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Original Article

An Artistic Experience at the Science Center: The Artistic Remark of the Scientific Context

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Abstract

The research focuses on transforming students' experiences, sensations, impressions, and perceptions in the science center into artistic expression. The research aims to examine how the scientific content of the science center exhibition is interpreted by the students of the visual art course of Science and Art Center according to the artistic context. The sample of the study carried out with the case study pattern consists of nine students aged 10-14, who are defined as gifted in the field of visual arts. For this study, an activity program called "Artistic Discovery in the Science Center" was created by the researchers. This program includes three activities named “Color and Light”, “Visual Illusions”, and “Geometry and Art”. Qualitative data sources included focus group interviews, worksheets, students' artistic works, and reflective diaries. Inductive analysis was applied by triangulating findings from multiple data sources. The learning experiences offered by the activities to the students were determined as the unit of analysis. Research findings have shown that science centers offer rich learning experiences to the students in understanding the causality of art-related subjects and exploring a different context of the information learned in the visual arts course, in a way that contributes to imaginative thinking.

Keywords

Science centers
Visual arts
Artistic learning
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Introduction

Science and art are taught as separate disciplines at schools. However, for the last 20 years, it has been seen that science and art are often studied together in various contexts. It takes attention that art is used as a discipline for instruction and the transfer of knowledge at science museums or science centers. Moreover, it is accepted as valuable to cooperate with the artist to create a rich visual context and make people think about innovative scientific projects at science centers. According to Plonczak and Goefz Zwirn (2015), art could have an important role in making science easy to understand and humanize. Moreover, there are some studies (Felleman Fattal, 2009; Hamilton, 1981; Lesen, Rogan, & Blum, 2016; Özdemir, 2012; Petzoldt, 2008; Plonczak & Goefz Zwirn, 2015) in which it is discussed that art is a tool to teach science and provide high engagement with it. In these studies, it is also emphasized

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that the uncertainty about whether the transfer of science through art is effective and should be viewed from a broader perspective. For this reason, there is a need to develop art-science-based integrated strategies that will create more opportunities for the intersection of both in schools and contribute to the student's understanding of science.

Science centers prefer simplified but interactive content to spark students' imaginations and make them think about the complex content of science. These contents can contribute to the students developing the formal and expressive aspects of their artistic work and enable them to understand the nature of artistic creativity. From this point of view, this research aims to examine how the scientific content of the science center exhibition is interpreted by the students of the visual art course of the Science and Art Center according to the artistic context. For this reason, the research focuses on transforming students' experiences, sensations, impressions, and perceptions in the science center into artistic expression.

Contextual Literature

Science centers with various scientific exhibitions have been established to encourage public understanding and participation in science. Science centers, with the mission of being a bridge between science and society, aim to bring society together with science, to make science and technology understandable and accessible for them, and to encourage individuals to experiment and explore with experimental and applied exhibitions ((Bozdoğan, 2007; Schwan, Grajal, & Lewather, 2014; Şen, 2019; TÜBİTAK, 2022). These centers, which aim to strengthen the science literacy and communication skills of the society offer simplified and interactive presentations as exhibitions of the scientific contents which are complex and difficult to understand in fields such as physics, chemistry, biology, mathematics, geology, and astronomy. In this respect, it is considered one of the informal learning environments that support formal education. In essence, the presentation of challenging scientific phenomena in a way that triggers curiosity and imagination strengthens the educational context of these institutions. Root-Bernstein and Root-Bernstein (2005) stated that creative thinking and producing ideas in art, science, and technology require a series of actions such as observing, recognizing patterns, analogy, empathizing, dimensional thinking, modeling, playing, transforming and synthesizing, so science centers offer a rich learning environment with encouraging features.

"Science centers have an important role in increasing curiosity towards science, providing the necessary readiness for learning scientific knowledge, and creating a scientific thinking system" (Bozdoğan, 2019, p. 58). In this respect, it has been revealed by scientific research that it plays a complementary and facilitating role in the development of science literacy, contributes to the development of students' scientific process skills, and increases their interest in science (Adadan & Kabapınar, 2019; Bozdoğan, 2007; Çığrık & Özkan, 2016; Han & Bilican, 2018; Schwan et al., 2014). However, it should not be misconstrued that science centers only offer a learning environment for science-based school applications. It is also possible to discuss the effects of science and technological inventions in a socio-scientific context. For instance, Felleman Fattal (2009), in an activity he planned for the botanical garden as an out-of-school learning environment, allowed students to observe the effect of temperature change on biodiversity while discussing issues such as the sustainability of human activities, climate change, urban landscapes, renewable energy, and food production. Thus, in the context of this activity, she states that different dimensions of social sciences, art, and visual culture can be added to the curriculum. Science centers have contents that support artistic creativity. For example, when science center exhibitions are examined, it is possible to see exhibitions on subjects such as color, light, perspective, perception, visual illusion, formal aesthetics, and darkroom in visual arts education. As in this example, when the practices of science centers in the world are examined, it is seen that art is used as a tool for science communication (Friedman, 2013; Lesen et al., 2016) and collaborative projects involving contemporary artists (Redler, 2009). Redler (2009) states that they have been collaborating with artists since 1996 within the scope of science museums' art projects (SMAP), working with them as researchers, producers, facilitators, and strategists, and allowing visitors to discover science. For this reason, he states that they have started to cooperate with artists who can surprise and excite visitors, and to non-explanatory artist approaches that deal with the ethical, political, social, and cultural effects or potentials of science and scientific theories.

Science and art unite at the point of imagination and innovative thinking, and they also inspire each other. For example, Root-Bernstein and Root-Bernstein (2005) point out that many Nobel laureates also have artistic hobbies. Desmond Morris, an internationally recognized zoologist, states that he is also a surrealist painter, desiring, in his own words, "to be both at once", "the imaginative and analytical –the artist and the scientist" (p. 5). According to Poroy (2014), "When people's curiosity, desire to learn and especially the ability to observe are combined with scientific foundations in fields such as biology, anatomy, physics, and mathematics, and emotional expressions are added, the way for innovations opens. Art and science both alone and together form the basis for endless interactions and creativity." (p. 214). It is seen that studies in fields such as science and mathematics and art complement each other in the historical process. For example, the golden ratio is a number often associated with mathematics and biology. However, the history of art is full of examples where the golden ratio is used in different fields of art. It is possible to see the golden ratio on "the minarets of the Süleymaniye and Selimiye Mosques" built by Mimar Sinan, and on "the crown gate of the Ince Minareli Madrasa" built by the Seljuks in Konya, which are important examples of Turkish art (Duru & İşleyen, 2005, p. 488).

Numerical measurements are also used in the works of the artist James Turrell. The artist used the principles of visual perception to create effects on spatial perception by using geometric shapes. According to Poroy (2014), "Turrell's work creates an instant effect like an illusion. However, his artworks contain great mathematical calculations and have scientific foundations that have been pre-studied for years" (p. 221). Many of the works of Danish artist Olafur Eliasson are related to natural elements such as air, light, water, pressure, heat, and climate, which are also concepts of science. The artist created a rainbow in a room by using the right angle of the eye, drops, and light in his work called "Beauty" in 1993. In another work of the artist, he focused on the relationship between nature and design. For example, he examined the crystallization patterns of basalt stones by questioning how space is used in nature. At the end of this study, the relationship he established between nature and geometry inspired the design of the Harpa Concert Hall. On the other hand, Israeli architect and designer Neri Oxman creates artworks called bio-art or biodesign by blending art, science, design, and engineering. He aims to design materials for nature that are compatible with nature. Moreover, the use of plastic in the world should be reduced. Nature is full of various organisms. These organisms are nature friendly and can contribute to reducing the use of plastic in the world. For example, casein is a milk protein but solid as a rock. As can be understood from the artist's statement, "Bioart is an art expression method in which biotechnologies are used as an art creation tool" (Aslan & Uysal, 2021, p. 4379). Bacteria, algae, yeasts, molds, and genetically modified organisms constitute the creation material of the bio artist, while laboratory equipment such as the microscope, petri dish, transparent tube, and incubator are the artist's art creation tools (Anker, 2021). On the other hand, Turkish artist Refik Anadol uses data and algorithms for the main material of his art. Refik Anadol visualizes the data produced by artificial intelligence concerning the place. The artist's goal is to convey an unexperienced emotion to the people, to help them dream optimistically.

