ACHIEVEMENT IN AND ATTITUDES TOWARD SCIENCE:

THE COMBINED EFFECTS OF FORMAL AND NON-FORMAL LEARNING

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DECLARATION OF ORIGINALITY

I, Sema Çağlar, certify that

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ABSTRACT

Achievement in and Attitudes Toward Science:

The Combined Effects of Formal and Non-Formal Learning

The purpose of this study is to investigate the combined effect of formal and non-formal learnings on the fifth -grade students' achievement in and attitude toward science. It compares the effects of formal education with combined effects of formal and non-formal education. An experimental design is implemented for 48 5^{th} -grade students at a private primary school in Istanbul. In the fall term of the 2015-2016 education year, science program objectives were covered in school as formal learning. Students were taught science in the classroom and at the science laboratory. In the spring term of the 2015-2016 education year, a science program was enriched with non-formal science learning. Throughout the spring term, students were taken to the non-formal learning settings and each unit in the 5^{th} -grade curriculum was taught both in school and at non-formal science centers. Students' achievement and attitudes were investigated with the quantitative analysis of test measurement. Wilcoxon Signed Ranks Test analysis showed that there was not a statistically significant difference between fall and spring term achievement scores of the students but that there was a statistically significant difference between their fall and spring term attitude scores. Moreover, the effects on students with varied performance were revealed.

ÖZET

Bilime Yönelik Başarı ve Tutumlar:

Okul içi ve Okul dışı Öğrenmenin Birleştirilmiş Etkileri

Bu çalışmanın amacı, okul içi ve okul dışı öğrenim arasındaki işbirliğinin 5. sınıf öğrencilerinin fen başarılarını ve bilime yönelik tutumlarını etkileyip etkilemediğini araştırmaktır. 5. Sınıf öğrencilerine fen kavramlarını öğretmeye ve fen tutumlarını artırmaya yardımcı olmak için tasarlanmış okul içi eğitim ile öğretimi, okul içi ve okul dışı eğitimin harmanı ile karşılaştırılmıştır. İstanbul'da özel bir ilköğretim okulunda 48 beşinci sınıf öğrencisine deneysel bir tasarım uygulanmıştır. 2015-2016 eğitim-öğretim yılının ilk döneminde okulda, resmi öğrenim ile fen programı hedefleri ele alınmıştır. Öğrencilere sınıfta ve fen laboratuvarlarında fen eğitim verilmiştir. 2015-2016 eğitim-öğretim yılının ikinci öğretim döneminde ise, fen bilimleri okul dışı fen öğrenimi ile zenginleştirilmiştir. İkinci dönem boyunca öğrenciler, sınıf dışı eğitim ortamlarına gönderilmiş ve her ünite hem okulda hem de bilim kurumlarında öğretilmiştir. Öğrencilerin başarı ve tutumları nicel analiz yöntemi ile incelenmiştir. Wilcoxon Signed Ranks test analizi, öğrencilerin birinci ve ikinci dönem başarı puanları arasında istatistiksel anlamlı bir farklılığın olmadığını ancak birinci ve ikinci dönem tutum puanları arasında istatistiksel olarak anlamlı farklılık olduğunu göstermektedir. Ayrıca, farklı başarı performansına sahip öğrenciler üzerindeki etkileri de araştırılmıştır.

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CHAPTER 1

INTRODUCTION

The purpose of this study is to investigate the combined effects of formal and non-formal learnings on the fifth- grade students' achievement in and attitudes toward science. The study also finds out the impacts of the fusion of formal and non-formal learnings on students with varied performance. In addition to these purposes, the study shows how non-formal education can be organized in parallel to formal education during a semester (4 months); how it can be integrated, where it is being taught, what programs are being offered and what objectives are emphasized. The outcomes of this education practice are revealed through achievement and attitude tests. One part of the study takes place in the formal setting i.e. school. The other part is composed of several partners from non-formal learning settings. Schools regularly ask these sites to perform extracurricular activities. Each partner in this study already has experience in improving the skills and knowledge of young people to become scientifically literate in the future, as well as doing scientific activities.

In Chapter 1, background of the study, statement of the problem, definitions of the terms, statement of the purpose, research questions, and significance of the study are presented.

1.1 Background of the study

The Program for International Student Assessment (PISA) shows that scientific performance in Turkey is among the lowest levels in the Organization for Economic Co-operation and Development (OECD) countries (OECD, 2016). "Scientific performance, for PISA, measures the scientific literacy in the use of scientific

knowledge to identify questions, acquire new knowledge, explain scientific phenomena, and draw evidence-based conclusions about science-related issues" (OECD, 2016, p.1). In 2015, 72 countries attended the PISA. The results of PISA showed that Turkey's mean school performance in the science section was 425, in a range of 401–559. The mean score of the PISA was 493 and this result pointed out that Turkey's mean score is significantly lower than the average of OECD countries.

To revise educational supplies, Turkey has made some changes in the educational system since 2004. The Ministry of National Education (MONE) has made some alterations to the school systems and the curriculums. Teachers, parents, academics, and NGOs are coming together regularly to improve the quality of scientific education. However, PISA's (2015) results show that the problems related to achievement in and attitudes towards science continue. Turkish students are still unable to use their knowledge and skills to meet the real-life challenges which PISA focuses on.

Just memorizing facts is not valuable for the international benchmarking study, PISA and the 21st century. Students have difficulty in meaningful learning of scientific education. This is backed by the research demonstrating that children's life- experience before the age of 14 is the most important determinant of any decision to follow the career in science, their attitudes toward science and their achievement in this area (DeWitt & Others, 2010). Low achievement in and attitudes toward science have several implications for the future development of the Turkish economy and job creation in this area.

People learn science from different sources, in different contexts, and for different purposes. In reality, it is hard to meet all students' educational needs, motivational characteristics and learning styles to make them interested in science

appropriately. However, schools are not the only place where science learning occurs. Science is everywhere in daily life and people experience scientific phenomena in routine implicitly (Hofstein and Rosenfeld, 1996). Learning science in daily life is also enjoyable and effortless. Therefore, combining daily life science with school science can be an alternative to make students more interested in science. At this point, bridging formal and informal learning that is supplementary to science learning can be an effective way to teach science (Hofstein and Rosenfeld, 1996). The design of exhibits and activities in settings such as science and technology institutions, museums, zoos, botanic gardens, and geological sites play an important role as informal learning (Hofstein and Rosenfeld, 1996). Media, magazines, newspapers, TV are also considered as informal science learning tools that can be used to maximize the science performance of students.

On any given day of the week, millions of children visit museums all over Turkey. According to data from the Ministry of Culture and Tourism, there are 98 museums, 92 special museums and 1204 special collections in Turkey. However, the exact participation rates are not known. Informal learning experiences can make better school science leaning and motivate students toward science if it is structured based on the specific aim (Eshach, 2007). Structured informal learning generally refers to non-formal learning. However, how these sites can be incorporated constructively to the ongoing school system and how they affect student's achievement in and attitudes toward science are still important questions.

1.2 Statement of the problem

Turkey's PISA results show that Turkish students are not as successful as desired. Literature offers many ways to improve students' achievement one of which is

outdoor science education. Outdoor science education mainly has two dimensions as informal and non-formal learnings. Informal science learning takes place in every moment of life. It is free choice learning that is not encompassed by the teacher as in formal education, hence informal learning may lead to misconceptions that are not desired. However, it can be constructed with specific learning objectives. In this way, informal learning settings can be utilized by teachers to meet the needs of the curriculum. At this point, non-formal learning takes place. Non-formal learning shares the same aspects of informal learning as being out of the classroom (Eshach, 2007). On the other hand, non-formal learning has specific educational objectives similar to formal education (Eshach, 2007). It is given by teachers but, it is mostly intrinsic due to its nature of fun. Therefore, it can be said that non-formal learning may be utilized to enrich formal learning. To manage this, how to bridge formal and non-formal learnings effectively should be identified. Although there are many current research studies about how to organize non-formal learning, there is very limited research which questions how non-formal education can be organized in parallel to formal education through an education term. The effect of this combination on students' achievement in and attitudes toward science is a big question.

1.3 Definitions of terms

1.3.1 Definition of Formal Education

"Formal education corresponds to a systematic, organized education model, structured and administered according to a given set of laws and norms, presenting a rather rigid curriculum as regards objectives, content and methodology" (Soh & Merrah, 2013, p.2).

1.3.2 Definition of informal education

"Informal education is generally considered to be a kind of learning which continues in every part and phase of an individual's life and usually occurs outside a formal educational establishment" (Soh & Merrah, 2013, p.3).

1.3.3 Definition of non-formal education

"Non-formal learning occurs in a planned but highly adaptable manner in institutions, organizations, and situations beyond the spheres of formal or informal education. It shares the characteristic of being mediated with formal education, but the motivation for learning may be wholly intrinsic to the learner" (Eshach, 2007, p.173).

1.3.4 Definition of the high achiever

Brainbridge (2019, 13) states "in school, a high achiever would be a student who gets high marks and good grades. They do the work that is required and do it well. They tend to be well-organized, with good time-management skills".

1.3.5 Definition of low achiever

In school, a low achiever is a student who generally gets low marks and bad grades. They usually do not do the required work properly. They tend to be disorganized and cannot manage the time. Their school motivation and attitudes are generally low, too (Jabeen & Khan, 2013).

1.3.6 Definition of the field trip

A trip organized by the instructor/s and set out for educational purposes, where the students go to fields in which the materials of instruction might be seen and worked directly in their context: for instance, a trip to a manufacturing plant, a city water system, a library, a zoo, etc. (Michie, 1998).

1.3.7 Definition of primary education

Primary education in Turkey is compulsory for all children aged 6-14. It lasts 8 years and is free in state schools (MONE, 2019).

1.4 Statement of the purpose

The purpose of the thesis is to explore the combined effects of formal and non-formal education on fifth graders' science achievement and science attitude.

Table 1 shows the formal and non-formal settings which the research is based on.

Table 1. Research Settings

Formal Setting	Non-Formal Settings
• A Private School in İstanbul	• Istanbul Technical University's Science Center • Nezahat Gökyiğit Botanical Garden • Santral Istanbul Energy Museum • Istanbul Technical University Museum of Faculty of Mines

1.5 Research questions

Especially, the study focused on the following research questions:

1.5.1 Questions related to achievement in science

1) Is there any significant difference between the 5th- grade students' fall and spring term achievements in science after receiving instruction in both formal and non-formal learning environments?

2) Is there any significant difference between high achievers' fall and spring term achievements in science after receiving instruction in both formal and non-formal learning environments?

3) Is there any significant difference between low achievers' fall and spring term achievements in science after receiving instruction in both formal and non-formal learning environments?

1.5.2. Questions related to attitudes toward science

1) Is there any significant difference between the 5th -grade students' fall and spring term attitudes toward science after receiving instruction in both formal and non-formal learning environments?

2) Is there any significant difference between high achievers' fall and spring term attitudes toward science after receiving instruction in both formal and non-formal learning environments?

3) Is there any significant difference between low achievers' fall and spring term attitudes toward science after receiving instruction in both formal and non-formal learning environments?

1.6 Significance of the study

In the literature, there are many types of research about the comparison of formal and non-formal learning and its effects on achievement, attitude and motivation but there are few studies on the development of long-term relationships between formal and non-formal learning and its effect on students' achievement in and attitudes toward science. The present study investigates scientific practices in school blended with non-formal learning through a lengthy application and assessment tests that cover the spring semester of the 2015-2016 educational year.

In schools, students have different performance levels concerning their assessment results. There is also a deep debate about the effects of the formal education on low achievers. This study may also reveal the combined effect of formal and non-formal learning on students with varied performance.

Furthermore, the results of the study may potentially provide an understanding of the steps of organizing non-formal education in primary school such as preparation, application and evaluation, which may contribute to better schooling and both pre- and in-service training teachers. From these perspectives, this study probably contributes to the research literature of Turkey.

CHAPTER 2

REVIEW OF THE LITERATURE

This chapter introduces and compares forms of education: informal and non-formal. Then, it explains the cognitive and affective outcomes of school field trips, a type of non-formal learning mostly seen in the school system. Finally, the benefits of field trips on students with varied performance and the role of teachers in field trips are explained.

2.1 Forms of education: Informal and non-formal

Most of the time, it is considered that learning takes place just in schools. However, science is everywhere and occurs every moment of life. Therefore, learning takes place not only in the schools but also out of the schools. Therefore, to appreciate children's learning, one should focus on both places at the same time.

In- and out- of- school experiences have important impacts on children's achievement in school (Eshach, 2006). It should be kept in mind that children spend 85% of their time outside the classroom (Medrich, 1982). Streets, playgrounds, televisions, magazines, newspapers and peer talks are the informal science learning tools that stimulate students' understanding of science. In addition, many children visit science museums with their families in their free time or with the school group as a school trip. At those places, they observe many scientific phenomena, some of which are experienced by hands-on activities. Being enjoyable, museums and science-related institutions also make a great contribution to the understanding of science (Eshach, 2006). Gardner (1991) claims that museums have a big potential to teach students scientific concepts, to draw a positive attitude toward science, to show

the enjoyable side of the science and to make them volunteer for a career in this area. It means that out –of- school learning can be in the form of both informal and non-formal and both of them have effects on students' learning and highlight the students' interest in science.

Informal learning gives students freedom in which exhibits their approach in scientific institutions. This free and unguided visit is shaped by students' desire. However, the concept of many museum and science center visits are highly structured. In these places, students follow a guide, fill files and conduct experiments. They do hands-on activities with their teachers or museum educators. There is a big difference between formal and informal learnings (Dierking, 2002) but, sometimes it shares similar aspects. Gilbert and Priest (1997) argue that education can be similar in terms of type and quality if the meaningful activity is promoted by educators at museums and by teachers at schools. Hofstein and Rosenfeld (1996) also argue the problem about the definition of informal learning because of sometimes being structured like formal learning and sometimes being unstructured that is free.

"Dividing out-of-school learning into informal and non-formal categories helps to achieve a better understanding of the characteristics of out-of-school learning" (Soh & Meerah, 2013, p.3). Due to this problem, out-of-school science learning is separated into two categories by Eshach (2006). The picture of distinguishing between non-formal and informal learning is shown in Figure 1.

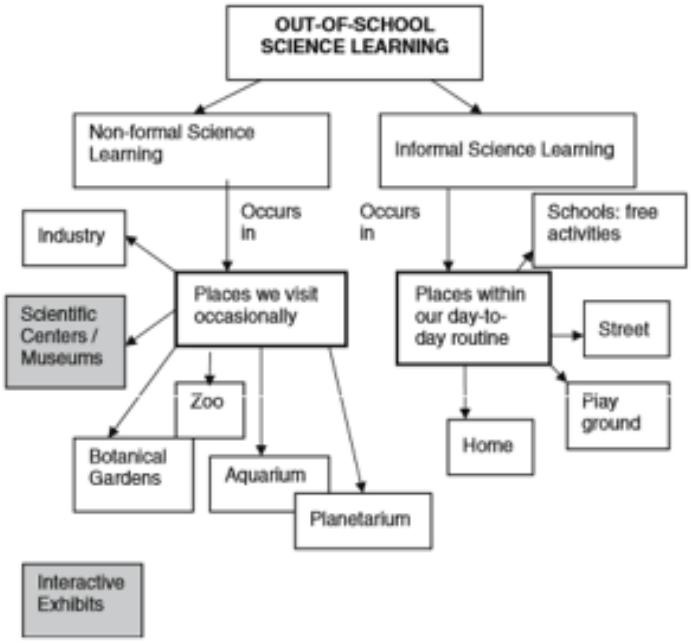


Fig. 1 Non-formal and informal learning
This Figure is taken from Eshach, 2006

2.2 The characteristics of informal learning

"Informal education is generally considered to be a kind of learning which continues in every part and phase of an individual's life and usually occurs outside a formal educational establishment" (Soh & Merrah, 2013, p.3). Such learning can occur within the family, the neighborhood, the friends, yard, parks or streets and so on. Television programs, radios, newspapers, magazines, internet, sports centers, museums, scientific centers, planetariums, or aquariums, botanic gardens or zoos are also other areas in which informal learning takes place (Pedretti, 2004). Since informal learning offers different learning ways, it meets students' different learning needs (Melber & Abraham, 1999). By nature, informal learning includes fun and enjoy which usually do not exist in traditional classroom environments. It is usually learner-led and non-sequential. This makes students motivated intrinsically and makes them free to determine which knowledge to learn and which skills to acquire

(Csikszentmihalyi and Hermanson, 1995). Crane, Nicholson, Chen, and Bitgood (1994) states that:

> Informal science learning refers to activities that occur outside the school setting, are not developed primarily for school use, are not developed to be part of an ongoing school curriculum, and are characterized as voluntary as opposed to mandatory participation as part of a credited school experience. (p. 3)

Informal learning is unstructured and students are volunteer to learn but, it can be supportive of formal learning, as well. Bozdoğan & Yalçın (2009) believes that the importance of supporting formal education with informal education. By fulfilling formal education with informal learning, the number of students who enjoy science and learn scientific concepts intrinsically can be increased.

