PROBLEMS
OF EDUCATION
IN THE 21st CENTURY
Vol. 80, No. 6, 2022
792

THE OPINIONS AND NEEDS OF SCIENCE CENTER INSTRUCTORS: THE CASE OF GOKMEN SPACE AND AVIATION TRAINING CENTER (GUHEM)

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Abstract

This study aimed to examine the opinions of the instructors who work at GUHEM (Gökmen Space and Aviation Training Center) on the exhibition's content, how the exhibition spaces contribute to science education, especially astronomy and aviation, and the types of visitors who frequently visit the center. Nine instructors from GUHEM's science centers participated in the study. Data were gathered using the "Instructor Opinion Form," with nine open-ended questions. The data elicited from these questions were subjected to content analysis. The findings showed that children aged 6 to 11 made up the majority of visitors; the fascinating exhibition areas focused on the Solar System and planets and interactive workshops with space and aviation themes, like those involving paper airplane construction and rocket competition, were very popular. In terms of the contribution of this center to science education, it was found that the GUHEM exhibitions played an active role in teaching the solar system, planets, and pressure. Although astronomy is the discipline with which the exhibition areas are most closely associated, it can also be linked to other disciplines like astrobiology, mathematics, and aviation. Instructors shared their worries that they won't be able to meet visitors' expectations and occasionally struggle to understand the subject during activities held at GUHEM. These findings led to the opinion that GUHEM and other science centers will function more effectively if schools and science centers collaborate more, the curriculum and exhibition content are improved, and the instructors receive professional assistance from academicians who are subject-matter experts.

Keywords: *astronomy and aviation, instructor, needs, opinion, science center*

Introduction

Nowadays, science education techniques must include a pedagogical and technical approach that blurs the lines between schools and science centers, including students and teachers. Science is mainly carried out in three types of learning environments. Classroom, laboratory, and out-of-school learning environments are examples of these environments. Among the most effective learning strategies is one in which students take an active role in their learning, learn by doing, associate the subjects they study with their environment, and connect with their social lives. Out-of-school learning environments (OSLEs) are at the forefront of where this understanding can be most effectively implemented (Eshach, 2007; Falk et al., 2007). Museums, aquariums, botanical gardens, zoos, and science centers, as well as visits to the natural environment, can help students appreciate the lessons presented in the classroom (Bozdoğan, 2007; Sturm & Bogner, 2010). OSLEs provide students with unique, interesting science learning experiences and various science teaching tools for classroom teachers. It is now widely acknowledged that critical thinking and creativity, as well as problem-solving, communication, digital, social, intercultural, and linguistic skills, are required for students to understand and act in society in an informed and reflective manner (Baptista, 2017). It is not

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sufficient to teach students scientific concepts, theories, and facts in order to develop their competencies. It will also be necessary to create learning situations that promote competency development. Science teaching has been liberated from one-way information transfer processes (stagnant structures) by new teaching strategies and transformed into a structure that activates students' science process skills (problem-solving, observation, deduction, etc.) (Gülçiçek & Güneş, 2004). As a result, such situations must appeal to and are relevant to students by making sense to them and involving them in their learning. Science educators must thoroughly understand how people learn science and the skills and dispositions necessary to promote meaningful learning at their individual levels of science teaching (Lamanauskas, 2012). In this context, there is a need for environments that will facilitate the science teaching process of educators and encourage individuals to learn science. One of the most popular of these environments is science centers.

Science centers, a type of OSLE, play a significant role in science education. Most studies demonstrate that science museums and centers play an essential role in science education in OSLEs (Bell et al., 2010; Stocklmayer et al., 2010). Science center visits in science education allow students to learn deeper and have more permanent information through experiments and demonstrations, use the scientific method, and gain scientific research skills (Griffin, 1998). Science centers increase students' interest in science and math in all aspects and enhance their attitudes, particularly when implementing what they have learned in school (Sample McMeeking et al., 2016; Şentürk & Özdemir, 2014). Slabeycius and Polčin (2012) discussed techniques for engaging primary and secondary school students in math and physics. They claimed that information and communication technologies are one of these methods. They also said that initiatives to increase the use of information and communication technologies can support this process. In this case, due to its technical infrastructure, science centers are believed to support the teaching of other subjects as well, including mathematics, geography, and especially science. Visits to science centers can also positively impact students with other science-related activities, such as watching TV documentaries, reading books, conducting research, experimenting, and deciding to become a scientist as a career (Alexander et al., 2012; Falk et al., 2007). Traditional science center/museum activities have begun to lose their former popularity due to growing Internet usage. Instead, the desire to give visitors a more interactive experience has been felt. As a result, exhibitions and fixed interactive activities focusing on students' excitement for 1-2 seconds have begun to be replaced by activities based on doing and understanding that can pique visitors' long-term interest. Practical interactive scientific activities have become standard at the majority of science centers in both developed and developing countries (Turkish Academy of Sciences, 2019).

One of the essential goals of science centers is to instill a love of scientific discoveries in students, educate them about the history of scientific breakthroughs, and motivate them to make their own scientific discoveries (Falk & Storksdieck, 2005). However, in recent years, these objectives of science centers have come under fire. The arguments are that it is impossible to make students love science by focusing solely on the entertainment aspect of the job and that students can't develop a long-term interest in scientific-related disciplines by focusing only on short-term enjoyable activities.