It is possible to increase these examples in the art world even more. According to Aslan and Uysal (2021), “the future is shaped by the opportunities provided by today's scientific knowledge and technology and by creativity skills” (p. 4385). For this reason, although science and art are two separate fields in terms of structure, it is necessary to realize that there is a close relationship between them. Lucas, Coleman, Hennessy, and Hellman (2006) states that “So, to me, art and science are very closely linked. Science gives us the "how," and art gives us the "why." (p. 37)”. Therefore, science and art are the disciplines that should be dealt with together in most cases. Approaches that associate science and art have started to be included in the contents of museum learning programs. For example, the Istanbul Museum of Modern Arts (Istanbul Modern) aims to meet children with art and chemistry in its program called BASF Kids' Lab (Chemistry of Art Workshop). In the program, the children first explore paint production through the history of art, then they produce their paints and write up experiment reports, and in the final stage, they paint abstract paintings with the paints they have produced. Mutual knowledge sharing, cohesion, or interdisciplinary between science and art could be beneficial through the formal curriculum of schools or after-school programs where gifted individuals are supported, such as Science and Art Center.

Integration of Science and Art Center and Science Center

Science and Art Centers are institutions serving under the General Directorate of Special Education and Guidance Services of the Ministry of National Education (MoNE) (to develop the talents of gifted individuals in Türkiye and to enable them to use their capacities at the highest level. Individuals who are defined as special talents in the fields of mental, visual arts, and music disciplines and also who are students in formal education institutions are offered training programs consisting of five parts, which follow each other to implement their original projects at Science and Art Centers. A three-stage program is followed for the students who have identified as talented in the field of visual arts and music. Students attend the Orientation Program, Special Talent Development Program, and Project Development Program, respectively. Within the scope of the "Special Talent Development Program", students conduct a series of activities to realize their talents in the field and take part in project studies including applications in which deeper artistic works are projected (MoNE Science and Art Center Directive, 2016).

Students who are qualified in the field of visual arts talent are offered a program within the framework of the Science and Art Center Visual Arts Course curriculum (MoNE, 2021) to improve their skills. In the program, it is recommended that the educational content be expanded to cover different subjects and applied by diversifying with differentiated learning strategies. Differentiation and enrichment are presented as the two main features of the program. In the mentioned program, it is stated that interdisciplinary issues and problems should be included and that gifted students should be directed to high-level and conceptually challenging content. This approach supports increasing multidisciplinary and interdisciplinary interactions in the learning activities. At this point, science centers, as an out-of-school learning environment, offer various opportunities to handle scientific content in an artistic context.

From this point of view, an activity program called “Artistic Discovery in the Science Center” was developed to examine how the scientific content of the scientific exhibition at Kocaeli Science Center was interpreted by the students in the visual arts field of the Science and Art Center in an artistic context. The aim of the research is to examine the ways of transforming students' experiences, sensations, impressions, and perceptions in the science center into artistic expression. In this context, the research question is as follows: What are the learning experiences of the Visual Arts students of the Science and Art Center from the "Artistic Discovery in the Science Center activity program”?

Method

This research is a case study that examines how the scientific content of the exhibitions at Kocaeli Science Center is interpreted by students in the visual arts field of the Science and Art Center in an artistic context. For this purpose, an activity program called "Artistic Discovery in the Science Center" has been developed. This program aimed to enable students to explore scientific subjects in depth, acquire skills integrated with science, mathematics, and art, produce new perspectives and turn their scientific discoveries into original artistic products or projects.

According to Merriam (2013), the characteristics of case studies are determined by the unit of analysis, not the subject of the research. In this context, the learning experiences offered by the activities to the students were determined as the unit of analysis. In this research, since the learning experiences of the students in the study group of the applied program were determined as the unit of analysis, the "holistic single case" design was used. "The holistic single case design is used in cases where a single case with a single unit of analysis is examined" (Ozan Leylum, Odabaşı, & Kabakçı Yurdakul, 2017, p. 377).

Participants and Context

This research was carried out with 9 students, 2 boys, and 7 girls, from Kocaeli Science and Art Center, which serves as an out-of-school education institution affiliated with the MoNE. Participants are students between the ages of 10-14 who are defined as gifted in the field of visual arts. Student information is presented in Table 1.

Tablo 1. Participants

Students Code	Age/Gender	Years of education in Science and Art Center
S1	10-B	3
S2	11-G	1
S3	11-G	1
S4	12-G	3
S5	12-G	3
S6	12-G	3
S7	12-G	3
S8	14-G	4
S9	14-B	4

In this research, criterion sampling, one of the purposive sampling approaches, was used to determine the participants. In this context, two criteria were effective in determining the participants. The first criterion is that they have completed the Science and Art Center compliance program, and the other is that they have voluntarily participated in the research.

The research was started after the Ethics Committee Decision of Pamukkale University dated 11.03.2022 and numbered E-93803232-622.02-182203 and the approval of the Research Permission of MoNE dated 04/04/2022 and numbered E-99332089-605.01-47059068. Since the participants were underage children, the parents of the students were informed about the research process through the "Informed Consent Form" and the application and research process started after their permission.

Development of Activities and Implementation Process

During the development process of activities that will support artistic learning in the science center, Kocaeli Science Center galleries and the exhibitions in each gallery (e.g., monochrome room, numerous colors) were examined. The scientific contents in the exhibits were associated with the practices of various artists and common concepts (e.g., color, illusion, pattern) were determined. These concepts have been decisive in the establishment of interdisciplinary relations and the learning objectives (e.g., Reflects natural events and concepts to visual artwork, Observing the path of light that changes the environment associating the cause of the refraction with the change in the environment.) to be focused on the activity process. Figure 1 reflects an overall plan of the preparation process for the activities.

