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Analysis of Middle School Students' Views and Impressions about a Science Center *

Dilek ZEREN ÖZER[1], Sema Nur GÜNGÖR [2]

[1] Asst. Prof. Dr., Uludag University, Bursa-TURKEY
[2] Dr. Uludag University, Bursa-TURKEY

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ABSTRACT

This study aims to evaluate middle school students' views about science centers as out-of-school learning environments. The study surveyed 195 5th-, 6th-, 7th-, and 8th-grade students attending Hatice Salih Primary School and Ahmet Cabuk Middle School in Province Bursa. It used a qualitative cross-sectional and longitudinal research design. For the purpose of the research, middle school students were helped to use the experimental setups at Bursa Science and Technology Center in company with instructors. Later, the students were asked to report their views and impressions about the science center through the "Science Center Opinion Survey". Students' views and impressions were compared based on grade levels. Accordingly, the participating students of all grade levels reported that they would like to come back to the science center, liked activities and experimental setups at the center, and found them fun and educative. However, the study found that a vast majority of the students of all grade levels, similarly, had difficulty in identifying science concepts that the experimental setups are related to.

Keywords: Science center, impression, middle school, developmental research

INTRODUCTION

Out-of-school education can be defined as a teaching method or strategy which facilitates learners' active participation and includes educational and acquisition-focused activities that are difficult or impossible to do in a classroom and thus performed in nature or environment. Out-of-school education allows students to observe and research outside the school. Thus, students make inferences about subjects they deeply learn using their observations and can explain the cause-and-effect relationships between events (Eltinge & Roberts, 1993). Out-of-school education includes acquisitions from different sources such as libraries, museums, nature and science centers, aquariums, zoos, botanical gardens, arboretums, television programs, films and videos, newspapers, radios, books, the internet, public health organizations, environmental organizations, and family (Davies, 1998; Falk & Dierking 2010; Falk & Hannu, 1993; Kelly, 2000; Martin, 2004; Falk & Needham, 2011; Pedretti, 2002). Individuals themselves control what, why, how and when they learn in out-of-

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Corresponding author e-mail: dzeren@uludag.edu.tr

school education (Stocklmayer & Gilbert, 2003) which is defined as informal learning by researchers (Gerber & Marek, 2001). In this regard, Payne (1985) defines out-of-school education as an effective teaching method or approach that is used outside the school, includes activities difficult or impossible to do in a classroom and helps students specializing in the acquisitions involved in curriculums (as cited in Tatar & Bağrıyanık, 2012). A considerable volume of research has suggested that out-of-school settings help individuals understand science-related concepts, use scientific methods, acquire skills, enhance their knowledge, and take responsibility for their subsequent learning processes (Falk, 1997; Falk & Adelman, 2003; Falk & Storksdieck, 2010; Olson, Cox-Petersen & McComas, 2001; Rennie & McClaffertiy, 1996; Yavuz & Kıyıcı, 2012). Additionally, such settings have been reported to positively affect students' achievement and knowledge and improve problem-solving skills.

Science centers, among of the out-of-school learning environments, are creative and dynamic spaces that undertake to help children, adolescents and adults to acquire the ability to perceive generally accepted scientific principles and facts, and understanding and comprehension skills. These organizations push their visitors' limits of creativity and imagination in areas such as technology, engineering, space sciences and rarely humanities. Thus, they play an important role in raising well-educated, curious, inquiring and questioning generations. They seek to help visitors create their own stories using their ideas and experiences and choose their own ways according to their own motivations (Afonso & Gilbert, 2006; Allen, 2004; Gregory & Miller, 1998). Visitors to these centers enjoy a fun and enjoyable time as they are also involved in individual learning. Unlike in-class learning, learning activities offered by these centers include those which shed light on everyday life, frequently evoke visitors' imagination and ensure a fun and social learning setting. Science, technology and discovery centers create a social learning environment with an understanding of enhancing visitors' knowledge and experience. In line with this created social learning, the main aims of these centers include surprising visitors, engaging their mind with questions and building their self-confidence through new learning (Johnson, 2009).

In Turkey, science centers have been recognized in recent years and the literature includes several studies that emphasize the importance of such centers and suggests their popularization (Çığrık & Özkan, 2015; Mills & Katzman, 2015; Salmi, 1993; Şentürk & Özdemir, 2014.). Çığrık and Özkan (2015) tried to determine the development of 6th-grade students' scientific process skills through live and do-learning activities carried out at the science center. They found that regular and scheduled visits to science centers are influential on students' scientific process skills. Şentürk and Özdemir (2014) investigated the effect of elementary students' visit to METU science center on their attitudes towards science and found that their visit had positive effects. Mills and Katzman (2015) also investigated the effect of elementary school students' trips to a science research and learning center on the change in their desires to learn and participate in science. According to the results of their research, there was an increase in students' desires to become a scientist and get interested in science after their trips. Additionally, Guisasola et al. (2005), Koosimile (2004) and Wellington (1990) also investigated the effects of such centers on the change in students' level of interest in science classes.

It is also clear from previous research that science centers have not been used sufficiently or extensively in science teaching as an out-of-school learning setting. Additionally, there is a need for studies in Turkey to determine the positive or negative effects of such out-of-school learning environments especially on science education; to help students, teachers and parents become aware and informed of this issue; and to identify ways of enhancing the permanence of learning in such environments.

Against this background, the purpose of this study is to identify middle school students' views and impressions about experimental setups covering various topics through visits to Bursa Science center as an out-of-school learning environment. For this purpose, answers to the following sub-problems were sought:

1. What are middle school students' views and impressions about the practices, activities and experimental setups at the science center?
2. Do middle school students' views and impressions about the practices, activities and experimental setups at the science center differ by grade levels?