On the other hand, informal education is sometimes full of joy in nature because the limits are shaped by the students. According to Shortland (1987), education gets less attention if it comes together with entertainment. Eshach (2006) stated that if the scientific institution visit is mainly fun, students learn something but not the teacher had planned. Research done a half century ago showed that a six-hour scientific school trip was found enjoyable by students but the task planned by the teacher could not be fulfilled (Shortland, 1987). Braund (2006) also agrees on the idea that enjoyment is better than educational gains in less formal contexts. Another criticism about learning in informal or non-formal contexts is that misconceptions are fostered by students' uncontrolled experiences (Braund, 2006). "At an interactive science center children have fun participating in a series of experiments, but they learn little science and may acquire a good many misconceptions which at the very least fail to match those offered in the captions" (Shortland, 1987, p.214). Therefore, the outcomes of the informal learning are still open to discussing for the researchers.

2.3 The characteristics of non-formal learning

Soh & Merrah (2013) states that “non-formal learning refers to any organized and systematic educational activity, carried on outside the framework of the formal system, to provide selected types of learning to particular subgroups in the population; adults as well as children” (p.3). It occurs at an institution out of the school as in museums and scientific centers and students generally visit such places in the framework of a school scientific trip. In these places, the activities are generally structured and guided.

Glick and Samarapungavan (2008) conducted an experimental study to find out the effects of pre -and post-visit field trip experiences. The experimental group received pre -and post- visit lessons but, the control group was just visiting the scientific institution. The results of the study showed that experimental group learned more than the control group. They claimed that a field trip should be constructed effectively to make students learn more (Glick & Samarapungavan, 2008). Scientific trips are prearranged by teachers so; motivation may be extrinsic. However, it is typically more intrinsic due to its funny nature.

Non-formal learning shares common features with formal and informal education. According to Eshach (2006) “the non-formal learning occurs in a planned but in a highly adaptable manner in institutions, organizations and situations beyond the spheres of formal or informal education” (p.173). So, non-formal education is led by the teacher, which seems to be characteristics of formal education. On the other hand, such learning is generally not evaluated , which is similar to the aspect of informal education. Briefly, formal, informal and non-formal learnings are slightly different from each other as shown in Table 2 (Estach (2007)).

Table 2. Comparison of the Forms of Education

Formal	Non-formal	Informal
Usually at school	At institution out of school	Everywhere
May be repressive	Usually supportive	Supportive
Structured	Structured	Unstructured
Usually prearranged	Usually prearranged	Spontaneous
Motivation is typically more extrinsic motivated	Motivation may be extrinsic but it is typically more intrinsic	Motivation is mainly intrinsic
Compulsory	Usually voluntary	voluntary
Teacher-led	May be guided or teacher-led	Usually learner led
Learning is evaluated	Learning is usually not evaluated	Learning is not evaluated
Sequential	Typically non-sequential	Non-sequential

2.4 Field trips: As non-formal learning

Behrendt and Franklin (2014) define a field trip as the one "which may also be termed as an instructional trip, school excursion, or school journey is a school or class trip with an educational intent, in which students interact with the setting, displays, and exhibits to gain an experiential connection to the ideas, concepts, and subject matter" (p. 236). School trips generally are organized by the teacher for several purposes. They usually ask the students to enable the first-hand experience at interactive locations but, these purposes mainly change based on the teachers' aim. Michie (1998, p.25) summarizes these purposes under five headings :

1) To enable students with firsthand experience,

2) To increase students' interest in science,

3) To make students learn scientific concepts better,

4) To strengthen students' science process skills,

5) To promote students' intrapersonal and interpersonal development.

Since exhibits in scientific institutions cannot be duplicated in the classroom, it is highly valuable to take students to the field trips (Nawi & Azmi, 2018). In schools, students are generally forced to perform paper and pencil activities with a

little chance of observation. However, field trips make students observe natural settings and enable them to make their meaning of the concepts. Interactive exhibits help students play with concepts; activities not possible in the classroom. By organizing field trips, “earlier course content suddenly becomes relevant as students assimilate and accommodate new understanding and cognition” (Khotimah, Budi and Sumantri, 2018). At this point, the connection between the field trip and the classroom is made by students. These connections may increase students’ interest and achievement as well.

Museums, science centers, aquariums, zoos, botanic gardens and planetariums offer excellent experiential learning activities and programs which are usually run by the staff. Each student shares the same experiences. Teachers find such programs comfortable because the students are bound to a determined agenda (Rennie, 2007). Students are free observers but they should follow the procedure as well. These features represent non-formal education. Therefore, it can be said that field trips are the best way of non-formal education. Teachers can combine school curricula with the appropriate programs run into non-formal education settings and mix the formal and non-formal learning concerning his or her educational purpose.

Experiential activities should play a significant role in science learning and field trips are the types of experiential learning. Experiential learning is authentic, hands-on, sensory-based learning. With experiential activities, students experience, observe, explore, touch and listen to things. Kolb (1983) states that experiential learning consists of having experiences, then making inferences and finally getting results. Students who acquire hands-on, authentic experience may develop curiosity and interest leading to a desire to learn more. Students may improve science process skills like observation, data collection, and interpretation of data, too (Tan, Poon &

Lim, 2014). Social skills develop as the students share perceptions and knowledge with others. Students may begin to look forward to classes and connect previous knowledge and experiences with the new concepts. They may become relevant to science concepts and the nature of science.

A strengthened interest in science may lead the student onto a science- related career path or establish higher- quality scientific literacy. Students are interested and motivated, permitting the instruction to rise to new and higher levels. Students who are interested and alerted in class will learn the concepts, thus standardized test scores may improve. Formal educators might consider increasing student interaction by adding non-formal learning opportunities to reinforce classroom knowledge and allow students to assimilate and accommodate experiences to their classroom knowledge (Nabors, Edwards, & Murray, 2009). Therefore, field trips as a non-formal education are one of the best ways of acquiring better achievement and motivation.

Dierking & Falk (1997) states that benefits from field trips are not guaranteed; the learning or interest development may only be temporary and short-term memory does not constitute learning. In contrast, Dillon (2013) suggested that the effects of a well-designed and a well-orchestrated field trip experience can be long -lasting. Students may remember what they had seen and heard even after a year.

Consequently, well- planned field trips can make an effective contribution to formal education outcomes. If the field trips are arranged successfully, its effects on students' cognitive and affective effects may be long-lasting.

2.4.1 Cognitive outcomes of field trips

Dewitt and Storksdieck (2008) stated that many types of research related to field trips and their effects on school-based learning have been done in the last 30 years. These studies are mostly about learning potential of out of school environments like museums, zoos, botanic gardens and scientific centers. Some of them also focused on the comparison of in-school learning without -of-school learning about their cognitive outcomes.

Bitgood (1989) claimed that field trips may lead to better learning than school-based learning if it is well-designed. The study done by Sneider, Eason, and Friedman (1979) found out that students who visited interactive astronomy exhibit learned better and developed using a telescope skill than the students who did not visit. Another study done by Fishon and Enochs (1987) concluded that students who experienced the hands-on exhibit outperformed the students who had no experience with the exhibition.

Beiers and Mcrobbie (1992) conducted a study to investigate the amount of learning in the non-formal learning environment. In an interactive scientific event, students outperformed regarding the concept of sound after attending the event. Similar results were obtained by Feher and Rice (1988) who focused on the concept of light. A true experimental design study with seven graders was conducted by Javlekar (1989) in India. He found that the experimental group who visited the scientific center outperformed the control group regarding related scientific concepts. Another study detected an increase in students' performance about animal classification tasks by participating in activities in nature (Stephenson and Parvin, 2004). Stephen and Parvin (2004) also found that visiting informal sites improved students' learning of the concepts of industry.

Parvin and Stephenson (1999) detected the students' improved understanding of concepts in his study using pre- and post-test assessments . He figured out the additional benefit of learning in the museum to the learning in the classroom about concepts of force and motion. Through such studies, it is concluded that learning from a field trip is an excellent way of learning and a valuable supplement to classroom learning.

Falk ,et al. (1986) and Ramey Gassert ,et al. (1994) explained the reason for these positive improvements as the constructivist theory of learning. Since students experience hands-on activities and real-world objects in scientific centers, there is a meaningful learning and the persistence of learning may be for a long time. Hofstein and Rosenfeld (1996) said that "Information acquired on a field trip may be remembered for a long time. This is an important addition to the notion that visits to museums, zoos and science centers are enjoyable and result in long-lasting memories" (p. 95).

DeWitt (2008) explored the impact of field trip on students' learning. The study demonstrated that 80% of the students were able to connect their school learning with the field trips experience. This research showed the potential contribution of the scientific institutions to learning science.

Miglietta, et al. (2008) examined the effects of a field trip on different genders. In the study conducted in Italy, the students were sent to a marine biology museum. The results of the study showed that female students learned more than male students in terms of science concept.

Tenenbaum , et al. (2004) examined the effect of the integration of formal and nonformal learning to understand more complex concepts. Students with diverse ethnic groups learned in both classroom and museum. As a result of the study,

students increased their understanding of the concepts of bubbles, currents ,and buoyancy.

Caleon and Subramaniam (2005) conducted an experimented with the effects of science centers on students' cognitive and affective aspects. In their study, they found out that students learned cryogenics related concepts effectively during the field trip. Besides, they increased their attitude toward science- related activities and science career immediately after the intervention.

Bowker (2004) conducted a study with students and assessed their learning about plants and nature after the field trip. He claimed that field trips are an effective way to encourage students to learn less attractive concepts effectively. The study also figured out the attitude gains regarding the enjoyment and social process of students.

Henriksen and Jorde (2001) noted the importance of well-designed field trips to respond to students' needs in field trips. In their study, pre-visit and post-visit activities were underlined. Linking teacher- led lectures in the classroom with the educator -led instruction in the museum needs careful planning (Henriksen and Jorde (2001). Similarly, Morrell (2003) in his study found that outdoor experience increased students' knowledge regarding forestry concepts. He advocated that many factors affect to get benefit from the field trip. Preparing students for the field trip and performing well-planned pre and post activities are the key elements to make students learn more in informal and non-formal learning settings (Morrell, 2003).

Falk et al. (1998) showed another reason to explain the positive effects of field trip on cognitive learning. They claimed that entertainment encourages learning that is one of the characteristics of field trips. In their study with 65 individuals, they found out that people who have more motivation in entertainment developed their vocabulary about gems and minerals better. Consequently, literature commonly

states that non-formal education improves children's achievement in science and makes great contributions to school science learning.

2.4.2 Effective outcomes of field trips

Many students appear to make their decisions about their career when they are just in kindergarten or primary school, hence, positive attitudes toward science are very important to make students follow their career in science (Blatchford, 1992). In their study, Musgrove and Batcock (1969) found out that a third of 338 science and engineering students at the University of Bradford chose to study science when they are just about 12. Such studies show the importance of attitude toward science to make students continue their life in science -related jobs.

In addition to career choice, "there is a strong association between attitudes toward science and a child's performance in the science class" (Eshach, 2006, p.178). Children who have positive attitudes toward science appear to be more active in scientific activities. Participating in exercise and experiments lead to more success. As it is seen, the positive attitude toward science is crucial for students' today's success and tomorrow's choice.

Many things can be done to increase students' attitudes toward science. In the words of Eshach (2006):

> Scientific field trips to science institutions can generate a sense of wonder, interest, enthusiasm, motivation, and eagerness to learn, which are neglected in traditional formal school science. Therefore, scientific fieldtrips may play a significant role in inculcating positive attitudes toward science among children. (p.178)

Scientific centers, museums, botanic gardens, and zoos are the most commonly visited places by students for a scientific field trip. These places are non-formal learning settings in which many teachers send their students. They believe

that the power of non-formal learning to improve students' achievement, increases their attitude and be willing to learn more about a particular area of study (Holmes, 2011). Non-formal learning makes a valuable contribution to formal learning (Borun, 1983) because the settings that non-formal education occurs cannot be replicated in a regular classroom. In such places, students have a chance to feel themselves to be real scientists by experiencing real science objects directly. In terms of the field trip, Bartels (2001) claimed that students' attitudes change ''from a third- person relationship to a first-person relationship'' (p. 45). Hence, field trips as non-formal learning places can be complementary to formal school learning.

Falk (1983) claimed that field trips mostly lead to enjoyable and long-lasting memories. Field trips are fun in nature. Students have a chance to connect with real objects. This makes them feel more excited about science. In the study by Hofsten and Rosenfeld (1996), the students who participated in geological field trips outperformed the students who discussed ecological concepts in the classroom on the attitude test. Salmi (2003) studied the motivating effect of scientific institutions. He found that the positive impact of field trips on primary school students was the biggest. He conducted another study on the university students, and concluded that science center visits affected the students' career choice.

Bozdogan and Yalçin (2009) state that scientific centers are "a combination of science, technology, and training" (p.28), hence they claim that scientific centers are the important places for affective and cognitive gains. In their study, they found the positive effects of field trips on students' attitudes and achievement in science.

Jarvis and Pell (2002) examined the attitude and knowledge changes in elementary school students after visiting the Challenger Learning Centre in the United Kingdom. During the field trip, students experienced a space mission

simulator. They found that after the field trip, most of the children's attitudes were more positive toward space -related tasks. They concluded that 24% of the students changed their minds to become a scientist. This was a short experience that needs to be considered carefully.

Consequently, literature commonly says that non-formal education improves children's attitudes towards science, make them follow a scientific career in the future and encourage them to know more about science. Therefore, non-formal education can be utilized to increase students' attitudes toward science.

2.4.3 The procedure before non-formal learning visits

Some steps should be taken into consideration while designing a field trip (Eshach, 2006). When designing field trip, Eshach (2006) offers pre-activities for teachers to make the field trips more effective. Before the field trip procedures are listed below.

1. "Decide what the purpose of the scientific field trip is" (Eshach, 2006).

First of all, the teacher should decide on the main purpose of the field trip. The purpose can be to introduce students with the topic or summarize it. It can be to deepen the topic or just to motivate the students to it.

2. "Visit the field trip location beforehand" (Eshach, 2006).

Secondly, the teacher should talk to educators about the purpose of the field trip. Generally, scientific institutions offer programs for the school. The teacher may visit the center and get information about the programs whether it is suitable for their purposes. The teacher may explain their expectations and shape the program due to these expectations. In this way, the teacher may arrange a pre- visit and post -visit activities they can do in the classroom.

3. “Share the purpose of the visit with the children before the visit and share your expectations of them” (Eshach, 2006).

The teacher should explain the purpose of the field trip to the students. He should motivate students and get their concentrations to the target. He can ask about students ’expectations and shape the field trip.

4. “To decrease the novelty phenomena, the children can be presented with the structure of the day” (Eshach, 2006).

The students should know what they are going to do during the field trip. To make them familiar with the center, the teacher may present the location via the internet. In this way, both students and teachers feel safe about the field trip.

5. “Conduct the relevant scientific activities in the class before going to fieldtrip” Eshach, 2006).

Doing activities before field trip motivates students. In addition, they may acquire some skills and knowledge they need for the field trip.

2.4.4 The procedure during non-formal learning visits

To make field trip more effective, the following steps should be taken into consideration while designing field trip (Eshach, 2006). Eshach (2006) offers the following steps to follow during each visit.

1. “Always provide some tasks to be conducted on the field trip” (Eshach, 2006).

It is very important to give students the tasks they will complete. Otherwise, they may ignore some points the teacher wants them to notice. Such tasks should include observation and discussion other than just recording knowledge. Besides, students should be given free time to participate in the activities they want.

2. “Share with parents and encourage them to join the trip” (Eshach, 2006).

The parents with scientific background might help organize scientific trip both before and during field trips.

2.4.5 The procedure after non-formal learning visits

The effective field trip has the post-activity part (Eshach, 2006). When designing field trips, Eshach (2006) offers the procedures listed below to do after field trip.

1. "Discussion in class after Scientific Fieldtrip" (Eshach, 2006).

After the field trip, the students should discuss what they observe, what they learned, etc. Doing this is very important to help students remember what they experienced. The best and worst parts of the field trip should be also discussed.

2. "Combine the field trip to the subject" (Eshach, 2006).

All field trips have a specific purpose. Combining the field trip and the subject related to this purpose changes. The field trip may be conducted before the subject just for motivating students or introducing the students to the subject. On the other hand, it may be conducted after the subject for deepening or summarizing it.

3. "Schools and museums should cooperate and bring some scientific activities into the classroom" (Eshach, 2006).

The teacher may conduct similar activities into the classroom that are experienced during the field trip. Moreover, some museums give students presents to make them continue their observation in the classroom. The field trip educator may visit students after some while there is a strong connection between school and the scientific center.

4. "It is suggested that schools prepare some activities in advance; activities that may be good for parents to join" (Eshach, 2006).

To inform parents about the details of the field trip is very important. They may want to continue the activities at home. To enable parents to do this, the guidance should be prepared for what they can do.

2.5 Benefits of field trips to students with varied performance

Each student has his own learning pace and their achievement scores and attitudes toward science may vary from each other. Since each students' learning needs are different, "the most appropriate learning environment can differ for each student by their characteristics" (Han, Capraro, and Capraro, 2014). In the school environment, some students are called higher achievers; whereas others are under achievers. The students who adapted to formal learning environments generally achieve better than the others do. However, formal education cannot be a guaranteed a way to meet all students' learning needs (Han, Capraro, and Capraro, 2014). At this point, non-formal education may play a crucial role to empower some students' achievements in an attitude toward science.