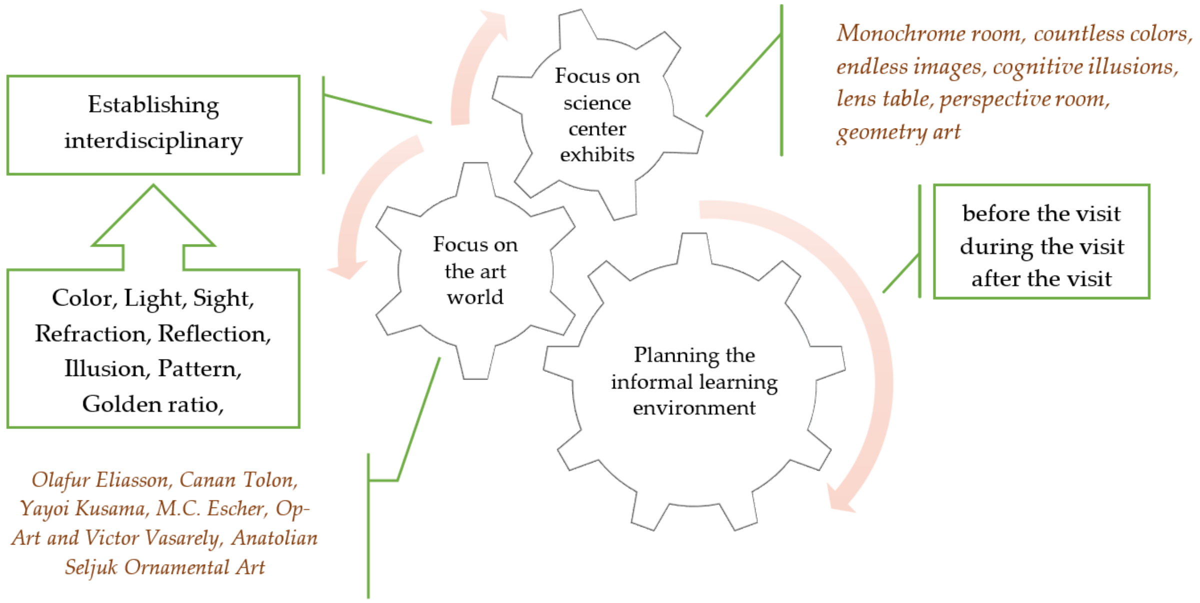

Figure 1. The preparation process for the activities

As seen in Figure 1, exhibits, such as the monochrome room, countless colors, endless images, cognitive reflections, lens table, perspective room, and geometry art in the science center, guide the researchers to examine the works of artists named Olafur Eliasson, Canan Tolon, Yoyoi Kusama, M.C. Escher, Victor Vasarely and Anatolian Seljuk Ornamental Art. In this research, a 6-week program consisting of a total of three activities was designed under the name of "Artistic Discovery in the Science Center". The topics of the activities in the program are determined as “Color and Light”, “Visual Illusions” and “Geometry and Art”. Each activity was structured according to the planning stages of out-of-school learning activities as shown in Figure 1. These activities were completed by performing before, during, and after the visit. The four-stage process of learning flow, which was developed by Joseph Cornell (1979) and adapted to the planning and implementation steps of all lessons, was used in transforming the activities into a lesson plan. The first stage in the learning flow is arousing curiosity (before the visit). In this stage, it is aimed to ensure that students are interested in learning and to increase their attention. In this study, students were asked thought-provoking questions related to the determined theme. In addition, students were directed to make inquiries about the works of the artists. The second stage is focusing attention (visiting process). At this stage, students focus their attention on the subject or content to be covered. Focusing attention was achieved through interacting with the relevant exhibits in the science center and by means of activity forms for observation and research prepared on those exhibits. The third phase is the learning experience (post-visit). In this stage, activities aimed at enabling students to experience the subject or content to be covered in depth are carried out. At this stage, students were expected to transform their experiences, sensations, and perceptions from the exhibits in the science center into artistic practices. The final stage is the sharing of experience (post-visit). In this last stage, students are allowed to express what they have learned in a meaningful way. At this stage, the students shared the ideas they developed in their artistic work with their friends. The general content of the lesson plans is presented in Table 2.

Table 2. The general framework of lesson plans

Planning of out-of-school learning	Stages of Joseph Cornell's learning flow	Activities
Before Visit	Arousing Curiosity	Let's think
		Let's look at the art world
During Visit	Focusing the Interest	Examine and experience
		Worksheet - search and find activity
		Reflective diary
After Visit	Learning Experience	Let's try
		Performing artistic practice
	Sharing Experience	Presentation

For example, “Color and Light Activity” clearly shows the general framework of the lesson plans presented in Table 2. In the "Color and Light" activity, it was aimed that students experience their knowledge of color in related exhibits and apply what they learned in an artistic project. In this process, concepts such as "color, light, reflection, monochromatic light, absorption of light, seeing" were discussed within the framework of "monochromatic room, countless colors, endless images, corner mirror" in the "Perception and Reality" exhibition gallery located in the Science Center. At the same time, the works of artists such as Olafur Eliasson, Canan Tolon, and Yoand yoi Kusama are focused on. In this context, asking questions to *students will lead students to think about the stage of arousing curiosity before the visit. Such questions as “How do we perceive colors? What kind of problems would we have if we did not see some colors in the world? How can we make colors disappear? Is it possible to make them disappear? How would you feel if you lived in a single color room? “What would happen if animals and plants living in an environment where there was only one color? Would it be? How are the colors of the rainbow formed?”* were asked. After this initial questioning process, the students were directed to gain experience in examining a work of art through the works of artist Olafur Eliasson called “Beauty (Image 1)” and “Monochrome room (Image 2)”, which he created in an art gallery. At this stage, the following questions were asked of the students;

Image 1. Olafur Eliasson, Beauty-Rainbow, 1993

Image 2. Olafur Eliasson, Room for one colour, 1997

- *How do you think the artist created the rainbow?*
- *What does the artist want to show us in this work?*
- *On what observation in nature do you think this study could be based?*
- *How did the artist create the yellow room where the other colors disappear?*
- *Why can’t we see different colors in this room?*
- *What do you think the people/audience in this room might be feeling?*
- *How would you feel if you were in this room that the artist presented to us?*

After this process in which curiosity was triggered, the Science Center was visited. The science center includes exhibits that allow the experience to focus the interests of the students. "Examine and experience" worksheets were distributed to students for the continuity of knowledge. In this worksheet, some questions that students can answer by experiencing the exhibits in the science center are presented. Some of the questions are given below;

- *As white light passes through the prism, they are refracted by different amounts. Which color is the least broken and which is the most broken?*
- *Let's examine the exhibit of Colored Shadow Experiments, what color is the shadow formed by the combination of red and green light?*
- *How is color formed? How do we see colors?*
- *How did the colors disappear in the monochrome room setup?*

The post-visit learning experience continued with the transformation of what was learned into artistic research after an experiment on light absorption. In this context, the students carried out an installation work in which the properties of fluorescent colors could be revealed under purple light. In this work, the students wanted to create small spaces similar to the mirror exhibit they experienced in the science center (Image 3). In this context, the visual arts teacher guides the students to examine the mirror installations created by the artists Canan Tolon (Image 4) and Yoyoi Kusama (Image 5).

Image 3. Science center experience (taken by the researcher)

Image 4. Canan Tolon, Colony, 2008

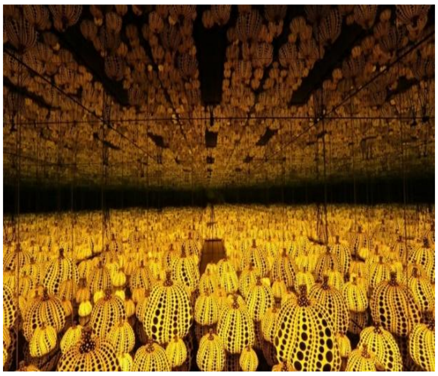

Image 5. Yoyoi Kusama, Infinity Mirror Rooms, 1965/2016

The last activity carried out in the classroom after the visit is the sharing of experience. At this last stage, the students shared their ideas about their artistic work with their friends. Questions which are mentioned below are shared with students to assist them in preparing their presentations;

- *What is the idea behind the artistic work?*
- *Where and how would you like to display your artistic work?*
- *What do you think people will think when they look at your artwork?*
- *What would you like people to think when they look at it?*
- *Who would you particularly like to talk to about your artistic work? Why?*

Data Collection

In this research, focus group interviews, worksheets, students' artistic works, and reflective diaries were used in the data collection process. In addition, the researcher's diary who is one of the authors of this research and carried out the implementation with the students as a teacher contributed to the data of the research. Data collection tools and processes are presented in Figure 2.

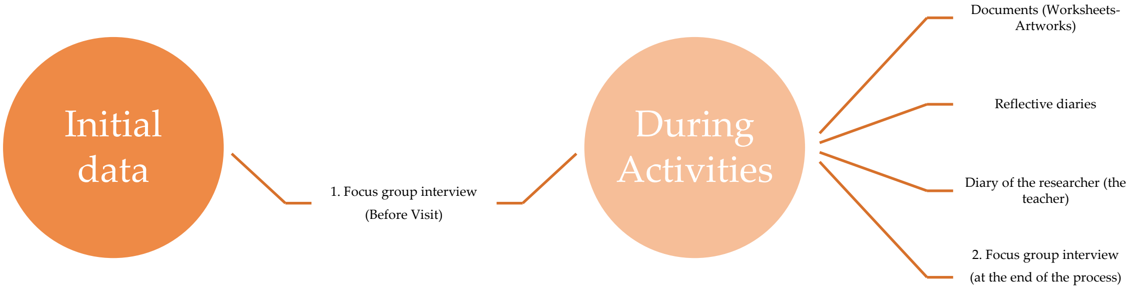

Figure 2. Data collection tools and process

At the beginning of the research, in the focus group interview, researchers and students came together and met each other. At first, the students were informed about the process and in the interview, questions focused on the students' past experiences of the Science Center, their perceptions of the relationship between art and science, and how they benefited from the knowledge and skills they learned in other courses (Mathematics, Science, Social Sciences) while doing their artistic work. Some of these questions are as follows: *How do you benefit from the knowledge and skills you learned in other courses (such as Mathematics, Science, and Social Sciences) while doing your artistic work? How do you use the knowledge and experiences you have gained in the artistic learning process in courses such as Mathematics, Science, and Social Sciences? Could you elaborate on this situation for us?*

In the focus group interviews, a semi-structured interview form developed by the researchers was used and these interviews were conducted using Zoom.