METHODS

This section includes the research model, detailed information about the students participating in the research, the applications carried out within the scope of the research, and the analyses on the data collected through these applications and data collection methods.
The study was carried out in order to obtain the views and impressions of middle school students about the practices and activities at science centers and to make comparisons according to different grade levels. The research was designed as developmental research which is one of the qualitative research methods. The cross-sectional method was used for the research. Developmental research, which is also defined as a descriptive research method, is used by researchers for their studies to analyze the lives of the individuals from different age groups and different cultures, and the changes and development of people's feelings, opinions, attitudes etc. in different time periods (Çepni, 2007; Şahin, 2014). The cross-sectional method, on the other hand, is defined as the longitudinal analysis of parallel groups simultaneously selected from a single population (Sahin, 2014). In this context, this study focused on taking the opinions of students of different grade levels (in other words, students from different age groups) about the science center and on evaluating their impressions.

a) The Study Group

This research was carried out in the spring term of the 2013-2014 academic year. The population (universe) of the study consisted of middle schools in Bursa. The sample of the study included a total of 195 students in the fifth, sixth, seventh and eighth grades attending Hatice Salih Primary School and Ahmet Çabuk Middle School selected by random sampling method, which is one of the rationality-based sampling methods. In the random sampling method, samples are selected through a completely random method (Yıldırım and Şimşek, 2005: 104).

106 female and 89 male students participated in the research. Accordingly, 27 female and 16 male students from the fifth grade took part in the research. 24 female and 20 male students from the sixth grade participated in the study. The seventh grade took part in the study with its 25 female and 24 male students while 30 female and 29 male students from eighth grade participated in the program. The "Science Center Opinion Survey" was conducted in all classes as a final test, and the results obtained from the survey were compared.

Table 1. *Number of students in the experimental and control groups according to grades*

Grade	Female		Male		Total	
	f	%	f	%	f	%
5.	27	13,85	16	8,21	43	22,05
6.	24	12,31	20	10,26	44	22,56
7.	25	12,82	24	12,31	49	25,13
8.	30	15,38	29	14,87	59	30,26
Total	106	54,36	89	45,65	195	100,00

b) Data Collection Tools

In this research, the "Science Center Opinion Survey" was used to receive students' opinions about the secience center and experimental setups after the application.

Science center opinion survey

The survey consists of a total of 10 items developed by the researchers and comprising open-ended questions to receive middle school students' views about the science center and experimental setups at the center after the application.

In order to ensure the internal validity of the measurement tool, the questionnaire was given to two expert and the final forms of the questions in the questionnaire were prepared by making necessary corrections with the opinions of the expert. Later, the survey was pre-applied. The data obtained after the preliminary application were examined by experts to determine whether the questions were clear and understandable, whether the responses reflected the answers to the questions asked, and the survey was given the final form. In this way, the internal validity of the questionnaire was provided. It was concluded that the open-ended questions provided the desired data and the measurement tool was applied to the middle school students in the sample.

The questions and analyses on the survey are given in the findings section.

c) Data Collection-Application

The process of data collection and application was conducted according to the following steps:

1. Middle school students were given the opportunity to participate in the applications of Bursa Science and Technology Center in company with instructors working at the center, on the basis of different classes at different times. The students have tried all of the experimental setups at the center first in company with the instructors and then on their own.
2. The "Science Center Opinion Survey" was conducted as a final test in order to assess the middle school students' views and impressions about the science center, the experimental setups, and the relevant scientific concepts.

d) Data Analysis

The data obtained from the Science Center Opinion Survey were analyzed using frequency (f) and percentage (%) distributions in addition to descriptive analysis. In the descriptive analysis, the findings are presented to the reader in an organized and interpreted way. In this analysis method, the data are described systematically and explicitly, these descriptions are explained and interpreted, cause-effect relationships are examined, and certain results are obtained. The results can be correlated and interpreted in terms of themes, and predictions can be made (Yıldırım and Şimşek, 2005: 224). Within the scope of the study, the data obtained from the answers given to the research questions were analyzed by forming a frame, processing the data according to the thematic framework, identifying and interpreting the findings. The second research question formed the most general frame for data analysis in the process of creating a framework for descriptive analysis. In the course of processing the data according to the thematic framework, the questions in the Science Center Opinion Survey were accepted as themes for the data within the determined frame, and these data are organized and presented under the aforesaid themes. In the identification and interpretation phase of the findings, the data obtained in line with the determined theme were analyzed and arranged. Then, the arranged data were defined and the findings were interpreted on these

themes. Briefly, at this stage, students' answers were examined one by one, and the expressions stated in the evaluations were grouped. Thus, the data were coded and categorized by the researchers.

In this context, the qualitative data were evaluated separately by two different researchers, and codes and categories were finalized after the co-evaluation of the different results.

FINDINGS

The research questions of this study are as follows: "What are middle school students' views and impressions about the practices, activities and experimental setups at the science center?", and "Do they differ by grade levels?". Accordingly, the answers given by 5th-, 6th-, 7th-, and 8th-grade students to the Science Center Opinion Survey after the application were analyzed through descriptive analysis. The findings obtained from this survey are presented below.