A field trip has the potential to increase students' cognitive and affective aspects. It may improve students' knowledge, skills, attitudes, interests, and motivations; even change their minds about the future careers (Hutson, Cooper & Talbert, 2011). Field trips offer an important opportunity for students to create connections, which will help them gain understanding and develop an enjoyment of learning. Hence, such places may be useful to meet the needs of students with varied performance.

In a classroom, there is a diversity among students' achievement levels. Teachers generally make their decisions about the instructional method they used by taking into account this diversity. "Underachievement is most commonly defined as

a discrepancy between potential and performance" (McCoach and Siegle, 2001, p.71). Therefore, a student who has the potential to succeed in school but the struggle is often called underachiever. "Factors commonly associated with underachievement include low academic self-concept, low self-efficacy, low self-motivation, low goal-valuation, and negative attitude toward school and teachers" (McCoach and Siegle, 2001, p.71). Higher achiever students are generally self-directed, so they just need teachers' assist in the learning process. On the other hand, underachiever students need teachers' assist more deeply in the learning process since they are insufficient for self-directed learning (Yoon, 2009).

Field trips lead to many different learning experiences appealed to different learning styles and levels of knowledge (Allen, 2004). Such diversity may meet students' diversity needs. Field trips enable students to increase their scientific process skills such as observation, collecting data, interpretation data, etc. by utilizing all their senses (Nabors et al., 2009).

Students develop a positive attitude toward learning, motivating them to develop connections between the theoretical concepts in the classroom and what has been experienced (Falk & Balling, 1977). Field trips are fun in nature that students mostly enjoy. Therefore, students generally have positive attitudes toward field trips. Although non-formal education is led by an educator at the institutions, students' motivation is typically intrinsic. Students generally volunteer to be part of the activities. Field trips provide an opportunity for students to develop increased perception, a greater vocabulary, and an increased interest in the outdoors (Hoisington, Savleski, & DeCosta, 2010). Developed interest stimulates curiosity, empowering students to ask questions, discuss observations, consider past experiences, or simply ponder the topic (Farmer, Knapp, & Benton, 2007).

Gardner (1991) underlines the importance of field trips and argues that schools are losing their power to engage students to learn. He adds that students can understand scientific concepts more clearly in museums. Furthermore, field trips help students take responsibility for their learning.

To summarize this point, a field trip has a potential impact on students' cognitive skills and affective skills such as knowledge, interests, and attitudes (Hutson, Cooper, & Talbert, 2011). This may be particularly true for students who are academically challenged or described as 'at risk' due to low performance on high-stakes tests or performance in the classroom. Field trips offer an opportunity for students to create connections, which will help them gain understanding and develop an enjoyment of learning. So, field trips as non-formal learning can appeal to a range of intelligence, promoting the likelihood of engagement by people with different strengths and preferences for learning (Eshach, 2006).

2.6 Role of teachers in field trips

Tal and Morag (2009) claim that teachers have little or no training in the process of field trip planning and preparation. According to Tal and Steiner (2006), teachers mostly fall into one of three patterns while on a field trip:

1) Teachers are active in all the preparation and during field trip activities
2) Teachers follow an established routine of the school
3) Teachers are inactive all the process of the field trip

Unfortunately, a teacher may rely completely on the school administration to set up a field trip, may not personally communicate with the venue, or during the field trip, the teacher does not participate in field trip activities. However, teachers' role in field trips is very important to get desired outcomes. There are paths which

the literature offers for the teachers to follow in order to compose effective field trips.

The three-step model is a research-based pedagogical tool for teachers to be utilized in planning field trips (Ksiel, 2006). The three-step model is based on the 5E learning cycle that was first used as an inquiry lesson planning model in the Science Curriculum Improvement Study (SCIS) program. The phases of the 5E model – engagement, exploration, explanation, elaboration, and evaluation – highlight the main aspects of inquiry-based science education (Rönnebeck, Bernholt, and Ropohl, 2016). The phase of engagement means getting to know the topic. In the phase of exploration, different ideas of pupils are explored through hands-on activities. The explanation is an advanced phase giving explanations and clarifying understanding. In the next phase, elaboration, the topic is deepened by applying the learned concepts to new fields. The last phase involves an evaluation: both self-reflection and the teacher's evaluation take place (Bybee et al., 1989).

The three-step model activates learning during the scientific center visit, because both the pre-visit and post-visit phases deepen the topic. Engagement takes place in the pre-visit phase, whereas exploration, explanation, and elaboration belong to the visit phase, and evaluation is performed in the post-visit phase (Frantz-Pittner, Grabner and Bachmann, 2011). The detailed explanation of the three-step model is given in the following sections.

2.6.1 The procedure followed before the field trip

The teacher should visit the center before the field trip, to learn the current program and determine whether the program is suitable for all the students. During the student orientation before the field trip, the teacher should prepare students by describing the

program and its layout (Rennie, 2007). Orion and Hofstein (1994) cited three variables that prepare students for field trips: understanding the venue layout, the focus of the activities, and being prepared to be in an open, informal venue, what the authors call “novelty space”.

Reduction of the novelty space would enhance learning during the field trip. Prepared students know behavior expectations, increase interaction with the exhibits and look for the connections between the exhibits and classroom concepts. The school’s science curriculum should be connected to the venue and its focus. There is little question that a field trip is a valuable experience for the students, but the teacher should connect the students’ experiences on the trip with concepts and lessons taught in the classroom. The field trip should not be a stand-alone experience (Kisiel, 2006).

2.6.2 The procedure followed during the field trip

As activities begin, the teacher should be prepared to interpret the program to any unfocused or confused student (Rennie& McClafferty, 1995). During the field trip, students experience learning in an authentic, informal and natural setting. Each student’s prior knowledge gained both from the classroom and their personal out-of-school experiences is used to make connections to the field trip experience (Pasquier & Narguizian, 2006). The teacher should keep the students engaged. The venue ’s staff should work in concert with the teacher to enable students to make connections between the experience and the concepts involved. Generally, the venue's staff must keep the activities interesting.

Teachers often utilize worksheets to help students focus on exploring and learning the targeted concepts. Worksheets are quite effective when one worksheet is

given to a small group, in which the students are better observers, interact more frequently, discuss the concepts, and ultimately develop more connections between the concepts and the experience (Rennie, 2007).

Students respond to a field trip in a variety of ways. Average students may suddenly reveal a never seen before level of excitement, focus, and inquiry (Hefferan, Heywood, & Ritte, 2002). Conversely, some students known for strong classroom performances might be less proficient in the field and may or may not enjoy the challenge to succeed in the new, informal environment. Each student is unique and each field experience is so unique that every field experience will result in many different academic, cognitive, and social gains (Rennie, 2007). If done properly, students will build long term memories of the field trip experiences (Wilson, 2011).

2.6.3 The procedure followed after the field trip

The teacher's actions after the field trip are very important. The students' experiences need to be reinforced through discussion, activities, reading, a television show or movie (Falk & Dierking, 2000; Kisiel, 2006; Orion & Hofstein, 1994; Pace & Tesi, 2004; Tal & Steiner, 2006). Students need to solidify their new ideas and observations which have not yet made connections. Reflection will help build those connections, as well as reinforce the successful connections already made on the trip. Students generate greater understanding as teachers develop potential connections through reflection (Kisiel, 2006). Students should discuss their observations and experiences, and create presentations to share with their classmates. During the remainder of the school year, the teacher should connect new classroom concepts to the students' field trip experiences (Rennie & McClafferty, 1995). In Tal and

Steiner's (2006) examination of teacher's roles during field trips to museums, neither elementary nor secondary grade level teachers carried out post-visit quality activities. Teachers must recognize the importance of post -field trip reflection and try to maximize student interest and learning.

CHAPTER 3

METHODS AND PROCEDURES

This part presents the design of the research, research population, selection of the sample, research locations, data collection instruments, science subjects and field trips as well as data analysis.

3.1 Design of the research

This research utilized a quantitative research method in which data is largely in numerical form. Creswell (2003) defines the quantitative method "as an approach for testing objective theories by examining the relationship among variables. These variables, in turn, can be measured, typically on instruments, so that numbered data can be analyzed using statistical procedures" (p.4).

In social science, some settings do not allow the researcher to have control over data collection procedures and an experimental stimulus which means true experimentation is not possible (Campbell & Stanley, 1966). Therefore, there are different types of experimental designs, one of which is pre-experimental. With pre-experimental designs, the researcher studies a single group and provides an intervention during the experiment. This design does not have a control group to compare with the experimental group so that the researcher studies only one group what is called a within-group design (Creswell, 2003). There are different forms of pre-experimental design types like One-Shot Case Study, One-group Pretest-Posttest Design and Static Group Comparison (Creswell, 2003). In this study, the pre-experimental research method was utilized for the research questions.

To determine the impacts of combined formal and non-formal learning on 5th graders' achievement in and attitudes toward science, all research questions are answered with the data gathered through achievement tests, and pre- and post - attitude tests.

3.2 Research population of the study

The population of the study includes the 5th -grade students in İstanbul. 5th grade is the first year of middle school and its curriculum is not so intensive. Hence, teachers have enough time to do extra-curricular activities with this grade. In addition to this, each unit subject is suitable for doing scientific experiments and other hands-on activities in school and there are many different museums for each of them in İstanbul.

Another reason why 5th grade is chosen as the population of the study is because of easy accessibility of the population for the researcher, who works as a science teacher in an elementary school and has 5th -grade students.

3.3 Selection of the research sample

"Purposive sampling method" (Gay et al., 2006) was used by applying the research with 5th -grade students. For the purpose of the study, combined formal and non-formal learnings and their effects on students, private school are more appropriate for the study since it is easier to get permission from private schools for the projects concerning time and funding. Moreover, as the study was done, the researcher was working in a private school in Ümraniye/İstanbul and it would rather be convenient to conduct the study in this school.

3.4 Locations that the research took place

The study was conducted on different sites as formal and non-formal learning settings. The summary of the settings is shown in Table 3. One part of the research was applied in a private school located in İstanbul, Turkey as a formal learning setting. This private school has 24-year- experience in education and 4 different campuses around İstanbul. In these 4 campuses, there are nearly 1000 students from pre-school to high school. The study was conducted on the campus located in Ümraniye/İstanbul.

The other part came out in non-formal learning settings and was supported – by several partners. These settings offer educational programs as extracurricular activities that students may attain as a group or on their own with their families. In the study, students were sent to 4 different scientific institutions up to spring term curriculum subjects. They included Istanbul Technical University's Science Center, Nezahat Gökyiğit Botanic Garden, Santral İstanbul Energy Museum and İstanbul Technical University Museum of Faculty of Mines.

Istanbul Technical University's Science Center is located on Taskışla campus in the district of Taksim, Istanbul. It was opened in November 2007. It is a center that encourages children to interact with exhibits. The exhibition contains exhibits related to mechanics, electricity and magnetism, mathematics, DNA, space and general physics.

The mission of Nezahat Gökyiğit Botanic Garden (NGBG) is to create a beautiful educational garden and a green lung for the city. It is located in Ataşehir, Istanbul. It was opened in 2003. The Garden ais to increase public knowledge related to the importance and value of plants, promote scientific research and education

relating to plant life worldwide, protect and support the biological diversity of the world. The center offers educational programs for students and encourages them to interact with plants.

Santral İstanbul Energy Museum was opened in 2007. It is art and cultural complex located at the upper end of Golden Horn in the Eyüp district of Istanbul, Turkey. The center consists of an energy museum, an amphitheater, concert halls, and a public library. It is situated within the Silahtarağa on the campus of Istanbul Bilgi University that was formerly the first power station of the Ottoman Empire. Arts, cultural, educational and social buildings of Santral Istanbul, measuring 118,000 m², and are all housed in the facilities of the former Silahtarağa Power Station, which served from 1914 to 1983 for supplying Istanbul with electric power. The site is named after the Turkish word "santral" for power plants. The center offers educational programs for students about the importance of energy and electricity.

İstanbul Technical University Museum of Faculty of Mines was established in 1953 in Istanbul. The mission of the Faculty of Mines is to serve the industry, the nation and the world by producing high- quality graduates, conducting research, and developing breakthrough technologies related to earth science and engineering applications. It is a center which encourages children to interact with exhibits. The exhibition contains exhibits related to the formation of fossils and fossil types, rock types, and formation of the earth's crust. There are many laboratories that students can visit and observe how scientists do scientific experiments with fossils and rocks.

Table 3. Summary of Learning Settings in the Research

Formal Learning Setting	Non-Formal Learning Settings
A Private School in İstanbul	İstanbul Technical University's Science Center Nezahat Gökyiğit Botanic Garden Santral İstanbul Energy Museum İstanbul Technical University Museum of Faculty of Mines

3.5 Data collection instruments

The study investigates the impacts of formal and non-formal learning settings on students' achievement in science. To find out this, students were taught formally only in school in the fall term. In the spring term, they were sent to the scientific institutions and taught non-formally for each unit besides formal education. Then, the fall and spring semester achievement scores of the students were compared. It was done using achievement tests. Since these achievement test results would be used in students' annual achievement reports, they were approved by the other science teachers in the schools and school administration. Therefore, the fall and spring term achievement tests were designed by the researcher and the science teachers in the private school.

It was developed in Turkish considering that it was going to be distributed among the Turkish students. In each term, three different achievement tests were developed concerning curriculum objectives in that term. They were composed of different sections as multiple choice, open -ended, matched and fill in the blanks questions. See appendix A, B, C, D, E, F, G for the spring term achievement tests. After the development of the achievement tests, three expert views were taken for the content validity of the tests. Each concept in the achievement tests was examined and matched with the curriculum by them.

To reveal the impacts of formal and non-formal learning blended settings on students' attitudes toward science, an attitude test was applied at the end of both fall and spring term. Attitude toward Science in School Assessment designed by Germann (1988) was used. It is a 5 -point Likert scale that contains 14 items and its reliability score is (Cronbach alpha) 0.93. Its transition and cultural adaptation were done with 140 Turkish students by Şaşmaz Oren and Tezcan (2009). Then, the number of items changed to 22. The new reliability score is (Cronbach alpha) 0.93, too. After the adaptation of the attitude test, five expert views were taken for its content validity. In the end, 5- point Likert scale s included 13 positive and 9 negative meaning items. The results were done as giving 5,4,3,2,1 to positive, 1,2,3,4,5 to negative meaning items. Students' scores were obtained by following this way. See appendix G & H for the attitude test.

3.6 Curriculum units and related scientific institutions

In the second term of the 5th Grade, there were four learning subjects. During each subject, different scientific field trips were organized as appropriate scientific institutions. Table 4 shows the subjects and the institutions with the visited date.

Table 4. Second Term Scientific Subjects and Scientific Institutions Students Visited

The Name of Subject	The Name of Scientific Institution	Visit Date
1. The light and sound emission	İstanbul Technical University's Science Center	23.03.2016
2. Getting to know the world of living beings	Nezahat Gökyiğit Botanic Garden	04.05.2016
3. Indispensable part of our lives: electricity	Santral İstanbul Energy Museum	12.05.2016
4. The mystery of the earth's crust	İstanbul Technical University Museum of Faculty of Mines	03.06.2016

The following sections explain the summary of the contents of each subject, which objectives are covered in the school and what happened before, during and after the field trip.

3.7 Organization of formal and non-formal learning

In school, each 5th grader had the same teacher and equal facilities. They all did the same experiments and activities in the school. In the scientific centers, they followed the same procedure, too. Each trip was organized concerning the scientific field trip visit outline offered by Eshach (2006). According to Eshach (2006), every field trip includes three main parts. The first part includes what to do before the field trip; the second part includes the procedure followed during the field trip; the last part includes what to do after the field trip. The procedure followed for all field trips is explained below.

3.7.1 UNIT 1: The light and sound emission

This is the first unit of the spring term. Before the beginning of the unit, all students were given a paper and pencil exam and evaluated this unit. This exam contains what the students should know after completing the unit. In this way, we acquire students' pre- knowledge and what they already know. Also, it was detected whether there is any difference between groups' (5A-5B) levels. The unit was completed as shown below. Content and duration of the unit are determined by the Ministry of Education. During the unit, all students followed the same lesson plans by the same teacher; the same simulations, videos, experiments, quizzes, homework,etc. At the end of the

unit, students visited İstanbul Technical University' Science Center. The short explanation and the objectives of the unit are below.

The purpose of this unit is to discover how light and sound are propagated in different environments, to comprehend that light is propagated linearly and to illustrate this situation with simple beam drawings, to test the sound propagation through waves in a material environment, to comprehend the results of the interaction of light and sound with matter and to explore the factors affecting the exact shade length of objects.

Objectives: Student;

1. Knows that the light coming from a source follows a linear path in every direction and shows by drawing.
2. Transparent materials, translucent materials and non-transparent materials
3. Classifies the items according to their transmission and gives examples.
4. Observes how the complete shadow is formed and shows with simple beam drawings.
5. Estimates and tests the variables that affect the state of the complete shadow.
6. Estimates and tests environments where sound can propagate.
7. Knows that sound from a source is moving in all directions and waves and shows by drawing.
8. Discovers that the sounds produced by different objects are different
9. Discovers that the same sound is heard differently in different environments.

3.7.1.1 Before visiting scientific institution for unit 1

1. Decide what the purpose of the scientific fieldtrip is.

The visit aims to summarize and concrete what students learned during the unit.

2. Visit the field trip location beforehand.

Before visiting the scientific institution, I went there and attended the education program. I experienced the stations and detected which ones are appropriate for the unit and the students' level. I talked to the education manager. The center already has an educational program for students. However, when I went there, I had a chance to talk to an educator and changed some parts of the trip. I eliminated some stations and gave more time to some stations etc.

