Ondokuz Mayıs Üniversitesi Eğitim Fakültesi Dergisi
Ondokuz Mayıs University Journal of Faculty of Education
e-ISSN: 2548-0278 OMU EFD, December 2023, 42(2): 813-852

Taking Interdisciplinary Science Learning to Nature

Disiplinlerarası Fen Öğreniminin Doğaya Taşınması

Bekir GÜLER[1], İsmail EYÜPOĞLU[2], Fatih TAŞ[3], Yasemin BÜYÜKŞAHİN[4]

[1]Bartın University, Bartın, Türkiye
· **bekirgulr@gmail.com** · ORCİD > 0000-0002-5713-4347
[2]Bartın University, Bartın, Türkiye
· **eyupogluismail@gmail.com** · ORCİD > 0000-0003-0705-6106
[3]Bartın University, Bartın, Türkiye
· **fatihtas@bartin.edu.tr** · ORCİD > 0000-0002-0534-2777
[4]Bartın University, Bartın, Türkiye
· **ybuyuksahin@bartin.edu.tr** · ORCİD > 0000-0002-5771-2063

Makale Bilgisi/Article Information

Makale Türü/Article Types: Araştırma Makalesi/Research Article
Geliş Tarihi/Received: 24 Nisan/April 2023
Kabul Tarihi/Accepted: 04 Eylül/September 2023
Yıl/Year: 2023 | **Cilt-Volume:** 42 | **Sayı-Issue:** 2 | **Sayfa/Pages:** 813-852

Atıf/Cite as: Güler, B., Eyüpoğlu, İ., Taş, F., Büyükşahin, Y. "Taking Interdisciplinary Science Learning to Nature" Ondokuz Mayıs Üniversitesi Eğitim Fakültesi Dergisi, Ondokuz Mayıs University Journal of Faculty of Education, 42(2), December 2023: 813-852.

Sorumlu Yazar/Corresponding Author: Bekir GÜLER

Etik Kurul Beyanı/Ethics Committee Approv: "Ethics committee approval was received for the research from the Scientific Research and Publication Ethics Committee of Bartın University with decision number 2018/094 dated 16.10.2018."

https://doi.org/10.7822/omuefd.1286835

TAKING INTERDISCIPLINARY SCIENCE LEARNING TO NATURE

ABSTRACT

In recent years, efforts to form a sustainable community rather than a consumption society deprived of nature have accelerated. To raise this awareness in individuals and; more importantly, to make it sustainable, education plays a significant role. Informal and nonformal learning are vital resources for individuals to recognize the importance of nature and to establish a healthy and balanced relationship with science and nature. One of the settings to experience such learning is science and nature camps. In light of this, the main purpose of this study was to investigate how an interdisciplinary science camp consisting of STEAM (Science, Technology, Engineering, Arts, and Maths) activities would affect secondary school students' perceptions of science and nature in rural areas. The prepared activities, it was also intended to present an application sample for process-oriented integration of science and nature practices. Within the scope of the study, 14 activities were prepared by the authors. Each activity was performed in natural areas. The study was based on a one-group pre-test post-test experimental design. The sample of the study consists of 140 students, between 5th and 8th grades, living in different villages in Bartın, Turkey. Analysis of data revealed that students' perceptions of the concepts of science and nature changed after the camp, and they gained awareness about the place of science and themselves as individuals in nature.

Keywords: Interdisciplinary Science, STEAM, Science Teaching, Nature Camp, Out-of-School Learning.

❋❋❋

DİSİPLİNLERARASI FEN ÖĞRENİMİNİN DOĞAYA TAŞINMASI

ÖZ

Doğadan uzak bir tüketim toplumu yerine sürdürülebilir bir toplum oluşturma çabaları son yıllarda hız kazanmıştır. Bireylerde bu farkındalığı oluşturmak ve sürdürülebilir olması için eğitim önemli bir rol oynamaktadır. Sargın ve yaygın öğrenme, bireylerin doğanın önemini kavraması, bilim ve doğa ile sağlıklı ve dengeli bir ilişki kurması için hayati kaynaklardır. Bu tür öğrenmelerin yaşanabileceği ortamlardan biri de bilim ve doğa kamplarıdır. Buradan hareketle bu çalışmanın temel amacı, STEAM (Bilim, Teknoloji, Mühendislik, Sanat ve Matematik) etkinliklerinden oluşan disiplinler arası bir bilim kampının kırsal kesimde ortaokul öğrencilerinin bilim ve doğa algılarını nasıl etkileyeceğini incelemektir. Ayrıca hazırlanan etkinliklerle bilim ve doğa uygulamalarının süreç odaklı bütünleşti-

https://doi.org/10.7822/omuefd.1286835

rilmesine yönelik bir uygulama örneği sunulması amaçlanmıştır. Çalışma kapsamında yazarlar tarafından 14 etkinlik hazırlanmıştır. Her aktivite doğal alanlarda gerçekleştirilmiştir. Araştırma, tek gruplu ön test son test deneysel desenine göre yapılmıştır. Araştırmanın örneklemini Bartın ilinin farklı köylerinde yaşayan 5. ve 8. sınıflar arasındaki 140 öğrenci oluşturmaktadır. Verilerin analizi, kamp sonrası öğrencilerin bilim ve doğa kavramlarına yönelik algılarının değiştiğini, bilimin ve doğadaki bireyler olarak kendilerinin yeri konusunda farkındalık kazandıklarını ortaya koymuştur.

Anahtar Sözcükler: Disiplinlerarası Fen, STEAM, Fen Öğretimi, Doğa Kampı, Okul Dışı Öğrenme.

❋❋❋

INTRODUCTION

The rapid increase in industrialization and production has led people to prioritize financial worries, and nature has mostly become of secondary importance. People have adopted a modern but more isolated lifestyle in which they decide how much they are exposed to nature in their lives. Consequently, their relationship with nature has substantially decreased (Aaron, 2009). The understanding of consumption which does not allow for the renewal of natural resources consumed by people and the flexibility required by the natural cycle, which adversely affects other living creatures and reduces biodiversity has considerably weakened nature (Güler, 2019; Kosker, 2013). The recent increase in natural disasters is a sign that nature cannot handle the damage caused by humans anymore (Maddox, Nagendra, Elmqvist & Russ, 2017, p. 17). It is a serious situation in which individuals are not aware of the negative effects of their behaviors and lifestyles (Digby, 2013). Therefore, the problem to resolve here may be about awareness, attitudes, and behaviors of people. Studies foresee that informal knowledge literacy is valuable potentially for personal and organizational improvement (Overwien, 2000). One of the innovations to provide this kind of improvement is presenting science to students in nature through science and nature camps. Science and nature camps are sets of indoor or outdoor activities developed to enhance individuals' awareness of natural events (Yildiz Yilmaz & Mentis Tas, 2018). They are one of the environments that offer useful informal and nonformal learning. These camps make participants learn about natural events and the relations between them (Hanscom, 2016, p. 56). Thus, individuals may realize both the natural cycle and the science behind it. This may first change their perceptions of nature and natural events (Aaron, 2009; Yardımcı, 2009), and then their awareness toward protecting it (Bell, Lewenstein, W. Shouse & A. Feder, 2009; Derr, Chawla, & Pevec, 2017, p. 9; Yildiz Yilmaz & Mentis Tas, 2018). Moreover, art is stated as another part of nature as well as science, and the need for an interdisciplinary approach is stated for understanding nature

(Jacobson, Seavey, & Mueller, 2016). Studies reveal that science and art integration makes positive contributions to reinforcing students' interest in science, increasing their motivation, improving their learning outcomes, improving their skills, and increasing their communication and cooperation skills (Hannigan, Wickman, Ferguson, Prain & Tytler, 2022; Straksiene, Ben-Horin, Espeland & Robberstad, 2022). As a result, science and nature camps are linked not only to science learning but also to interdisciplinary learning experiences. In recent years, STEM and STEAM activities have been used to make students experience science, mathematics, engineering, technology, and art components in an interdisciplinary way in science and nature camps. In various regions of Europe, America, and Australia, there are some practices like forest schools or nature schools to strengthen students' ties with nature. In these practices, students visit different regions besides natural areas in their surroundings, and commune with nature (Derr, Chawla & Pevec, 2017, p. 6).

In this study, as the first study in this region of Turkey (Western Black Sea), we examined how interdisciplinary science and nature camps affect children's perceptions of science and nature in rural areas. One of the most common criticisms to note about STEAM or similar interdisciplinary activities is that art is often used as an "ornament" without providing largely integrated applications (Straksiene, Ben-Horin, Espeland & Robberstad, 2022). In this respect, it is often emphasized that the art components should be process-oriented, not product-oriented, in such interdisciplinary studies (Perignat & Katz-Buonincontro, 2019). However, we think that it is an essential aspect of the study that both science and art practices were carried out as process-oriented, not as product-oriented. We also believe that the results indicating this integration's positive changes on children even in a two-day application will make significant contributions to STEM, STEAM, and similar interdisciplinary studies on science-art integration. As a matter of fact, Jacobson, Seavey, and Mueller (2016) brought together students of fine arts and science in their study. They gathered these students together with scientists and artists as part of an only one-day excursion and involved them in hands-on activities about climate change. It was identified, after this one-day application, that there was a decrease in the misconceptions of the students in both groups about climate change. More importantly, the participant students stated that the other group's perspectives towards events were different, and they were pleased to gain new viewpoints due to this difference. Thus, the study is expected to contribute to studies, especially on science and art integration.

LITERATURE REVIEW

Today it is necessary to design habitats in a practical way to provide enough living spaces for the growing population. Technological developments may enable the designing of such spaces. However, technology that facilitates many daily tas-

ks and diversifies interpersonal communication channels has also differentiated human interactions (Griffin, 2015). On the other hand, it is also possible to see long-term negative outcomes of applications regarding the design of living spaces in terms of sustainability in this modernization process accompanied by increasing urbanization (Maddox, Nagendra Elmqvist, & Russ, 2017, p. 13). In today's living conditions, quality time in the open air has decreased considerably. Furthermore, nonphysical interactions in virtual environments have developed a different way of perception in people, particularly in children, and they have begun to have a superficial relationship with nature. The decrease in nature awareness and interaction may cause quality ties with nature to turn into meaningless relationships, lacking quality (Kosker, 2013).

