

# Determining the Space Camp Experiences of Gifted Girl Students

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**Abstract:** It has been demonstrated that space camps represent the most appealing informal learning environments for students. The objective of this research is to provide a detailed account of the experiences of gifted girl students before and after their space camp participation. As part of the research, the students participated in a 6-day programme at a space camp supported by NASA, the second of its kind in the world, located in Turkey. The study involved a sample of five gifted sixth-grade students enrolled in secondary school. An embedded single case design, representing a qualitative research design, was employed in this study. In this research, semi-structured interview questions and the drawing technique were utilised as qualitative data collection tools. The NVivo 11 programme was utilised for the purpose of data analysis. The experience of attending the space camp had an emotional and cognitive impact on the gifted girl students. It was determined that experience-based activities at the space camp supported the career orientation of gifted students. This situation demonstrates that the space camp is a powerful educational tool that has the capacity to transform curiosity into scientific thinking, nurture areas of interest, and shape potential career orientations.

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The authors affirm that artificial intelligence did not contribute to the process of preparing the work. Ethical Statement.

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## **Introduction**

**E**DUCATIONAL activities are conducted in student-centred environments guided by teachers, extending beyond the confines of the school. Informal learning environments have been shown to support formal education in schools by incorporating informal settings and offering a more enjoyable and flexible structure (Oktay & Sen, 2020). These environments encompass open spaces such as school grounds, playgrounds, zoos, aquariums, botanical gardens, national parks, and natural monuments, as well as enclosed spaces within institutional structures such as hospitals, sports centres, museums, science centres, planetariums, and space camps.

Informal learning environments have been shown to foster creativity in children and support their cognitive and emotional development (Davies & McGregor, 2020). Research has demonstrated that informal learning environments facilitate the development of students' science skills, enable them to learn by exploring different scientific topics, and are effective in stimulating their scientific curiosity (Bozdogan, 2018; Laçın Şimşek, 2020). Participation in informal learning environments has been demonstrated to result in higher levels of knowledge and skills, greater physical strength and motor skill development, and the demonstration of leadership, social, and environmentally friendly characteristics (Davies & McGregor, 2020). The experiences offered in informal learning environments have been shown to engender heightened interest and participation in science among students (National Science Teachers Association, 2012). These environments also serve to reinforce scientific concepts and practices in a school setting.

Informal learning environments have been shown to facilitate students' attainment of long-term learning outcomes through engaging experiences, as well as fostering the development of a scientific identity by enabling them to comprehend the methodologies of scientific research (Bozdogan, 2018). Informal learning experiences have been shown to be a significant factor in increasing the number of students proficient in STEM fields and guiding students towards careers in these areas (Hitt, 2017). Informal learning activities have been shown to provide experiences that can support the development of students' STEM identity (Knezek & Christensen, 2020).

Platforms that facilitate the transfer of knowledge between theoretical and practical domains in the field of space science have been

shown to engender curiosity through the provision of interactive and hands-on learning experiences. This, in turn, has been demonstrated to encourage future generations to pursue careers in STEM (Science, Technology, Engineering and Mathematics) fields. It is evident that space camps employ a variety of activities to facilitate the comprehension of complex aerospace concepts and to render space exploration more accessible to the general public. These activities include astronaut training simulations, rocket launches and robotics workshops (Behboudi et al., 2025).

Surveys conducted with graduates who participated in space camps during childhood and are now in the workforce reveal that 88% of participants took more STEM courses after the camp, 71% work in a STEM-based field, and 66% of those working in this field state that the space camp influenced their career choice (Hitt, 2017). As asserted by Fields (2009), an observation has been made that students participating in space camps appear to evolve reflective identities associated with science. Space camps that are supported by the European Space Agency (ESA) have been designed to cultivate young people who will become experts in science and who will be interested in working in the space sector in the long term (Ercolani, Kowalczyk, Saccoccia, & Bartilla 2018). There is a paucity of studies that directly compare mixed and girls-only informal STEM learning experiences. It has been demonstrated by several studies that the participation of girls in informal STEM experiences has a positive effect on their self-efficacy (Schilling and Pinnel, 2019; Sanders et al., 2024).

Informal learning environments have been shown to engender opportunities for students to cultivate interest, readiness, and capacity for science, technology, engineering, and mathematics (STEM) learning both in and out of school (NSTA, 2012). These opportunities have the potential to facilitate a deeper comprehension of the intricacies of scientific disciplines, their pertinence to everyday life, and the multifaceted nature of engagement with scientific inquiry. The National Science Teachers' Association (NSTA) has advocated for the expansion of these opportunities to encompass all students, with a particular emphasis on those from communities that are underrepresented in STEM fields. In numerous countries worldwide, women continue to be underrepresented in STEM professions (UNESCO, 2018). It is imperative to recognise that ensuring equitable access to STEM education and careers for girls and women is not merely an optional extra, but rather an indispensable component of human rights, scientific advancement, and sustainable development (UNESCO, 2018). Moreover, the sustainable development

goals include the promotion of equal access to education for girls, the provision of quality education, the promotion of gender equality, and the reduction of inequalities. The provision of STEM education at an early age has been demonstrated to hold significant potential in terms of transforming gender perceptions and increasing girls' participation in STEM fields (Erol, Demir, & Erol, 2025). Consequently, this research was conducted with female participants who are underrepresented in STEM fields at a space camp where they experienced astronomy.

