of the academic year, the permanence test could not be applied. In the studies to be carried out later on, the impact of hydroelectric power plants on the permanence of the information learned can be investigated.

5- Studies can be conducted for examining the cognitive and affective impacts of hydroelectric power plants or other informal educational environments for different courses.

6- Trips to hydroelectric power plants can be organized on issues such as sustainable development, energy conversions and the environment.

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