In this study, the students were first asked to answer the following questions: "Would you like to come back to the science center? Why?". The results of the research were as follows: the fifth (f=43, 100%), sixth (f=44, 100%), seventh (f=49, 100%) and eighth grade (f=59, 100%) students stated that they would like to come back to this center, which meant that all of the students wanted to visit the center again. The table given below (Table 2) shows the reasons for desire to revisit the center, as stated by the fifth graders (f=43, 100%), the sixth graders (f = 41, 93.2%), the seventh graders (f = 48, 98%) and the eighth graders (f=56, 95%) in total.

Table 2. *Reasons for the desire to revisit the Science Center according to the grade levels*

Grades	Reasons for the desire to revisit the science center	Yes	
		f	%
5th-Grade	Because I get new information/ I learn with experiments/by experience/because it is very educational.	17	39.5
	Because I like it very much /I appreciate it very much.	16	37.2
	Because it is so entertaining/I had fun/it is enjoyable.	16	37.2
	Because the experimental setups were interesting./There are interesting things./There are interesting experimental setups.	7	16.3
	Because I have not seen an experimental setup before./I have never seen it in the daily life.	2	4.7
	Because I wanted to share this information with others	1	2.3
	Because I did not explore the science center well enough.	1	2.3
6th-Grade	Because I like it very much/I appreciate it very much.	18	43.9
	Because it's an entertaining place./ Because it is so entertaining/I had fun.	12	29.3
	Because I get new information / try new experiments/ Because it is very educational.	10	24.4
	Because the experimental setups were interesting. There are interesting things. There are interesting setups.	8	19.5
	Because I want to see test the experimental setups again.	3	7.3
	Because I learn new things through experiments / I like making experiments.	1	2.4
7th-Grade	Because it's an entertaining place. Because it is so entertaining/I had fun.	28	58.3
	Because I get new information / try new experiments/ Because it is very educational.	20	41.7
	Because the experimental setups were interesting. There are interesting things. There are interesting experimental setups.	15	31.2
	Because it was fun /it was very entertaining/I had a lot of fun /I am satisfied.	7	14.6
	Because I learn new things through experiments/I like making experiments.	5	10.4
8th-Grade	Because it's an entertaining place. Because it is so entertaining/I had fun.	18	32.1
	Because I get new information / try new experiments.// Because it is very educational.	18	32.1
	Because it is a beautiful place./ I liked it./ I am satisfied.	17	30.4
	Because the experimental setups were interesting. There are interesting things. There are interesting experimental setups.	8	14.3
	Because I learn new things through experiments./ I like making experiments.	3	5.4

In the analyses that were carried out, 39.5% (f = 17) of 5th-grade students stated that they learned new things by making experiments and by means of the activities performed at the science center. Moreover, 16 students (37.2%) said that they liked the science center and wanted to revisit it because they had fun there.

The sixth, seventh and eighth-grade students expressed their opinions which are similar to the ones of the fifth graders, and they remarked that the center of science was an entertaining, enjoyable place, that they liked it very much. In addition, they emphasized that they obtained new information and tried new experiments.

Considering the responses of the fifth graders to the question "*Has your interest in sciences increased?*" (Table 3), the majority of the students participating in the research (35 students-81.4%) gave positive responses to the question. However, few students (1 student-2.3%) answered the question negatively while some students (7 students-16.3%) remained hesitant. Similarly, the majority of the sixth grade-students gave positive responses (36 students-81.8%) while the responses of 2 students (4.6%) were negative. Some of the students (6 students-13.6%) stated that they were hesitant. Among the seventh and eighth grade students who participated in the survey, 45 seventh graders (91.8%) and 47 eighth graders (80%) also reported that their interests in science increased after the visit, which was a similar result to those obtained in other grades.

Table 3. *The perceived increase in students' interests in science after their visit to the science center*

Grade	Yes		No		Hesitant	
	f	%	f	%	f	%
5	35	81.4	1	2,3	7	16.3
6	36	81.8	2	4.6	6	13.6
7	45	91.8	-	-	4	8.2
8	47	80	-	-	12	20

The students' responses to the third question "*Would you tell your immediate surroundings ((friends, family, etc.) about your impressions and observations at the science center? Why?"* were analyzed. Accordingly, the majority of the students (42 5th-grade students- 97.7% and 39 6th-grade students-88.6%) stated that they would like to share their experiences and observations with their surroundings (Table 4). The rate of the desire to tell about their trip was found 91.8% for 7th-grade students (45 students), while the rate was 81.14% for 8th-grade students (52 students).

Table 4. *The Desire to Tell the Immediate Surroundings about Impressions and Acquisitions at the science center*

Grade	Yes		No		Hesitant	
	f	%	f	%	f	%
5	42	97.7	-	-	1	2.3
6	39	88.6	4	9.1	1	2.3
7	45	91.8	2	4.1	2	4.1
8	52	88.14	1	1.7	6	10.2

Table 5 below includes the statements of 41 (95.3%) 5th-grade students reporting that they told their immediate surroundings about their science center trip. A considerable number of 5th-grade students (21 students-51.2%) stated that they would also like their relatives and friends to learn, see, know, benefit and be informed of what they learned at the science center. Similarly, 7 students (17.1%) reported that they would tell about their trip because the center is a good place; 5 students (12.2%) would tell because their family and friend also wonder

and love the center and because the center would attract their family's and friends' attention. 5 students (12.2%) stated that they had a lot of fun; therefore, they would tell their family and friends about their trip.