The first of NASA-supported space camps is the U.S. Space and Rocket Centre in Alabama. The second is Space Camp Turkey, which is located in Izmir. Izmir Space Camp is an institution that facilitates STEM education for students between the ages of 7 and 18 through the mediums of rocket science, robotics, and aerospace programmes. The institution's modern facilities and engaging curriculum are designed to cultivate interest in space technology throughout the region. The objective of this space camp is to motivate young people to pursue careers in science, mathematics and technology (Space Camp Turkey, 2025). The programmes implemented at the camp, which are in line with STEAM learning approaches, aim to increase participants' interest in science and guide them in questioning and critical thinking. The space camp employs simulations that engender a sense of living and working in space among participants in these educational programmes. According to the National Research Council (2009), simulations are defined by the majority of researchers as ideal environments for the learning of science. Simulations facilitate the customisation of the learning environment by students, thereby rendering the learning process more realistic. Simulations have been shown to facilitate direct experience and interaction with abstract, ideal, complex, or otherwise inaccessible scientific phenomena, thereby engaging students in collaborative, active, and problem-based learning (NRC, 2009).

A key aim of Turkey's National Space Programme is to cultivate proficient human resources in the domain of space. In accordance with this aim, it is intended to cultivate children's fascination with space and motivate them to pursue careers in this domain (Turkish Space Agency, 2022). The female students participating in this research received training through the Turkish Space Travellers Programme, which was conducted in collaboration with the Ministry of National Education, the Turkish Space Agency, and Space Camp Turkey, with scholarships provided by Space Camp Turkey. Participation in space camps is an expensive undertaking. As stated by Fields (2009), the financial outlay required for a 13-day space camp in Alabama can reach up to 1,700 US dollars. The

financial obligations associated with the six-day Space Camp programme in Turkey amount to approximately 1,100 US dollars, as indicated by Space Camp Turkey (2025).

The extant research on informal learning environments is limited when restricted to space camps, with only a small number of studies available. A number of studies have been published which provide introductory information about space camps supported by NASA (Bigham, 2019; Hitt, 2017; Perkins, 2007), ESA (Ercolani, Kowalczyk, Saccoccia & Bartilla, 2018; Hansen, Bendiksen & Henninen, 2003), and in Japan (Wakabayashi et al., 2019). A number of studies have been conducted with students participating in these camps (Knezek & Christensen, 2020; Kulegel & Topsakal, 2020; Aktamıs, Acar & Unal Coban, 2015; Fields, 2009). Participants in space camps, which are informal learning environments, gain experience in this field through simulations. A recurrent theme in the examined studies is the utilisation of interviews as a methodological approach to elicit discourse pertaining to these experiences. The present study is distinct from other research in this field in that it was conducted with gifted girl students. It has been demonstrated that gifted students may require career guidance at an earlier stage than their peers, as they tend to develop earlier (Moon, 2002; Yu & Jen, 2019). It has been hypothesised that individuals with high levels of giftedness are more likely to enter professions that require strict entry requirements and long orientation periods, and to advance rapidly in their careers (Hall & Kelly, 2015; Yu & Jen, 2019). However, despite their innate aptitudes, gifted girls frequently exhibit reluctance in pursuing careers within STEM disciplines (Boston & Cimpian, 2018). Gifted girl students who are interested in pursuing a career in a STEM field may find themselves compelled to alter their career aspirations during their secondary education, a phenomenon that can be attributed to adverse school experiences (Grant, Battle, & Heggoy, 2000, Yu & Jen, 2019). To this end, a study was conducted on a group of gifted secondary school girls in an informal learning environment. The aim of this study was to provide a detailed account of the experiences and perceptions of these students before and after their space camp experience. In this case study, the following research question was addressed: What are the views of the gifted female students who participated in the study regarding their space camp experience in Turkey?

## **Method**

## ***Research Model***

In the study, an embedded single-case design from qualitative research designs was used to describe the changes experienced by gifted girl students attending a science and art centre before and after their space camp experience. A case study is defined as the examination, investigation, and description of a phenomenon within its real-life context (Yin, 2013). Moreover, the analysis of the students' perceptions of the space camp, based on both their drawings and their responses to interview questions, led to the selection of this design.