A Way to Strengthen the Ties with Nature: Science and Nature Camps

In recent years, efforts to form a sustainable community rather than a consumption society deprived of nature have accelerated. To raise this awareness in individuals and, more importantly, to make it sustainable, education plays a significant role. Today children live more impassively, surrounded by electronic stimuli and isolated from the outer world (Griffin, 2015). In this lifestyle, it has become quite easy for children to reach and relay information. Nevertheless, the passivity brought by easy access to information and other people has also changed the ways that children play, spend time outdoors, and interact with nature and their peers. Therefore, it is possible that ties with nature remain weak or cannot be established at all. This may lead to a narrowing of the boundaries in children's creative worlds (Hanscom, 2016, p. 54). Deniş Çeliker and Akar (2015) investigated children's perception of nature in a study that they conducted with secondary school students. In the study, it was determined that the majority of students considered nature as a living space. In another study, 4th-grade students were requested to draw pictures to examine their perceptions of science and nature (Yilmaz & Kahraman, 2015). They were also requested to create written content in addition to their drawings so that the details could be understood. At the end of the study, it was identified that students expressed the concept of science mostly with laboratory studies while expressing the concept of nature with a clean environment, green space, mountains, and rivers. It was noteworthy that students defined science as events happening beyond them, and nature as wilderness outside the urban life of people. In another study conducted with a different age group, 48/72-month preschool students' perceptions of scientists were investigated through drawings. It was observed that children drew scientists as individuals working alone in a laboratory or a room of their own (Ayvaci, Atik & Urey, 2016). Furthermore, another study investigating the creatures living in the forest indicated that students' knowledge of their habitat and nutrition was limited. However, after a visit to the forest, students obtained a variety of detailed information on those living creatures, and their learning was

enriched (Strommen, 1995). Children's interactions with nature are the most important indicator of their perceptions and behaviors regarding nature, science, and living creatures.

Nature deprivation in children may lead to difficulties in establishing ties with nature again as well as deprivation of experiences gained by spending time in nature (Cabuk, 2019). For this reason, studies to support the formal education that students receive at school have been conducted for a long time. However, upon observing the effects of non-formal and informal learning on the formal learning process, studies have also begun to examine the former process (Lin & Schunn, 2016). Informal learning, as distinct from formal ones, occurs at a wide range of times and places. They can occur during domestic interactions or visits to places such as museums, botanical gardens, zoos, libraries, etc. as well as at schools and other formal learning environments (La Belle, 1982). One of the settings where these studies are performed is science and nature camps. These camps are regarded as non-formal learning environments. Non-formal learning environments are planned learning settings in which training contents are prepared by instructors in line with a purpose, and most participants have the initiative to attend the process (Heimlich, Adams & Stern, 2017, p. 3). Science and nature camps have those features. Since the participants can make choices and shape their learning at each step in the activities performed, these environments are also quite suitable for informal learning to occur. Science and nature camps are activities organized to enable individuals to realize, learn about, and adapt to the natural order in which they live. These camps can be organized indoors as well as outdoors, communing with nature (Yildiz Yilmaz & Mentis Tas, 2018). Learning in nature allows individuals to encounter unexpected situations in which they learn about the natural mechanisms and risks in their environment (Hanscom, 2016, p. 56). In science and nature camps, all materials in the environment can be used and shaped for different purposes, which triggers creativity. Learning about the functioning of nature interactively brings in individuals' inquiries about natural events and the science that lies within. This kind of learning process may help people develop attitudes and behaviors toward protecting nature (Bell, Lewenstein, W. Shouse & A. Feder, 2009; Derr, Chawla, & Pevec, 2017, p. 9; Yildiz Yilmaz & Mentis Tas, 2018). These discoveries may facilitate students to exhibit their skills more easily and express their opinions more comfortably in interactions with their peers and teachers. This means nonformal and informal learning may provide significant support to in-class formal learning.

Research has indicated that nature experiences make significant changes in children's definitions and perceptions of nature, and diversify the figures that children use to describe nature (Aaron, 2009; Yardımcı, 2009). In the studies examining student perceptions of science and scientist, students were identified to consider science as an information-production job comprising of proven and constant facts,

and scientist as an individual doing science, wearing a lab coat and glasses, and dealing with laboratory equipment (Ayvaci, Atik & Urey, 2016; Turgut, Ozturk & Es, 2017; Yilmaz & Kahraman, 2015). When their nature experiences increased, it has been observed that there are positive changes in students' understanding of science and its functioning (Leblebicioğlu, Metin, Yardımcı & Berkyürek, 2011), and significant increases in their environmental awareness levels (Yıldız Yılmaz & Mentiş Taş, 2018). After a science camp, Gunesch and Winter (1996) found that students' enthusiasm and knowledge of science increased. In the same study, after the camp, it was seen that the children who mentioned that science was a difficulty far from their daily life stated that they could do science themselves. Strommen (1995) states that when children spend time in a natural environment, their nature awareness expands, and they can apprehend nature's raison d'etre. That children are deprived of nature may lead to nature destruction, disturbed nature balance, and physical and psychological problems. To prevent these and help children establish sustainable solid relations with nature, science and nature camps are highly important and rich environments. It is possible to bring the required educational content to children through these camps because individuals learn through informal ways as well as formal ones (Lin & Schunn, 2016). Regarding the studies, science and nature camps are considered important tools to raise people's awareness of nature that they live in and bring them to a scientific perspective in the meantime.

To interpret the world that we live in through discovery, art activities are also stated to play a part as well as science and scientific methods. Very little of the science produced in "labs" reaches ordinary people. At this point, it can be said that it is extremely important that science-art integration facilitates the understanding of the technical language of science and enables it to reach a wider audience (Zaelzer, 2020). Therefore, it is emphasized that science and art should be used in an interdisciplinary way to teach nature's functioning (Jacobson, Seavey, & Mueller, 2016). In recent years, it has been aimed at students experiencing science, mathematics, engineering, technology, and art components in an interdisciplinary way in science and nature camps through STEM and STEAM. Kwon, Capraro, and Capraro (2021) stated in their study that STEM-based students had positive changes in their opinions about science and mathematics. In the research conducted, it is highlighted that components, especially art, should not be product-oriented but process-oriented in these interdisciplinary studies (Perignat & Katz-Buonincontro, 2019). Besides, it is indicated that failing to apply the necessary integration in a qualified way may affect the motivation of teachers who aim to perform interdisciplinary practices (Bequette & Bequette, 2012).

Against this background, this study examined how a science and nature camp affects children's perceptions of science and nature. A two-day science and nature camp was held within the scope of the study. Considering the studies, in the STEAM activities prepared within the context of this study, the visual arts com-

ponent was applied as process-oriented. Data were collected through the pictures that children drew before and after the camp. Evaluations were made regarding the changes and developments in children's images about the concepts of science and nature in their minds. The research question that shapes the study is as follows:

How did the experiences in the interdisciplinary science camp consisting of STEAM activities affect children's perceptions toward the concepts of "science" and "nature"?

METHOD

The study was part of a project supported by the Scientific and Technological Research Council of Turkey (TÜBİTAK). Within the scope of the project, 14 activities were designed and implemented to expand the science and nature awareness of students living in the villages. Details of the implementation process are presented in the relevant section.

Research Design

By the requirements of the project program supporting the present research, the participants voluntarily participated in all the activities. In this case, it was not possible to establish a control group for the study. Therefore, this study was based on one group pre-test post-test experimental design, which is one of the quantitative research methods. This method, which is also called a pre-experimental design, is preferred when a control group cannot be formed (Creswell, 2017; Karasar, 2018). In this method, the group the study is performed with can be one or more. However, the groups are not the control group of the study. It is all considered as the experimental group. The same experimental procedure is carried out in all groups (Sönmez & Alacapınar, 2019). Within the scope of the project, all of the participants attended the same events within the same program.

Study Sample

The sample of the study consists of 140 students in the 5th, 6th, 7th, and 8th grades living in different villages of Bartın, Turkey. The target group of the study was determined as secondary school students living in socio-economically disadvantaged villages of Bartın. These students are also relatively disadvantaged in their education in terms of attending events like science and nature activities, science fests, and nature camps organized in the city center by various institutions or communities. Contrary to this disadvantage of participating in educational organizations, the villages they live in are in natural areas where they can experience wildlife and observe a great variety of plant and animal species. Therefore, they live

in a region where they have the chance to observe and protect nature and science closely. Children's interaction with nature and how their social learning turns into behavior in a guidance process are the main aims of this study. For this reason, it was considered essential that these students were supported and selected as the study sample.

Based on investigations to reach the target group, regions with a high number of students receiving social support were determined as the leading centers for implementation. After that, researchers visited these regions. Criteria such as location and population of villages, information on students who were active residents, and their accessibility status were examined, and a village from each region was selected. These 6 villages were visited again, and implementation areas were planned with school principals, teachers, and administrative authorities in the regions. To receive applications from possible project participants, announcements were made in these regions through leaflets, posters, social media notices, and visits to schools. An online form was created to centralize applications, and the link for the form was shared on posters and the project web page. The target group of the project was primarily students from the regions determined by the project team. For this reason, the first criterion sought for the participants was their residence in these regions. This situation has been kept confidential on the posters and during the application process. Upon completing the application process, all applicants were examined in terms of sampling criteria, and students meeting the criteria were identified as the participants. The study group consisted of 66% female (n = 92) and 34% male (n = 48) students.