Table 5. *5th-Grade Students' Reasons for Telling About the Trip to Their Immediate Surroundings*

	Yes	
	f	**%**
I would also like them to learn/learn through trial/ benefit/know/be informed of what I learned.	21	51.2
I had a lot of fun. /It is fun/enjoyable.	7	17.1
My family also wonders./It attracts their attention./They also like it.	5	12.2
I liked/loved here.	5	12.2
It is an educative place./I would tell I learned new information.	4	9.8
I would also like them to come.	3	7.3
There are interesting things./It is an interesting place.	1	2.4

Table 6 includes the statements of 31 (70.5%) 6th-grade students about their reasons for telling about their science center trip to their immediate surroundings.

Table 6. *6th-Grade Students' Reasons for Telling About the Trip to Their Immediate Surroundings*

	Yes	
	f	**%**
I would also like them to learn/learn through trial/ benefit/know/be informed of what I learned.	16	51.6
I would also like them to go to/come to the science center.	7	22.6
My family also wonders./It attracts their attention./They also like it.	5	16.1
It is an educative place./I would tell I learned new information.	3	9.7
I had a lot of fun. /It is a fun/an enjoyable place.	3	9.7
It is very good.	2	6.5
I would tell as I would like to come again.	2	6.5
There are interesting things./It is an interesting place.	1	3.2

A considerable number of 6th-grade students (16 students-51.6%) stated that they would also like their relatives and friends to learn, see, know, benefit and be informed of what they learned at the science center. Similarly, 7 students (22.6%) would also like their relatives and friends to come; 5 students (16.1%) reported that their family would wonder and the science center would attract their family's attention. 3 students (9.7%) highlighted the educative aspect of the science center and that they learned new information.

Table 7 includes the statements of 43 (87.8%) 7th-grade students reporting that they told their immediate surroundings about their science center trip. One of the two (4.1%) students who answered no to the question gave the following reason for not telling about the trip: *"We saw much, I would forget."*

Table 7. *7th-Grade Students' Reasons for Telling About the Trip to Their Immediate Surroundings*

	Yes	
	f	**%**
I would also like them to learn/learn through trial/ benefit/know/be informed of what I learned.	19	44.2
I would also like them to go to/see the science center.	10	23.3
I had a lot of fun. /It is fun/enjoyable.	5	11.6
I liked/loved here./It aroused my interest/I would like to come again.	4	9.3
I like to tell.	3	6.9
There are interesting things./It is an interesting place.	2	4.7
My family also wonders./It attracts their attention./They also like it.	2	4.7

19 7th-grade students (44.2%) reported that they would also like their relatives and friends to learn, see, know, benefit and be informed of what they learned at the science center. Similarly, the students would tell about their trip because they would also like their relatives and friends to go to the science center (10 students-23.3%) and they liked the center and would like to come again (4 students-9.3%). 3 students (6.9%) stated that they would tell about their trip because they like to tell.

Table 8 includes the statements of 46 (78%) 8th-grade students reporting that they told their immediate surroundings about their science center trip.

Table 8. *8th-Grade Students' Reasons for Telling About the Trip to Their Immediate Surroundings*

	Yes	
	f	**%**
I would also like them to learn/learn through trial/ benefit/know/be informed of what I learned.	21	45.7
I would also like them to go to/see the science center.	10	21.7
I had a lot of fun. /It is fun/enjoyable.	6	13
It is useful./It is useful/beneficial for science.	5	10.9
I liked/loved here./It aroused my interest/I would like to come again.	5	10.9
My family also wonders./It attracts their attention./They also like it.	4	8.7
I would like to come again.	3	6.5
To help increase the importance that people give to science.	1	2.2
There are technological tools.	1	2.2
I would like to share.	1	2.2

21 8th-grade students (45.7%) reported that they would also like their relatives and friends to learn, see, know, benefit and be informed of what they learned at the science center. Similarly, 10 students (21.7%) would tell about their trip because they would also like their relatives and friends to go to the science center; 6 students (13%) would tell because they had a lot of fun and the science center was fun and enjoyable. One 8th-grade student (2.2%) reported that he would tell "in order to help increase the importance that people give to science".

Considering 5th-grade students' responses to the fourth question in the Science Center Opinion Survey *"Do you think that the experimental setups at the science and technology center are related to the subjects taught at school? Please explain why giving an example."*, 65.1% (28) of the students think that the experimental setups at the science center are related to the subjects taught at school, while 27.9% (12) students think that they are not related. 3 students (6.98%) did not comment on this topic. Table 9 includes the statements of 5th-grade students (40 students-93.02%) expressing their opinion about the relevance/irrelevance of the experimental setups at the science center to the school subjects.

Table 9. *5th-grade Students' Views about the Relevance of the Experimental Setups to the School Subjects*

		f	**%**
Relevance	Because such studies/experiments are done at school (Seasons, Moon and Sun; the spread of sound in a vacuum, Shadow, Electricity, Light Sources, Force)	21	49.5
	Because they think the subjects taught at the science center are more detailed and advanced than those taught at school.	5	12.5
Irrelevance	Because they think there is not enough material at school.	2	5
	Because they think that the experiments at the science center are more different/distinct/good.	4	10
	Because they think that the experiments at the science center are more fun.	1	2.5
	Because they think they did not make the science center experimental setups at school.	1	2.5
	Because they think they are not relevant.	2	5
	Because they did more experiments at the science center	2	5

As seen in Table 9, 49.5% of 5th-grade students think that the experimental setups at the science center are relevant to the school subjects as they do such studies/experiments at school. According to the opinions of 4 students (10%) thinking that the experimental setups are irrelevant to the school subjects, the experimental setups at the science center are better, more distinct, and more different.