In the activity process, worksheets designed by the researchers aiming to encourage students to observe and research were used. After the activities were done, reflective diaries designed for students to write and draw their experiences during the activity were used. This diary basically consists of 6 questions including affective (experienced excitement, emotions), cognitive (intellectual), and psychomotor (doing-exercising) dimensions:

- *My feelings about today's activities:*
- *What I learned in today's activities:*
- *What excites me most about today's activities:*
- *What I have trouble understanding in today's activities:*
- *What I have difficulty in doing/implementing in today's activities:*
- *Can you draw on the back of this paper what impressed or made you think the most today?*

In addition to the students, the teacher, who took part in the research process, recorded her observations and experiences about the process in a researcher diary. The contents of this log are as follows:

- *What were the students' reactions, thoughts, feelings, and artistic values about the activity?*
- *What were the satisfying aspects of the event?*
- *What were the concerns about the event?*
- *What could have been done differently to make the event more effective?*

The teacher who guided the application also contributed to the collection of documents (artistic works and worksheets) belonging to the process.

2nd focus group interview was held at the end of the implementation process. In this interview, the focus was on students' knowledge obtained from the activities carried out in the Science Center. For instance, questions such as *"Which part of the science center did you enjoy the most? What impressed/excited you the most there? What did make you think about art? What do you think these activities in the science center have provided for you?"* were used during the interview. In this interview, students were also asked to share their experiences with an artwork they chose. The questions that guide this experience-sharing process are *"What is the name of your work? Can you talk about the process of creating your work? What was your starting point? What did you think about during the process? How did you transfer what you learned at the science center to your artistic work? What were the things that excited you during the process? What else could/would you do about your work?"*.

Analysis of Data

An inductive method was preferred in the analysis of the data in the study. In this context, codes were created by reading the data obtained from the participants. After that, the codes were classified according to their similarities and differences, and sub-themes were reached, and from the sub-themes, the main themes were reached. The initial data of the study were obtained from the first focus group interview. This interview was transcribed and coded. In the analysis of the process data, the focus was first on the worksheets, the reflective diaries of the students and the teacher. In this context, similar words and common themes were tried to be defined. Then, the codes were checked with the practitioner-researcher (the teacher). After the data from the second focus group interview were written down, they were coded separately and combined with the codes obtained from the worksheets and reflective diaries. In this way, cross-referencing of some data allowed some of the answers in the focus group interview to be correlated and confirmed with the reflective diary data. The data from the focus group interview provided the researchers with information about the students' readiness for the relationship between science and art, what they found interesting in their experience, what motivates them in the artistic practice process, and the processes that deepen or change artistic thinking. After all the codes and categories created were independently reviewed by three other researchers to check their validity, the final form presented in Table 3 was given. Research findings are discussed under two main categories as initial findings and findings of the process.

Table 3. Coding Table

Initial Data (Findings)			
Theme	**Sub-Theme**	**Codes**	
Previous Science Center experiences	- Experiencing the science center	- Visit with school - Visit with family	
	- Not experiencing the science center		
Evaluating interdisciplinary relations	- Evaluating the relationship between art and mathematics	- Common concepts of both fields such as measure-ratio	
	- Evaluating the relationship between arts and sciences	- Observation	
	- Evaluating the relationship between arts and social sciences	- Creating awareness of recycling	
Process Data (Findings)			
Theme	**Sub-Theme**	**Codes**	
What did they feel?	During the visit to the science center* (out of school)	**How?** - Fun -Excited -Happy -Amazing	**Why?** - Seeing different unexpected things - Experiencing every exhibits - Exploring art-related subjects in scientific exhibits
	During the post-visit activity (at school)	-Mixed feelings	- Working with materials other than the art materials they know - Interacting with other course subjects - Working with new techniques and methods
What did they learn/discover?	Learning and understanding related concepts	- Understanding cause-effect relationships in matters related to art - New knowledge acquisition	
	Transforming it into an original art form	- Searching for alternative ideas - Emotional and aesthetic reactions/anxieties - Benefit from daily aesthetic experiences - Discovering new narrative methods	
	Transfer of experience	- Between topics - To the audience - Real-life situations	
Where did they struggle?	Students	- Difficulty understanding some subjects and exhibits - The conflict between the concepts they learned in the past and the concepts they have just learned	
	Teacher	- Keeping the student's attention constantly - Managing the process and feedback - Not feeling competent about non-art disciplines related to the activity	

*Pre-visit learning activities were held in the Science Center's activity class. Since the students perceived the science center visit as a whole, there was no pre-visit sub-theme.

In qualitative research, methods such as triangulation, participant confirmation, and colleague confirmation should be used to help the researcher confirm the data obtained and the conclusions reached in order to create a holistic picture of the phenomenon and event being researched (Yıldırım & Şimşek, 2013). In this study, one of the researchers interacted with the data sources for a long time as a practitioner. In this way, it was possible to gain a deeper understanding of the participants' perspectives on the situation under study. The study also utilized triangulation strategies to contribute to credibility. For this purpose, different data collection approaches such as interviews, observations and document analysis were used to reveal the situation under study from the perspectives of the participants and the practitioner. In the planning of the implementation process of this interdisciplinary study, all researchers were also involved in the process as experts in the control and confirmation of codes and categories after data analysis.

Results

The initial findings: The initial findings were analyzed under two sub-themes as students' previous experiences of the science center and evaluating interdisciplinary relationships. Among the students, only the students that are coded as S6 and S7 visited a science center with their families and as part of a school trip before. The students defined their experiences here as "fun and enjoyable" by saying "It's a nice fun environment. You can try everything there" (S6) and "…. I enjoyed it. It was very different for me" (S7). This shows that the reasons why the students enjoyed the trip are that the setting allowed them to see and experience different things. S7 stated that she visited the science center as part of a school trip, but this trip was a short one with the statement "School took us there, but I couldn't try all of them because time was a little limited".

When the students were asked about the relationships between art and other subjects (mathematics, science, social sciences), they gave answers mostly about the relationship between art and mathematics.

S4: There are ratios. Ratios are concepts that we also use in mathematics (Focus Group Interview-I).

S6: We pay attention to the scales while drawing people (Focus Group Interview -I).

S5: We can paint based on geometric shapes. For example, I have portraits consisting of triangles (Focus Group Interview -I).

S8: We also use it in our work to add depth. That is, we use math to provide depth (Focus Group Interview -I).

As seen in the statements above, students established a relationship between art and mathematics through concepts such as measurement, ratio and shape, which are the subjects of both disciplines. They presented the use of geometric shapes in surface arrangement, perspective drawing techniques that are used to add depth to the work, and the use of measurement techniques to ensure ratio-proportion in figurative drawings as examples for the ways they use mathematics in their artistic works. On the other hand, only three of the students evaluated the relationship between science and art. He connected this relationship with the concept of "observation", which is the source of sensory data in both fields, rather than a conceptual association they established in mathematics.

S2: Yes, there is, for example, observation in art is important for drawing. For example, we observe and draw the phases of the moon (Focus Group Interview -I).

S7: We observe the plants. We can design clothes and fabrics inspired by them (Focus Group Interview -I).