Procedure

Within the scope of the study, 14 activities were prepared in total by the researchers. Each activity was performed in natural areas. In the activities, students were enabled to examine natural events on-site, evaluate them within their science and art knowledge, and interpret nature from a different viewpoint. Thus, it was aimed that the students examine nature and natural phenomena, associate them with each other, and interpret their designs. In addition, it was aimed to create awareness about the place of humans in nature. Contexts and contents of activities are presented in Table 1.

Table 1. *Activity contexts and contents*

Activity Name	Activity Context	Activity Content
Orienteering	Science + Sports	Astronomy-Mathematics-Sports
Paper Bridge Design Competition	STEAM	Physics-Mathematics-Art
Legs Enabling Pollination	Science	Biology
Galileoscope	STEAM	Physics-Astronomy-Mathematics-Art
My Night Observation	Science	Physics-Astronomy
Mosaic	Art	Design
Water Cleaning	STEAM	Physics-Chemistry-Biology-Mathematics-Art
My Birdhouse	STEAM	Biology-Mathematics-Art
Flying Butterflies	STEAM	Physics-Mathematics-Art
First Aid Training in Nature	Science	Biology
Math Sweet as Honey	STEAM	Physics-Mathematics-Art
Making Soap with Natural Materials	STEAM	Chemistry-Mathematics-Art
Blue Spruce	Science	Biology
Sports in Nature	Sports	Sports

The activities, whose contexts and contents are presented in the table, were performed with secondary school students for two days. Science, technology, mathematics, engineering, and art were presented together in an interdisciplinary approach to these activities. In all these activities, importance was given to scientific communication, and conversations were held with students about their preliminary knowledge and views on the nature of science. In this way, it was aimed to develop a holistic understanding rather than focusing on a single objective with the activities.

The activities designed by the researchers were performed for 2 days in each village from 6 different regions, and 12 days in total. At each village, students from the surrounding villages made applications and participated in the activities. For each village, preparations were made beforehand, and activity steps were enriched in a way that included the environmental conditions of the region in the process. Students worked in groups in all activities, and each group was accompanied by a guide beside the researchers. Furthermore, to coordinate students' work and provide closed spaces, when necessary, school buildings affiliated to Bartın Provincial the Directorate for National Education, and education buildings and village halls affiliated to Directorate of Kure Mountains National Park were made available to students during the implementation. The relevant institutions supported the study in preparation for these environments.

Figure 1. *A sample center of implementation (1st location)*

Data Collection

When we try to measure the effects of such outdoor learning environments on individuals within the formal assessment system, we may not get the expected results. To measure the informal learning brought about by outdoor learning environments, it is necessary to apply measurement-evaluation methods suitable for this learning (Kimche, 1978). In expressing feelings and thoughts, children behave differently from adults. They express their emotions and opinions without feeling pressure or concern (Yilmaz & Kahraman, 2015). Especially in their drawings, they reveal the world and events in their mind explicitly and sincerely. Therefore, drawing pictures is a good activity for students at young ages (Stebbins, 2012, p. 21). To identify students' perspectives towards science and nature in the study, it was intended to benefit from the feeling of comfort that painting would give to students, and the power of interview to interpret their pictures.

To examine participants' perception of science and nature, they were addressed the question "What do science and nature mean to you? Can you draw the images appearing in your mind when science and nature is mentioned?" before and after the implementation and requested to draw a relevant picture each time. The first drawings were requested right after the registration of the participants before they met each other. By doing so, any effects such as interactions with each other or researchers on the pre-test data were avoided. After the drawings, which took about 30 minutes, were completed the process started. Upon completion of implementations, students were given blank paper to draw and address the same question.

Students were informed that they could draw wherever they wanted (table, dining area, park, green zone, etc.) within the safe borders of the implementation area so that they could express their thoughts better and not affect each other. Following the final drawings, semi-structured interviews were held with 10 students randomly selected among the volunteers. Students' views and definitions of the concepts of science and nature were inquired about in the interviews. The semi-structured interview form was developed by the researchers, and its validity was ensured by expert opinion. For the interview to be appropriate for the student's age, the number of questions and the duration were restricted. The interview form comprised of 5 questions intended to reveal the participants' perspectives on science and nature.

Figure 2. *A sample picture from the data collection process*

Data Analysis

The data obtained from the research were analyzed through content analysis. In the content analysis, the codes created based on the data are examined in detail. Findings are revealed through the themes obtained because of coding (Sözer & Aydın, 2020). The analysis was conducted through the following steps for drawings.

- After activities were completed, each student's drawings before and after the implementation were matched and all drawings were examined. The data from participants who drew nothing on their paper or had one of their tests missing were excluded from the analysis. The number of participants whose data were evaluated was 89.

- Drawings were enumerated for everyone. The figures, writings, and settings in students' drawings regarding the concepts of science and nature were investigated.
- First, it was determined that there are differences between students' ways of using the concepts in the drawings, and the data were analyzed in this regard.
- As the next step, the pictures were examined individually by three researchers. Two of them were experts in science education, and one was an expert in art education. Coding was performed by each researcher independently, and students' mental images were coded. For each student picture, coding was performed; subthemes were determined, and what the experts inferred from the pictures was briefly noted. Consequently, three experts' separate coding, all together subtheme categorization and annotating constituted the research data set draft. These data were compared over each picture, and unanimous common codes, subthemes, and notes were created for each student. Total consensus and disagreement were identified for all student drawings, and the overall agreement between the coders was calculated based on Miles and Huberman's (1994) formula (Reliability= Consensus/ [Consensus + Disagreement]). The compliance of the codes for the first drawings was calculated as 88.97% and 89.62 for the final drawings. Therefore, the codes can be considered reliable (Miles & Huberman, 1994).

The analysis for the interviews was conducted through the following steps:

- During these interviews, students' thoughts, and definitions for the concepts of science and nature were questioned, as in their drawings. The students' responses to the questions were transcribed by listening to the audio recordings.
- The responses were analyzed by two of the researchers who examined the pictures. The codes were created separately, and the intercoder reliability (79,59%) was calculated. Based on this value, it can be stated that the coding for the interview analysis is reliable (Miles & Huberman, 1994).
- The codes were organized into themes and sub-themes by the joint decision of both analysts, and they were placed in tables by specifying their frequency and percentages. Interpretations were supported by presenting sample expressions from the themes.
- The findings obtained from the interviews were used as support data for the findings of the drawings.

Reliability-Validity- Ethics

In this study designed as quantitative, the data were collected qualitatively. Therefore, reliability and validity threats to be considered in qualitative data collection were identified and handled. Before the research, the ethics committee approval and necessary permissions for the applications were received from the Social and Humanities Ethics Committee of Bartın University.

Qualitative data involve subjectivity by nature. To turn this into an advantage and trigger the same feeling in every reader, a control mechanism for different people was developed. Intercoder reliability coefficients were calculated, and they were 88,97% for the pre-test, 89,62% for the post-test, and 79,59% for the interviews. To ensure the validity of the data obtained by transcribing the interviews, the documents were checked by the interviewee.

In the study, triangulation for resources and analyzers was used. With the resource triangulation, consistency control was ensured by utilizing different data resources for the same type of data. With the analyzer triangulation, different people were enabled to work on the presentation of the findings, and importance was attached to the consistency of the findings.

Ethics Committee Approval

Ethics committee approval was received for this study from Bartın University.

The Title of The Ethics Committee: Social Sciences and Humanities Ethics Committee

Approval Date: 16.10.2018

Ethics Document's Number: 2018/094

FINDINGS

When the drawings were examined overall, it was observed that some students, although they were not guided, drew science and nature by associating them with each other, and some drew them separately. The latter students mostly divided the paper into two with a line and described science on one side and nature on the other. General themes were inspired by this distinction of students. Subthemes, which were formed under three main themes nature-science relationship, nature description, and science description, were categorized. Themes, subthemes, codes, and notes extracted from students' first drawings are presented in Table 2.

Table 2. *Themes and subthemes based on the first student drawings, code drawings, and sample drawing notes for subthemes*

Themes	Subthemes	Code drawings for subthemes	Sample drawing notes for subthemes
Nature-science relationship	Science in nature through observation	• Telescope, • Tree, • Star, • Flower, Sun, • Moon, • Cloud, kid, mountain, • Girl, magnifier, bird, • Table • Fish, DNA helix, apple tree, planet, • Insect, tent, animal, river, Pi, rabbit, • Treehouse, person wearing a mask, volumetric flask, bench, computer, science event poster, ruler, grass, test tubes, binoculars, boy, night, recycling, sun panel, solar system, dreaming kid, cow, scout sign, Jupiter, campfire, ants, butterflies, Ursa-minor, Mars, meteor rain, fruit tree, microscope, Newton, fishing line, spider, snail, Saturn, question mark, stethoscope, puddle, waterfall, lightning, caterpillar, tube, ladybug, leaf, dove with an olive branch	• A telescope is directed towards stars and planets. A kid is observing ants with a magnifier. • A kid is examining an insect on a leaf with a magnifier. • Tree trunks are drawn as DNA helix; a kid in a treehouse is observing with a telescope. • An insect in a microscope is drawn in detail, as zoomed. Scientific research is interpreted as observations in nature.