Considering the responses of 6th-grade students to the fourth question, a significant number (18 students-62.1%) of the students reporting their views think that the experimental setups at the science center are relevant to the school subjects, while 11 students (37.9%) think that they are irrelevant. 15 students (34.1%) did not comment on this topic. Table 10 includes the statements of 6th-grade students (29 students-65.9%) expressing their opinion about the relevance/irrelevance of the experimental setups at the science center to the school subjects.

Table 10. *6th-grade Students' Views about the Relevance of the Experimental Setups to the School Subjects*

		f	%
Relevance	Because studies/experiments/subjects about some experimental setups are covered/discussed at school/in science classes (Force, bulb brightness, body capacitance, electricity)	16	55.2
Irrelevance	Because they do/ they themselves do experiments at the science center.	3	10.3
	Because they think that the experiments at the science center are more different/distinct/good.	2	6.9
	Because they think they did not make the science center experimental setups at school.	2	6.9
	Because they think that the experiments at the science center are more fun.	1	3.3

Considering the responses of 7th-grade students to the fourth question, 69.4% (34) of the students think that the experimental setups at the science center are relevant to the school subjects, while 16.3% (8) think they are irrelevant. 7 students (14.3%) did not comment on this topic. Table 11 includes the statements of 7th-grade students (42 students-85.7%) expressing their opinion about the relevance/irrelevance of the experimental setups at the science center to the school subjects.

Table 11. *7th-grade Students' Views about the Relevance of the Experimental Setups to the School Subjects*

		f	%
Relevance	Because such studies/experiments are done at school/in science classes (electric, electric circuit, magnet, magnetic field, series and parallel circuits, pressure, air)	27	64.3
	Because they think the subjects taught at the science center are more detailed and advanced than those taught at school	5	11.9
	Because they have some commonness.	2	4.8
Irrelevance	Because they think that the experiments at the science center are more different/distinct/good.	4	9.6
	Because they think that they are irrelevant.	2	4.8
	Because they think they did not make the science center experimental setups at school	1	2.4
	Because they did more experiments at the science center.	1	2.4

Considering the responses of 8th-grade students to the fourth question, a great majority (48 students-81.4%) think that the experimental setups at the science center are relevant to the school subjects, while 3 students (5.1%) think that they are irrelevant. 1 student (1.7%) remained hesitant. 7 students (11.9%) did not comment on this topic. Table 11 includes the

statements of 8th-grade students (38 students-64.4%) expressing their opinion about the relevance/irrelevance of the experimental setups at the science center to the school subjects.

Table 12. *8th-grade Students' Views about the Relevance of the Experimental Setups to the School Subjects*

		f	%
Relevance	Because such studies/experiments are done at school (Balloon explosion test, renewable energy, voltmeter, parallel connected circuit, states of matter, hydraulic press, sound, vacuum bell-shaped glass jar, condensation, pressure-related devices)	35	92.1
	Because they think the subjects taught at the science center are more detailed and advanced than those taught at school	1	2.6
Irrelevance	Because they think that the experiments at the science center are more different/distinct/good.	2	5.2

The following three questions were asked to determine what behaviors the participating students exhibited during their visit to the science center*: "Did you ask instructors questions during the visit?", "Did you take notes in your notebook during the visit?"*, and *"Did you practice every experimental setup by yourself?"*. Table 13 includes students' responses to these questions according to grade level.

Table 13. *The Percentage of Some Behaviors Students Exhibited at the Science and Technology Center According to Grade Level*

		5th-grade				6th-grade				7th-grade				8th-grade			
		Yes		No		Yes		No		Yes		No		Yes		No	
		f	%	f	%	f	%	f	%	f	%	f	%	f	%	f	%
1	Did you ask instructors questions?	29	67,4	14	32.6	23	52.3	21	47.7	37	75.5	12	24.5	41	69.5	18	30.5
2	Did you take notes in your notebook?	12	27.9	31	72.1	5	11.4	39	88.6	8	16.3	41	83.7	2	3.4	57	96,6
3	Did you practice every experimental setup by yourself?	30	69.8	13	30.2	32	72.7	12	27.3	41	83.7	8	16.3	47	79.7	12	20.3

Considering the responses of 5th-, 7th-, and 8th-grade students, a great number asked the instructors questions. As seen in Table 13, 6th-grade students asked instructors fewer questions (47.7%) compared to other grade levels. It is noteworthy that 5th-, 6th-, 7th-, and 8th-grade students did not take notes in their notebooks. Additionally, a significant number of students of all grade levels practices and used the experimental setups at the science center by themselves.

The participating students were also asked *"What are your favorite three experimental setups at the ccience center? Please write the relevant concepts"*. Table 14 includes the responses of 5th-grade students. The names of experimental setups are given as the students expressed.

Table 14. *5th-grade Students' Favorite Experimental Setups and the Concepts They Think Relevant*