3. Share the purpose of the visit with the children before the visit and share your expectations of them.

Before going to the center, students were given information about the aim of the visit as summarizing the unit. I presented the center via the internet and gave some information about it as where it is, when it was opened, what the aim of it is, etc. We read all of them on the internet and looked at the pictures of the center. I underlined our aim of visit and rules of the center.

4. To decrease the novelty phenomena, the children can be presented with the structure of the day.

We all together outlined the day step by step.

1. Leaving the school at 10.00 am, returning at 3:30 pm.
2. The rules for the school bus
3. The rules during the visit and education program
4. Education time from 11.00 am to 12.00 pm.
5. Lunchtime from 12.00 pm to 1.00 pm.

6. Evaluation time from 1.00 pm to 2.00 pm.
7. Free time from 2.00 pm to 2.30
5. Conduct the relevant scientific activities in the class before going to the field trip.

During the unit, we did many experiments on light and sound. Before the visit, students just specify which phenomena they want to observe, experience and wonder more.

3.7.1.2 During visiting scientific institution for unit 1

1. Always provide some tasks to be conducted on the field trip.

At the beginning of the trip, the informal educator presented the center and what it contains. She expressed what they should do during education. At each station, she asked the students questions and then explained the phenomena beyond the station. Then, she took questions. Since students should prepare a presentation about the visit after turning to the school, after each explanation, she gave time to the students for taking pictures and they took notes themselves after each station. Table 5 shows some stations and their relation to the objectives of the unit.

3.7.1.3 After visiting scientific institution for unit 1

1. Discussion in class after the scientific field trip

We did this part in the Garden of the Science Center immediately after the trip. We sat down as a circle and tried to remember trip flow from the beginning to the end. Volunteer students expressed which stations were the most interesting and what they learned at each station.

Table 5. Sample of Stations at Istanbul Technical University's Science Center and Explanation

Station	Explanation
	In this station, students observed sound waves. In this station, students observed that different types of guitar strings sounded different.

2. Combine the fieldtrip with the subject

After the trip, students were given a presentation homework. When they came to the next course, they brought their presentations and some students presented their work. While doing the presentation, they explained what they learned at each station and the teacher directed this discussion.

3. Schools and museums should cooperate and bring some scientific activities into the classroom.

For this visit, we didn't do anything for this part.

4. It is suggested that schools prepare some activities in advance; activities that may be good for parents to join.

I asked the students to prepare their presentations with their families. While doing this, I asked them to tell their parents what they learned and how they felt during the science center visit.

3.7.2 UNIT 2: Getting to know the world of living beings

This is the second unit of the spring term. Before the beginning of the unit, both groups were given a paper and pencil exam and evaluated this unit. This exam contains what the students should know after completing the unit. In this way, we acquire students' pre -knowledge and what they already know. Besides, each students' content knowledge levels and the differences between groups' levels were detected.

The unit was completed as shown below. The content and duration of unit are determined by the Ministry of Education. During the unit, both groups followed the same lesson plans by the same teacher; the same simulations, videos, experiments, quizzes, homework, etc. In the middle of the unit, students visited Nezahat Gökyiğit Botanic Garden. The short explanation and the objectives of the unit are as follows.

The purpose of the unit is to classify the living things according to their similarities and differences; to recognize microscopic organisms, fungi, plants and animals. It is aimed to gain sensitivity for environmental problems arising from human activities and gain knowledge and skills to solve these problems.

Objectives: Students;

1. By giving examples to living things, groups them according to their similarities and differences.
2. Investigates environmental problems resulting from human activities and makes suggestions for the solution of these problems.
3. Designs and presents a project for the solution of an environmental problem in the immediate environment.

3.7.2.1 Before visiting scientific institution for unit 2

1. Decide what the purpose of the scientific field trip is.

During this unit, students discovered the aspects of animals, plants, fungus, and macrobiotics. Firstly, students learned how to classify animals. Then plants were classified and students examined the parts of flowering plants. After these objectives, to deepen and extend information about animals and plants, to observe fungus, and to take the sample from the lake for macrobiotics, the scientific trip was organized.

2. Visit the field trip location beforehand.

I, as a researcher, worked as an informal educator at NGBG from 2010 to 2014. That is why I know every side of the center and education programs. Since this is the situation, I composed a program appropriate for our aims and applied it in the Garden.

3. Share the purpose of the visit with the children before the visit and share your expectations of them.

Before going to the garden, I presented the center to the students via internet. We looked at the pictures and I explained the aim of the Garden and what I did when I was there. Then, I explained our aim of visit as to summarize and make the aspects of animals and plants concrete; to observe and take sample of fungus and macrobiotics.

4. To decrease the novelty phenomena, the children can be presented with the structures of the day.

We all together outlined the day step by step.

- Leaving the school at 09.30 am, returning at 3.00 pm.
- The rules for the school bus

- The rules during the visit and education program
- Education time from 10.00 am to 12.00 pm.
- Lunchtime from 12.00 pm to 1.00 pm.
- Evaluation time from 1.00 pm to 2.00 pm.
- Free time from 2.00 pm to 2.30.

5. Conduct the relevant scientific activities in the class before going to thefield trip.

We played many games and did many activities during the unit. Before going to the Garden, we listed the names of some plants we would see in the garden. We looked at their pictures on the internet and planned to visit real ones in the garden. Besides, we dig plants in the classroom. Figure 2 shows the classroom activities.

Fig. 2 School activities about the unit of getting to know the world of living beings

3.7.2.2. During visiting scientific institution for unit 2

1. Always provide some tasks to be conducted on the field trip.

Students arrived at NGBG at 10.00 am. I reminded them of the Garden rules and started the program. We visited 5 different parts of the garden and while visiting, students made long-time hiking. In each part, students discovered different animals and plants. They observed them in a natural environment. They took plants and fungus samples and notes about them. Moreover, we took a bottle of lake water to

observe macrobiotics under the microscope in the school. Plant observation activity is shown in figure 3.

Fig. 3 Field trip activities about the unit of getting to know the world of living beings

3.7.2.3 After visiting scientific institution for unit 2

1. Discussion in class after scientific fieldtrip

The first discussion was made immediately after the educational program in the Garden. After lunchtime, students were given a task list to complete (File is attached). They had half an hour to manage it. They completed the task on their own. When time finished, everybody showed what s/he did. The teacher collected the lists. The circle discussion is shown in Figure 4.

Fig. 4 Circle discussion after Nezahat Gökyiğit Botanic Garden field trip

2. Combine the field trip with the subject

In the school, students summarized the trip and expressed what the best part of the trip was, the most interesting ones, etc. Then, teacher distributed the tasks they completed. On these tasks, the teacher combined the trip with the subject. Then, the students observed macrobiotics under the microscope.

3. Schools and museums should cooperate and bring some scientific activities into the classroom.

Students observed macrobiotics taken from the lake at Nezahat Gökyiğit Botanic Garden under the microscope. Students are taking the sample from the lake in Figure 4.

Fig. 5 Combining school activities with the field trip

5. It is suggested that schools prepare some activities in advance; activities that may be good for parents to join.

Students were asked to tell their trip experience to their family. They showed the final picture of the field trip to their families seen in Figure 6.

Fig. 6 End of Nezahat Gökyiğit Botanic Garden field trip

3.7.3 UNIT 3: An indispensable part of our lives: Electricity

This is the third unit of the spring term. Before the beginning of the unit, both groups were given a paper and pencil exam and evaluated this unit. This exam contains what the students should know after completing the unit. In this way, we acquire students' pre- knowledge and what they already know. Besides, students' content knowledge levels one by one and the differences between groups' levels were detected. The exam sheet is attached.

The unit was completed as shown below. The content and duration of unit are determined by the Ministry of Education. During the unit, both groups followed the same lesson plans by the same teacher; the same simulations, videos, experiments,

quizzes, homework, etc. At the end of the unit, students visited Santral İstanbul Energy Museum. The short explanation and the objectives of the unit are as follows.

In this unit, the aims are to discover the effects of the change on the circuit by changing the number of batteries and lamps in different electrical circuits, to show circuit elements by symbols, to draw circuit diagrams, to understand the importance of circuit diagrams in terms of common scientific language, to establish and operate the circuits they draw.

Objectives: Student;

1. Estimates and tests the variables that affect lamp brightness in an electrical circuit.
2. Shows the elements in an electrical circuit with symbols. The importance of circuit diagrams in terms of common scientific language is indicated.
3. Draws an electrical circuit diagram, establishes and operates the circuit.

3.7.3.1 Before visiting science institution for unit 3

1. Decide what the purpose of the scientific field trip is.

The Electricity unit is one of the most frightening units. Students have prejudice about the understanding of it. To eliminate this scene, I wanted to take the students to the Santral İstanbul Energy Museum, which is the first power station of İstanbul. The trip aims to motivate students toward the unit and show them the importance of electricity in each part of life.

2. Visit the field trip location beforehand.

Before taking students to the center, I went to Santral İstanbul Energy Museum and talked to the education manager about my aim. They gave me an educational program called “Importance of Energy”. I listened to the program and thought it would be appropriate for the students.

3. Share the purpose of the visit with the children before the visit and share your expectations of them.

When I told them about this trip to the students, they became so excited about it because this museum was once alive. Students looked at the pictures and read their history.

4. To decrease the novelty phenomena, the children can be presented with the structure of the day.

We all together outlined the day step by step.

- Leaving the school at 09.00 am, returning at 3.00 pm.
- The rules for the school bus
- The rules during the visit and educational program
- Education time from 11.00 am to 12.00 pm.
- Lunchtime from 12.00 pm to 1.00 pm.
- Evaluation time from 1.00 pm to 2.00 pm.
- Free time from 2.00 pm to 2.30.

5. Conduct the relevant scientific activities in the class before going to the field trip.

Students discussed the importance of electricity, how electricity is obtained, etc. They conducted basic electric circuits. Figure 7 shows the classroom activities

about electricity circuits.

Fig. 7 School activities about the unit of an indispensable part of our lives: electricity

3.7.3.2 During visiting science institution for unit 3

1. Always provide some tasks to be conducted on the field trip.

Education Program was applied by an informal educator in Santral İstanbul Energy Museum. The program started with electricity in our lives. Then, students learned how electricity is obtained through brainstorming. After this part, students visited the museum under the instructor's guidance.

They had a chance to mix what they have learned with the objects they observed. In the end, students visited stations that show the different aspects of electricity.

At the beginning of the education, students did brainstorming and educator composed a chart about what students know about electricity. At the end of the education, students did the same thing and this showed us how students' thoughts were shaped and changed by the program. Figure 8 shows the parts of the visit.

Fig. 8 Field activities about the unit of indispensable part of our lives: electricity

3.7.3.3 After visiting scientific institution for unit 3

1. Discussion in class after scientific fieldtrip

When the education program was finished students had lunch in the Garden of the University. After lunch, I asked students about the best part and the most interesting

part of the visit. Then, I showed students two different concept maps and repeated what is new for us.

2. Combine the field trip to the subject

In the school, we told about the trip and after this, students drew a picture of what they want to mention about the museum. We exhibited them in the school. Then, I kept them down. When we started the unit, we referred to the museum trip and what we learned there. Learning somethings helped us to understand some concepts in the unit.

3. Schools and museums should cooperate and bring some scientific activities into the classroom

Smaller electricity ball was bought in the scientific institution and examined in the classroom. In Figure 9, students were experiencing the electricity ball in both classroom and science center.

4. It is suggested that schools prepare some activities in advance; activities that may be good for parents to join.

Students were asked to tell the trip to their family.

Fig. 9 Combining school activities with the field trip

3.7.4 UNIT 4: The mystery of the earth's crust

This is the fourth unit of the spring term. The unit was completed as shown below. The content and duration of unit are determined by the Ministry of Education.

During the unit, both groups followed the same lesson plans by the same teacher; the same simulations, videos, experiments, quizzes, homework, etc. At the end of the unit, students visited İstanbul Technical University Faculty of Mines. The short explanation and the objectives of the unit are as follows.

In this unit; this course aims to teach the components about the earth's crust, the effect of erosion and landslide on the earth's crust, groundwater, surface water and air, soil, water pollution, skills and career awareness about fossil science.

Objectives: Student;

1. Knows that the black layer of the earth's crust consists of rocks. Rock types are not entered.
2. Associates rocks with mines and discusses the importance of mines as technological raw materials.

3. Investigates the formation of fossils and fossil types.

4. Understands that fossil science is a branch of science and knows what is given to experts working in this field.

5. Gives examples of natural monuments and discusses their importance as cultural heritage.

6. Offers suggestions for preserving natural monuments and transferring them to future generations.

7. Explains the difference between erosion and landslide and predicts the future consequences of erosion.

8. Offers solutions to protect soil from the negative effects of erosion.

9. Gives examples of ground and surface waters and explains the usage areas.

10. Discusses the causes of air, soil and water pollution, the negative consequences of air pollution and the precautions to be taken.

3.7.4.1 Before visiting scientific institution for unit 4

1. Decide what the purpose of the scientific field trip is.

This is the last unit of the semester. That is why students are so tired and uninterested in the school. However, The Mystery of the Earth's Crust is a very important unit concerning everyday life. Besides, it is a very enjoyable unit because students learn the parts of the earth crust. To make the unit more enjoyable and the learning more permanent (although they do not concentrate on school), I decided to set up this trip.

2. Visit the fieldtrip location beforehand.

I visited İTÜ and the Faculty of Mines one week ago. They said they did not accept middle school students. I explained my aim and asked them to help me. I explained why I needed this trip. Soon, I convinced them. Then, we decided which parts of the museum we will visit and what the students will learn from this visit.

3. Share the purpose of the visit with the children before the visit and share your expectations of them.

In the school, I explained to the students how hard it was to set up the trip. Then, I asked them to take the maximum advantage of this tour. We looked at the pictures of the faculty on the internet, read the aim of the faculty, and met the different professions. I wrote 5 questions on the board and students prepared their own worksheet with these questions. They should answer them during the trip.

To decrease the novelty phenomena, the children can be presented with the structure of the day.

We all together outlined the day step by step.

- Leaving the school at 09.00 am, returning at 3.00 pm.
- The rules for the school bus
- The rules during the visit and education program
- Education time from 11.00 am to 12.00 pm.
- Lunch time from 12.00 pm to 1.00 pm.
- Evaluation time from 1.00 pm to 2.00 pm.
- Free time from 2.00 pm to 2.30.

4. Conduct the relevant scientific activities in the class before going to fieldtrip.

Before going to the science institution, we examined the different rock samples in our school laboratory.

3.7.4.2 During visiting science institution for unit 4

1. Always provide some tasks to be conducted on the field trip.

At the beginning of the trip, an assistant student welcomed us and began to present the center. He expressed what they should do in the museum. At each station, he asked the students questions and then explained the phenomena beyond the exhibition. Since the students should answer the questions on the worksheets, after each explanation, he gave time to the students for taking a picture and notes. Figure 10 shows the students' observation of exhibits. They are taking a lecture about how fossils are examined in the laboratory and which equipment is used while examining them.

Fig. 10 Field trip activities about the unit of the mystery of the earth's crust

3.7.4.3 After visiting scientific institution for unit 4

1. Discussion in class after Scientific Field trip

   After turning the school, every student expressed his feeling about the trip and the weak and strong part of it.

2. Combine the fieldtrip with the subject

   In the next lesson, they read the answers one by one and told what they learned.

3. Schools and museums should cooperate and bring some scientific activities into the classroom.

We were so lucky that each student was given a fossil coral taken from Tekirdağ. In the next lesson, students went to the school laboratory and looked at their corals under the microscope. In Figure 11, students are taking their corals from the lecturer.

Fig. 11 Combining school activities with the field trip

CHAPTER 4

ANALYSIS AND RESULTS

Data of the study was gathered from 48 5th -grade students who attended the courses in both formal and non-formal settings over the 2015-2016 education year. Findings are based on the quantitative analysis of test scores. Throughout this chapter, means, frequencies, and the results of the analysis are presented.

The data gathered with several instruments (achievement and attitude tests) were analyzed as quantitative and contained statistical analysis. Quantitative analysis aimed to examine the students' improvement in achievement and attitude toward science.

Firstly, the achievement and attitude pretest and posttest scores of the whole group were controlled whether the data were normally distributed or not with Kolmogorov-Smirnov and Shapiro-Wilk Tests. According to the result, non-parametric tests were chosen. Then, Wilcoxon Signed Ranks Tests were performed for the pretest and posttest scores of the group. This analysis aimed to check whether the learning outcome is statistically significant or by chance.

In the fall term, students were in a formal learning setting like school, they took 3 achievement tests appropriate for the science topics studied. In the spring term, students were in both formal and non-formal learning settings formally in school and non-formally at science institutions. During the semester, they took 3 achievement tests appropriate for the science lesson subjects. Tables 6 and 7 show the summary of the application of achievement tests in the fall and spring term.

Table 6. Fall Term Application of Achievement Tests

Group	Fall Term Intervention	During the Fall Term
48 5th Graders	School	3 Achievement Tests

Table 7. Spring Term Application of Achievement Tests

Group	Spring Term Intervention	During The Spring Term
48 5th Graders	School + Non-Formal Science Institutions Experiences	3 Achievement Tests

In addition to the achievement tests, the attitude test was applied to the students at the end of the first semester. After students were taught in both formal and non-formal learning settings at the second term, the attitude test was applied again at the end of the second semester. Table 8 shows a summary of the application of attitude tests.