	Science in nature	• Sun, • Tree, • Flowers, • Apple tree, cloud, • Girl, river, bird, grass, • Water, Moon, telescope, book, • Star, rain, fish, insect, tent, DNA helix, test tube, mountains, campfire, butterfly, Newton, kid, • Ursa-minor, spacecraft, sleeping bag, stone, seed, water drop, water purification system, stethoscope, Pi number, Arrow-bow, microscope, fruit trees, mushroom, mines, miners, mine entrances, rail system used in mining, bird nest, wolf, bridge, sheep, chemical formulae, cat, black hole, snow, heart (affection), pencil, animal cell, H_2O, solar system, sun panel, celestial rain, planets, camera, house, boy, element symbols, Einstein, thought bubble, earth, hail, germination, magnifier, evaporation, plant cell, science event poster, volumetric flask, atom model, mainland, saw	• The division of light into colours through raindrops (formation of a rainbow) in a detailed nature description is a good example of the scientific events in nature. • A loop showing the evaporation in the puddle on the ground and the cloud formed because of evaporation was drawn. • A girl represents Newton. Science relationship was described with an apple falling on the ground.
	Science in nature through a desk job	• Table, • Clouds, test tubes, • Tree, sun, • Girl, flower, • Scientist, volumetric flask, grass, kid, house, bird, fruit tree, telescope, stars, mathematic operations • Science event poster, magnifier, ruler, mountains, experimental setup, DNA helix, apples, boy, Erlenmeyer flask, formulae, butterflies, lithium element, magnet, chair, constellation, rabbit, rain, board	• A scientist is sticking out his tongue, based on Einstein's photo. A hand from a tree is giving lithium in a container to the scientist at a desk • There is an experimental setup on a table. Science is depicted on a table. • Science is expressed by test tubes on a table in nature.

https://doi.org/10.7822/omuefd.1286835

	Science for nature	• Tree, • Telescope, stars, mountains, • Garbage cans, recycling logo • Moon, beaker, kid, experimental setup, test tube, gear wheels, planet, sun panel, Sun, cow, human, paper, pine cone, mushroom, table, magnet, microscope, Newton cradle, rabbit, fox	• The drawer has knowledge about the use of resources in nature for scientific purposes and for nature itself. • Recycling is tried to be described as returning the items taken from a tree. • Plants and animals are preserved in an underground mechanism created.
	Science in nature through technology	• Robot • Tree, mountain, drone, flower, cloud, grass, puddle,	• A robot is watering a tree, a drone is filling water into a watering bowl in its hand. Science is described with technology. • There is an entity with a camera in front, a tail, 4 legs, and sun panels on it, it is a combination of a living creature and a robot.
	Nature-science interaction	• Chemical formulae, earth, atom model, Newton, apple tree, germination, plant cell, animal cell, bird, flower, magnifier, butterfly, black hole, solar system, planets, spacecraft, moon, star, tent, kid, ursa-minor, campfire	• Science and nature are associated. The world is presented to be comprised of atoms and living creatures of cells. Each object has an association. Sky observations and some current events are also drawn.

Nature description	Nature description through nature elements	• Tree, • Clouds, • Mountains, • Flowers, Sun, • River, • Birds, • Kid, • House, lake, butterfly, bridge, • Rabbit, stars, • Fish, grass, cut trees with roots, leaves, • Man-cutting tree, barn, octopus, car, fire, moon, bench, flag, plant, tea, starfish, bread, cow, human, castle, turtle, cat, sheep, coop, log, seagull, fruit tree, lotus flowers, school, playground, vegetable garden, chickens, saw, caterpillar, ball, kite, ladybug, moss	• No signs of science are found; a standard nature view is drawn with simple nature elements. • The drawings are simple; there is no science-related content. Only nature is described with some creatures in nature. • Only a tree is used to describe nature.
	Nature description through natural events	• Wind, • Tree, insect, clouds, kid, sun, seasons, rain, leaves	• "Seasons" are written, and wind is depicted. Natural events are made use of to describe nature.

https://doi.org/10.7822/omuefd.1286835

Science description	Science description through lab environment	• Laboratory, test tubes, • Masa, • Kid, • Scientist, • Microscope, telescope, • Experimental setup, world model, spirit stove	• There is a scientist with glasses, a tie, and shaggy hair in a lab environment. He is holding test tubes in his hand. • There is a kid doing an experiment at a table in the laboratory. • A child is experimenting with a desk is portrayed. It represents Einstein as a kid; he is sticking his tongue out.
	Science description through tools	• Test tubes, • Volumetric flask, beaker, magnifier, • America continent, Brazil, paint, ruler, experimental setup, detergent, world model, earth, Erlenmeyer, planet, meteors, miter, pencil box, book, scissors, table, magnet, microscope, Newton cradle, vinegar, telescope, board, stars	• Independent objects are drawn. Science is written on a board, and a little heart is drawn underneath. • Scientific tools are drawn. No relationship is established between them. • Only objects symbolizing science are included.
	Science description through symbols	• Chemical formulae, Pi • Physics formulae, math formulae, question marks,	• Scientific figures are drawn disorderly, without association.
	Science description through technology	• Lightbulb, computer, development stages of telephone	• Technological products are used to describe science. • The drawer knows about scientific developments. Inventions and technological development in science are mentioned.

Sample drawings for the subthemes are listed based on their frequency. Those written together in the drawings in decreasing order have the same frequency. For example, in the nature-science relationship theme, "science in nature through observation" is the most encountered subtheme, in which the most observed code drawing is a telescope, and flowers and sun are drawn at equal frequency.

In the themes created based on students' drawings as together/associated or separately/unassociated, categorization was made considering what they associated the sub themes with or what they used to define them. In some pictures, code drawings eligible for two different sub themes were identified. In that case, all codes were included in the same theme, and relevant codes were included in different themes. For instance, if a student depicted both observation of the sky with a telescope and preservation of nature through recycling, all the codes in his/her picture were involved in both "science in nature through observation" and "science for nature" subthemes. For this reason, it is natural to see the telescope code in the "science for nature" subtheme, albeit less frequently. If the student drew his/her picture by dividing the paper into two and tried to describe nature on one side and science on the other, the drawings only in the nature part were included in the "nature description" theme, and the ones in the science part were included only in the "science description" theme.

In the **nature-science relationship** theme, the following subthemes are categorized:

Science in nature through observation. In this subtheme where students depicted science and nature relatedly, the most frequently encountered drawings were telescope, tree, star, flower, sun, moon, cloud, kid, and mountain. In these drawings, where observation of the sky with a telescope in nature was depicted, it was indicated that nature was observed with science. In addition to a telescope, a microscope and magnifier for observations were also encountered in the drawings.

Science in nature. Drawings associating nature elements with scientific knowledge were categorized. In these drawings; images of the sun, trees, flowers, apple trees and clouds were frequently encountered. It is noteworthy that, to establish a nature-science relationship, students attempted to describe scientific knowledge production by being inspired by nature. This situation was generally depicted by drawing kids or Newton under apple trees with an apple on their heads.

Science in nature through a desk job. It comprised of the student drawings in which a table in a natural environment and various experiment equipment and tools on the table were drawn. The most common drawings in this sub theme were tables, clouds, test tubes, trees, sun, girl, and flower images. Even though the students did not locate science and nature separately, they reflected the view that science was a desk job.

Science for nature. Student drawings emphasizing that natural resources should be preserved were categorized in this subtheme. The drawings commonly encountered here were trees, telescopes, stars, mountains, garbage cans, and recycling logos.

Science in nature through technology. The pictures of the students who added technology and science to their nature drawings were evaluated in this category. The codes identified in the pictures categorized here were robot, tree, mountain, drone, flower, cloud, grass, and puddle. The focus of the pictures in this theme was on robots irrigating trees or animal-like robots.

Nature-science interaction. It was the least frequently encountered subtheme in the first drawings. Nature-science interaction was built with two-way relationships and benefits. Drawings regarding the effects of nature on science, the effects of science on nature, and the use of nature by science and the use of science by nature were sought in the pictures. This mutual interaction was encountered in only one student's picture in the first drawing process. This student drew chemical formulae, earth, moon, atom model, Newton, apple tree, germination, plant cell, animal cell, bird, flower, magnifier, butterfly, black hole, solar system, planets, spacecraft, moon, star, tent, campfire, and Ursa-minor in his/her picture.

In **Nature description** theme, the following subthemes are categorized:

Nature description through nature elements. It is the most preferred subtheme of the nature description theme, where students who did not describe any symbol that can be associated with science in their drawings were categorized. Students generally made descriptions with nature elements, which were mostly trees, clouds, mountains, flowers, sun, and river drawings. Another feature of these pictures was that they were generally titled by the students, who mostly wrote "Nature" as the title in the relevant part of their pictures.

Nature description through natural events. It is the subtheme in which several students who chose to depict natural events to describe nature were categorized. The codes in the pictures were wind, tree, insect, clouds, kid, sun, seasons, rain, and leaf drawings.

In **Science description** theme, the following themes are categorized:

Science description through lab environment. It is the most common subtheme encountered in the science description theme. Students depicted a laboratory environment in their pictures and preferred laboratory, test tubes, table, kid, scientist, microscope, telescope, experiment setup, world model, and spirit stove drawings. Scientists or kids doing experiments at a desk with test tubes in their

hands were drawn in the laboratory environment. It attracts attention that these kids were usually drawn with their tongues out, inspired by Einstein's photograph. Besides, when an adult scientist was depicted instead of a kid, it was mostly a male with an apron, glasses, and shaggy hair.

Science description through tools. It is a sub theme created with pictures in which scientific tools were drawn independently, without a specified environment. Students generally drew test tubes, volumetric flasks, beakers, and magnifiers in this subtheme.

Science description through symbols. It is the sub theme of the pictures including scientific symbols that were independent from other drawn objects. The drawings mostly encountered in this sub theme were chemistry formulae, Pi number, physics formulae, math formulae, and question marks.

Science description through technology. It is the subtheme consisting of the pictures of the students who reflected the science image in their mind with a technological product. It was identified in the pictures by a small number of students, who depicted science through technology by drawing light bulbs, computers, and development stages of the telephone.

The perspectives of the students who received a two-day training after their first drawings were investigated again with a second picture. To support the findings obtained from the pictures and to diversify the data resources, semi-structured interviews were conducted with 10 volunteers among the participating students. Findings from the final drawings and semi-structured interviews are presented in Table 3 and Tables 5, 6.