Name of the Experimental Setup	f	Concepts and Frequencies
Vortex Tunnel	8	Space (f=2), Universe (f=2), Milky Way (f=1), Effect (f=1)
Tornado Formation/Air Tornado/ Air Smoke	13	Electricity (f=1), Natural disaster (f=2), Air (f=1), Steam (f=2), Wind (f=1), Pressure (f=4), Water (f=3), Atmosphere (f=1), Smoke (f=1),
Water pressure/water match/water ball	6	Water pressure (f=5), Water Movement (f=1)
Mirror flying/Mirrors/Flying mirror	7	Gravity (f=1), Electricity (f=1)
Water waves /Tsunami	5	Waves (f=1), Water (f=1), Water pressure (f=1), Electricity (f=2)
Wind energy/Solar energy/Electricity energy	6	Electricity (f=4), Solar energy (f=1), Force (f=1),
Electric current/Electric circuits /Electricity	5	Electricity (f=2), Electricity shock (f=1),
Harp	4	Finger Detection (f=1), Laser (f=2)
Water Purification Plant	3	Water purification (f=1), Su (f=1), Purification (f=1),
Green Screen/ Green Curtain	4	Photograph (f=2)
Solar System/Solar Eclipse/Lunar Eclipse	5	Sun (f=1), Ay (f=1), Earth (f=1),
Thermal power station	3	Air (f=1), Electricity (f=2)
Reflexmeter	3	Electricity (f=3),
Formation of colors	1	Colors (f=1)
Submarine	1	Pressure (f=1)
Magnet	1	Magnet (f=1)
Fan	1	Electricity (f=1)
Tide	2	Pressure (f=1)
Eye delusion	2	Eye delusion (f=1), Rotation (f=1)
Solar panels	2	Solar energy (f=2)
Ship Game	2	Wind (f=1), Intelligence (f=1)
Jacob's Ladder/Lightning strike	1	Condensation(f=1),
Water Vortex	3	Water (f=1), Pressure (f=2)

As seen in Table 14, for the 5th-grade students, the three most favorite experimental setups at the science center include "tornado formation", "vortex tunnel", and "mirrors". Considering the scientific concepts relevant to these three experimental setups, the students associated the setup of "tornado formation" with concepts such as electricity, natural disaster, air, steam, wind, pressure, water, atmosphere, and smoke. They associated "vortex tunnel" with space, universe, the Milky Way and effect. They used gravity and electricity with respect to "mirrors". They reported that they also liked the experimental setups "wind energy/solar energy/electricity energy", "water ball", "water waves", "Solar system", and "electric circuits".

For the 6th-grade students, the three most favorite experimental setups at the science center include "vortex tunnel", "body capacitance setup", and "playground". Considering the scientific concepts relevant to these three experimental setups, the students associated "vortex tunnel" with concepts such as dizziness, rotation, picture rotation, later rotation (f=8), electricity (f=2), and eye delusion (f=2). They used only electricity (f=10) to define the experimental setup "body capacitance".

Table 15. *6th-grade Students' Favorite Experimental Setups and the Concepts They Think Relevant*

Name of the Experimental Setup	f	Concepts Reported by Students
Electricity Generation	4	Electricity (f=2)
Body Capacitance	18	Electricity (f=10)
Bobbin	5	Electricity (f=5)
Vortex Tunnel	33	Electricity (f=2), Dizziness/Rotation/Picture Rotation/Later Rotation (f=8), Pressure (f=1), Circuits (f=1), Eye delusion (f=2), Light (f=1)
Mirrors	2	
Tornado	4	Steam (f=1), Isı (f=1), Cold (f=1), Nature (f=1)
Water Match/Water Ball	3	Electricity (f=1)
Airbag	4	Pressure (f=1)
Jacob's Ladder	1	Electricity in the void (f=1)
Newton's Balls	2	
Water Purification	4	Water (f=1)
Playground	5	Pressure (f=1), Air Pressure (f=1)
Drums playing with heart rhythm	2	
Submarine	1	Pressure (f=1)

Table 16 includes 7th-grade students favorite experimental setups at the science center and their views about the scientific concepts related to these setups. For the 7th-grade students, the three most favorite experimental setups at the science center include "vortex tunnel", "tornado", and "electric circuits". Considering the related concepts reported by the students, they associated the experimental setup "vortex tunnel" with electricity (f=1), rotation (f=6), dizziness (f=5), eye delusion (f=5), hallucination (f=1), and balance (f=1). For the experimental setup "tornado", they used electricity (f=2), water (f=5), air pressure (f=2), evaporation (f=3), pressure (f=2), and air (f=1).

Table 16. *7th-grade Students' Favorite Experimental Setups and the Concepts They Think Relevant*

Name of the Experimental Setup	f	Concepts Reported by Students
Harp	7	Laser (f=2), Electricity (f=1), Sound (f=2)
Water purification	4	Electricity (f=1), Water purification (f=1), Pressure (f=1)
Tornado	16	Electricity (f=2), Su (f=5), Air pressure (f=2), Evaporation (f=3), Pressure (f=2), Air (f=1)
Bridge	1	Water (f=1), Wind (f=1), Sun (f=1)
Body Capacitance	3	Electricity (f=1), Electric current (f=1)
Electric circuits	9	Electricity (f=8)
Vortex Tunnel	44	Electricity (f=1), Rotation (f=6), Dizziness (f=5), Eye delusion (f=5), Hallucination (f=1), Balance (f=1)
Water pressure	2	Water (f=1)
Reflexmeter	2	
Water ball/water football	4	Water (f=1)
Lever	1	
Bouncing balls	1	
Airbag/Trampoline	8	Air pressure (f=2), Pressure (f=1), Bouncing (f=1)
Mirrors	6	Reflection (f=2)
Magnet-magnetic field	1	
Submarine	8	Water pressure (f=2), Air (f=1), Water (f=1), Electricity (f=1)
Playground	3	Fun (f=1)
Power plants	1	Electricity (f=1), Pressure (f=1)
Hypnotizing circles	1	Eye delusion (f=1)
Jacob's Ladder	1	Electricity (f=1), Lightning (f=1)
Newton's Balls	1	Pressure (f=1)
Green screen-bicycle	1	
Solar panels	1	Electricity (f=1)
Electricity generation by wave	1	Electricity generation (f=1)

Table 17 includes 8th-grade students favorite experimental setups at the science center and their views about the scientific concepts related to these setups. For the 8th-grade students, the three most favorite experimental setups at Bursa Science and Technology Center include "vortex tunnel", "tornado formation", and "water purification plant model". Considering the related concepts reported by the students, they associated the experimental setup "vortex tunnel" with such concepts as electricity (f=6), dizziness (f=2), eye delusion (f=6), balance (f=1), error/illusion (f=7), pressure (f=1), and rotation (f=2). They associated the setup "tornado" with evaporation (f=1), states of matter (f=3), pressure (f=9), and heat (f=1). For the experimental setup "water purification plant model", they used such concepts as water energy (f=2), water clarity (f=1), water hardness (f=1), water (f=2), and pressure (f=1).