## ***Study Group***

The participants in this study comprise five gifted girl students enrolled at the Science and Arts Centre (BİLSEM) located in a district of a major city. The participants were enrolled in a space camp that was organised under a cooperation protocol between the Ministry of National Education and the Turkish Space Agency (TUA). The participants are students aged 12-13 who have been identified as gifted by the Ministry of National Education and actively participate in scientific activities. Furthermore, the students are pursuing their education at a state secondary school. The principal target demographic of NASA-supported space camp initiatives is secondary school-aged children. It has been determined that middle school represents a suitable period for the cultivation of an interest in science that will endure into high school, university, and subsequent career life (Knezek & Christensen, 2020). The students hail from families that lack the financial means to cover the space camp fee, and their participation was made possible through a scholarship.

The study specifically included only girl students. The aim of the selection of participants was threefold: firstly, to increase female students' interest in space science and technology in the context of gender equality; secondly, to support their career potential in this field; and thirdly, to encourage girls to pursue STEM fields. Consequently, 'critical incident sampling' was selected from among purposeful sampling methods to determine the participants.

## ***Ethical Considerations***

Prior to the research process, the parents of the participating students were informed about the purpose and procedures of the study, and written

parental consent was obtained. The students' identity information was kept confidential in accordance with ethical principles.

## ***Space Camp Activities***

During the six-day space camp, students engaged in a variety of activities. Following breakfast, the students participated in a four-hour training session, subsequently followed by a five-hour session after lunch and a two-hour session after dinner, thus amounting to a total of 11 hours of training per day. A number of the activities were presented by experts, after which question-and-answer sessions ensued. In certain activities, students participated in simulations under the guidance of camp educators and with the requisite safety procedures in place. In the course of the programme of events, students participated in a series of hands-on projects. Information was obtained through a process of observation and documentation, undertaken during visits to the laboratories and exhibitions at the camp. Furthermore, the students underwent training in the planetarium and conducted observations through telescopes. Due to legal restrictions, it is not possible to disclose all of the activities in which the students participated. The activities that are listed on the camp's official website (Space Camp, 2025) and those in which the students participated are shown in **Table 1**.

The images of the students who participated in the space camp are displayed in **Figure 1**.

## **Data Collection Tools**

In this study, semi-structured interview questions and drawing techniques were utilised as qualitative data collection tools.

In the first stage of the data collection process, a semi-structured interview form developed by researchers was used to gain an in-depth understanding of the participants' level of knowledge, areas of interest, expectations and experiences regarding the space camp. The administration of this form occurred in two stages: before and after the camp. Before the camp, students were asked three open-ended questions. The objective of these inquiries was to ascertain the students' pre-camp knowledge level, their emotional disposition towards the camp, their expectations of the camp process, and the experiences they desired to acquire at the camp. Following completion of the camp, students were invited to respond to two open-ended questions. The purpose of these

**Table 1. Activities Conducted at The Space Camp.**

Activities	Explanations
Discovery virtual space flight mission	In this activity, which simulates the work carried out in real space shuttle missions, each team member is assigned a role such as space shuttle commander, flight engineer at the space station, or flight manager at the ground control centre. The tasks assigned to students necessitate the assumption of responsibility, the dissemination of information, and the execution of collaborative work in order to achieve success, or, conversely, to demonstrate an inability to do so. This process also serves to facilitate the demonstration of leadership skills.
Simulations	Astronaut, Virtual Mars Tour (Mars explorers), Hurricane 360 VR (virtual reality adventure), Riot 3D Ride (3D space adventure), Use of equipment adapted from NASA's astronaut programmes
Observations with a telescope	The Sun, the Moon, and the planets
Digital planetarium	Identifying constellations
Presentations and exhibitions	Space exploration, astronaut suits, Mars colony design and presentation



**Figure 1. The images of the students who participated in the space camp**

inquiries was to ascertain the knowledge that students had acquired by the end of the camp, to identify the positive aspects of the camp activities, to assess their satisfaction levels with the camp experience, to evaluate the camp's impact on their professional orientation and career goals, and to measure their interest in the national space agency and the scientific fields they encountered there.

The following questions were prepared by the following three individuals: one faculty member specialising in science education and astronomy education, one science teacher with a PhD in astronomy

education, and one science teacher with a master's degree in astronomy education. These questions were then sent to three subject experts to ascertain their expert opinion. Subsequently, the interview form was finalised based on the feedback received from the aforementioned experts.

In the second stage of the data collection process, the drawing-based approach was selected for the purpose of determining the participants' mental models of space camp. In this context, students were tasked with producing visual representations in accordance with the following two instructions:

Before Camp: "Draw a picture of your dream space camp and explain why you drew it."

After Camp: "Draw a picture of the space camp and yourself during the camp and explain why you drew it."