Table 3. *Themes and subthemes based on the final student drawings, sample drawings on subthemes, and relevant notes.*

Themes	Subthemes	Sample drawings on subthemes	Sample drawing notes regarding subthemes
Nature-science relationship	Science in nature through observation	• Kid • Telescope • Star • Tree • Moon, Sun • Cloud • Microscope, water purification system • Table • Flower • Instructor, bird nest • Mountain, orienteering • Prepared microscope slide, leaf • Insect, magnifier, binoculars, house, ant, butterfly, girl, bridge, bird, birdhouse • Soap, apple tree, lame-lamella, river • Tent, various fruits, fence, experiment setup, goggles, test tubes, sapling, river, paper, garbage can, larva, fruit, pollen, puddle, rabbit, ball • Scissors, tree branch, lion, fire, atom model, footprints, fish, science tent, water, bay leaf, tomato juice, whistle, Erlenmeyer, physics formula, camera, Galileoscope, planet, map, carrot, animal, helicopter, Jupiter, ant foot, cardboard, dog, village fountain, village mansion, lens, fruit tree, Newton, playground, snail, basket, silicon gun, fly, saliva, soap-making	• He drew himself in the observation activity. Somewhere different from the world is being watched. Celestial bodies are drawn outside the earth. • A child in the observation activity was drawn. The stars were drawn as small circles, not in the familiar star shape, showing that they are indeed different from imagined. • Considering the prepared microscope slide and the kid on the telescope, it is emphasized that science investigates nature.

	Nature-science interaction	• Kid • Tree, water purification system, telescope, star • Sun • Cloud • Instructor, orienteering • Moon • Flower, soap-making • Apple tree, birdhouse, table • Mountain, ant, bridge, • Tent, binoculars, house, sapling, solar energy panel, river, paper bridge, butterfly, girl, bird nest, lame-lamella, lens, river, Newton, wind turbines • Bee head, atom model, dam, beaker, insects, various fruits, garbage cans, garbage, garbage inventions, bay tree, test tubes, DNA helixes, "nature inventions" text, Einstein, hand washing man, electronic scale, equal arm scale, physics formula, formulae, Galileoscope, recycling sign, planet, "cell" text, paper helicopter making, container, cat, book, dog, bridge building activity, village mansion, reel system, scissors, utility knife, prepared microscope slide, basket, silicone gun, microscope, puddle, prepared microscope slide from water, constellation, ball, prepared microscope saliva slide, leaf	• A reel is installed on the tree, some load is being carried. The use of science in daily life is shown. An association is made. • The purification system is associated with nature, soap-making, and hand-washing with science. • By using science with a water purification system, it is intended to create a clean water source for nature. Also, nature observation is used for science.

https://doi.org/10.7822/omuefd.1286835

	Science for nature	• Water purification system • Tree, kid, birdhouse, telescope, star • Sun, cloud • Instructor, orienteering • Moon, table, soap-making, • Flower, • Binoculars, apple tree, house, sapling, river, ant, girl, bridge building activity, microscope, wind turbine, silicon gun • Light bulb, dam, various fruits, fence, garbage cans, garbage, garbage inventions, mountain, "nature inventions" text, nature preservation center, world model, Edison, hand washing man, Galileoscope, recycling sign, solar energy panel, paper helicopter, container, dirty water, book, dog, bridge, hourglass, bird, scissors, utility knife, Newton, prepared microscope slide, numbers, rabbit, leaf	• There is a science-nature relationship described through renewable energy. • Buildings melting in the hourglass were drawn to attract attention to nature preservation. • Nature is depicted. Science for nature is written. It is indicated that scientists work for nature.
	Science in nature through a desk job	• Table • Kids, test tubes, sun, cloud • Mountain, flower, tree, experiment setup • Science tent, insect, magnifier, apple tree, house, magnet, microscope, river, teacher, constellation, rabbit, board, stars	• Science is expressed as a desk job in nature. • They are doing experiments at a table in nature. • All objects related to science are drawn on the table located in the middle of a nature environment.

Nature description	Nature description through nature elements	• Tree • Sun • Cloud • Kid • Flower • Mountain • Bird, river • House, cat, bridge • Moon, flag, bird nest, table, fruit tree, playground • Bee, nature preservation center, earth, apple tree, rainbow, animal, campfire, dog, park, picnic table, swing, lightning, rabbits, top, rain, stars	• Nature, science and art are depicted separately. The drawer draws what c to his/her mind regarding the concepts. Science is not considered as an intervention in nature. There is no association, either. • Science and nature are drawn separately. There is an experimental setup in science, and a depiction of an environment in nature. There is no association.
	Nature description through natural events	• Tree, kid, leaf, lightning • Flowers, "hail" text, wind, window, ball, sun, rain, earth	• Examples of natural events are drawn. Figures are independent, there is no flow.
Science description	Science description through tools	• Test tubes, telescope • Volumetric flask, magnifier, ruler, experiment setup, microscope • Beaker, scientist, scientific questions, study desks, garbage can, garbage, Erlenmeyer, recycling sign, bridge, scissors	• The drawer divided the paper into sections. Science and nature were drawn separately. Tools were drawn in the Science section. • Figures are placed independently. There is no association. • The concepts are expressed separately with objects without making an association.
	Science description through lab environment	• Test tubes, laboratory, table • Einstein, book	• Science and nature are drawn independently. Science in a lab environment is tried to be explained. As the scientist, Einstein is drawn with his tongue-out pose in the picture.

https://doi.org/10.7822/omuefd.1286835

	Science description through symbols	• Formulae, Erlenmeyer	• Chemical symbols spouting from a big Erlenmeyer are drawn to describe science.
Nature-Science-Art relationship	Science and art in nature	• Mosaic art • Tree, kids, telescope • Star • Water purification system • Moon, sun, birdhouse, orienteering • Cloud, mountain, bird, table, microscope, soap • Galileoscope, guitar, fruit tree, silicone gun, ball • Lion, fire, atom model, magnifier, flower, fence, whistle, binoculars, instructor, apple tree, physics formula, planet, paper helicopter, container, ant, butterflies, chemicals, village mansion, scissors, utility knife, math symbols, mutation, music, Newton, playground, preparation, snail, puddle, artificial butterfly from rubber and paper	• A kid depicting nature is drawn. There are two more concepts in that picture. Sky observation is described with a telescope and the stars. A kid artist who wants to explain the art of nature and science in nature is drawn. • A kid is standing with a telescope in his hand. The stars are drawn like snowflakes different from the familiar shape. A bird nest and purification are drawn on a tree, and a bird is drinking water. • A kid observing the sky with a telescope, and a kid under an apple tree with an apple on his head. A flower representing nature in mosaic art is embroidered with geometric shapes.

When the final drawings of the students are examined, it is noteworthy that they differ from the first ones. It was identified that some students referred to the nature-science and -art relationship, which was not encountered in the first drawings. Explanations for the themes, subthemes, and code drawings in these sub themes are presented below.

The **Nature-science relationship** theme, the subthemes are as follows:

Science in nature through observation. In this subtheme where students associated nature and science with observation, the most frequently encountered elements were kid, telescope, star, tree, moon, sun, and cloud. Students depicted observations made in nature with a telescope, microscope, and magnifier.

Nature-science interaction. Despite being encountered the least in the first drawings, it was the second most common subtheme in the last ones. In the pictures seeking mutual relationship or benefit, the frequently observed images were a kid, tree, water purification system, telescope, star, sun, cloud, instructor, orienteering, and moon. Even though the effects of the practices and instructors reflected on students' pictures, it is inferred from the following note and sample picture (figure 4) that the students apprehended the interaction:

"A reel is installed on a tree; some load is being carried. The use of science in daily life is shown. An association is made."

Figure 3. *A sample picture from students' final drawing*

Science for nature. In this sub theme conveying the importance of sustainability and protection of natural life, students mostly drew a water purification system, a tree, a kid, a birdhouse, a telescope, a star, a sun, a cloud, an instructor, orienteering, a moon, a table, and a soap-making. Being under the influence of the activities led them to frequently draw instructor and orienteering during which they had fun. In addition, the message of the necessity of science to preserve and keep nature alive in the activities was understood and internalized by the students.

Science in nature through desk jobs. It is one of the sub themes whose frequency rate decreased considerably in the final drawings compared to the first ones. All the scientific objects depicted in nature were presented on a desk, and there was generally a kid at the desk.

In **Nature description** theme, the subthemes are as follows:

Nature description through nature elements. It is a subtheme with a decrease of approximately 50% between the first drawings and the last ones. Students separated nature from science less. Students who preferred to describe nature with nature elements generally drew trees, sun, clouds, kids, flowers, mountains, birds, and rivers in their final drawings. Although no change in the elements was observed between the first and final drawings, the kid image attracted attention with its increasing frequency. Students may have felt that kids/they, themselves, belonged to the natural environment after the applications and reflected it in their pictures.

Nature description through natural events. It is the subtheme comprising the students who prefer natural events to describe nature in their pictures. No significant difference was observed between the first and final drawings. In this sub theme, students frequently drew trees, kids, leaves, lighting, flowers, wind, window, balls, sun, rain, and earth, and wrote "hail".

In **Science description** theme, these subthemes are categorized:

Science description through tools. In this sub theme, where students did not have drawings related to nature, the total number of students who described science as unassociated decreased substantially even though there was no significant difference compared to the first drawings. Students tried to explain science by using tools to draw test tubes, a telescope, a volumetric flask, a magnifier, a ruler, an experiment setup, and a microscope. Compared to the first drawings, the frequency of devices such as telescopes and microscopes increased.

Science description through lab environment. It was the most frequently encountered subtheme in the science description theme for the first drawings; however, its frequency decreased by 75% in the last drawings. The lab environment was depicted with test tubes, a table, Einstein, and a book in the drawings.

Science description through symbols. In this sub theme where the pictures of students who described science with independent symbols were categorized, there was an 80% decrease compared to the first drawings. The only student who used symbols in his/her picture drew formulae and an Erlenmeyer.

The **Nature-Science-Art relationship** theme, the sub themes categorized are as follows:

Science and art in nature. It is the subtheme encountered in the drawings after the implementation, unlike the first drawings. While describing science and nature, students also included art in their drawings. These students who discovered the science and inspiration from nature in artistic products mostly drew mosaic art, tree, kids, telescope, stars, water purification systems, the moon, sun, birdhouse, orienteering, cloud, mountain, bird, table, microscope, soap, Galileoscope, guitar, fruit tree, silicon gun, and ball. The art in the pictures was stated in the relevant notes as follows, and the sample pictures (figure 4 and 5) were presented afterward:

"A kid depicting the nature is drawn. There are two more concepts in that picture. Sky observation is described with a telescope and the stars. A kid artist who wants to explain the art of nature and science in nature is drawn."