Table 8. Application of Attitude Tests

Group	Fall Term Intervention	At the End of The First Term	Spring Term Intervention	At the End of The Second Term
48 5th Graders	School	Attitude Test	School + Non-Formal Science Institutions Experiences	Attitude Test

Secondly, a potential advantage of formal and non-formal learning combination was investigated on students with different performance. The students were separated into groups as high achievers and low achievers at the beginning of the 2015-2016 education year concerning academic performances of their fourth-

grade scores. All students were listed sequentially from high achiever to low achiever, then they were divided into three categories. The first 30% of the 48 students were considered as higher achievers, while the last 30% of the 48 students were considered as low achievers.

The study investigated the effects of the formal and non-formal combination on students with different performance and showed which group got benefit more. The difference between their science scores was compared to see whether it increased or decreased by the effects of this combination. Tables 9 and 10 show the application of achievement tests to high and low achievers in fall and spring terms.

Table 9. Fall Term Application of Achievement Tests to High and Low Achievers

Groups	Intervention	Achievement Tests
16 High Achiever Students 16 Low Achiever Students	School	3 Achievement Tests

Table 10. Spring Term Application of Achievement Tests to High and Low Achievers

Groups	Intervention	Achievement Tests
16 High Achiever Students 16 Low Achiever Students	School + Non-Formal Science Institutions Experiences	3 Achievement Tests

Table 11 shows the application of attitudes tests to high and low achievers in the fall and spring terms.

Table 11. Application of Attitude Tests to High and Low Achievers

Groups	Fall Term Intervention	At the End of The First Term	Spring Term Intervention	At the End of The Second Term
16 High Achiever Students 16 Low Achiever Students	School	Attitude Test	School + Non-Formal Scientific Institutions Experiences	Attitude Test

After entering all the dataset in SPSS 21, the test of normality was applied for both pretest and posttest scores (fall and spring term scores). The test results for each variable in the fall and spring terms are shown in Tables 12 and 13.

Table 12. Tests of Normality-Fall Term

	Kolmogorov-Smirnov*			Shapiro-Wilk		
	Statistic	df	Sig.	Statistic	df	Sig.
Science Achievement	.152	48	.007	.879	48	.000
Science Attitude	.132	48	.037	.908	48	.001

* Lilliefors Significance Correction

Table 13. Tests of Normality-Spring Term

	Kolmogorov-Smirnov*			Shapiro-Wilk		
	Statistic	df	Sig.	Statistic	df	Sig.
Science Achievement	.185	48	.000	.871	48	.000
Science Attitude	.219	48	.000	.851	48	.000

* Lilliefors Significance Correction

The Kolmogorov-Smirnov and Shapiro-Wilk test results showed that scores were not normally distributed. Thus, non-parametric tests were utilized in the data analysis. “Nonparametric tests are sometimes called distribution-free tests because they are based on fewer assumptions (e.g., they do not assume that the outcome is approximately normally distributed)” (LaMorte, 2017).

This research aimed to see the difference in all 5th -grade students' achievement score after treatment. It means, this pre-experimental study compares the treatment in one group. The Wilcoxon Signed-Ranks Test is a non-parametric statistical hypothesis test used when comparing two related samples, matched samples, or repeated measurements on a single sample to assess whether their population mean ranks differ (i.e. it is a paired difference test). It should be used when the data are not normally distributed, and they cannot be transformed to a normal distribution using a logarithmic transformation.

Table 14 shows the descriptive comparison of students' fall and spring term average science achievement scores. Table 15 shows the statistical comparison of fall and spring term achievement scores of all 5th graders.

Table 14. Descriptive Comparison of Fall and Spring Term Achievement Scores of All 5th Graders

	Groups	N	Mean	Std. Deviation	Std. Error Mean
Fall and Spring Term Achievement	Fall Term	48	86.3527	12.7807	1.75775
	Spring Term	48	89.5694	9.41704	1.5923

Table 15. Statistical Comparison of Fall and Spring Term Achievement Scores of All 5th Graders

Spring Term - Fall Term	N	Mean Rank	Sum of Ranks	z	p
Negative Ranks	18	18.83	339.00	-2.55*	.011
Positive Ranks	30	27.90	837.00		
Ties	0				

* Based on negative ranks.

The first research questions ask if there is any significant difference between 5th grade students' fall and spring term achievement scores in science after receiving instruction in both formal and non-formal learning environments. As seen in Table 15, the descriptive analysis shows there is a little increase in the spring term but

statistical results show that sigma value (0.11) is greater than 0.05 which means that there is no statistically significant difference between students' achievement test averages between the fall and spring terms.

Another Wilcoxon Signed Ranks Test was used to evaluate the effects of formal and non-formal learning blend on high and low achievers concerning achievement scores. Table 16 shows the descriptive analysis of the comparison of fall and spring term achievement scores of high achievers. Table 17 shows the statistical comparison of fall and spring term achievement scores of high achievers.

Table 16. Descriptive Analysis of Comparison of Fall and Spring Term Achievement Scores of High Achievers

	N	Mean	Std. Deviation	Min.	Max.
Fall Term	16	97.27	2.19	93.00	100.00
Spring Term	16	96.29	3.36	89.00	100.00

Table 17. Statistical Comparison of Fall and Spring Term Achievement Scores of High Achievers

Spring Term - Fall Term	N	Mean Rank	Sum of Ranks	z	p
Negative Ranks	8	9.19	73.50	-.67*	.443
Positive Ranks	7	6.64	46.50		
Ties	1				

* Based on negative ranks.

Descriptive analysis shows that there is a very small variation between the average scores of fall and spring semesters. Statistically, sigma value is equal to 0.443 (bigger than 0.05) which means that there is not a significant difference between fall and spring terms of high achievers.

Table 18 shows the descriptive comparison of fall and spring term achievement scores of low achievers. Table 19 shows the statistical comparison of fall and spring term achievement scores of low achievers.

Table 18. Descriptive Analysis of Comparison of Fall and Spring Term Achievement Scores of Low Achievers

	N	Mean	Std. Deviation	Min.	Max.
Fall Term	16	72.83	10.90	51.67	85.00
Spring Term	16	79.83	8.88	66.33	98.00

Table 19. Statistical Comparison of Fall and Spring Term Achievement Scores of Low Achievers

Spring Term - Fall Term	N	Mean Rank	Sum of Ranks	z	p
Negative Ranks	7	4.71	33.00	-1.81*	.070
Positive Ranks	9	11.44	103.00		
Ties	0				

* Based on negative ranks.

The descriptive analysis shows that there is a difference between low achievers' fall and spring term science achievement averages. Statistically, sigma value is equal to 0.07 (very close to 0.05) which means that there is not a statistically significant difference between fall and spring term of the students of low achievers but very close to being significant.

To understand the effect of the formal and non-formal blend on low achievers, another analysis was done. Table 20 shows the descriptive comparison of high and low achievers in science scores in the fall term. Table 21 shows the statistical comparison of high and low achievers in science scores the fall term.

Table 20. Descriptive Analysis of Comparison of Fall Term Achievement Scores of High and Low Achievers

Group	N	Mean	Std. Deviation	Std. Error Mean
Low Achiever	16	72.83	10.90	2.72
High Achievers	16	97.27	2.19	.54

Table 21. Statistical Comparison of Fall Term Achievement Scores of High and Low Achievers

Group	N	Mean Rank	Sum of Ranks	U	P
Low Achievers	16	8.50	136.00	.00	.000
High Achievers	16	24.50	392.00		

As seen in Table 20, there is a difference between mean scores of high and low achievers in fall term achievement scores. Table 21 shows that there is a significant difference between fall term achievement scores of low and high achievers.

Table 22 shows the descriptive comparison of high and low achievers in science scores in the spring term. Table 23 shows the statistical comparison of high and low achievers in science scores in the spring term.

Table 22. Descriptive Analysis of Comparison of Spring Term Achievement Scores of High and Low Achievers

Groups	N	Mean	Std. Deviation	Std. Error Mean
Low Achievers	16	79.83	8.88	2.22
High Achievers	16	96.29	3.36	.84

Table 23. Statistical Comparison of Spring Term Achievement Scores of High and Low Achievers

Groups	N	Mean Rank	Sum of Ranks	U	P
Low Achievers	16	9.25	148.00	12.00	.000
High Achievers	16	23.75	380.00		

Although low achievers' science mean scores increased in the spring term, Tables 22 and 23 shows that there is a still significant difference between high and low achievers science scores in the spring term similar in the fall term.

In this research, another important aim is to see the difference in all 5th - grade students' attitude scores after treatment. This pre-experimental study compares

the treatment in one group. Since the data is non-parametric, the Wilcoxon Signed-Ranks Test was utilized.

The first research questions related to attitude asks if there is any significant difference between 5th- grade students' fall and spring term attitude scores toward science after receiving instruction in both formal and non-formal learning environments. Table 24 shows the descriptive comparison of fall and spring term attitude scores of all 5th graders.

Table 24. Descriptive Comparison of Fall and Spring Term Attitude Scores of All 5th Graders

	Group	N	Mean	Std. Deviation	Std. Error Mean
Attitude	Pretest	48	92.1458	11.08572	1.60009
	Posttest	48	105.3958	4.57904	.66093

The descriptive analysis shows that there is a difference between students' fall and spring term attitude test results. To understand whether the difference is statistically significant or not, a statistical comparison is made. Table 25 shows the statistical comparison of the 1st and spring term attitude scores of all 5th graders.

The results showed that sigma value (0.000) is smaller than 0.05 which means that there is statistically significant difference between all 5th grade students' attitude test averages between the fall and spring terms.

Another research question in the study is if there is any significant difference between high achievers' and low achievers' fall and spring term attitude scores toward science separately after receiving instruction in both formal and non-formal learning environments. Therefore, the Wilcoxon Signed Ranks Test was used to

evaluate the effects of formal and non-formal learning blended settings on high and low achievers concerning attitude scores.

Table 25. Statistical Comparison of Fall and Spring Term Attitude Scores of All 5th Graders

Spring Term - Fall Term	N	Mean Rank	Sum of Ranks	z	p
Negative Ranks	0	.00	.00	-6.03*	.000
Positive Ranks	48	24.50	1176.00		
Ties	0				

* Based on negative ranks.

Table 26 shows the descriptive comparison of fall and spring term attitude scores of high achievers. Table 27 shows the statistical comparison of fall and spring term attitude scores of high achievers.

Table 26. Descriptive Comparison of Fall and Spring Term Attitude Scores of High Achievers

	N	Mean	Std. Deviation	Minimum	Maximum
Fall Term	16	93.37	10.70	65.00	105.00
Spring Term	16	106.43	3.53	100.00	110.00

Table 27. Statistical Comparison of Fall and Spring Term Attitude Scores of High Achievers

Spring Term - Fall Term	N	Mean Rank	Sum of Ranks	z	p
Negative Ranks	0	.00	.00	-3.51*	.000
Positive Ranks	16	8.50	136.00		
Ties	0				

* Based on negative ranks.

The sigma value (0.000) is smaller than 0,05 which means there is a statistically significant difference between high achiever students' attitude test averages between the fall and spring terms. Table 28 shows descriptive comparison

of fall and spring term attitude scores of low achievers. Table 29 shows the statistical comparison of fall and spring term attitude scores of low achievers.

Table 28. Descriptive Comparison of Fall and Spring Term Attitude Scores of Low Achievers

	N	Mean	Std. Deviation	Min.	Max.
Fall Term	16	88.25	12.34	66.00	105.00
Spring Term	16	103.12	6.11	88.00	110.00

Table 29. Statistical Comparison of Fall and Spring Term Attitude Scores of Low Achievers

Spring Term - Fall Term	N	Mean Rank	Sum of Ranks	z	p
Negative Ranks	0	.00	.00	-3.51*	.000
Positive Ranks	16	8.50	136.00		
Ties	0				

* Based on negative ranks.

The sigma value (0.000) is smaller than 0.05 which means that there is statistically significant difference between low achiever students' attitude test averages between the fall and spring terms.

CHAPTER 5

CONCLUSION

Summary and discussion of the results, limitations of the study, recommendations, and suggestions for further research and the researcher's background are the main parts of the conclusion chapter.

5.1 Summary and discussion of the results

Scientific subjects have many complex and abstract concepts, and process. Because of their inherent nature, teachers try to find ways to make students learn better. To achieve this aim, different learning forms can create a positive impact to support learning science. For this reason, many researchers in science education have focused on students' understanding of scientific concepts by observing students in different types of learning settings. "Researchers have had varying degrees of success in measuring cognitive learning resulting from a school field trip, but the evidence generally suggests that such trips can have a positive impact on learning of facts and concepts" (DeWitt, 2008, p.182). On the other hand, there is still discussion about the effectiveness of learning settings. Although several studies showed that non-formal education was more effective for learners, others advocated the utilization of non-formal learning contexts by itself does not automatically provide good or efficient learning due to not being necessarily equivalent to formal education.

This study makes an important contribution to the literature on the school field trips because it is notable for exploring a large-scale program. The study aimed to examine the impacts of the combination of formal and non-formal learning on 5^{th} - grade students' achievement and attitudes toward science. The basic assumption here

is that the mix of these two interventions is better than formal education. To test these hypotheses, a pre-experimental study was conducted and data was analyzed quantitatively.

For all 5th graders in the study, test results pointed out that there was not a statistically significant difference between students' fall and spring term achievement averages in favor of their spring term scores which are obtained by combining the formal learning with non-formal learning. On the other hand, the other test results showed that low achiever students' spring term averages were very close to being statistically significantly different from the fall term. It means that low achiever students got more benefit from the combination of formal and non-formal learning than the higher achievers in terms of cognitive outcomes. However, there is still significantly difference between high and low achievers in spring term achievement scores after conducting the study. Based on these findings, we can conclude that the intervention increased students' average science scores but they are not statistically significant. Thus, the results of the study do not confirm the idea that instruction enriched with the non-formal learning can assist students learning processes (Bamberger & Tal, 2006; Beiers & McRobbie, 1992).

As seen in the literature part, cognitive learning can occur as a result of non-formal learning. However, learning in informal settings is affected by several factors. "It includes the structure of the field trip itself, setting novelty, prior knowledge of the students, the social context of the visit, teacher agendas and actions on the field trip, and the presence or absence and quality of preparation and follow-up experiences" (DeWitt, 2008, p.181). In the present study, students were not affected as statistically significant by the intervention. The descriptive data shows the small increase in the mean scores of students but it is not statistically significant. It might

be influenced by the factors that are mentioned above. Thus, to maximize the benefits of field trips, teachers should focus on the factors and design the field trips under the light of these factors (Storksdieck et al., 2006). However, it can be argued that all gains are noteworthy. The study showed the positive effects on lower achievers, especially. Therefore, such combination should be planned very carefully and can be utilized especially for lower achievers.

Besides cognitive outcomes, affective outcomes are also very important for field trips. "It could even be argued that affective outcomes—such as increased motivation or interest, sparking curiosity, or improved attitudes towards a topic—may be more reasonable for school trips than specific factual or concept learning outcomes" (DeWitt, 2008, p.183). When considered with the educational year, field trips generally take short time and it is difficult to gain major cognitive understanding in this amount of time. However, short -term experiences may lead to affective outcomes such as strong interest or motivation to the related scientific area (Stordieck, 2001). Many studies related to field trips focused on affective learning and pointed out that such experiences can have positive impacts on affective outcomes (Fortner & Lahm, 1990; Knapp, 1996; Sibthorp & Knapp, 2000; Storksdieck, 2006). For instance, Salmi (2003) surveyed the university students and found out that their visits to science centers played a significant role in choosing their science career.

For all 5th graders in the study, test results point out that there is a statistically significant difference between students' fall and spring term attitude averages in favor of their spring term scores which is obtained by fusion of formal and non-formal learning. Moreover, both high and low achievers increased their attitude score after the treatment.

As a result, combined formal and non-formal learnings make the learning experience more effective and interesting. The learning outcomes confirmed by teachers and students are positive. The analysis results showed a positive impact on students' affective domains especially. The most important benefits that students gain from non-formal experiences are social skills, cooperation, assertive communication, positive attitudes towards others and the empathy that formal education system is failing to develop to a great extent (Csikszentmihalyi & Hermanson, 1995). Teachers and students involved in the study recognized that non-formal education provided different opportunities for discovering the physical world around us. All those learning experiences offer diversity in learning and should be taken into account when designing school lessons because it could optimize students' school performance and attitudes.

While the study had been conducting, it was very difficult to find appropriate programs in the scientific institutions. Although there are many scientific institutions in Istanbul, they offer a very limited number of programs. Therefore, it was hard to convince them to conduct the programs concerning unit objectives. Hence, scientific institutions need to have programs for all grades and in parallel to school curricula. In addition, school and scientific institution collaboration should be conducted in the curricula, too.

5.2 Limitations of the study

Although the research shows the impacts of fusion of formal and nonformal learning on achievement and attitude toward science, several issues need to be improved.

This research is limited to just 48 students (all 5^{th}- grade students in the school). This potentially led to the data being skewed and hence, non-parametric

analysis. The total number of samples should be increased and the number of girls and boys should be equal since the number of girls was smaller than that of boys in the study.