Table 17. *8th-grade Students' Favorite Experimental Setups and the Concepts They Think Relevant*

Name of the Experimental Setup	f	Concepts Reported by Students
Vortex Tunnel	37	Electricity (f=6), Dizziness (f=2), Eye Delusion (f=6), Balance (f=1), Error/Illusion f=7), Pressure (f=1), Rotation (f=2),
Electric circuits	1	
Power plants / thermal	6	Electricity (f=6)
Body Capacitance	5	Electricity (f=2)
Playground / Airbag	1	
Magnetic balls/magnet	5	Aspects of transmission (f=1), Force of attraction (f=1), Poles (f=1), Electricity (f=1), Electrification (f=1)
Water Purification Plant	11	Water energy (f=2), Water clarity (f=1), Water hardness (f=1), Water (f=2), Pressure (f=1)
Tornado Formation/Air Tornado	19	Evaporation (f=1), States of matter (f=3), Pressure (f=9), Heat (f=1)
Mirror flying / Mirrors	2	Sight (f=1)
Mirror-cartoon machines	1	Mirror (f=1)
Vocal cords	1	Vibration (f=1), Sound (f=1)
Newton's balls	10	Pressure (f=6)
Water pressure/water match/water ball	1	
Voltmeter	1	
Wave Energy/wind energy/solar energy/electric energy	1	Pressure (f=1)
Submarine	6	States of matter (f=1), Pressure (f=1), Lift force (f=1), Air pressure (f=1), Water exchange (f=1)
Telephone communication model	1	Electricity (f=1)
Green screen	1	Electricity (f=1)
Reflexmeter	10	
Calculator model	4	Electricity (f=3), Intelligence (f=1)
Infinite space/infinite mirrors	3	Reflection (f=2), Mirrors (f=1)
Model for container shape and water level	1	Pressure (f=1)

The students of all grade levels were asked to write their reasons why they liked their favorite experimental setups at the science center. Table 18 shows the relevant data. According the table, 43.5% of 23 5th-grade students responding the question reported the following:"Because it is fun/enjoyable","Because it is good/interesting/impressive/attractive", and "Because it is educative", and "Because it attracted my attention" (Table 18). 31.3% of 16 5th-grade students responding the question stated the following with respect to their favorite experimental setups:"Because it is fun/enjoyable","Because it is good/interesting/impressive", and "Because it is educative". Additionally, 9 7th-grade and 21 8th-grade students reporting their views on this question gave similar responses 6th-grade students.

Table 18. Students Reasons for Liking the Experimental Setups

	5th-grade		6th-grade		7th-grade		8th-grade	
	f	%	f	%	f	%	f	%
Because it is fun/enjoyable	10	43.5	5	31.3	4	44.4	12	61.9
Because it attracted my attention/I liked it	2	8.7	4	25	3	33.3	3	14.3
Because it is good/interesting/impressive	6	26.1	5	31.3	1	11.1	2	9.5
Because I would like to see again.	1	4.4	1	6.3				
Because I have never seen before	1	4.4					1	4.8
Because I learned new information/things					1	11.1	2	9.5
Because it is educative			4	25	3	33.3	1	4.8
Because it is related to electricity							1	4.8

The participating students were lastly asked *"Is there any experimental setup that you do not like? If any, which one/ones? Please explain why"*. Table 19 includes students' responses to this question. Accordingly, a great majority of 5th-grade students (33 students) stated no experimental setup they did not like, while 10 students reported the experimental setups listed in Table 19. Concerning their reasons for disliking these setups, they stated the following: "It made me feel dizzy" (f=4), "I do not like/love/It did not arouse my interest" (f=5), "it is too simple" (f=1), "it is related to sound" (f=2), and "it is an experiment I already know" (Figure 2).

Table 19. *Experimental Setups Students Disliked*

	5th-grade		**6th-grade**		**7th-grade**		**8th-grade**	
	f	**%**	**f**	**%**	**f**	**%**	**f**	**%**
Tornado Formation	1	10			1	7.1	3	23.1
Water pressure/Water ball	2	20			1	7.1		23.1
Green Screen/curtain/green screen-bicycle	2	20			2	14.3		
Vortex tunnel	2	20			3	21.4	3	23.1
Windmills	1	10						
Eye delusion	4	40						
Submarine	1	10					1	7.7
Sound in the void/bell-shaped glass jar	3	30						
Mirrors			1	12.5	4	28.6	5	38.5
Newton's balls			3	12.5	2	14.3		
Drum			3	37.5	1	7.1	2	15.3
Water purification					2	14.3	2	15.3
Phone model					1	7.1		
Serial circuit					1	7.1		
Drum making using pipes					1	7.1		
Science show					1	7.1		
The earth-sun-moon model							1	7.7
Water waves							3	23.1
Jacob's Ladder							1	7.7