The students were invited to provide a concise description of their drawings in their own words.

## **Data Analysis**

In this study, content analysis was employed to analyse data obtained from semi-structured interview forms. The NVivo 11 programme was utilised for the purpose of data analysis. The research findings were transferred to the relevant programme, and the data obtained were grouped under common categories and codes. The data was visualised using mind maps. A comparative analysis of before-and-after camp data was conducted.

In the second stage of the research, the data obtained from the students' drawings were examined within the scope of visual data analysis, and a descriptive analysis was performed. Weber and Michell (1996) posited that drawings represent a highly efficacious means of evaluation, particularly in circumstances where individuals are unable to articulate their thoughts and emotions verbally. In the context of this study, the students' drawings were examined before and after the camp, with all explanations being read and analysed. In this analysis, the drawings were examined under the following themes.

1. Scientific concepts and technology
2. Emotional indicators and social interaction
3. Career orientations

When analysing the drawings made by the students, the following operational definitions were employed as a basis: The presence of planets, stars, spacecraft or technological devices in the drawings was examined, as was their level of scientific accuracy. These findings were then coded

under the overarching theme of ‘scientific concepts and technology’. Thematic analysis was employed to evaluate the ‘emotional indicators’ represented by facial expressions, such as smiles and curiosity, as well as interactions between figures in the drawings. The students were categorised under the overarching theme of ‘career orientations’ in instances where they depicted themselves or other figures using telescopes or in astronaut suits, or where they expressed their aspirations to pursue a career in a scientific field.

The formula proposed by Miles and Huberman (1994),  $[\text{Consensus} / (\text{Consensus} + \text{Disagreement}) \times 100]$ , was utilised to ascertain the consistency between the analyses conducted by the expert faculty member and the responsible author in the field of science education and astronomy education. The percentage of agreement between the expert in science education and astronomy education and the responsible author has been calculated as 90%. In order to ensure the transferability of the research, the data obtained were described in detail and purposive sampling strategies were employed.

## **Findings**

In accordance with the study’s aims, the findings obtained from responses to interview questions completed before and after the camp have been systematically categorised and coded. The categorisation and coding system is outlined in **Table 2** below.

**Table 2** shows that students have coded the concept of ‘space camp’ in their minds with ideas such as having fun with friends, simulations, space experiences, and learning about space. During the space camp, it was determined that students wanted to 3D reality environment, moonwalk, observe planets, learn everything about space, and Walking in zero gravity. The word cloud created based on the students’ responses is shown in **Figure 2**.

As illustrated in **Figure 2**, the terms “space,” “information,” and “thinking” emerge as the most frequently cited concepts in the students’ responses.

As illustrated in **Figure 3**, a coding comparison diagram, the data set reveals a change in career choice preferences among students participating in the study before and after the camp.

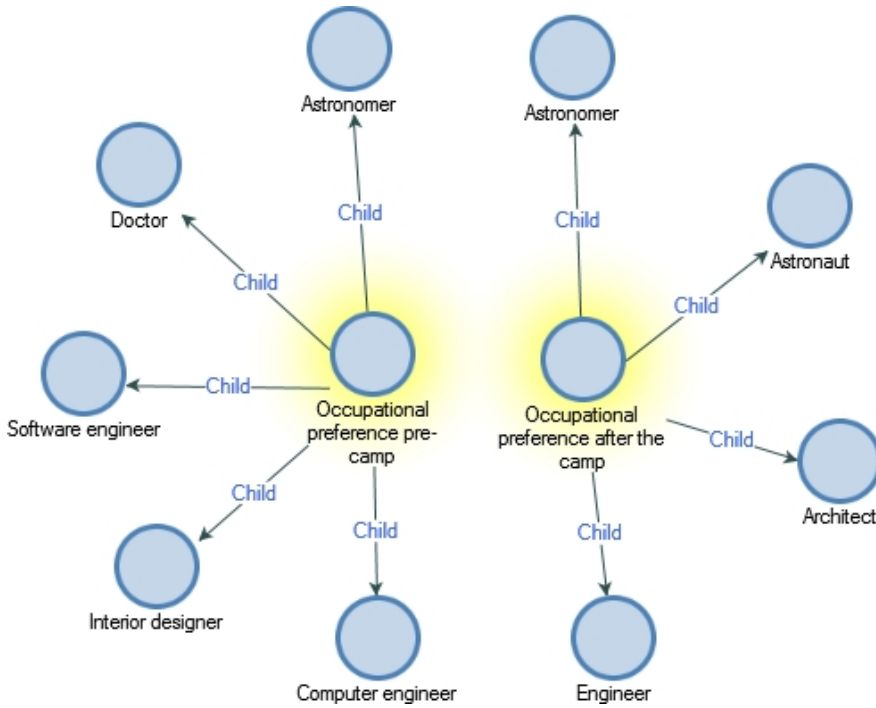
**Table 2. Categories and Codes Regarding Students' Responses to the Concept of "Space Camp"**