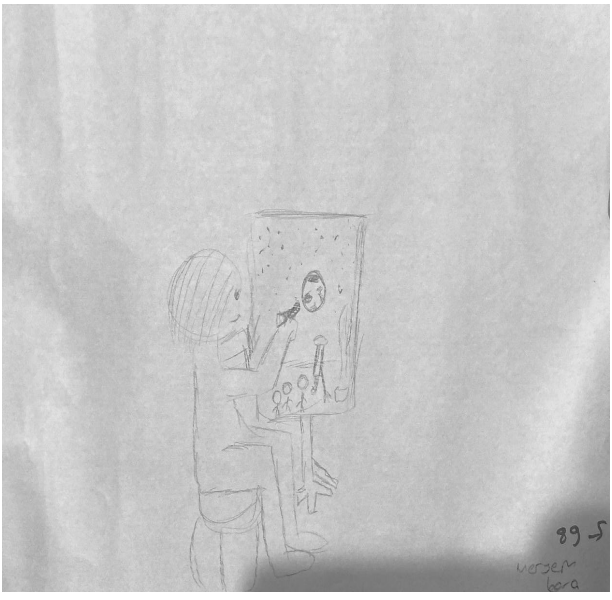

Figure 4. *A sample picture from students' final drawing*

"There is a kid observing the sky with a telescope, and a kid under an apple tree with an apple on his head. A flower representing the nature in mosaic art is embroidered with geometric shapes."

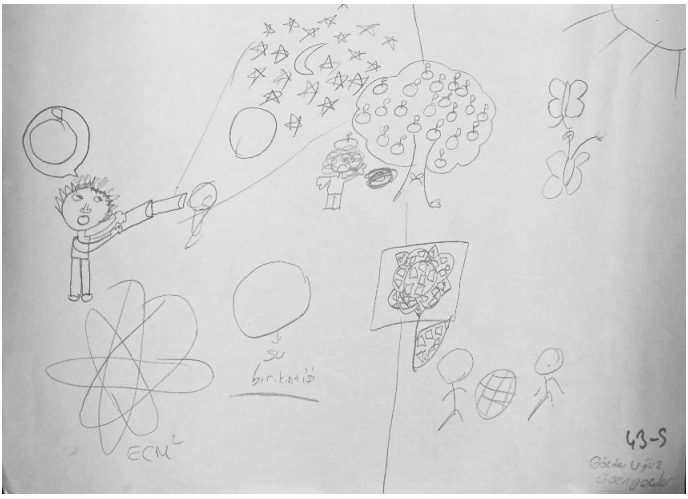

Figure 5. *A sample picture from students' final drawing*

Since the overall examination of the themes and subthemes for all the drawings with their frequencies and percentages would facilitate understanding, the findings are presented in Table 4.

Table 4. *Frequency and percentage distribution of the themes and subthemes based on first and final drawings of the students*

		First Drawings		Final Drawings	
Themes	**Subthemes**	**n**	**%**	**n**	**%**
Nature-science relationship	Science in nature through observation	20	%22,4	44	%49,4
	Science in nature	17	%19,1	0	0
	Science in nature through a desk job	10	%11,3	4	%4,4
	Science for nature	4	%4,4	20	%22,4
	Science in nature through technology	2	%2,2	0	0
	Nature-science interaction	1	%1,1	24	%26,9
	Total	54	%60,6	97	%108,9

Nature description	Nature description through nature elements	30	%33,7	17	%19,1
	Nature description through natural events	2	%2,2	3	%3,3
	Total	32	%35,9	20	%22,4
Science description	Science description through lab environment	8	%8,9	2	%2,2
	Science description through tools	7	%7,8	8	%8,9
	Science description through symbols	5	%5,6	1	%1,1
	Science description through technology	3	%3,3	0	0
	Total	23	%25,8	11	%12,3
Nature-science-art relationship	Science and art in nature	0	0	10	%11,2

In Table 4, the distribution rates of all drawings to themes and subthemes can be seen more clearly. As there are cases where more than one sub theme is encountered in the pictures of the students, it is natural to exceed 100% in total. In the first drawings, students mostly tried to establish the "*nature-science relationship*" by describing "*science in nature through observation*". Students who wanted to make "*nature description*" often depicted nature elements, and those who wanted to make "*science description*" expressed science in their mental images through laboratory environmenst.

Comparing the first and final drawings, the number of students who depicted nature and science separately, without association decreased by almost half whereas that of students who established a nature-science relationship nearly doubled. The nature-science-art relationship, which was not encountered in the first drawings, was observed in the final ones, even by 11%. It is noteworthy that the subthemes of "*science in nature through technology*", "*science in nature*" and "*science with technology*" were not encountered in the last drawings. Another difference attracted attention in the "*science for nature*" subtheme. The increase rate in this subtheme was five times more compared to the first drawings. On the other hand, a quadruple decrease was identified in "*science description through lab environment*".

To understand the differentiation in the perspectives of students who preferred to take science out of the laboratory environment and from the monopoly of scientists in their drawings, semi-structured interviews were conducted with them. The responses to the questions addressed to present kids' perspectives towards science are presented in Table 5 in themes and subthemes.

Table 5. *Perspectives of kids towards science*

	Themes	Subthemes	n	%
SCIENCE	**Practitioners**	Themselves-Everyone	7	70
		Scientists	2	20
	Outcomes	Production	3	30
		Benefit	2	20
		Development	2	20
		Discovery	1	10
		Invention	1	10
	Content	Comprehensive	3	30
		Infinite	3	30
		Changeable	1	10
		Unknown	1	10
	Ways of Production	Research	2	20
		Curiosity	1	10
		Experiment	1	10
	Concepts	Space	1	10
		Microscopic creature	1	10
		DNA	1	10

In the semi-structured interviews held with the students, their definitions for science were inquired, and in Table 5, how often they talked about the concepts was presented as frequency. While defining science, the participants mentioned its practitioners, outcomes, content, ways of production, and concepts. Although scientists were mentioned as practitioners, the majority also considered themselves or everyone as practitioners. They cited the outputs of science as production, benefit, development, discovery, and invention. They described its content as comprehensive, infinite, changeable, and unknown. They listed the ways of producing scientific knowledge as research, curiosity, and experiment. While defining science, some participants preferred to use sample concepts which were space, microscopic creaturses, and DNA.

S8 who wanted to emphasize the comprehensiveness of science content expressed his opinion as follows:

"I think science is everywhere. Therefore, I see everything as science."

Statements of S4 who defined science by presenting sample concepts and citing that it was infinite, changeable, and comprehensive are as follows:

"Science… For example, there are DNAs. These are different for everyone. I think science is immense, and I know that there is no such thing as certain in science. I heard, for instance, there is 99 percent, and I think that science involves many more things in life."

S4 who was aware of the fact that he/she could do science himself/herself emphasized this as follows:

"…I did science; I did it here, indeed, and I enjoyed it very much. We made soap. My soap did not freeze, but the second group's soap did…"

In the interview, it was identified that science-related opinions of students were compatible with the post-positivist mindset. It was frequently stated by the students that science is the production of useful knowledge and offers development and innovations. Moreover, the kids who were aware of the changeability of scientific knowledge, also knew that they could do science themselves. While indicating science as comprehensive and even infinite, they also emphasized that science requires research, curiosity and experiment.

Another factor inquired in the interviews was the opinions of students on the concept of nature. The findings obtained from the interviews are presented in themes and subthemes in Table 6.

Table 6. *Perspectives of kids towards nature*

	Themes	Subthemes	n	%
NATURE	**Nature elements**	Tree	6	60
		Animal/insect	6	60
		Plant/green	5	50
		Forest	2	20
		World/Earth	2	20
		Soil	1	10
		Air	1	10
		Mountain	1	10
	Nature's functioning	Balance	4	40
		Life cycle	3	30
		Food chain	3	30
	Nature-human relationship	Reconciliation	2	20
		Adverse human effect	2	20
	Nature events	Rain	1	10

In the semi-structured interview, students' definition of nature was questioned and in Table 6, how often they talked about the concepts was presented as frequency. While defining nature, the participants mentioned the elements it contained, its functioning, its relationship with humans, and natural events. They expressed that there were images of trees, animals, insects, planst, greens, forests, worlds, earths, soil, air, and mountaisn in the nature picture in their minds. Students who also mentioned nature's functioning emphasized that there was a balance in nature, and the life cycle and food chain maintained the functioning. It is noteworthy that kids described nature as a peaceful environment and talked about the adverse effects of human on nature.

S7 who indicated nature as a source of tranquility expressed his/her opinions with these statements:

"*When the subject is nature, I think of people who go and relax in the greenery when they get angry or unhappy… In the nature, flowers bloom; insects fly and so on, but now people pollute the nature a lot. They throw garbage, and do not install filters in chimneys, or factory chimneys. Well, they pollute nature very much. So, there will be no more functioning in the coming years; I think it will not function in the future generations.*

S1 who listed sample elements involved in nature and explained that the balance in nature, which he/she considered as peaceful, was maintained by food chain stated:

"*When I think of nature, animals come to my mind; for example, trees come, peace comes. Nature has a balance like this: If there are no lions, there will be a lot of gazelles, and grass will be less than because lions eat gazelles; gazelles eat grass. However, I don't think there will be enough grass but for the carnivores, maybe almost none will be left, and carnivores will be hungry but for the herbivores. So, it has such a regular balance. "*"

It is observed in the interview that students often prefer to make definitions by listing the nature-related elements in their minds. Besides, it can be inferred from the subthemes of balance, life cycle, and food chain that they have an idea about the functioning of nature. Furthermore, they emphasize that the balance in nature should be preserved, human's negative effects on nature should be eliminated, and nature should remain a peaceful environment for humans.