Secondly, this research was done pre-experimental for ethical reasons. The researcher avoided the unethical treatment of the students by separating them as experimental and control groups. Ethically, all students have the same rights; therefore, they should have the same facilities for their education. As students were seen as a single group, the pre-experimental design was utilized.

Thirdly, achievement tests of this study were developed with the contribution of subject-matter experts; science teachers of the school by mapping the concepts in the learning subjects. Six different science teachers examined the achievement tests. Face and content validity were done in this way. Since this achievement test belongs to the school's database, other schools' students were not allowed to apply it. Therefore, the reliability of the tests was not measured.

5.3 Recommendations and suggestions for further research

Literature states that non-formal education has an important effect on learning scientific concepts and attitudes of students toward science. The findings of this research showed the combined effects of formal and non-formal learnings on student's achievement and attitudes toward science, too. There are still important points to conduct further research on this issue.

Firstly, the study aimed to determine the combined effects of formal and non-formal learning on 5^{th}- grade students. Similar research might be developed to study the effects of this combination on different elementary grades. It might be studied on

pre-school or high school students. In this way, which grade benefits more from a combination of formal and non-formal learnings can be revealed.

Secondly, we still need to have more experimental studies to evaluate which type of learning is better for the learners. This study showed that the fusion of formal and non-formal learnings did not have an advantage to students' achievement but, has a more positive impact on low achievers. However, as the literature pointed, field trips are so valuable for cognitive outcomes. At this point, learning might have been affected by many factors. In addition, one should look at what happened at school and at home before and after field trip. Therefore, to obtain the deeper understanding of non-formal learning, the study may be done qualitatively. By conducting the qualitative research, the detailed information about students' experiences might be obtained. In this way, the points that prevent students from learning can be identified and this can help us to see bigger picture.

Finally, this study examined the combined effects of formal and non-formal learnings on student's achievements in and attitudes toward science. Non-formal learning experience enables students with hands-on activities and observations that are impossible to duplicate in the school environment. However, achievement tests are mostly composed of memorizing concepts. Therefore, another research study might be done on the effects of this combination on students' scientific process skills and knowledge of the nature of science. With non-formal learning experiences, students study real science in the real environment with real materials. Therefore, in addition to achievement and attitude, the improvement of science process skills and understanding of the nature of science can be studied.

APPENDIX A

SPRING TERM ACHIEVEMENT TEST-1

A. Complete the dotted places in the sentences below using the appropriate word or

Light Ray	material	artificial	in the space	different	opaque
transparent	translusent	shrinks	grow	right part	
natural	same	solid	liquid	gas	

phrase.

1. It is called substances that pass almost all the light falling on them…….
2. It is called matter that transmits a part of the light……
3. Non-transmissive substances are called……
4. If the light source is brought closer to the object, the shadow……
   shade away…….
5. Where sound does not spread is ……
6. The direction of light propagation is indicated by .....
7. Musical instruments are sound sources that is ……
8. What kind of environment is required for the sound to propagate? …….
9. The same sound is heard …….. in different environments.
10. The sound spreads the fastest in the ……

B. Type “D” for the expression that you think is correct and “Y” for the expression that you think is wrong. Write the correct statement that you decide is wrong.

(...) 1. Transmissible substances are transparent substances.
(...) 2. Light sources are divided into natural and artificial.
(...) 3. Light emits circularly.
(...) 4. Light forms a shadow of opaque materials.
(...) 5. Eclipse occurs when the Earth is between the Moon and the Sun.
(...) 6. Sun, candle, lamp are natural light sources.
(...) 7. When the light source is brought closer to the object while the object and screen are held steady, the shadow length increases.
(...) 8. It is noon when the shadow of our height appears the longest.

C. Answer the following questions.

a) Describe the shape of the Moon Eclipse b) Describe the shape of the Solar Eclipse.

D. Select the correct option by reading the multiple-choice questions below.

1. Which of the following is not a natural light source?
A. Firefly B. Candle C. Sun D. Lightning

2.
I. Shadow formation
II. Solar Eclipse
III. Lunar eclipse
Which of the above events indicate which light is propagated in a linear way?
A. I C. I & III
B. II & III D. I, II & III

3. Which of the following items transmits some of the light?
A. Glass B. Water
C. Greaseproof paper D. Cardboard

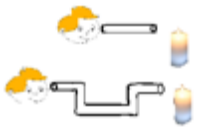
4. I. Transparent materials are opaque.
II. Shadow of opaque substances occurs.
III. The thickness of the glass increases and the light transmittance decreases.
Which or which information is correct in the statements above?
A. I B. II C. I & II D. II & III

5. Which of the following materials should you prefer in your windows if you want more light in your environment?
A. Frosted glass B. Black glass
C. Transparent glass D. White glass

6. In which of the following conditions does eclipse occur?
A. When the moon is between Earth and the Sun
B. When the Earth is between the Sun and the Moon
C. When the sun is between the Earth and the Moon
D. In all cases where the Moon, the Sun and the Earth are in the same direction

7. Which of the following is a natural sound source?
A. Bird B. Guitar C. Violin D. Radio

8. Which of the following items best transmits the sound?
A. Water B. Concrete Wall C. Air D. Sponge



9. A researcher can see the flame of the candle when he looks at the burning candle with a plastic pipe as in FIG 1 but cannot see when he looks at the burning candle with a plastic pipe as in FIG 2.
Accordingly, which of the following results can the researcher reach?

A. Light beams are emitted linearly.

B. Light emitted from a light source is emitted in one direction.

C. The rate of diffusion of light rays depends on the ambient temperature.

D. Bright surfaces reflect light falling on it.

10. A student prepares the device as in the figure. Accordingly, which of the following information is the student testing?

In air Not in air

A. Sound cannot emit, while light can emit in space.

B. Sound waves that hit an obstacle are reflected.

C. A sound medium is required to propagate sound waves.

D. Light is faster than sound.

11. Which student's answer to the propagation velocity of sound is correct?

A. Elif: solid> liquid> gas

B. Yasin: liquid> gas> solid

C. Hasan: solid> gas> liquid

D. Busra: liquid> solid> gas

12. What is the environment in which the sound cannot be emitted?

A. Solid

B. Liquid

C. Gas

D. Gaps

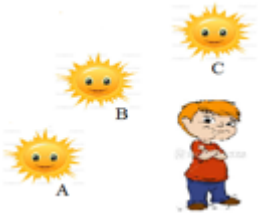
13. Mehmet plays in the dollhouse outside on a sunny day. He placed K, L and M objects separately in front of the window to close the window. Each time he recorded the light status of his house on the table.
K: No light inside
L: Some light inside
M: Light inside

Which of the following is the correct state of transparency?
A. K: transparent L: Translucent M: Opaque
B. K: Translucent L: Transparent M: Opaque
C. K: Opaque L: Translucent M: Transparent
D. Opaque L: Transparent M: Translucent

14. Mark which of the following sentences belongs to the sound and which belongs to the light.

Sentence	Light	Sound
Linear spreads		
Material is required for its spread		
Cannot move on opaque matter		
Can spread in space		
Propagated in waves		

15.



The figure shows three different positions of the Sun over a period of time. In all three positions of the Sun, the shadows of the child in shape are formed.
Accordingly, what is the order of the child's shadows from small to large in different positions of the Sun?

A. A-B-C
B. B-A-C
C. C-B-A
D. C-A-B

16. Which of the following events can we simulate the propagation of sound waves?

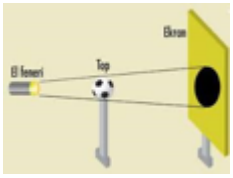
A. The arrow from the bow reaches its destination
B. To advance the bullet from the weapon
C. Propagation of waves caused by water thrown into the water
D. Movement of the stone rolling down the slope

17. The path of light emitted from a light source is given below. According to this;

I. The light source is artificial.
II. The path of the light is given correctly.
III. The light emitted from the source is only emitted in one direction.
Which statements can be said?

A. II
B. I & II
C. I & III
D. II & III

18.



The screen in the figure is asked to enlarge the shadow. Which of the following should be done for this?

A- The object should be removed from the light source.
B- The light source should be brought closer to the object.
C- The screen should be brought closer to the object.
D-Light source should be removed from the object.

19. In which of the following sentences is the underlined object a transparent substance?

A. beautiful bird was placed in front of the window.

B. When I opened the door, I saw my father.

C. When I brought my book before my eyes, I couldn't see it outside.

D. The flashlight did not pass through the wall.

APPENDIX B

SPRING TERM ACHIEVEMENT TEST-1 (TURKISH)

A. Aşağıdaki cümlelerde yer alan noktalı yerleri verilen sözcük veya sözcük gruplarından uygun olanlarını kullanarak tamamlayınız.

Işık ışını maddesel yapay boşlukta farklı opak saydam yarı saydam küçülür büyür Doğru parçası doğal aynı katı sıvı gaz

1.Üzerine düşen ışığı tamamına yakınlığı geçiren maddelere ……. denir.
2.Işığın bir kısmını geçiren maddeye …….. denir.
3.Işığı hiç geçirmeyen maddelere ……..denir.
4.Işık kaynağı cisme yaklaştırılırsa gölge ……. uzaklaştırılırsa gölge ……... .
5.Ses ……. yayılmaz.
6.Işığın yayılma doğrultusu ..... ile gösterilir.
7.Müzik aletleri ..... ses kaynaklarıdır.
8.Sesin yayılabilmesi için ..... ortam gereklidir.
9.Aynı ses farklı ortamlarda ..... işitilir.
10.Ses en hızlı …….. yayılır

B. Aşağıdaki ifadelerin başında yer alan yay ayracın içine doğru olduğunu düşündüğünüz ifade için "D", yanlış olduğunu düşündüğünüz ifade için "Y" yazınız. Yanlış olduğuna karar verdiğiniz ifadenin doğrusunu yazınız.

(...) 1. Işığı geçirmeyen maddeler saydam maddedir.
(...) 2. Işık kaynakları doğal ve yapay olarak ikiye ayrılır.
(...) 3. Işık dairesel olarak yayılır.
(...) 4. Işık opak maddelerin gölgesini oluşturur.
(...) 5. Dünya'nın, Ay ve Güneş'in arasında bulunması ile Ay tutulması oluşur.
(...) 6. Güneş, mum, lamba doğal ışık kaynaklarıdır.
(...) 7. Cisim ve ekran sabit tutularak ışık kaynağı cisme yaklaştırıldığında gölge boyu büyür.
(...) 8. Gölge boyumuzun en uzun göründüğü zaman öğle vaktidir.

C. Aşağıdaki soruları cevaplayınız.
a) Ay Tutulmasının şeklini çizerek anlatınız. b) Güneş Tutulmasının şeklini çizerek anlatınız.

D. Aşağıdaki çoktan seçmeli soruları okuyarak doğru seçeneği işaretleyiniz.

1. Aşağıda verilenlerden hangisi doğal ışık kaynağı değildir?
A. Ateş böceği B. Mum C. Güneş D. Şimşek

2. I. Gölge oluşumu
II. Güneş tutulması
III. Ay tutulması
Yukarıda verilen olaylardan hangisi veya hangileri ışığın doğrusal yolla yayıldığını gösterir?
A. Yalnız I C. I ve III
B. II ve III D. I, II ve III

3. Aşağıda verilen maddelerin hangisi ışığın bir kısmını geçirir?
A. Cam B. Su C. Yağlı kâğıt D. Mukavva

4. I. Saydam maddeler ışığı geçirmez.
II. Opak maddelerin gölgesi oluşur.
III. Kalınlığı artan camın, ışığı geçirme özelliği azalır.
Yukarıdaki ifadelerde yer alan bilgilerin hangisi veya hangileri doğrudur?
A. Yalnız I B. Yalnız II C. I ve II D. II ve III

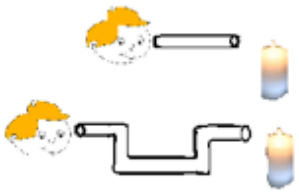
5. Bulunduğunuz ortamın daha fazla ışık almasını isterseniz pencerelerinizde aşağıdaki malzemelerden hangisini tercih etmeniz gerekir?
A. Buzlu cam C. Saydam cam
B. Siyah cam D. Beyaz cam

6. Aşağıdaki durumların hangisinde Güneş tutulması meydana gelir?

A. Ay, Dünya ve Güneş'in arasında olduğunda
B. Dünya, Güneş ve Ay'ın arasında olduğunda
C. Güneş, Dünya ve Ay'ın arasında olduğunda
D. Ay, Güneş ve Dünya'nın aynı doğrultuda olduğu her durumda

7.Aşağıdakilerden hangisi doğal ses kaynağıdır?
A. Kuş B. Gitar C. Keman D. Radyo

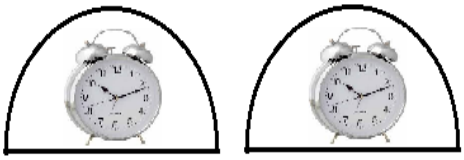
8. Aşağıdaki maddelerden hangisi sesi en iyi iletir?
A. Su B. Beton duvar C. Hava D. Sünger



9. Bir araştırmacı şekil 1 deki gibi bir plastik boruyla yanan muma baktığında mumun alevini görebilirken şekil 2 deki gibi bir plastik borudan baktığında mumun alevini göremiyor.

Buna göre araştırmacı, aşağıdaki sonuçlardan hangisine ulaşabilir?
A. Işık ışınları doğrusal olarak yayılır.
B. Bir ışık kaynağından çıkan ışık bir yönde yayılır.
C. Işık ışınlarının yayılma hızı, ortamın sıcaklığına bağlıdır.
D. Parlak yüzeyler, üzerine düşen ışığı yansıtır.

10. Bir öğrenci şekildeki gibi düzenek hazırlıyor. Buna göre öğrenci aşağıdaki bilgilerden hangisini test etmektedir?



A.Işık boşlukta yayılabilirken, ses yayılamaz.
B.Bir engele çarpan ses dalgaları yansımaya uğrar.
C.Ses dalgalarının yayılabilmesi için maddesel ortam gerekir.
D.Işık sesten hızlıdır.

11. Sesin yayılma hızları ile ilgili hangi öğrencinin cevabı doğrudur?

A. Elif: katı > sıvı > gaz
B. Yasin : sıvı> gaz > katı
C. Hasan : katı> gaz > sıvı
D. Büşra : sıvı> katı > gaz

12. Sesin yayılamadığı ortam aşağıdakilerden hangisidir?

A. Katı
B. Sıvı
C. Gaz
D. Boşluk

13.

Mehmet, güneşli bir günde dışarıdaki oyuncak evinin içerisinde oynamaktadır. Oyuncak evin penceresi ile aynı büyüklükte olan K, L ve M cisimlerini, pencereyi kapatacak şekilde ayrı ayrı pencereye koydu. Her seferinde evinin ışık durumunu tabloya kaydetti.

Cisim	Işık Durumu
K	Hiç ışık yok
L	Az ışık var
M	Çok ışık var

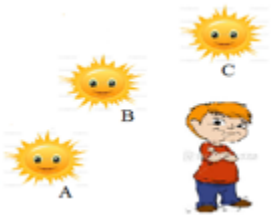
Buna göre, cisimlerin saydamlık durumları aşağıdakilerin hangisinde doğru verilmiştir?

	K	L	M
A)	Saydam	Yarı saydam	Opak
B)	Yarı saydam	Saydam	Opak
C)	Opak	Yarı saydam	Saydam
D)	Opak	Saydam	Yarı saydam

14. Aşağıdaki cümlelerden hangisinin sese hangisinin ışığa ait olduğunu işaretleyiniz.

Cümle	Işık	Ses
Doğrusal yayılır		
Yayılması için maddesel ortam gereklidir		
Opak maddede yoluna devam edemez		
Boşlukta yayılabilir		
Dalgalar halinde yayılır		

15.



Şekilde, Güneş' in bir zaman dilimi boyunca üç farklı konumu verilmiştir. Güneş' in üç konumunda da şekildeki çocuğun gölgeleri oluşmuştur.
Buna göre, Güneş' in farklı konumlarında çocuğun oluşan gölgelerinin boylarını küçükten büyüğe doğru sıralanışı nasıldır

A. A-B-C
B. B-A-C
C. C-B-A
D. C-A-B

16. Ses dalgalarının yayılmasını aşağıdaki olaylardan hangisine benzetebiliriz?

A. Yaydan çıkan okun hedefine varmasına
B. Silahtan çıkan merminin ilerlemesine
C. Suya atılan taşın suda oluşturduğu dalgaların yayılmasına
D. Yokuştan aşağı yuvarlanan taşın hareketine

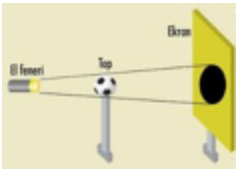
17. Bir ışık kaynağından yayılan ışığın izlediği yol aşağıda verilmiştir. Buna göre;

I. Işık kaynağı yapaydır.
II. Işığın izlediği yol doğru verilmiştir.
III. Kaynaktan yayılan ışık sadece bir yönde yayılır.

İfadelerinden hangileri söylenebilir?

A. Yalnız II
B. I ve II
C. I ve III
D. II ve III

18.



Şekildeki ekranda oluşan gölgenin büyütülmesi isteniyor. Bunun için aşağıdaki işlemlerden hangisi yapılmalıdır?