S9: I also love anatomy drawings. I watch human anatomy to help my drawings. I'm not sure if it's correct. It is both art and science (Focus Group Interview -I).

Seemingly, the students made associations by referring to the observation and monitoring processes in science and art. Observational processes, namely seeing, are important for understanding and interpretation in both science and art. Art often uses observational data for modification while science uses it for explanation. In this context, it shows that the students are aware of the importance of the previous background information and sensory stimuli before the processes of interpretation and explanation. Limited number of views were received from the students on the relationship between social sciences and art. Only S5 stated that "by making art from waste materials, we can raise awareness of people about recycling waste materials" and that a social and environmental problem can be made visible through art.

Findings of the Process: Findings of the Process were analyzed under the themes What did they feel?, What did they learn/discover? and Where did they struggle?.

What did they feel?

The students' feelings about the experience they had in their reflective diaries were "fun, exciting, happy, surprising and complex emotions". The reason for their thinking this way was seeing different unexpected things, experiencing every exhibit and exploring art-related subjects in various scientific exhibits, especially in science center (out-of-school) activities. Here are some examples from the reflective diaries:

S5: I was happy to see different places. I was happy to create a rainbow when I refracted shadow, color and light with color schemes (Reflective Diary-I).

S4: I had a lot of fun. I was amazed at the way the light was refracted. Almost every new event in the monochrome room excited me (Reflective Diary -I).

S6: I felt good seeing different things. I learned color differently than I learned in the painting class (Reflective Diary -I).

S7: The work of the artists shown to us was amazing. It was very close to the applications in the exhibits we saw at the science center. I learned many different things (Reflective Diary -III).

Similar expressions can be seen in the diary of the visual arts teacher: “They experienced each exhibit, took photos, felt like a part of the exhibit and enjoyed it” (13.04.2022). There are also expressions in the reflective diaries that suggest students experienced "complex feelings". Expressions such as “Weird” (S5), “It was fun but a bit confusing” (S1), “Very complex” (S2) show that students had different emotions within the scope of the new information they discovered. This emotional state is also depicted in reflective diary drawings. While the student (S5) visualized her anxiety about the concept of "Light" in Image 6, another student (S8) reflected the confusion she experienced as a result of the difference she saw in Image 7 with a question mark.

Image 6. S5- Reflective Diary -I

Image 7. S8- Reflective Diary -II

Positive feelings of the students continued during the activities they did in the school after the visit, which they also expressed in the reflective diaries and focus group interview records. According to the findings, it can be said that the interest created by the science center is directed towards artistic activities. It was found out in the students’ diaries that the reason for the positive emotions is that the students worked with materials other than the art materials they know, interacted with other course subjects, and worked with new techniques and methods. Some of the expressions in the students’ diaries are as follows:

S9: I'm excited because we work with different materials. Here, we combine the subjects we have seen in other lessons with art (Reflective Diary -III).

S6: I had so much fun. We did a pattern study. We needed to create a layout with geometric shapes. I liked my design. We can go on infinitely with our design that we created based on the pattern (Reflective Diary -IV).

S8: We did very different things from the works we had done before. Except for the pattern study, the other two studies were different for me. I was not aware that artists were so interested in scientific subjects and applied them to works of art (Focus Group Interview).

Students (S9 and S6) were excited to establish links between concepts and other course subjects. A student (S8) expressed her astonishment about the relationship/interest of the artists with scientific subjects. A similar expression to this was also seen in the teacher's diary.

"They first saw the spatial works of Olafur Eliasson, Yayoi Kusama and Canan Tolon, and then they were surprised when they came across exhibits very close to them in the science center. They were excited when I asked them for comments similar to those works" (Researcher's Diary-19.04.2022).

In general, the students' feelings about the activity processes are positive though they experienced confusion from time to time. While it was observed that the students experienced the pleasure of learning new information in the science center activities, this turned into the pleasure of creating something new in the artistic activities held in the school after the visit.

What did they learn/discover?

The findings show that interaction with the science center contributes to students' learning and understanding concepts such as color, light and visual perception, which are the subjects of art. In their reflective diaries, it was observed that the students often responded with the names of the subjects that are related to the names of the exhibits in the science center such as the use of color, optical illusions, refraction of light, and absorption of light, to the question "What I learned in today's activity...". Moreover, focus group interviews provided data on what students learned. In this context, it can be said that the students had the opportunity to understand the cause-effect relationships in the subjects related to art. For example, in the focus group interview, the student (S2) said, "I learned how the colors of light are formed. You know, I learned how different pictures look appropriate [to the light]", while expressing his awareness of the change of color based on light. Another student (S6) reflected her awareness of acquiring new knowledge with the statement "I saw that colors are important in optical illusion, but the way of using shapes is more important". Some of the students' statements are as follows:

S1: There were optical illusions. I learned how they are made, why they occur and how they affect our vision (Focus Group Interview -II).

S5: We entered one room at the science center. It had turned into a monochromatic room with yellow light. I was impressed with it. We didn't get rid of the colors in the classroom, but with a single color, by giving purple light, we made neon colors shine more. We obtained the purple light by wrapping dark blue acetate around a white fluorescent lamp (Focus Group Interview -II).

S6: We saw that the color can change with the light or can be used differently than what we learned in class. We saw different aspects of it from what we learned in our color painting lesson at the science center (Focus Group Interview -II).

S1: There was something like a convex mirror. The picture on the floor appeared flat. If I had seen such a thing before, I would have thought that something meaningless would come out, but I understood why. When I saw the original picture, I learned what an anamorphic setup is. It's great (Focus Group Interview-II).

The statements above are an indication that students question the concepts they know from a new perspective and reconstruct the new information they have learned by comparing it with previous information. The most repetitive code in the sub-theme of transforming what students have learned into an original artistic form was "searching for alternative ideas". The students constantly searched for a new order on the effects of different materials. “Aesthetic anxiety” played a leading role in the installations they created. For example, in the first activity called “Color and Light”, students were expected to transform what they learned into an artistic narrative after they experienced their knowledge of color in related exhibits (e.g. monochrome room) and focused on the works of artists. Images 8, 9 and 10 created within the scope of this activity are the interior and exterior views of the installation named “Infinite cubes” of the student.

Image 8. S1

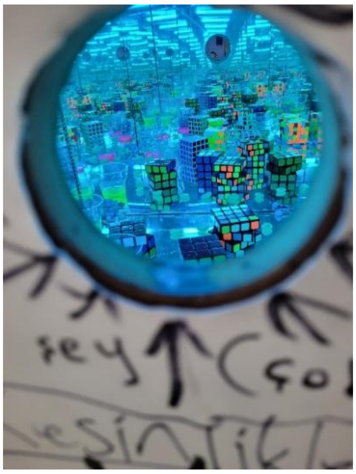

Image 9. S1

Image 10. S1

S1 used the following expression in the focus group interview for his work seen in Images 8, 9 and 10.

S1: I worked with my friend in this study. We both loved Rubik's cubes. The surface colors of the Rubik's cubes we chose were neon colors, which would make them look better under purple light. That's why, we thought of doing this study. Then, we thought about what and where we could place it, and we came up with such a study. Before choosing these cubes, we cut plastic materials, and then we decided on this because we love Rubik's cubes (Focus Group Interview-II).

Interviewer: How do you expect the audience to feel when they look at this work?

S1: It is like an absorbing structure. I want them to feel like they are in a huge room rather than a single box (Focus Group Interview-II).

The expression of the student indicates the aesthetic anxiety of the students in the process of creating, constantly experimenting with different materials and turning to a material with which they are emotionally connected. The student wants his audience to feel the emotional experience he had in the monochrome room at the science center.