DISCUSSION AND CONCLUSION

Changes in the Ways to Express Concepts

The first detail attracting attention to students' change during the camp was the ways that they expressed nature and science concepts. When the pre-camp drawings were examined, it was deduced that the concepts of nature and science had a separate place in the minds of the participants. Because these two concepts are depicted as if there is no commonality in the drawings. After the process, the concepts of nature and science were drawn together with their common elements in the same painting composition. Participants included fewer figures in the latter, and preferred the ones that they could associate the two concepts. This result may prove that students realized the relationship between nature and science, and that positive changes in the discovery of science in nature occurred. Similarly, Kwon, Capraro and Capraro (2021) stated in their study that STEM-based students had positive changes in their opinions about science and mathematics, and their career perceptions, and developed awareness for the future.

The second point that grabbed attention was the difference between the layouts of children's drawings in their first and last pictures. The first drawings were mostly disorganised, and every figure that came to mind was pictured. The number of figures was high might led to this disorganization. It may be the sign of spontaneous responses listed in students' minds corresponding to some concepts. According to Piaget (2005), it presents spontaneity that students list those ready in their minds and appropriate for the expected answer. In the first drawings, the students pictured every figure in their mind regarding the concepts that may reveal that they could not internalize the situation. Naturally that a child who feels out of the relevant situation draws this kind of painting. It indicates that students were far from realising the interrelationship between the concepts of nature and science at the beginning. Considering the pictures after camp, however, figures were situated in a more purposefully way, and students tried to associate the figures of science and nature. It was also found that figures were pictured in a certain event or flow. In other words, while the students were painting the concepts of nature and science, they emphasised a scientific process as a composition, a scientific event, and the fact that the phenomena took place in nature. After the applications, students may have felt more belonging to nature, realised that their work was a scientific process, and established a relationship between their mental images of concepts.

Before participating in the activities during the camp, students frequently used trees, clouds and suns as nature-related figures, and used them mostly within a still layout encountered in nature photography. They displayed nature in forestlands as isolated from cities prominently. Moreover, they pictured human figures as har-

ming nature while associating nature-related figures with them. It revealed that students were aware of the fact that various behaviours and consumption habits of people damage nature. Although the reasons for nature's being harmed cannot be examined within such a narrow framework, it is a significant finding that students had an awareness regarding some of these reasons.

Most of the students pictured the natural settings that they saw up close and were personally involved in the picture. They located the living creatures that they added to their figures within a layout in which their living spaces were made clearer and included animal nests in nature. They emphasised the flow of nature in their drawings rather than human effect. It can be considered as a sign of students' awareness of the diversity and each living creature's state in nature. What is more, the human figures harming nature in the first drawings had completely different roles after the activities. Human figures in the posttest were mostly children as in the pretest but none was pictured as harming nature. Children were drawn as individuals who attempted to investigate and understand nature and solve its problems through science. In this way, they pictured themselves communed with nature, and indicated that human-animal-plant liveness could be sustained together within nature. Strommen (1995) states that when children spend time in a natural environment, their nature awareness expands, and they can apprehend nature's raison d'etre. Likewise, results obtained from the study revealed that students' natural awareness expanded, and they began to see themselves as a part of the natural environment.

Before the camp, students considered science as a laboratory or desk work performed by scientists using a variety of test equipment, and scientists as old adults with glasses, who were very different from other people. Many studies conducted to determine the scientist image in students' minds have revealed similar findings (Ayvaci, Atik & Urey, 2016; Camci Erdogan, 2013; Güler & Akman, 2006; Kara & Akarsu, 2013; Losh, Wilke & Pop, 2008; Turgut, Ozturk & Es, 2017; Yontar Togrol, 2000). These science-related figures were also pictured at a desk or in a closed space, as independent from nature and other figures. Students generally thought that science was a serious job requiring experience, and they did not feel drawn to the idea of doing science, which can be regarded as a result of a positivist education philosophy. Science considered the objective may have created a perception of a system that is far from daily life and shaped through certain individuals' opinions and studies only. This perception can be conveyed to students by teachers in the classroom or informally out of school, which is supported by research investigating teachers' opinions of the nature of science (Abd-El-Khalick & Lederman, 2000; Aslan, Yalcin & Tasar, 2009; Mihladiz & Dogan, 2012; Murcia & Schibeci, 1999).

In the studies examining student perceptions of science and scientist, students were identified to consider science as an information-production job comprising

of proven and constant facts, and scientist as an individual doing science, wearing a lab coat and glasses, and dealing with laboratory equipment (Ayvaci, Atik & Urey, 2016; Turgut, Ozturk & Es, 2017; Yilmaz & Kahraman, 2015). Before the implementation, perceptions of students regarding science were similar to these examples in the literature; however, after the camp, it was observed that the relationship of science-related figures in the drawings was cared more than their number. Besides, several students who did not include any science-related figures in pretest drawings were observed to draw some in the posttest. A remarkable change in post-test was related to scientists. Students did not picture scientists, children, and other people independent of each other as in pretest; on the contrary, they drew children doing science. They also included the children, who were involved in the process, in addition to all the science-related figures and well-known scientists. Accordingly, students felt closer to science and scientists, and believed that their studies could also be science. They realized that they were closer to science than they supposed.

Changes in the Perceptions Regarding the Concepts

Informal learning are source of information that both children and adults frequently consult in their daily lives. They also play a big role in shaping the images of the world around us in our minds. Children who participated in the research process revealed how informal learnings from the events that they saw, heard, and followed shaped their perceptions of science and nature. They expressed with their drawings that humans interfered in nature, adversely affected it with their consumption habits and disproportionate behaviors, and they witnessed this process as a kid. Furthermore, they showed that they knew people with different characteristics doing science. Extraordinary images of scientists like Einstein's photograph in which he stuck out his tongue and an apple falling on Newton's head were widely encountered in the drawings of children, which were mostly supported by informal learning. After camp, children started to associate many images in their minds like these with both other figures and their lives. That students diversified nature-related images in their mind after such experiences were also observed in different studies (Aaron, 2009; Yardimci, 2009). They realized that they were not isolated from nature and science. With this realisation, they began to think that they could contribute to the natural cycle at will, and prevent the damage. For this reason, in the drawings that they included themselves in, they pictured that they intervened in natural life directly, and the living creatures were happier. Similarly, they started to think that their studies could be related to science, and a kid could also do science. Students expressed that they could do science like a scientist, understand and contribute to nature with the science they did, which is a major sign that the study brought the students the target outcomes.

Formal learning has an important role in children's lives, yet informal experiences can also be gained in both formal and informal learning environments. Therefore, in the studies aimed at teaching science and nature of science, informal and nonformal learning environments are also preferred (Antink-Meyer, Bartos, Lederman & Lederman, 2016; Gunesch & Winter, 1996; Leblebicioglu, Metin, Yardimci & Berkyurek, 2011; Yildiz, Yilmaz & Mentis Tas, 2018). Moreover, further studies on these environments in which families and children can experience together are seen as an important need. (Brahms, 2014). Leblebicioglu, Metin, Yardimci, and Berkyurek (2011) performed activities on the nature of science with secondary school students in the science camp they organised. At the end of the camp, it was identified that students' understanding related to science's experimentality, making use of data and changeability developed. Similarly, in another study, the changes in students' perceptions of science attending the summer science camp were examined. At the end of the camp, it was determined that students' enthusiasm and knowledge of science increased (Gunesch & Winter, 1996). In the same study, it was seen that the children who mentioned that science was a difficult concept and far from their daily life before the camp stated that they could do science themselves after the camp.

To conclude, it is of great importance that children have the correct learning experiences for people to establish healthy relationships with nature not only based on consumption, adopt a more sustainable lifestyle, and eliminate the risk of becoming nature-deprived generations. The results obtained from the study revealed that this interdisciplinary science camp offered enriched experiences and provided positive changes in children's perception of science and nature. The sustainability of the positive changes that occur because of the research is more important. Examining the transfer of these gains to daily life and the sustainability of individuals through longitudinal studies can provide more qualified learning environments and experiences. In addition, examining the transfer of these experiences of individuals to different age groups after the camp can provide important data on the process of determining the target groups of similar studies. Studies on these issues can enable informal and nonformal learning environments to increase their quality by determining richer content, and target audiences.

Conflict of Interest and Funding

The authors declare that they have no conflict of interest.

The study was a project supported within the scope of the TUBITAK (The Scientific and Technological Research Council of Turkey) Nature Education and Science Schools program, and that aimed at enabling secondary school students to experience science, nature and art activities.

Author Contribution

Design of Study: BG(%25), İE(%25), FT(%25), YB(%25)

Data Acquisition: BG(%25), İE(%25), FT(%25), YB(%25)

Data Analysis: BG(%25), İE(%25), FT(%25), YB(%25)

Writing Up: BG(%25), İE(%25), FT(%25), YB(%25)

Submission and Revision: BG(%25), İE(%25), FT(%25), YB(%25)

REFERENCES

Aaron, R. F. (2009). *Planting a seed: an examination of nature perception, program processes, and outdoor experience.* Texas A&M University.

Abd-El-Khalick, F., & Lederman, N. G. (2000). The influence of the history of science courses on students' views of nature of science. *Journal of Research in Science Teaching, 37*(10), 1057-1095. https://doi.org/10.1002/1098-2736(200012)37:10%3C1057::AID-TEA3%3E3.0.CO;2-C

Antink-Meyer, A., Bartos, S., Lederman, J. S., & Lederman, N. G. (2016). Using science camps to develop understandings about scientific inquiry-Taiwanese students in a U.S. summer science camp. *International Journal of Science and Mathematics Education*(14), 29-53. https://doi.org/10.1007/s10763-014-9576-3

Aslan, O., Yalçın, N., & Taşar, M. F. (2009). Fen ve teknoloji öğretmenlerinin bilimin doğası hakkındaki görüşleri. *Ahi Evran Üniversitesi Eğitim Fakültesi Dergisi, 10(3),* 1-8.