A- Cisim ışık kaynağından uzaklaştırılmalıdır.
B- Işık kaynağı cisme yaklaştırılmalıdır.
C- Ekran cisme yaklaştırılmalıdır.
D- Işık kaynağı cisimden uzaklaştırılmalıdır.

19. Aşağıdaki cümlelerin hangisinde altı çizili cisim saydam bir maddedir?

A. Camın önüne güzel bir kuş kondu.
B. Kapıyı açtığımda karşımda babamı gördüm.
C. Gözümün önüne kitabımı getirince dışarısını göremedim.
D. El fenerinin ışığı duvardan geçemedi.

APPENDIX C

SPRING TERM ACHIEVEMENT TEST- 2

Type "D" for the expression that you think is correct and "Y" for the expression that you think is wrong.

1. (…...) Mushrooms; They are living things without leaves and flowers.
2. (…...) The bat is a group of mammals that can fly.
3. (…...) All microscopic organisms are harmful to humans.
4. (…...) Similarities and differences are taken into consideration when classifying living things.
5. (……) Each plant has roots, stems, leaves and flowers.
6. (……) The beings are divided into living and non-living beings.
7. (…...) Yeast mushrooms are effective in making cheese, bread.
8. (…...) Classification makes it easier to examine living things.
9. (…...) Mushrooms belong to the group of plants without flowers.
10. (…...) Plants make their own food.

Fill in the following blanks with the given words.

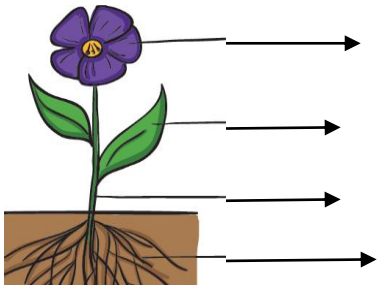
(((Mammals – warm-blooded- lungs –cold-blooded-moss- snake – worm– macrobiotics- symbols – by laying –giving birth- invertebrate- vertebrate- rose-gill)))

1.)……. is a flowerless plant.
2.) Although the whale swims, it is in the …… class.
3)… ..... is a flowering plant.
4.) How fish breathe? …….
5.) How bird breathe? …….
6.) Bee is a …….. living-creature.
7.) ……, is one of the example of invertebrates.
8.) The reproduction type of fishes is …….
9.) Reptiles are ……..animals in terms of body temperature.
10)……. enters our body in various ways and causes us to become ill.

In the table below, mark the groups that they belong to by (x).

	Fish	Mammal	Bird	Reptile
Anchovy				
Lizard				
Dolphin				
Penguin				
Bat				

Write down the parts of the flowering plant in the appropriate places indicated by arrows.



Specify the animal species given in the table below by placing them as X according to their vertebrates.

Animals	Vertebrate	Invertebrate
Trout		
Eagle		
Mosquito		
Sheep		
Snail		

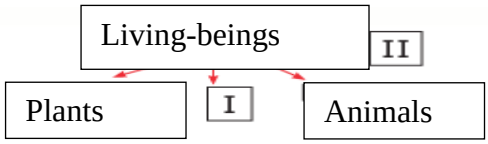
In the following multiple-choice questions, select the appropriate option.

1)
- Makes breathing with lungs.
- It belongs to the most advanced group of vertebrates.
- She gives birth to her pups and takes care of her.

Which of the following creatures may belong to the above features?

A) B) C) D)

2)



Which of the following should come to places left blank in the diagram showing the classification of living things?

A) I-Invertebrates, II- Vertebrates
B) I- Mushrooms, II- Fishes
C) I- Fungi, II- Microscopic Life
D) I- Invertebrates, II- Mushrooms

3) Which of the following groups consists of only plants without flowers?

A) Seaweed, horsetail, nuts
B) Black moss, chamomile, water moss
C) Seaweed, black moss, fern
D) Black moss, tulip, liver grass

4) A group of students are wondering which vertebrate group of creatures called platypus belong to.

As a result of this research they learn that this creature belongs to the group of mammals.
Which of the following characteristics makes this living being in the mammal group?

A) Beaked
B) Reproduction with eggs
C) Living on land and in water
D) Feeding their young

5) Which of the following is an invertebrate?

A) Snake B) Frog C) Scorpion D) Pigeon

6) Which of the following is incorrect for mushrooms?
A) There are no leaves and flowers.
B) They are not considered plants.
C) There are varieties that cause various diseases.
D) They produce their own food.

7) "YUSUF: The roots of some plants can be used as nutrients."
Which of the following is not an example of these plants?

A) Carrot B) Radish
C) Sugar beet D) Tomato

8) Which of the following is not a fungus?

A) Mold B) Yeast
C) Hat D) Ornament

9) Which of the above events or which are the source of microscopic living?

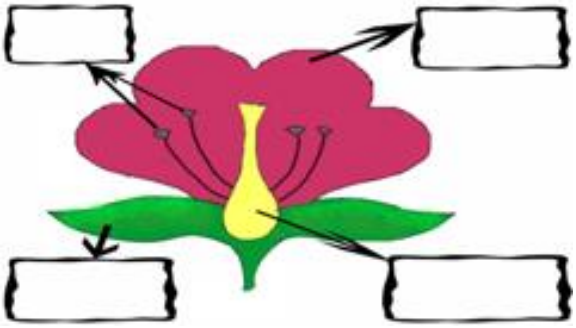
I. Melting ice cream from the refrigerator
II. Heartburn of exposed yogurt
III. Decay of fallen leaves
IV. Milk conversion into yogurt.

A) I. B) I. & II.
C) I. II. & III. D) II. III. & IV.

10) Which of the following is not one of the positive effects of fungi?

A) Cultured mushrooms can be used as protein rich food sources.
B) Some mold fungus is used in medicine.
C) Fungi decompose dead organisms and increase the yield of soil.
D) Mushrooms accelerate the spoilage of nutrients under favorable conditions.

Write the parts of the flower below to the appropriate places indicated by arrows.



Parts of the plant are mixed.(→) Match them.

Makes photosynthesis, respiration and perspiration — Stem

Allows the plant to stand upright. — Leaf

Binds the plant to soil. — Flower

It is the reproductive organ of the plant. — Root

Today, we face many environmental problems. Choose one of these problems and suggest solutions.

APPENDIX D

SPRING TERM ACHIEVEMENT TEST-2 (TURKISH)

Aşağıda yazılan ifadelerin başına doğru ise "D" yanlış ise "Y" yazınız.

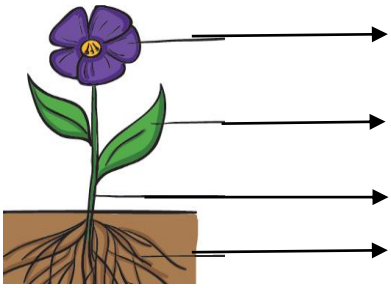
1. (…...) Mantarlar; yaprak ve çiçekleri olmayan canlılardır.
2. (…...) Yarasa uçabilen memeliler grubundadır.
3. (…...) Mikroskobik canlıların tamamı insanlar için zararlıdır.
4. (…...) Canlılar sınıflandırılırken benzerlikleri ve farklılıkları dikkate alınır.
5. (……) Her bitkide kök, gövde, yaprak ve çiçek bulunur.
6. (……) Varlıklar canlılar ve cansızlar olmak üzere 2 ye ayrılır
7. (…...) Maya mantarları peynir, ekmek yapımında etkilidir.
8. (…...) Sınıflandırma canlıların daha kolay incelenebilmesini sağlar.
9. (…...) Mantarlar çiçeksiz bitkiler grubunda yer alır.
10. (…...) Bitkiler kendi besinlerini kendileri yaparlar.

Aşağıdaki boşlukları, verilen kelimelerle uygun şekilde doldurunuz.

(((Memeliler - sıcakkanlı- akciğer –soğukkanlı-Karayosunu- Yılan – Solucan– mikroskobik canlılar- Semboller - Yumurtlayarak –doğurarak- Omurgasız- Omurgalı- Gül- Solungaçlar)))

1.)……. çiçeksiz bir bitkidir.
2.) Balina yüzmesine rağmen …… sınıfında yer alır. .
3)……. çiçekli bir bitkidir.
4.) Balıklar ……..ile solunum yaparlar.
5.) kuşlar ……. ile solunum yaparlar.
6.) Arı ……bir canlıdır.
7.) ……, omurgasız hayvanlara örnek olarak gösterilebilir.
8.) Balıklar …… çoğalan canlılardır.
9.) Sürüngenler vücut sıcaklığı açısından …….. hayvanlardır.
10)…….çeşitli yollarla vücudumuza girerek hastalanmamıza neden olur.

Aşağıda bulunan çiçekli bitkinin kısımlarını oklarla gösterilen uygun yerlere yazınız.



Aşağıdaki tabloda verilen hayvan türü örneklerini uygunluklarına göre X işareti koyarak belirtiniz.

	Balık	Memeli	Kuş	Sürün-gen
Hamsi				
Kertenkele				
Yunus				
Penguen				
Yarasa				

Aşağıdaki tabloda verilen hayvan türü örneklerini uygunluklarına göre X işareti koyarak belirtiniz.

Hayvanlar	Omurgalı	Omurgasız
Alabalık		
Kartal		
Sivrisinek		
Koyun		
Salyangoz		

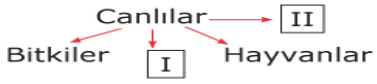
Aşağıdaki çoktan seçmeli sorularda sizce uygun olan şıkkı işaretleyiniz.

1)
-Akciğerleriyle solunum yapar.
-Omurgalıların en gelişmiş grubuna ait bir canlıdır.
-Yavrularını doğurur ve onunla ilgilenir.

Yukarıda verilen özellikler aşağıdaki canlılardan hangisine ait olabilir?

A) B) C) D)

2)



Canlıların sınıflandırılmasını gösteren şemada boş bırakılan yerlere aşağıdakilerden hangisi gelmelidir?

A) I-Omurgasızlar, II- Omurgalılar
B) I- Mantarlar, II- Balıklar
C) I- Mantarlar, II- Mikroskobik Canlılar
D) I- Omurgasızlar, II- Mantarlar

3) Aşağıdaki gruplardan hangisi, sadece çiçeksiz bitkilerden oluşmaktadır?

A) Su yosunu, at kuyruğu, fındık
B) Kara yosunu, papatya, su yosunu
C) Su yosunu, kara yosunu, eğrelti otu
D) Kara yosunu, lale, ciğer otu

4)

Bir grup öğrenci, şekildeki "ornitorenk" adlı canlının, hangi omurgalı hayvan grubunda olduğunu merak ediyor.

Araştırmaları sonucunda bu canlının "memeliler" grubunda olduğunu öğreniyorlar.
Bu canlı, aşağıda verilen özelliklerinden hangisi nedeniyle "memeliler" grubunda yer almıştır?

A) Gagalı oluşu
B) Yumurta ile çoğalması
C) Hem karada hem suda yaşaması
D) Yavrularını sütüyle beslemesi

5) Aşağıdakilerden hangisi omurgasız bir canlıdır?

A)Yılan B)Kurbağa
C)Akrep D)Güvercin

6) Mantarlar için aşağıda verilenlerden hangisi yanlıştır?

A) Yaprak ve çiçekleri yoktur.
B) Bitki olarak kabul edilmezler.
C) Çeşitli hastalıklara neden olan çeşitleri de vardır.
D) Kendi besinlerini kendileri üretirler.

7)"YUSUF: Bazı bitkilerin kökleri besin olarak kullanılabilir."
Aşağıdakilerden hangisi bu bitkilere örnek verilemez?

A) Havuç B) Turp
C) Şeker pancarı D) Domates

8) Aşağıdakilerden hangisi bir mantar çeşidi değildir?

A) Küf B) Maya. C) Şapkalı D) Süs

9) I. Buzdolabından çıkan dondurmanın erimesi
II. Açıkta bırakılan yoğurdun ekşimesi
III. Yere dökülen yaprakların çürümesi
IV. Sütün yoğurda dönüşmesi.
Yukarıda verilen olaylardan hangisinin veya hangilerinin kaynağı mikroskobik canlılardır?

A) Yalnız I.
B) I. ve II.
C) I. II. ve III.
D) II. III. ve IV.

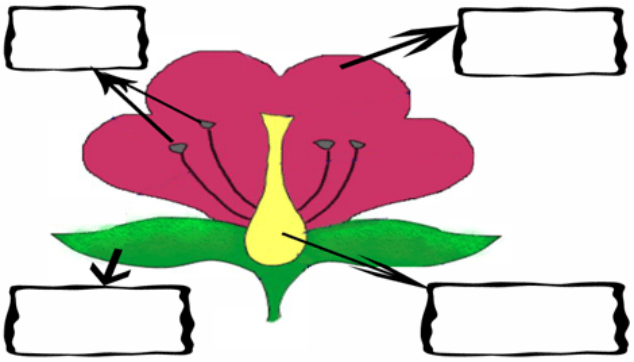
10) Aşağıdakilerden hangisi mantarların olumlu etkilerinden değildir?

A) Kültür mantarları, proteince zengin besin kaynakları olarak kullanılabilir.
B) Bazı küf mantarları ilaç yapımında kullanılır.
C) Mantarlar ölü canlıları ayrıştırarak toprağın verimini arttırırlar.
D) Mantarlar uygun koşullarda, besinlerin bozulmasını hızlandırırlar.

Aşağıda bitkinin kısımları karışık olarak verilmiştir. (⟶) Eşleştiriniz

Bitkiyi toprağa bağlar.	Çiçek
Bitkinin üreme organıdır.	Gövde
Bitkinin dik durmasını sağlar.	Yaprak
Fotosentez, solunum ve terleme yapar.	Kök

Aşağıda bulunan çiçeğin kısımlarını oklarla gösterilen uygun yerlere yazınız.

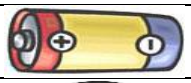


Günümüzde birçok çevre problemi ile karşı karşıyayız. Bu problemlerden birini seçerek çözüm yolları öneriniz.

APPENDIX E

SPRING TERM ACHIEVEMENT TEST-3

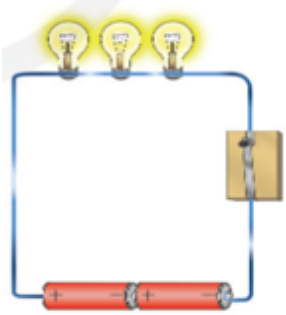
1.Type the names of the circuit elements shown in the box below.

Picture	Circuit Elements
	

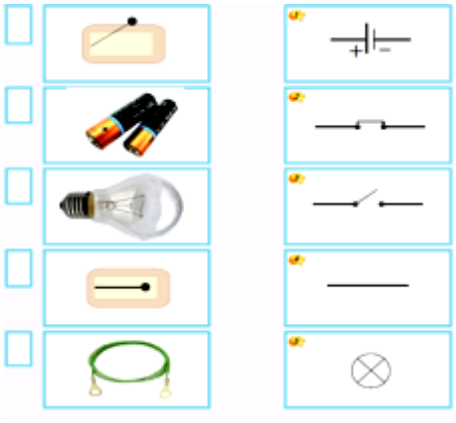
2. Draw one electrical circuit with the following circuit elements.

2 battery- 3 lamb- 1 switch- as many connection cables as you want

3.Use the symbols to draw the circuit diagram below.



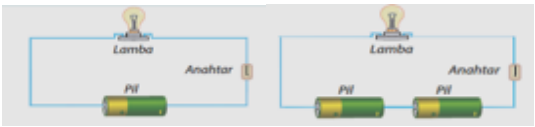
4.Find the symbols of the circuit elements and write their numbers in the boxes next to them.



5. Write the names of the circuit elements given below.
(BATTERY-HEADLAMB-CABLE- BULB-SWICH)

Allows electricity to pass through the circuit	
Provides electrical energy to the circuit	
Allows to open and close the circuit	
It is the vehicle that the bulb is attached to	
Gives light	

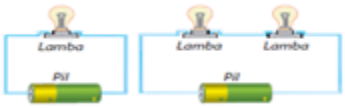
6.Emre made a change in the first period, as seen in the second. Accordingly,
in which of the following variables are given correctly?



<u>independent-control- dependent</u>

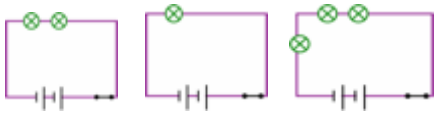
A) Number of bulbs- Number of batteries- Brightness
B) Brightness- Number of batteries- Number of bulbs
C) Number of batteries- Number of bulbs- Brightness
D) Number of batteries- Brightness- Number of bulbs

7.



INDEPENDENT VARIABLE: ……
CONTROL GROUP : ……..
DEPENDENT VARIABLE: ……

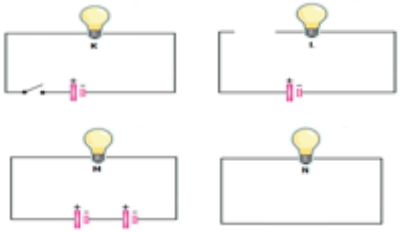
8. Identical batteries and bulbs with the following electrical circuit is installed. How does the brightness of the bulbs in the circuit be sorted from long to low?



I II III

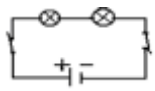
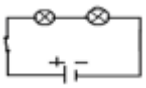
A) I, II, III
B) III, II, I
C) II, I, III
D) II, III, I

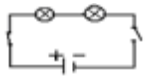
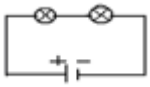
9. Which of the following circuits lamp does not light?