Image 11. S5

Image 12. S5

Image 13. S5

In Images 11, 12 and 13, the materials chosen by the student (S5) and her friend for the installation and the transformation process of the study can be seen. Before reaching the final result, the students searched about what results the effects of different materials would lead to. The student's views on his installation are as follows:

S5: In our first study, we worked with the Quantum ball. The lights inside the quantum ball moved when they were plugged into electricity, and a very beautiful image was formed in the mirrored box. Our physics teacher gave us information about it. For example, the image inside this ball is the fourth state of matter. Then, we experimented and changed the work a little. It was very good. Neon colors glowed more under violet light, while non-neon ones did not show their own colors. We mixed all the neon colors with water and put them in bottles, we mixed all the water and stuff. It was very different. If I wanted to name it, I would put a "friend's icon". In fact, where we put that plastic, we drew a heart on the ball there. We used plastic waste material and took advantage of the transparency of plastic bottles and painted them with neon pens. We used more neon colors to bring it out more and placed neon colored stones in an arrangement next to them. We put in rose-like things to create a bright neon effect, but it didn't turn out as we expected. It didn't shine very brightly (Focus Group Interview-II).

Interviewer: What do you expect people to think when they look at your work? What do you want them to imagine?

S5: I would like them to question how neon colors glow under purple light and to show that exhibits made with mirrors can be works of art with different materials. In other words, I would like people to create works of art inspired by different objects. After all, they find and see it thanks to my design. If there is a work of art from different things, they can say that they can do it too, and they can get inspired (Focus Group Interview-II).

As seen in the statement of the student, it is understood that thinking through material and artistic values such as the movement effect of light obtained with a quantum ball, the transparent effect created by plastic materials, the transformation of paper by taking different forms, neon-colored water and designs and strengthening the color effect happen together. It is seen that the students are pushing the possibilities and limitations of the equipment they use. It is understood that the student is motivated by the belief that different and unusual use of materials will inspire people and create new ideas for them.

The student (S7) named her installation in Images 14 and 15 "Neon ships". In this installation, it is seen that the students think about a theme. In order to create the water effect, the students tended to think through concepts related to water.

Image 14. S7

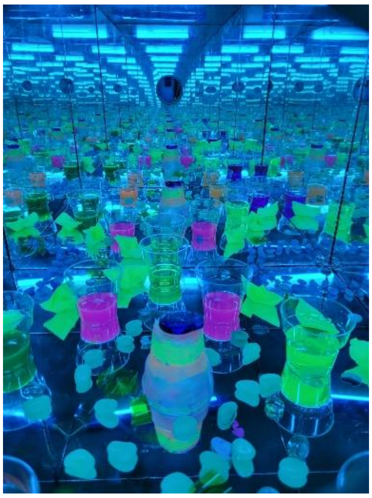

Image 15. S7

The views of the student (S7) in the focus group interview are as follows:

S7. We made ships out of neon-colored crepon paper. Then, we lined up the neon-colored stones, trying to give the feel of water and a waterfront, which made the ships stood out better. We used them because they are more eye-catching and visible under purple light, but we wanted to do something a little more. After the experiment video our teacher showed us, we took the paints of neon colored felt-tip pens into the water and put them in transparent plastic cups and placed them in our setup. We liked it when it was finished (Focus Group Interview-II).

The explanations made by the students on their artistic installations show that they think about the concept (color), technique (installation) and theme (water and depth), and they constantly experiment on the effects of different materials for an installation with a strong aesthetic aspect. The visual arts teacher also expressed the students' pursuits and emotional and aesthetic reactions in the process in the researcher's diary as follows:

Although we tried many different materials, we did not get the result we wanted at first. Therefore, the students had a hard time understanding what we were going to do. When we exactly prepared the neon light and neon-colored materials and showed different artistic examples, it became easier for them to perceive the event and make artistic designs. First, they were not satisfied with the placements they made. Therefore, they constantly changed the materials they used in the installation. In this way, they reached the result that they were satisfied with (Reflective Diary - 29.04.2022).

The second activity, called visual illusions, was carried out to make students think about visual perception processes and to support their visual thinking and imagination skills. For this purpose, in the "Perception and Reality" gallery, lens table, water lens ball, infinity view, perspective room and cognitive illusions exhibits were examined. In order to make students think about concepts such as seeing, reflection, and illusion, the artist M.C. Escher, Victor Vasarely, the important representative of optical art, and three-dimensional effective examples of street art on roads and pavements were examined. Anamorphic images, which were among the lens exhibits experienced during the visit, guided the artistic application process of the students after the visit.

Two elements draw attention in the visual illusions-anamorphic art works that emerged in this context. These are the transfer of experience and the use of daily aesthetic experiences. Students tended to transfer their experiences of color and light in the first study to this study. While creating their images, they used materials such as pots, teapots and thermos for the convex form at home (Image 16, Image 17, Image 18).

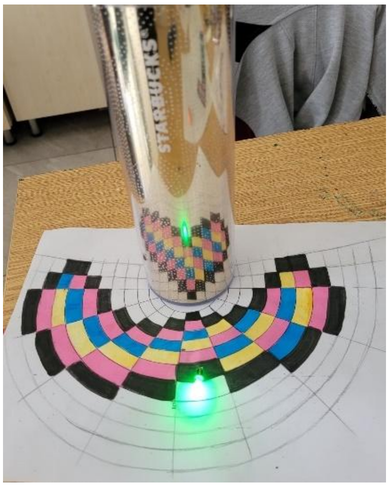

Image 16. S2

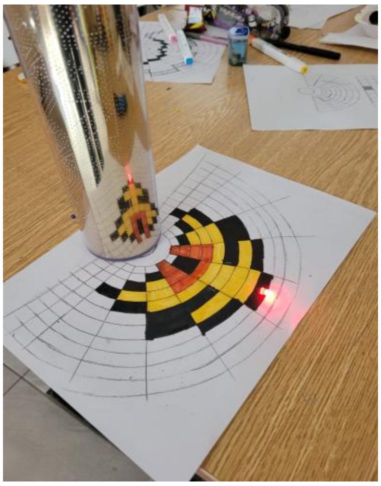

Image 17. S1

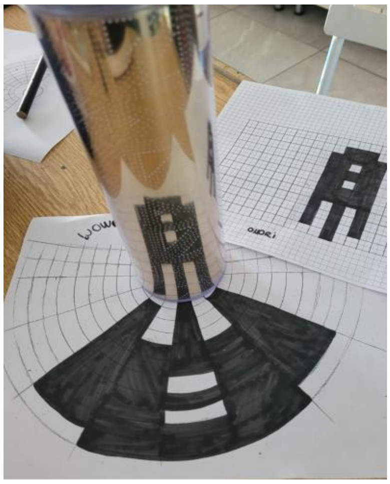

Image 18. S6

In Images 16 and 17, it is seen that the students add light to the works they have created. In visuals 17 and 18, the starting point of the students is the game characters in the digital world. A student (S6) stated about her study that "Teacher! That is the character himself. I was inspired by a game character (Focus Group Interview -II)". The students were inspired by the digital game characters because the small square arrangements on the anamorphic paper were associated with the computer pixels. The visual arts teacher also wrote the following in her research diary:

> *They formed their favorite images on the anamorphic surface. They described their work as being similar to Pixel art. For the convex image, they sent photos of their works with materials such as pots and teapots, which they made at home. They wanted to add LED light to the works. This pleased the children and me. In the designs they created, they generally wanted to use the game characters. I thought that they might have got inspired by them because they enjoyed it (Researcher's Diary - 11.05.2022).*

In the third activity, called Geometry and Art, it was aimed for students to focus on the relationship between geometry and design and to explore the relationship between aesthetics and mathematics. Concepts such as pattern, golden ratio, geometric decoration, and formal aesthetics were the basic concepts of the activity. Before the visit, students examined examples of the golden ratio in art and nature, and Escher and Anatolian Seljuk decorations. During the visit, they experienced the "Geometric Art" setup in the gallery called "Sultans of Science" (Image 19). After the visit, the students were expected to transform their experiences into a pattern by transforming the geometric form given to them. S2 (Image 20) and S7 (Image 21) expressed their thinking behind their work as follows.

Image 19.