Considering 6th-grade students' responses to the same question, a great majority of them (36 students-81.8%) reported no experimental setup they did not like, while 8 students (18.2%) indicated the experimental setups listed in Table 19. 6th-grade students did not like the setups mirrors, Newton's balls, and drum. They reported the following reasons: "I do not like/love/It did not arouse my interest" (f=4), and "it is too simple/basic" (f=1). 71.4% of 7th-grade students (f=35) reported no experimental setup they did not like, while 14 students (28.6%) responding the question stated the following reasons: "it is simple" (f=3), "it is complicated and I could not understand" (f=3), and "I have seen the same setup before" (f=7). Additionally, a great majority of 8th-grade students (46 students-78%) also reported no

experimental setup they did not like. 11 students did not like the experimental setups because they did not like the setup (f=3), the setups were simple and boring (f=6), and they were not fun (f=3).

DISCUSSION and CONCLUSION

This study was conducted to evaluate middle school students' views and impression about the science center as an out-of-school learning environment and presented the results obtained from the "Science Center Opinion Survey".

According to the research results, the application performed at the science center created a positive impact on students of all grade levels. In other words, it is clear from the research results that students were impressed by, liked and enjoyed the science center and the setups there and they would like to revisit the center. This result is true for all grade levels.
The survey also asked the question *"Would you like to come back to the science center"* and all participating students of all grade levels stated that they would like to revisit the center. This result indicated that all the students liked the science center and found it interesting. When the students were asked their reasons for the desire to revisit, the most common responses for all grade levels include "I had a lot of fun and it was very enjoyable", "It is very good", and "I learned new information".

Considering the students statements such as "the place is good", and "there are funny experimental setups", it seems that the majority of the students perceive the science center as more a place of entertainment than a science center. Thus, for students, learning remained in the background. At the end of their trip, the students were also asked the question *"Has your interest in sciences increased?"*. An increase was observed in the responses of students who remained hesitant and responded no. This increase was similarly detected in all grade levels. Thus, this result is another indication that learning remained in the background.

Throughout the world, students are known to be impressed by out-of-school settings like science centers. In Turkey, Bozdoğan (2007) reported that preservice teachers described a science center as an enjoyable and interesting place; thus, they would like to revisit the science center. In other words, preservice teachers were impressed by such settings. Çığrık (2016) found the same results in the doctoral dissertation. Rennie and McClafferty (1996) also examined visitors' reasons for visiting interactive exhibits and investigated whether visitors intended to learn concepts in such exhibits or to have fun. Research also argued that the entertainment aspects of science centers outweighed their educational aspect (Ertaş, Şen & Parmaksızoğlu, 2011; Rennie & McClafferty, 1996). This research result is consistent with that of the present study indicating that students found the experimental setups at the science center impressive and enjoyable. Eshach (2007) also claimed that education was missed when entertainment was foregrounded, and further noted that when education and entertainment were brought under the same roof, education would lose.

In order for education to be realized through planned activities in out-of-school learning environments and in order to help students acquire specific goals and behaviors, teachers should clarify their goals and take precautions, if necessary, according to the nature of such visits.

In this study, the participating students were asked a set of questions to determine their behaviors during the visit to the science center. Among these questions, the question *"Did you ask instructors questions during the visit?"* was answered yes slightly above the average. Considering the students' responses to the question *"Did you practice every experimental setup by yourself?"*, it was answered yes in a fashion increasing from lower grades to higher grades.

When the students were asked whether the experimental setups at the science center were relevant to the topics taught at school, approximately 50%-65% of fifth, sixth and

seventh-grade students reported that there were relevant. The rate was 92% for the eighth graders. Considering the students' responses to the question *"What are your favorite three experimental setups at the Science Center?,* the two most favored experimental setups at Bursa Science and Technology Center were tornado formation for all grade levels, and vortex tunnel for sixth, seventh and eighth-grade levels. The reason why these experimental setups were found interesting at every grade level can be the fact that they practiced themselves, there were different visual elements (Vortex Tunnel), or they confronted an unexpected situation (Tornado Formation).

In Champagne's (1975) research, a total of six hours visit to the science museum was made and this situation was described as "having fun but not being satisfied". Champagne highlighted the point where the true meaning became obscured. In this study, the students were asked to write the names of experimental setups that they liked. However, when they were asked to report the underlying concepts, the majority of students failed to express. Although the experimental setups consistent with curriculum acquisitions were also practiced within the scope of this study, different teaching methods and techniques were not used to support learning. Accordingly, for the accurate description of concepts related to the experimental setups or in other words, for the effective association of these concepts with everyday life as cited in the literature (Bozdoğan, 2007; DeWitt & Osborne, 2007; Erten & Taşcı, 2016), it can be helpful when teachers plan such trips in advance and repeat and when different teaching methods and techniques applicable in out-of-school settings are used.

Science classes involve many phenomena and events that we encounter in everyday life. Research has shown that it is more meaningful and persistent for students to learn science subjects in relation to everyday life, that is, to learn by watching, touching, researching materials in the natural environment (Tatar & Bağrıyanık, 2012). Based on the research results, out-of-school learning environments should not be planned only as trips, activities to be conducted in such environments should be associated with science curricula, and thus, students are helped to have several acquisitions, to better understand subjects, and to conceptualize new concepts in concrete terms. Under this perspective, science centers seem to contribute to the association of science with everyday life.

Suggestions

1. The most favored experimental setups at science centers can be identified for all grade levels, and they can be used as a focus of interest when students become less interested during visits.
2. Students can be informed by science centers about their operation.

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