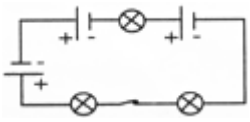


A) K & L B) K, L & N
C) K & M D) L, M & N

10. Which electrical circuit consists of 2 bulbs, 1 battery, one switched on and one switched off?

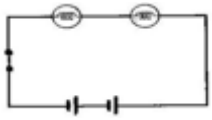
A)  B) 

C)  D) 

11. 

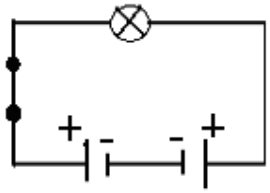
How many bulbs in the electrical circuit given in the figure and how many batteries are there?

A) 1 battery, 3 lamb
B) 3 battery, 3 lamb
C) 4 lamb, 1 battery
D) 3 battery, 1 lamb

12. 

What should be done to reduce the brightness of the bulbs in the above circuit?
I - Battery must be added to the circuit.
II - A light bulb must be added to the circuit.
III - A battery must be removed from the circuit.

A) III B) II , III C) I , III D) I , I

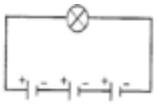
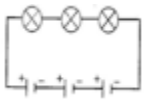
13) 

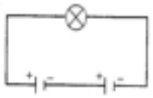
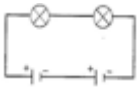
Which of the following should be done to light the bulb in the circuit in the figure?
A) The key must be opened.
B) Another bulb should be added.
C) Batteries must be connected correctly.
D) Quality cable should be used.

14. I- Break in the cable.
II- Switch off
III- Reverse connection of the battery.
IV-The bulb breaks out.

Which of the above is one of the reasons why the bulb does not light in a circuit?
A) I B) I – II C) II – III D) I – III- IV

15. Since the batteries and bulbs used in the following circuits are identical, which circuit will make the bulb brighter?

A)  B) 

C)  D) 

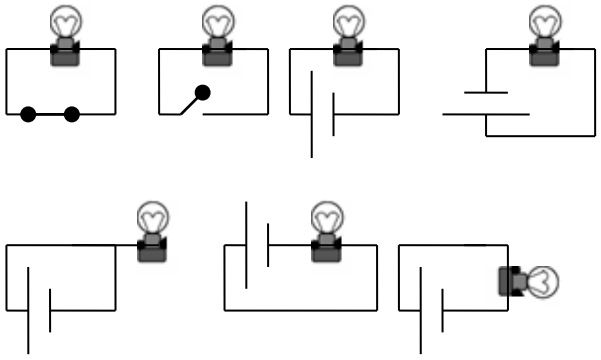
16.

If the number of bulbs is kept constant in the simple electric circuit and the number of batteries is increased, the number of batteries is ..... variable.
Which word should be written on the dotted line in the above sentence? Dependent Independent Control Constant

17. Answer the following questions as an 'increases' 'or' 'decreases'.

1. How do we change the brightness of the bulb if we connect one more battery to the circuit consisting of two batteries and two bulbs?
.....
2. How does the brightness of the bulb change if we remove a battery from the circuit consisting of three batteries and three bulbs?
……
3. If we remove a bulb from the circuit consisting of two batteries and two bulbs, how does the bulb's brightness change? ……
4. If we connect one more bulb to the circuit consisting of four batteries and four bulbs, how does the bulb's brightness change? ……

18.



Which bulbs above do not light? A) 1,2,5 B) 1,5,7 C) 2, 4, 6. D) 3,4,6,7

19. Which of the following increases the brightness of the bulb in the circuit?

A) Removing a switched-on bulb
B) Switch connection to the circuit
C) Bulb connection to the circuit
D) Removing a deactivated battery

20. He investigates the effect of increasing the number of bulbs on the brightness of a bulb in a simple electric circuit. Since the variables in this experiment are the number of batteries, the number of bulbs and the brightness of the bulb, which of the following are the variables that the Emir should keep independent, dependent and constant?

	Independent	Dependent	Constant
A)	Number of bulbs	Number of batteries	Brightness
B)	Brightness	Number of batteries	Number of bulbs
C)	Number of batteries	Number of bulbs	Brightness
D)	Number of batteries	Brightness	Number of bulbs

APPENDIX F

SPRING TERM ACHIEVEMENT TEST-3 (TURKISH)

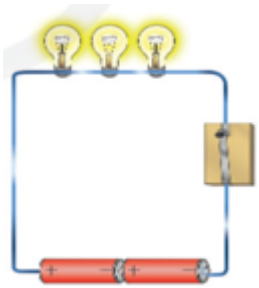
1.Aşağıda gösterilen devre elemanlarının isimlerini yanındaki kutucuğa yazınız.

Resim	Devre Elemanı

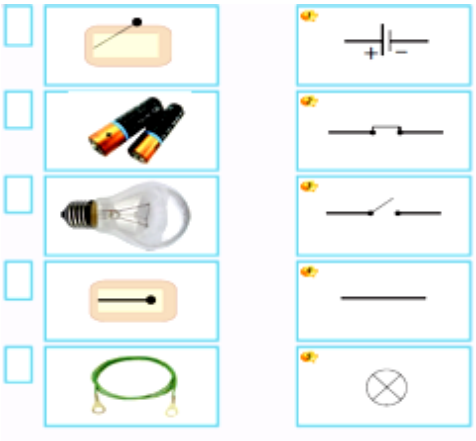
2. Aşağıda verilen devre elemanlarıyla bir tane elektrik devresi resmi çiziniz.

2 pil	3 lamba	1 anahtar	yeterli miktarda bağlantı kablosu

3. Aşağıdaki devrenin şemasını semboller kullanarak yanına çiziniz.



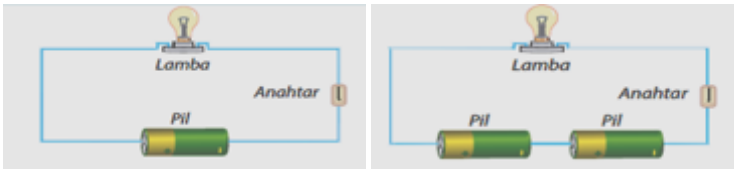
4.Devre elemanlarının sembollerini bulup yanlarındaki kutucuklara numaralarını yazınız.



5.Aşağıda verilen devre elemanlarının adlarını yazınız.
(PİL-DUY-KABLO-AMPUL-ANAHTAR)

Devreden elektrik geçmesini sağlayan devre elemanıdır.	
Devreye elektrik enerjisini sağlayan devre elemanıdır.	
Bir elektrik devresini açıp kapamaya yarayan devre elemanıdır.	
Ampulün takıldığı araçtır.	
Işık veren devre elemanıdır.	

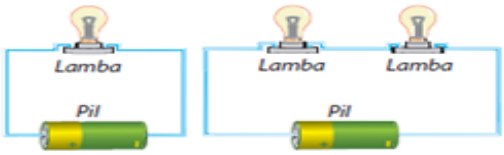
6.Emre, ilk devrede, ikincisinde görüldüğü gibi bir değişiklik yapmıştır. Buna göre eğişkenler aşağıdakilerden hangisinde doğru verilmiştir?



<u>BAĞIMSIZ-SABİT TUTULAN-BAĞIMLI</u>

A) Ampul sayısı- Pil sayısı-Parlaklık
B) Parlaklık-Pil sayısı-Ampul sayısı
C) Pil sayısı-Ampul sayısı- Parlaklık
D) Pil sayısı-Parlaklık-Ampul sayısı

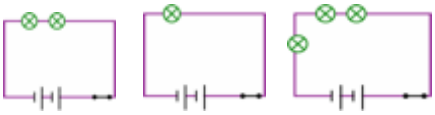
7.Aşağıdaki deneyde yer alan bağımsız, sabit tutulan ve bağımlı değişkenleri yazınız.



BAĞIMSIZ DEĞİŞKEN : ……
SABİT TUTULAN DEĞİŞKEN : ……
BAĞIMLI DEĞİŞKEN : ……

8.Özdeş pil ve ampullerle aşağıdaki elektrik devresi kuruluyor. Devredeki ampullerin parlaklığının çoktan aza doğru sıralanışı nasıl olur?

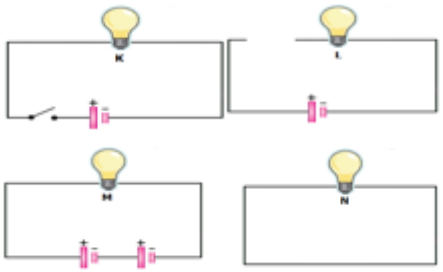
8.



I II III

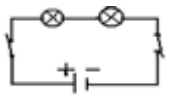
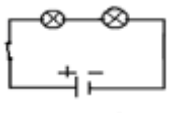
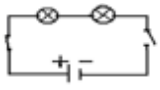
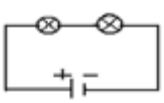
A) I, II, III
B) III, II, I
C) II, I, III
D) II, III, I

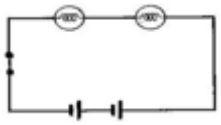
9.Aşağıdaki devrelerden hangisi ya da hangilerinde lamba ışık vermez?



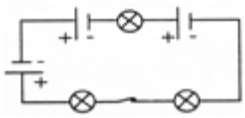
A) K ve L B) K, L ve N
C) K ve M D) L, M ve N

10. İki ampul, 1 pil, biri açık diğeri kapalı iki anahtardan oluşan elektrik devresi aşağıdakilerden hangisidir?

A) 
B) 
C) 
D) 

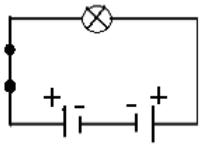
11. 

Şekilde verilen elektrik devresinde kaç ampul ve kaç pil vardır?
A) 1 pil, 3 ampul
B) 3 pil, 3 ampul
C) 4 ampul, 1 pil
D) 3 pil, 1 ampulü

12. 

Yukarıdaki devredeki ampullerin parlaklığını azaltmak için hangileri yapılmalıdır?
I - Devreye pil eklenmelidir.
II - Devreye ampul eklenmelidir.
III - Devreden bir pil çıkarılmalıdır.

A) III B) II , III
C) I , III D) I , I

13. 

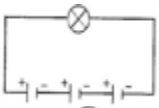
Şekildeki devrede ampulün yanması için aşağıdakilerden hangisi yapılmalıdır?
A) Anahtar açılmalıdır.
B) Bir ampul daha eklenmelidir.
C) Piller doğru bağlanmalıdır.
D) Kaliteli kablo kullanılmalıdır.

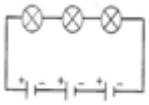
14.Aşağıda verilenlerden hangileri bir devrede ampulün yanmamasının sebeplerindendir?

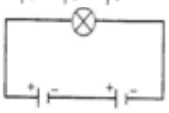
I- Kablo içindeki kopukluk.
II- Anahtarın kapalı olması
III- Pilin , ters bağlanması.
IV- Ampulün patlak olması.

A) Yalnız I B) I – II
C) II – III D) I – III- IV

15. Aşağıdaki devrelerde kullanılan piller ve ampuller özdeş olduğuna göre hangi devrede ampul daha parlak yanar?

A) 

B) 

C) 

D)

16.

17. Aşağıdaki soruları ‘’artar’’ ya da ‘’azalır’’ şeklinde cevaplayınız.

Basit elektrik devresinde ampul sayısı sabit tutulup pil sayısı artırılıyorsa pil sayısı ..... değişkendir. Yukarıdaki cümlede noktalı yere hangi sözcük yazılmalıdır? (4 Puan)
Bağımlı Bağımsız Kontrol edilen Sabit

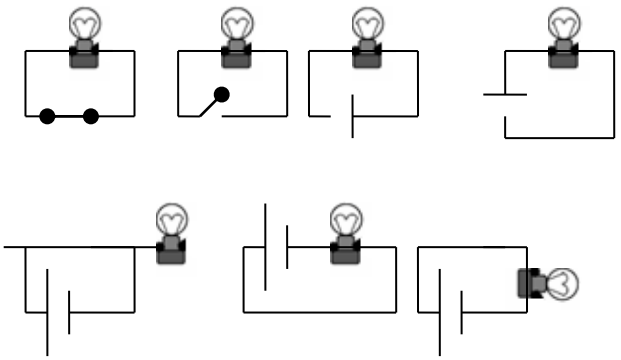
1. İki pil ve iki ampulden oluşan devreye, bir pil daha bağlarsak ampulün parlaklığı nasıldeğişir? .....

2. Üç pil ve üç ampulden oluşan devreden , bir pil çıkarırsak ampulün parlaklığı nasıl değişir? ……

3. İki pil ve iki ampulden oluşan devreden, bir ampul çıkarırsak ampulün parlaklığı nasıl değişir? ……

4. Dört pil ve dört ampulden oluşan devreye, bir ampul daha bağlarsak ampulünparlaklığı nasıl değişir? ……

18.



Yukarıdaki hangi ampuller ışık vermez?

A) 1,2,5 C) 2, 4, 6

B) 1,5,7 D) 3,4,6,7

19. Aşağıdakilerden hangisi, devredeki ampulün parlaklığını artırır?

A) Devreden bir ampulün çıkarılması
B) Devreye anahtar bağlanması
C) Devreye ampul bağlanması
D) Devreden bir pilin çıkarılması

20. Emir kurduğu bir basit elektrik devresinde ampul sayısının artmasının ampul parlaklığına etkisini araştırıyor. Bu deneydeki değişkenler pil sayısı, ampul sayısı ve ampul parlaklığı olduğuna göre, Emir'in bağımsız, bağımlı ve sabit tutması gereken değişkenler aşağıdakilerin hangisinde doğru verilmiştir?

	Bağımsız değişken	Bağımlı değişken	Sabit tutulan değişken
A)	Ampul sayısı	Pil sayısı	Ampul parlaklığı
B)	Ampul parlaklığı	Ampul sayısı	Pil sayısı
C)	Pil sayısı	Ampul parlaklığı	Ampul sayısı
D)	Ampul sayısı	Ampul parlaklığı	Pil sayısı

APPENDIX G

ATTITUDE TEST

	TOTALLY AGREE	AGREE	UNDECIDED	NOT AGREE	TOTALLY NOT AGREE
1. Science lesson is fun.					
2. I like reading books about science.					
3. I do not like science and I do not like having to study this lesson.					
4. Science course has no important place in daily life.					
5. I'm usually interested in a science course.					
6. I'd like to know more about science.					
7. I don't like reading science-related news in newspapers and magazines.					
8. I'd be upset if I knew I'd never go to science lesson again.					
9. Science is interesting to me and I like science.					
10. I feel uncomfortable, restless, irritable and impatient in science.					
11. The science lesson is fascinating and fun.					
12. Science lesson scares me.					
13. I have good feelings for science lesson.					
14. I feel bad when I hear a word about science.					
15. Science is a lesson I like to study.					
16. Science course helps us to better understand the natural events around us.					
17. School would be more enjoyable for me if there is not a science course.					
18. Time does not pass in science class.					
19. I want more science classes.					
20. I find it easy and I love science.					
21. I describe my feelings for science as positive.					
22. Science is boring.					

APPENDIX H

ATTITUDE TEST (TURKISH)

	TAMAMEN KATILIYORUM	KATILIYORUM	KARARSIZIM	KATILMIYORUM	HİÇ KATILMIYORUM
1. Fen Bilgisi dersi eğlencelidir.					
2. Fen Bilgisi ile ilgili kitapları okumaktan hoşlanırım.					
3. Fen Bilgisi dersinden ve bu dersi çalışmak zorunda olmaktan hoşlanmıyorum.					
4. Fen Bilgisi dersinin günlük hayatta önemli bir yeri yoktur.					
5. Fen Bilgisi dersinde genellikle derse karşı ilgiliyimdir.					
6. Fen Bilgisi dersi hakkında daha fazla şey öğrenmek isterim.					
7. Gazete ve dergilerdeki fen ile ilgili haberleri okumaktan hoşlanmam.					
8. Eğer Fen Bilgisi dersine bir daha asla gitmeyeceğimi bilseydim üzülürdüm.					
9. Fen Bilgisi dersi benim için ilginçtir ve fenden hoşlanırım.					
10. Fen Bilgisi dersinde kendimi rahatsız, huzursuz, sinirli ve sabırsız hissederim.					
11. Fen Bilgisi dersi büyüleyici ve eğlencelidir.					
12. Fen Bilgisi dersi beni ürkütür.					
13. Fen Bilgisi dersine karşı iyi duygulara sahibim.					
14. Fen ile ilgili bir kelime duyduğumda kendimi kötü hissederim.					
15. Fen Bilgisi çalışmaktan hoşlandığım bir derstir.					
16. Fen Bilgisi dersi çevremizdeki doğal olayların daha iyi anlaşılmasına yardımcı olur.					
17. Fen Bilgisi dersi olmasa okul benim için daha zevkli hale gelir.					
18. Fen Bilgisi dersinde zaman geçmek bilmez.					
19. Fen Bilgisi ders saatinin daha fazla olmasını isterim.					
20. Fen Bilgisi dersini kolay buluyorum ve çok seviyorum.					
21. Fen Bilgisi dersine karşı olan hislerimi olumlu olarak tanımlarım.					
22. Fen Bilgisi dersi sıkıcıdır.					

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