Categories	Codes
What do you think of when you hear the words "space camp"?	Having fun with friends
	Simulations
	Space experience
	Camp with space instruments
	Find out more about space
What kind of experience are they looking for at the camp?	Experience the 3D reality environment
	Moonwalk
	See the planets
	Everything about space
	Walking in zero gravity



**Figure 2. Word Cloud of the 30 Top Words from Answers to the Question "What Do You Think of When You Hear the Words "Space Camp"?"**

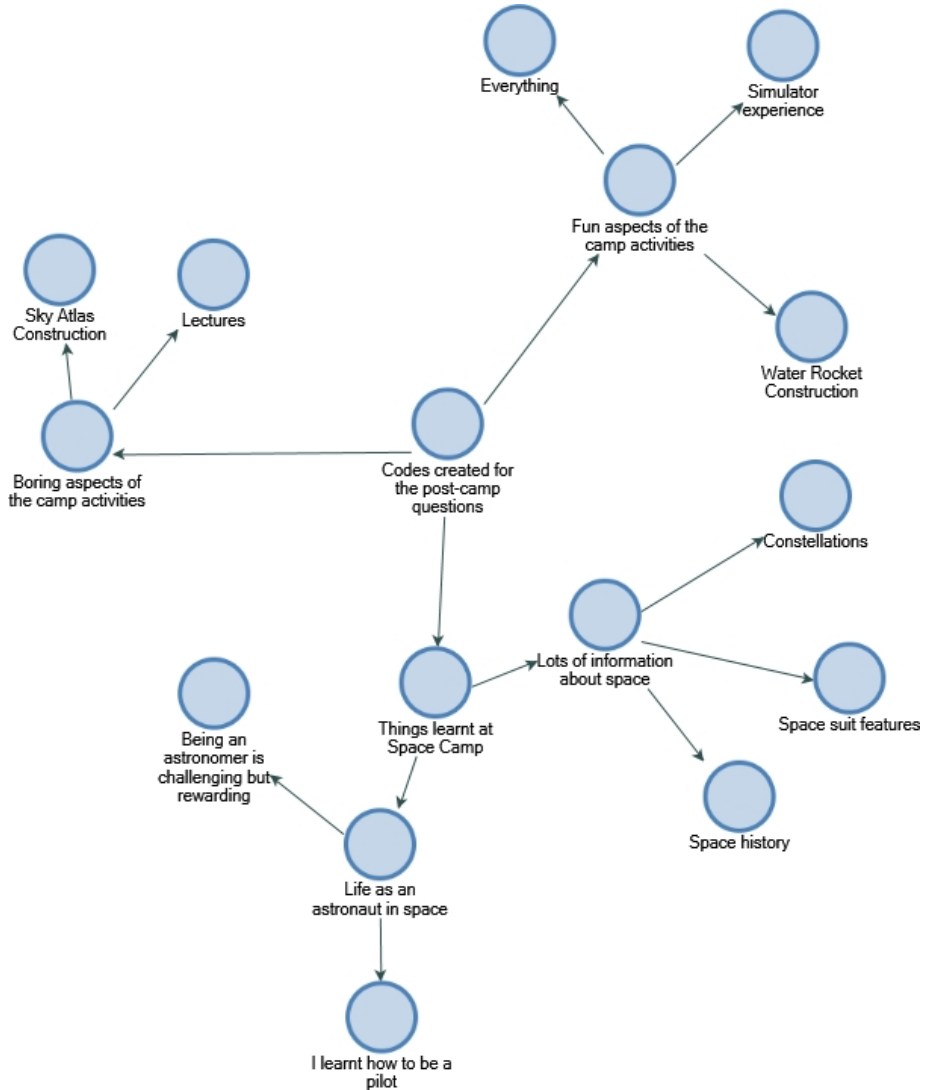
As demonstrated in **Figure 3**, the students participating in the study highlighted professions such as astronomer, computer engineer, doctor, interior designer, and software engineer before the camp; however, after the camp, they cited the concepts of astronomer, astronaut, engineer/architect. It is also noteworthy that after the camp, all participants expressed an interest in working at the Turkish Space Agency, with the exception of one individual.