Image 20. S2

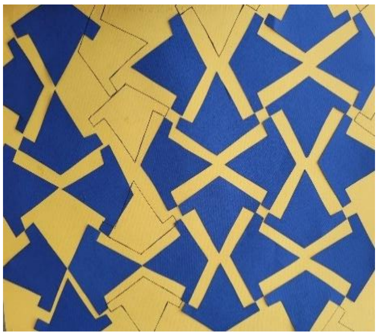

Image 21. S7

S2: We had a diamond-like geometric shape. There was also a shape like a fish tail, so we decided to make the shapes we took out of the square look like fish. We decided to turn it into fish together. Then, we glued them with moving eyes and arranged them with warm and cold color combinations as if they were moving. The patterns here can be colorful fish, so I want to show people that patterns can also take these shapes. This can get fun though, so here's a very simple repetition of the square. We made very small changes. It was nice. I want them to realize this (Focus Group Interview -II).

S7: In this study (Image 21), we benefited from the patterns found in Ecsher's works. We used the opposite color purple on yellow. We tried to understand where the unit comes from, where it goes, how it creates a pattern in an order. In other words, we thought is as negative or positive (Focus Group Interview -II).

The statements of the students in the focus group interview show that they think about concepts such as pattern, order, rhythm (repetition) and ratio. On the other hand, the applications show that students discover new expression methods about art. The students claimed that their perspectives on art expanded in terms of subject, material usage, technique and attitude. For example,

S6: We can make art out of anything. It taught me that (Focus Group Interview -II).

S5: It taught me to make art with everything in different environments (Focus Group Interview -II).

S2: Now I think about art that things are not just done on paper anymore. The important thing is to learn something new and science. This may be the separation of light (Focus Group Interview -II).

S8: I think there is so much we can try in our own work. Everything can be the subject or tool of art. I learned this (Focus Group Interview -II).

The activities reveal that students do not only tend to transfer what they have learned not only between subjects, but also contribute to the development of different ideas about transferring them to their real lives. When the students were asked where they could use the experience they gained through the activities in the focus group interview, they talked about the transfer.

S5: Teacher, I would use it in interior architecture because a pattern is formed by arranging them side by side. I can make a wall design (Focus Group Interview -II).

S4: For example, we could use it in the construction of the pavement, such stones sometimes go in order (Focus Group Interview -II).

S9: We can also use that anamorphic art in some designs. I can't remember it right now, but it would be very effective when used (Focus Group Interview -II).

S2: It can be used on the clothes worn by miners to highlight them in dark. For example, fashion designers can use and pay attention to it (Focus Group Interview -II).

The artistic creation process has a subjective dimension. How students transform the information they receive or how they interpret it within their own point of view can be observed in the explanations they make about their artistic works. During the activity, students were expected to transfer what they learned conceptually from the exhibits in the science center to their imaginative thinking processes. In this context, it can be said on the basis of the findings that the experience in the science center contributed to learning that will boost students' creativity.

Where did they struggle?

Reflective diaries show that students and teachers experienced some difficulties in the process. Some of the students, especially young children, stated that they had difficulty in understanding some subjects and exhibits at the science center. For example, while S5 stated "Visual illusions in the perspective room confused me" (Reflective Diary -I) in the student's diary, she also drew a picture of the confusion she experienced in the perspective room. S1 used the expression "The part where we can examine pupil of our eye, where we examine the blood cells in our eye…, How colored things become black and white (Reflective Diary -I)" and depicted the confusion he experienced in his drawing.

Image 22. S5

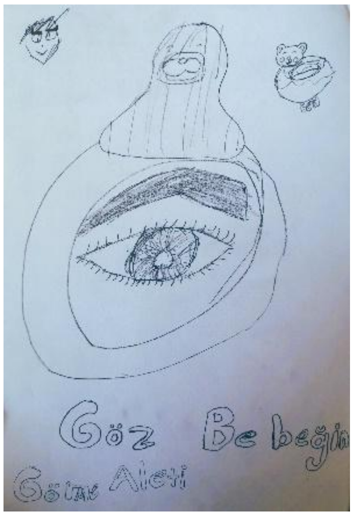

Image 23. S1

As shown in Images 22 and 23, it was seen that the content of some concepts they learned in the art class such as "Perspective, color, vision", and the new information they discovered in the experiences at the science center contradicted, and this challenged the students. In particular, students' reflective diaries show that the "optical reflections" section put a lot of strain on the students. In fact, the visual arts teacher also thought that the students had difficulty in understanding some exhibits, and the reason for this was that they did not have any experience with these subjects in their school lessons and expressed his views as follows:

> *I realized that my younger students did not understand. While younger children had difficulty perceiving, older children perceived it more easily. Since my 8th grade students had seen these subjects in their classes before, they were involved in the subject more quickly and in detail (Researcher's Diary, 18.05.2022).*

S8 and S9 are 8th grade students. The responses they gave in the focus group interview support the teacher's observation.

> *S8: We revised the information we had covered in other lessons and had the chance to see the information we will cover in our future educational life (Focus Group Interview -II).*

> *S9: We revised a lot of information we had covered in the science lesson during our trips. There are good examples of refraction of light, some of which we have encountered before. Yes, we both refreshed our knowledge and learned new things. The ones related to light and color most attracted our attention because we will use them in our works (Focus Group Interview -II).*

Concerns experienced by the visual arts teacher conducting the activities during the activity processes emerged as keeping the student's attention constantly active and managing the process, giving feedback and not feeling competent about activity-related non-art disciplines. The teacher reflected the difficulty he experienced in managing the process in his diary as follows:

> *Some of my students participated in science center activities while some others did not. However, since they were in the same group, I matched a participant with a non-participant student and had them carry out the in-class practice studies. My attempt to keep students who participated and did not participate in the activity together sometimes caused students to lose interest and made it difficult for the activity to run as planned. Actually, my aim was to carry out the process in this way and to enable the students who had the experience in the science center to transfer knowledge and experience to other students who did not through peer learning (Researcher's Diary, 12.05.2022).*

Volunteering was an important criterion for participation in the study. For this reason, some students from the teacher's course groups participated in the science center activity process while some others did not. While this creates difficulties for the teacher in the management of the process, it is expressed in the reflective diaries that it causes the student to be distracted. The visual arts teacher said that immediately after the activities in the science center, the application studies should continue in the science center itself by stating "Since my students came on different days, I had difficulty in providing integrity or giving feedback to the student" (Researcher's Diary, 27.05.2022). Another concern of the teacher about feedback is that as she wrote in his research diary "Because my field is not mathematics or science, I avoided giving incomplete or incorrect information. For this reason, especially in the application phase of the first study, I contacted the physics and the mathematics teachers in the study about patterns" (Researcher's Diary, 27.05.2022). On the other hand, the visual arts teacher expressed his feelings in the last research diary as "The process was difficult, but the products were impressive. Parents of my students were very pleased with the exhibition and the work done. My students wanted to share how they did their work with everyone in the exhibition, and I enjoyed their excitement. I might have even learned more from the students in this process".

Discussion, Conclusion and Suggestions

This research focused on exploring student experiences that emerged from a science and art-based project prepared in the context of the science center collection for students in the field of Science and Art Center visual arts. In the program, it was aimed that students could transform their discoveries in the science center into original artistic products with an interdisciplinary perspective. 7 out of 9 participating students are students who had not visited the science center before. In this sense, it can be said that most of the students do not have previous life experiences related to the collection in the science center. Moreover, in the context of the interdisciplinary nature of the project, it was concluded that the students had tendencies to use scientific knowledge (mathematics, science, social studies) in artistic studies, or they had awareness of the relationship between science and art, despite limited. "The interdisciplinary approach integrates knowledge and methods from different disciplines using an actual synthesis of approach. There is a mutual exchange of information between different disciplines" (Çolakoğlu, 2019, p.35). In this sense, it was seen that the students established and realized the interdisciplinary relations between art and mathematics through concepts such as measurement, ratio and shape, and they explained the relationship between science and art through "observation", which is one of the first steps of generating ideas.