Ayvaci, H. S., Atik, A., & Urey, M. (2016). Okul Öncesi Çocuklarının Bilim İnsanı Kavramına Yönelik Algıları. *Bartın Üniversitesi Eğitim Fakültesi Dergisi, 5*(3), 669-689. https://doi.org/10.14686/buefad.v5i3.5000193186

Bell, P., Lewenstein, B., W. Shouse, A., & A. Feder, M. (Eds.). (2009). *Learning Science In Informal Environments: People, Places and Pursuits.* D.C.: The National Academies Press.

Bequette, J. W., & Bequette, M. B. (2012). A place for art and design education in the STEM conversation. *Art Education, 65*(2), 40-47. https://doi.org/10.1080/00043125.2012.11519167

Brahms, L. J. (2014). *Making as a learning process: Identifying and supporting family learning in informal settings.* University of Pittsburgh.

Cabuk, B. (2019). Çevre Eğitimi. D. Kahriman Pamuk (Ed.), *Erken Çocukluk Döneminde Çevre Eğitimi ve Sürdürülebilirlik* (pp. 1-51). Anı.

Camcı Erdoğan, S. (2013). Üstün zekâlı ve yetenekli öğrencilerin bilim insanlarına yönelik algıları. *Türk Üstün Zekâ ve Eğitim Dergisi, 3*(1), 13-37.

Creswell, J. W. (2017). *Araştırma Deseni.* (S. B. Demir, Trans.) Eğiten.

Deniş Çeliker, H., & Akar, A. (2015). Ortaokul Öğrencilerinin Doğaya İlişkin Metaforları. *Ahi Evran Üniversitesi Kırşehir Eğitim Fakültesi Dergisi, 16*(2), 101-119.

Derr, V., Chawla, L., & Pevec, I. (2017). Early Childhood. In A. Russ, & M. E. Krasny, *Urban Environmental Education Review.* Ithaca: Comstock Publishing Associates.

Digby, C. L. (2013). The influences of socio-demographic factors, and non-formal and informal learning participation on adult environmental behaviors. *International Electronic Journal of Environmental Education, 3*(1), 37-55.

Güler, B. (2019). Doğayla uyumlu sürdürülebilir bir toplum. N. Özgen; M. Kahyaoğlu (Ed.), Sürdürülebilir Kalkınma (pp 198-212). Pegem.

Güler, T., & Akman, B. (2006). 6 yaş çocuklarının bilim ve bilim insanı hakkındaki görüşleri. *Hacettepe Üniversitesi Eğitim Fakültesi Dergisi, 31,* 55-66.

Griffin, K. R. (2015). *Texas chapter of the Wildlife Society's wildlife conservation camp: An evaluation of long-term impacts on high school participants.* Tarleton University.

Gunesch, M. M., & Winter, C. R. (1996). Summer science camps. *Science Scope, 19*(8), 22-25.

Hannigan, S., Wickman, P., Ferguson, J. P., Prain, V. & Tytler, R. (2022) The role of aesthetics in learning science in an art-science lesson, *International Journal of Science Education*, 44(5), 797-814. https://doi.org/10.1080/09500693.2021.1909773

Hanscom, A. J. (2016). *Balanced and Barefoot: How Unrestricted Outdoor Play Makes for Strong, Confident, and Capable Children.* New Harbinger Publications.

Heimlich, J. E., Adams, J. D., & Stern, M. J. (2017). Nonformal Educational Settings. In A. Russ, & M. E. Krasny, *Urban Environmental Education Review.* Comstock Publishing Associates.

Jacobson, S. K., Seavey, J. R., & Mueller, R. C. (2016). Integrated science and art education for creative climate change communication. *Ecology and Society, 21*(3), 30. http://dx.doi.org/10.5751/ES-08626-210330
Kara, B., & Akarsu, B. (2013). Ortaokul öğrencilerinin bilim insanına yönelik tutum ve imajının belirlenmesi. *Journal of European Education, 3*(1), 8-15.
Karasar, N. (2018). *Bilimsel Araştırma Yöntemi: Kavramlar, İlkeler, Teknikler.* Nobel Akademi.
Kimche, L. (1978). Science centers: A potential for learning. *Science, 199*(4326), 270-273. https://doi.org/ 10.1126/science.619454
Kosker, N. (2013). İlkokul öğrenciler ve sınıf öğretmeni adaylarının doğaya ilişkin algıları ve sorumluluklarına yönelik düşünceleri. *Turkish Studies, 8*(3), 341-355. http://dx.doi.org/10.7827/TurkishStudies.4037
Kwon, H., Capraro, R. M., & Capraro, M. M. (2021). When I Believe, I Can: Success STEMs from My Perceptions. *Canadian Journal for Science, Mathematics, and Technology Education, 21*(1). https://doi.org/10.1007/s42330-020-00132-4
La Belle, T. J. (1982). Formal, nonformal and informal education: A holistic perspective on lifelong learning. *International Review of Education, 28*, 159-175. https://doi.org/10.1007/BF00598444
Leblebicioglu, G., Metin, D., Yardimci, E., & Berkyurek, İ. (2011). Teaching the nature of science in the nature: A summer science camp. *Elementary Education Online, 10*(3), 1037-1055.
Lin, P.-Y., & Schunn, C. D. (2016). The dimensions and impact of informal science learning experiences on middle schoolers' attitudes and abilities in science. *International Journal of Science Education, 38*(17), 2551-2572. http://dx.doi.org/10.1080/09500693.2016.1251631
Losh, S. C., Wilke, R., & Pop, M. (2008). Some methodological issues with "Draw a Scientist Tests" among young children. *International Journal of Science Education, 30*(6), 773-792. http://dx.doi.org/10.1080/09500690701250452
Mıhladız, G., & Doğan, A. (2012). Fen ve teknoloji öğretmenleri ve öğretmen adaylarının bilimin doğası konusundaki alan bilgilerinin karşılaştırılması. *e-Uluslararası Eğitim Araştırmaları Dergisi, 3*(1), 78-96.
Maddox, D., Nagendra, H., Elmqvist, T., & Russ, A. (2017). Advancing Urbanization. In A. Russ, M. E. Krasny, A. Russ, & M. E. Krasny (Eds.), *Urban Environmental Education Review.* Comstock Publishing Associates.
Miles, M. B., & Huberman, A. M. (1994). *Qualitative data analysis: An expanded sourcebook.* Sage Publications.
Murcia, K., & Schibeci, R. (1999). Primary student teachers' conceptions of the nature of science. *International Journal of Science Education, 21*(11), 1123-1140. https://doi.org/10.1080/095006999290101
Overwien, B. (2000). Informal learning and the role of social movements. *International Review of Education, 46*(6), 621-640.
Perignat, E., & Katz-Buonincontro, J. (2019). STEAM in practice and research: An integrative literature review. *Thinking Skills and Creativity, 31*, 31-43. https://doi.org/10.1016/j.tsc.2018.10.002
Piaget, J. (2005). Giriş: Sorunlar ve yöntemler. (İ. Yerguz, Çev.) Dost Kitabevi.
Sönmez, V., & Alacapınar, F. G. (2019). Örneklendirilmiş Bilimsel Araştırma Yöntemleri. Anı Yayıncılık.
Sözer, Y., & Aydın, M. (2020). Nitel veri toplama teknikleri ve nitel veri analizi süreci. In B. Oral, & A. Çoban (Eds.), *Kuramdan uygulamaya eğitimde bilimsel araştırma yöntemleri.* Pegem.
Stebbins, R. C. (2012). *Connecting with Nature: A Naturalist's Perspective.* NSTA Press.
Straksiene, G., Ben-Horin, O., Espeland, M. & Robberstad, J. (2022). Towards a rationale for science-art integration as a transdisciplinary signature pedagogy, *Cogent Education*, 9:1, 1-15. https://doi.org/10.1080/2331186X.2022.2087459
Strommen, E. (1995). Lions and tigers and bears, oh my! Children's conceptions of forests and their inhabitants. *Journal of Research in Science Teaching, 32*(7), 683-698. https://doi.org/10.1002/tea.3660320704
Turgut, H., Öztürk, N., & Eş, H. (2017). Üstün zekâlı öğrencilerin bilim ve bilim insanı algısı. *Abant İzzet Baysal Üniversitesi Eğitim Fakültesi Dergisi, 17*(1), 423-440. https://doi.org/10.17240/aibuefd.2017.17.28551-304646
Yardımcı, E. (2009). *Yaz Bilim Kampında Yapılan Etkinlik Temelli Doğa Eğitiminin İlköğretim 4 ve 5. Sınıftaki Çocukların Doğa Algılarına Etkisi.* (No:241805) (Master Thesis, Abant İzzet Baysal Üniversitesi). https://tez.yok.gov.tr/UlusalTezMerkezi/tezDetay.jsp?id=EPeWePZiCEeaceYNeGB8Uw&no=otHf97iEk9t-q9LdKJ2qfg
Yıldız Yılmaz, N., & Mentiş Taş, A. (2018). The effect of nature education program on the level of environmental awareness of the elementary school students from different socioeconomic status. *Universal Journal of Educational Research, 6*(9), 1928-1937. https://doi.org/10.13189/ujer.2018.060911
Yilmaz, F., & Kahraman, A. D. (2015). Science and nature perception in the images and pictures of the children. *Procedia - Social and Behavioral Sciences, 176*, 650-658. https://doi.org/10.1016/j.sbspro.2015.01.523
Yontar Toğrol, A. (2000). Öğrencilerin bilim insanı ile ilgili imgeleri. *Eğitim ve Bilim, 25*(118), 49-57.
Zaelzer, C. (2020) The Value in Science-Art Partnerships for Science Education and Science Communication. *eNeuro.*7(4), 1-6. https://doi.org/10.1523/ENEURO.0238-20.2020