**Figure 3. Coding Comparison Diagram Demonstrating Changes in Students' Career Choice Preferences Before and After the Camp.**

**Table 3. Categories and Codes for Students' Responses to Questions Regarding their Experiences after Space Camp.**

Categories	Codes
Fun aspects of the camp activities	Everything
	Simulator experience
	Water Rocket Construction
Boring aspects of the camp activities	Lectures
	Sky Atlas Construction
Things learnt at space camp	Life as an astronaut in space
	Being an astronomer is challenging but rewarding.
	I learnt how to be a pilot
	Lots of information about space.
	Constellations
	Space history
	Space suit features



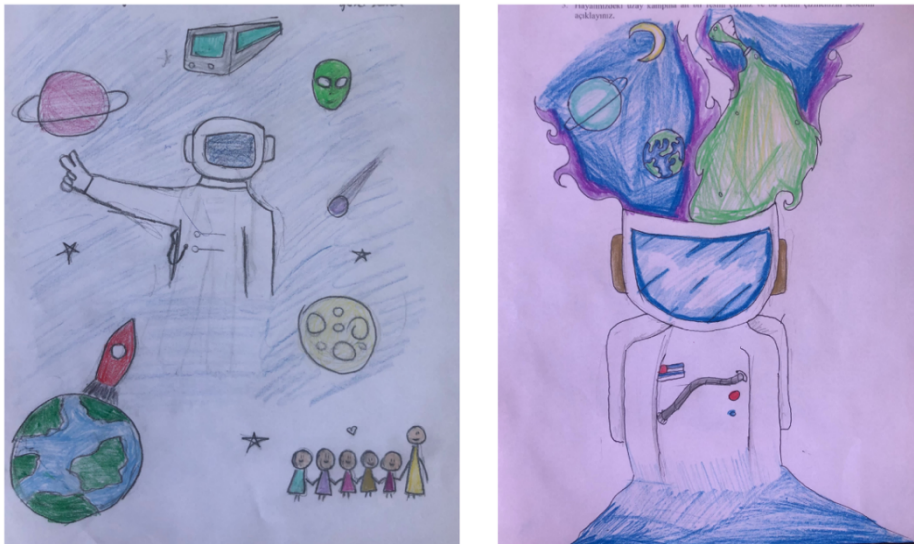
**Figure 4. Coding Comparison Diagram Presenting the Categories and Codes of Students' Responses to Questions Regarding Their Experiences After Space Camp.**

The categories and codes corresponding to the responses given by the students participating in the study to questions about their experiences after the space camp are presented in **Table 3**.

As illustrated in **Table 3**, within the domain of after-camp experiences, the simulation code was frequently emphasised in the category of “fun activities,” with students asserting that the entirety of the activities was found to be enjoyable. The students provided a negative

**Table 4. Findings Regarding the Visual Analysis of Student Drawings before Space Camp.**

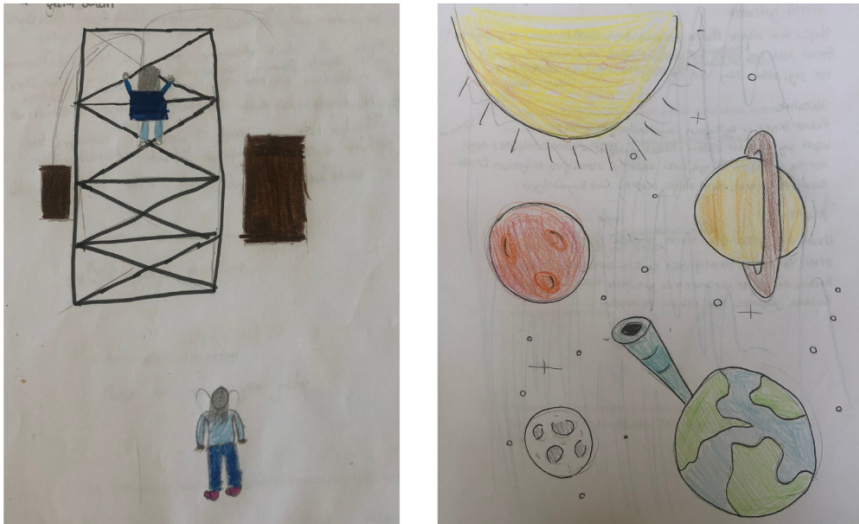
Student	Symbol and Spatial Elements	Emotional Indicators	Interpretation
S1	<ul style="list-style-type: none"> <li>▪ Planets</li> <li>▪ Planetary rotation</li> </ul>	No emotional representation	<ul style="list-style-type: none"> <li>▪ A conceptual, knowledge-based approach.</li> <li>▪ Technical thinking about space</li> </ul>
S2	<ul style="list-style-type: none"> <li>▪ Planet</li> <li>▪ Simulation</li> </ul>	The dream of technology-orientated learning	The expectation of interactive learning in space education.
S3	Simulation - Moonwalk	-----	A technology-based space camp dream.
S4	<ul style="list-style-type: none"> <li>▪ Planet</li> <li>▪ Train</li> <li>▪ Astronaut</li> <li>▪ Star</li> <li>▪ Comet</li> <li>▪ Earth</li> <li>▪ Spacecraft</li> <li>▪ Alien</li> <li>▪ Teacher</li> <li>▪ Students</li> </ul>	<ul style="list-style-type: none"> <li>▪ Imagination</li> <li>▪ Social learning area</li> </ul>	<ul style="list-style-type: none"> <li>▪ Desire to be an active participant</li> <li>▪ Expectation of integrating science and entertainment into the experience</li> </ul>
S5	<ul style="list-style-type: none"> <li>▪ Astronaut</li> <li>▪ Thought</li> <li>▪ Planet</li> <li>▪ Moon</li> <li>▪ Flasks</li> </ul>	<ul style="list-style-type: none"> <li>▪ Interest in science experiments</li> <li>▪ Imagination</li> </ul>	The prospect of exploring space.