It can be said that the visit to the science center and the activities held in the classroom afterward aroused "excitement, happiness and complex emotions" in the students. The process is expected to arouse interest, excitement or to cause some confusion in the student. The fact that the science center had not been visited by most of the students before and the experience of a different learning environment outside the school contributed greatly to this. However, it can be said that the structure of the exhibits that appeals to different senses and allows feedback, rich data content and their experience-based fun side also have an effect on this interest and excitement. Moreover, it was concluded that the activities carried out in the science center and afterwards were effective in raising the student's awareness of learning. It was found out that students experienced the pleasure of learning new information in science center activities, and then they had the pleasure of creating something new in school activities.

It is important for the student to encounter sensory stimuli that will trigger their creativity in the process of artistic creation. It was seen that the science center offers rich learning experiences to the students in understanding the cause-effect relationship (causality) of art-related subjects and exploring a different context of the information learned in the visual arts course, in a way that contributes to imaginative thinking. It was concluded that the students were able to interpret the subjects and concepts they learned from their own perspectives and transform them into a new artistic form. It was observed that the students searched for new ideas and materials in the artistic creation process on the basis of the task requested from them, and they challenged the possibilities and limitations of the materials they used. They tended to add moving objects, real light (bulb), or some visual effects provided by technology such as pixels and computer game characters to their works in relation to the subject stood out. According to Kırışoğlu (2014), “Using a tool in a different way by pushing the limits of possibilities, approaching a subject in a different way than everyone else, finding new ways while solving a problem in a study are behaviors that can be defined as creativity in children” (p.16). From this perspective, it was observed that students constantly sought different ways due to aesthetic concerns. It can be said in the context of the focus group interview records that they had to recall what they learned in the science center in every search they carried out on the material. However, it is not possible to say that the artistic works of the students reflected the depth of the scientific knowledge they had learned. No information about this could be obtained from the reflective diaries of the students. The visual arts teacher also stated that the students, especially the younger students, had difficulty in making sense of what they learned about color, light, or visual illusions in the science center. On the other hand, it was concluded that the activities carried out expanded the students' perspectives in artistic production in terms of subject, material use, technique and attitude, and gained a more flexible perspective on art beyond sharp boundaries. As a matter of fact, Herrmann (2005) states that a learning environment that will enable students to understand that art is not only about the creative use and transformation of materials, but also about the transformation and restructuring of ideas should be created. In this research, the interdisciplinary learning environment has a great contribution to the transformation and restructuring of ideas. In fact, the results of a study conducted by Kim (2018) in which the effect of interdisciplinary practices in art education on creativity were analyzed showed that interdisciplinary practices have a significant impact on the development of learners' creativity.

There are some difficulties experienced during the implementation of the program. Although the students have completed the Science and Art Center adaptation program, the voluntary participation of the students was taken as the basis in the research. This has led to student participation from different levels between the ages of 10 and 14. It was found out that young students had difficulties in understanding some subjects and concepts in the science center. This was not the case for older children. The reason for this is that two students aged 14 are already familiar with some of the subjects and concepts in the science center thanks to the lessons they had at school. Older students established inter-concept or interdisciplinary relationships faster. As a matter of fact, the studies conducted by Anderson, Lucas Ginns, and Dierking (2000) and Gerber, Cavallo, and Marek (2001) show that students' previous knowledge affects the extent and depth of their conceptual gains gained from their experiences in the science center (as cited in Adadan & Karapınar, 2019, p. 107). However, this result may not be interpreted in the sense that an adequate learning does not occur in young children. "According to Wellington (1990), interactive science centers contribute to the cognitive field in two ways. The first is its direct contribution, which is related to providing new knowledge that certain things happen under certain conditions. The second is the indirect contribution, which is related to sowing seeds and ensuring separation with memories that can ultimately lead to understanding" (as cited in Adadan & Karapınar, 2019, p. 106). As a matter of fact, the artistic works created by the students and the experiences shared through these works show that the students internalize the process. The visual arts teacher, who carries out the implementation process, thinks that it is more sensible to plan the artistic works there after the science center experience in order not to decrease the interest of the student and to ensure integrity. She stated that she had difficulty in managing the process due to the structure of the weekly syllabus in Science and Art Center. Moreover, she stated that she was worried about giving the student incomplete or incorrect information in other disciplines such as physics and mathematics, which are integrated into the artistic learning process. For this reason, she felt the need to interact with the Physics and Mathematics teacher of the school in unexpected situations in the classroom. Although the management of the process is difficult for the teacher, it is another result of the research that the original artistic works and the richness of learning from interdisciplinary interaction satisfy the teacher. In a study they conducted, Yürümezoğlu, Karabey, Yiğit Koyunkara, and Enginoğlu (2019) proposed an innovative method for teaching colors to gifted individuals. In the activity, complementary colors and their areas of use were examined in an integrated manner in physics, mathematics and art. Analyzing the phenomena using the methodologies of different disciplines provided a holistic view of the phenomena and the opportunity for learners to learn by discovery. For this reason, it is recommended that gifted individuals with many interests can be guided more accurately with an interdisciplinary education on the basis of lifelong learning so that they can exhibit superior performance. In addition, it was stated in the study that it is important to ensure the continuity, integrity and connectivity of learning in and out of school.

This research is based on the argument how the science center collection can enrich artistic learning by activating students' perception and understanding abilities. Therefore, it has many contexts in terms of interdisciplinary integration from the science center collection and in terms of differentiating the education of gifted students from the perspective of out-of-school learning and Science and Art Center. The use of museums as out-of-school learning environments is common in visual arts education. However, it is pointed out in the literature (Çağlayan, 2020; Özsoy, 2019) that it should be diversified to produce different artistic ideas due to the increasing interest in out-of-school learning environments. Teaching in different places requires systematic planning of course activities in relation to the content of the place. In this research, considering the science center as an out-of-school learning environment has carried the artistic learning process to an interdisciplinary dimension. Interdisciplinary interactions also made it difficult to define goals. However, although the definitions of concepts, expectations, values and methods differ between fields, it is possible to establish partnerships by discussing the desired results. Since science refers to mental thinking and art to intuitive thinking skills, distance can sometimes come between them. In fact, Alioğlu (2010) defines art and science as "two human occupations that developed around the verb "seeking" but whose main veins overlap" (p. 226). Arnheim (2009) sees art and science as a joint product of the effort to understand and explain "reality" and characterizes both as the signature of things perceived by the sensory world. However, he states that art speaks with images while science does so with concepts. According to Alioğlu (2010), "the institutionalization and development of today's science and art has broken the relations between them and turned them into two separate institutions that almost despise each other" (p. 225). However, it is seen that the distance between these two structures has been converged/transformed by both scientists and artists in the context of art-science collaborations or inspiring each other. The Royal College of Art in London, which is considered one of the most important art schools in the world, announced in early 2019 that it plans to expand its curriculum to include science and technology (Faramarzi, 2019). The number of these interactions will increase. According to Özdemir (2012), the unpredictable destructions caused by science education carried out in a one-dimensional way under the guidance of the mind and technique are insufficient for individuals to gain multidimensional and in-depth understanding and reach life satisfaction. For this reason, science education should also be enriched with aesthetic processes.

In conclusion, in this research, student achievements can be briefly summarized as discovering the creative possibilities that scientific knowledge will bring to their artistic work and developing a more flexible perspective on art in terms of subject, material use, technique and attitude. In recent years, the number of science centers has increased in our country with the help of local municipalities and the support of The Scientific and Technological Research Council of Türkiye. The planned new projects show that the number of these centers will continue to increase. Just like museums, science centers also need to be brought into visual arts course activities. It is possible to associate the contents and exhibits in the science center with contemporary art practices. In the programs to be prepared, connectivity can be ensured with the interests, studies and methods of artists that will surprise and excite students. In this study, an integrated content with art, science and mathematics was prepared. The content can be enriched even more by making it a part of the curriculum on subjects related to social sciences. Collaborative working groups can be established in schools so that teachers specialized in different fields can plan out-of-school learning.

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