**Figure 5. Examples Of Drawings Created by Students Before the Space Camp.**

**Table 5. Findings from the Visual Analysis of Students' Drawings after the Space Camp.**

Student	Symbol and Spatial Elements	Emotional Indicators	Interpretation
S1		<ul style="list-style-type: none"> <li>▪ Fun</li> <li>▪ Satisfaction</li> </ul>	An opportunity to experience the antigravity environment first-hand.
S2	Zero gravity wall		An opportunity to experience the antigravity environment first-hand.
S3			An opportunity to experience the antigravity environment first-hand.
S4	<ul style="list-style-type: none"> <li>▪ Sun</li> <li>▪ Earth</li> <li>▪ Planet</li> <li>▪ Moon</li> <li>▪ Telescope</li> </ul>	Satisfaction	<ul style="list-style-type: none"> <li>▪ Experience using a scientific observation tool.</li> <li>▪ Observe concepts in observation-based astronomy.</li> </ul>
S5	<ul style="list-style-type: none"> <li>▪ Astronaut</li> <li>▪ Spacecraft (Discovery)</li> <li>▪ Planet</li> <li>▪ Meteorite</li> </ul>		<ul style="list-style-type: none"> <li>▪ Observe concepts in observation-based astronomy.</li> <li>▪ Orientation to profession choice</li> </ul>



**Figure 6. Examples of Students' Drawings After the Space Camp.**

evaluation of the lectures and the sky atlas construction, describing them as boring. Furthermore, students expounded on the scientific concepts and professions they had learned about in astronomy.

The students' responses to questions regarding their after-camp experiences are also visualised in **Figure 4** in the form of a coding comparison diagram.

## **Findings from the Drawings**

A preliminary analysis of the students' drawings before the camp yielded the following findings. The findings are presented in **Table 4**.

As shown in **Table 4**, before visiting the space camp, students produced drawings including elements such as planets, astronauts, simulations, and spacecraft in their drawings. In their explanations, they mentioned the information and experiences they would learn about space.

Examples of the drawings made by the students before the space camp are provided in **Figure 5**.

A subsequent analysis of the students' drawings yielded the following findings following the conclusion of the camp. The findings are presented in **Table 5**.

As illustrated in **Table 5**, within the after-camp drawings, three students specifically noted the 'zero gravity wall' experience. The drawings of other students feature real objects, such as telescopes, meteors, the Moon and spacecraft, as well as observation-based scientific concepts.

Examples of the students' after-space camp drawings are shown in **Figure 6**.

## **Results, Discussion and Recommendations**

This study examined the changes experienced by gifted girl students before and after their space camp experience. The findings demonstrate that before the camp, the students conceptualised space camp more in terms of simulations in their imaginary worlds, planets and socialising with friends. Participants, specifically in the S4 drawing, used their imagination to create a contextually unusual but creative drawing featuring aliens, and the teacher and students' drawings also emphasized learning in a social context. It can be seen that students emotionally associated the experience they would have at the space camp with their imagination. In their drawings, elements such as planets, astronauts, spacecraft and simulations were prominent, revealing that the students'

expectations prior to the camp were oriented towards a scientific-technological learning environment. In the study conducted by Fields (2009) on the perceptions of young people participating in space camp, it was also concluded that students' scientific knowledge underwent a process of deepening. The recurrent emphasis on the expectation of 'simulation' signifies the pivotal role attributed to technological equipment by students.

Following the conclusion of the camp, a number of significant changes were observed in the students' perceptions, both cognitive and emotional. It was demonstrated that the activities experienced by the students had a permanent impact on their learning, as evidenced by the reflection of simulations based on concrete experiences, such as the 'zero gravity wall', in their drawings. Moreover, the incorporation of observational elements, such as telescopes, meteorites, the Moon, and spacecraft, into the illustrations suggests that the camp facilitated the development of scientific concepts related to astronomy among the students. Kulegel & Topsakal (2020) found that students who participated in the space camp derived enjoyment from the simulations and gained experience of space. The study concluded that informal learning environments such as space camps have positive effects on students. The research observed that students performed their duties in a teamwork environment during space shuttle missions and developed their critical, questioning, and thinking skills by discussing the subject with experts. Moreover, the results of this study demonstrated that the subjects derived pleasure from the experience of using the simulators. The integration of digital simulations, interactive applications, and informal learning environments within the teaching process is advocated to facilitate the establishment of accurate relationships between students and astronomical concepts (Cetin, 2025). Authentic and active learning experiences have been demonstrated to contribute to the internalisation of science learning (Knezek & Christensen, 2020). The incorporation of scientific observation instruments and phenomena (e.g., telescopes, meteorites, the Moon) into the students' post-camp drawings further substantiates the notion that the camp engendered cognitive enhancements. Informal science education has the capacity to be effective in the development of students' social and cognitive learning areas, whilst also making good use of their free time (NRC, 2009).

The findings of the interviews indicated that, before the camp, students exhibited a wide range of career preferences, including astronomer, computer engineer, doctor, and interior designer, among others. However, after the camp, a shift in career aspirations was

observed, with a notable concentration towards careers in astronomy, astronautics, and engineering/architecture. A notable finding is that the student with code S5 drew an astronaut and the Discovery spacecraft, indicating a professional orientation. It is also worthy of note that the vast majority of students expressed a desire to seek employment with the Turkish Space Agency following the conclusion of the camp. This finding demonstrates that the camp exerts a significant influence on the shaping of students' career orientations. It is evident that experience-based activities, such as space camps, have a significant impact on the professional orientation of gifted students. This situation demonstrates that space camps are a potent educational instrument capable of transforming curiosity into scientific thinking, cultivating areas of interest, and shaping potential career orientations. Research conducted on an international level has yielded analogous results. A study conducted by Kager (2015) indicated that following participation in a STEM camp, female students in middle school discovered new STEM fields, reshaped their career orientations, and that hands-on activities, in particular, increased their motivation. This finding is consistent with the results of the present study, which emphasises the transformative function of camps in the vocational orientations of female students. Participation in space camps has been demonstrated to engender positive identities related to science, which are then associated with the rest of the students' lives (Fields, 2009). Informal learning environments provide students with direct access to career role models in the field of science (NSTA, 2012).

This assertion is further substantiated by the feedback provided by students in relation to their after-camp experiences. The students reported a positive experience, with particular emphasis on team-based activities such as simulations and water rocket construction. The sky atlas activity, which had been previously encountered at the Science and Art Centre, was regarded as tedious due to its repetitive nature. Furthermore, students have asserted that the camp has furnished them with knowledge on a variety of subjects, including the life of astronauts, the history of space, celestial constellations, the development of space suits, and the intricacies of piloting spacecraft.

The findings indicate that the space camp is a potent informal learning environment that fosters the scientific curiosity of gifted girl students, transforms their career orientation, and engenders both affective and cognitive gains. The fact that students' concept of their ideal space camp has evolved towards tangible experiences and future-oriented professional objectives serves as a testament to the efficacy of this process.

Social interaction and emotional expectations are more pronounced in some of the drawings, particularly S4. The analysis of these illustrations suggests that the students perceive the space camp as an educational and exploratory endeavour, rather than merely a recreational activity. The integration of informal science education has been demonstrated to enhance students' engagement with scientific disciplines, facilitating the exploration of cognitive, emotional, and social domains (NSTA, 2012). Fields (2009) observed that one of the subjects most frequently discussed by young people participating in science camps was the friendships they formed with their peers. It is emphasised that this feature fosters a shared interest in astronomy among students and that their relationships develop through collaborative work on projects. Kulegel & Topsakal (2020) found that students participating in space camps developed increased interest and curiosity in astronomy, gained in-depth knowledge, and improved their peer relationships. Aktamis, Acar & Unal Coban (2015) observed that students participating in space camp derived enjoyment from the activities, were motivated, and acquired knowledge on astronomy topics. Informal science education has been shown to facilitate moments of intellectual curiosity between adults and students (NSTA, 2012).

In view of the modest sample size, it is clear that further research is required in order to provide a comprehensive analysis of the outcomes for students in the context of learning experiences in gender-based informal space camps. Furthermore, the findings of this study indicate that space camp experiences have a significant impact on students' career orientations. Consequently, it is recommended that gifted students, particularly girls, be encouraged to participate in such camps. The students' drawings and interviews, which were based on concrete experiences, demonstrate that practical activities have a significant impact on learning. It is therefore recommended that camp programmes include a greater number of practical and interactive activities. The findings demonstrate that the career preferences of the students changed both before and after their participation in the camp, thereby substantiating the efficacy of informal learning environments in influencing career orientation. Consequently, it is recommended that camp experiences be integrated into the education system with greater frequency and systematicity.

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