The complexity of scientific inventions and technological developments, which are difficult for ordinary citizens to understand, can be more understandable and concrete by revealing the relationship of concepts with daily life and nature. Therefore, science centers are becoming increasingly important in science education (Falk & Needham, 2011; Galanis et al., 2016). The exhibitions in science centers must be compatible with scientific reality, as well as the architectural beauty of the center for a good psychological experience, its acoustic layout, and its pedagogical features for effective learning space and experience, for this effect to occur on visitors (Koster, 1999; Gürsoy, 2022). Without these features, science centers will struggle to provide a good experience for visitors.

PROBLEMS
OF EDUCATION
IN THE 21st CENTURY
Vol. 80, No. 6, 2022

Science centers are expected to actively monitor breakthroughs in fields other than mathematics, science, and engineering and to hold exhibitions and workshops in these areas. When designing concepts for new science centers, the capabilities of current science centers to minimize repetition should be evaluated. Furthermore, the number of activities in science centers should be increased and varied and replaced regularly. Moreover, science centers should emphasize teacher education, particularly in the field of basic sciences, and develop unique programs within this framework. Since exhibition designs wear out after a certain period and their renewal imposes a significant financial burden, it is suggested that instructional programs (science workshops, laboratories) should be prioritized at science centers. On the other hand, employees working in science centers must be scientifically competent to explain science accurately and endear it to pupils. As a result, postgraduate and doctoral graduates should be favored for employment at these centers, and attractive and flexible working circumstances should be provided (Turkish Academy of Sciences, 2019).

When the characteristics of science centers were evaluated, it was noticed that the instructors working at the science center, as well as the physical qualities and exhibition places, should be qualified individuals in their profession. Visitors to science centers regard educators as the most knowledgeable (Gomes da Costa, 2005) and serve as the human contact between science and society (Iuliano, 2013). The instructor's communication skills, subject knowledge, and overall role are directly tied to the success of a class excursion (Rodari & Xanthoudaki, 2005). Science center instructors in general:

- Answer visitors' questions,
- Enable them to participate in activities actively,
- Help visitors with how the exhibition setup/experimental device works,
- Accompany the school groups throughout the visit,
- Use exhibits and events not to provide visitors with a textbook-style explanation of a scientific topic but rather to excite their interest in the field,
- Underline that science does not only consist of complicated mathematics and that everything around us has a scientific explanation; they provide a new perspective for perceiving daily events from a scientific point of view.
- Sometimes they repair broken test instruments/exhibition setups (Rodari & Xanthoudaki, 2005).

Teachers and instructors are expected to meet certain standards before, during and after the out-of-school learning activity in a science center. For example, instructors prepare students (visitors) before the trip, support the process with visuals, ensure active participation of students (visitors) during the trip, and collaborate with the teacher. After the trip, they have pedagogical responsibilities such as gathering feedback from students and teachers, evaluating students' individual and group work, and planning assessment and evaluation activities to support teachers (Kanlı et al., 2019). These pedagogical standards are anticipated to be fulfilled by instructors at all science centers and at GUHEM (The Gokmen Space and Aviation Training Center), which was founded as a thematic science center and has only recently begun to receive visitors.

When science centers around the world are examined, it is discovered that a small number of science centers are themed around space and aviation. The National Space Center in England, Cite Espace in France, Space Expo in the Netherlands, the National Air and Space Museum in the United States, and the Euro Space Center in Belgium are among the most popular. With recent developments in space and aviation in Turkey, societal awareness in this area is expected to grow. Therefore, it is critical to supplement young individuals' education in formal learning environments for space and aviation subjects with out-of-school learning environments.

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PROBLEMS
OF EDUCATION
IN THE 21st CENTURY
Vol. 80, No. 6, 2022

GUHEM (The Gokmen Space and Aviation Training Center) and Its Features

GUHEM (The Gokmen Space and Aviation Training Center) is a 13.500 square meter facility constructed under the leadership of the Bursa Chamber of Commerce and Industry (BTSO) in partnership with the Bursa Municipality and The Scientific and Technological Research Council of Turkey (TUBITAK). GUHEM is the first interactive space-themed center to inspire younger generations to pursue research in high-tech disciplines and enhance Turkiye's international competitiveness through indigenous and national technologies.

GUHEM aims to provide science enthusiasts of all ages with essential knowledge and experience in space, aviation, and technology and inspire younger generations by raising their awareness. With an emphasis on education and experience, GUHEM employs a modern, dynamic learning strategy that supports individual efforts through practices centered on experimentation and creativity. The center features 154 interactive education systems, an aviation training center, a space innovation laboratory, a chemistry, and biology laboratory, mathematics, robotic programming, space, and aviation workshops (Figure 1). In 2019, GUHEM, Europe's largest center and one of only five in the world earned an award in the category of Public Buildings at the European Property Awards (GUHEM, 2022).

Figure 1
Images of Different Parts of GUHEM

GUHEM is regarded as a science center that should be assessed holistically, considering all of its qualifications and experienced instructors. As a result, the purpose of this study was to gather opinions from GUHEM instructors about the GUHEM exhibition contents, the contribution of the exhibition areas to science teaching, and the visitor profiles visiting the center. Simultaneously, within the scope of this study, it was intended to assess the extent to which trainers feel themselves competent in terms of both pedagogical competency and field competence, as well as the points at which they wish to obtain assistance in this process. The study sought answers to the following sub-problems within the framework of this purpose:

1- What are the instructors' opinions about GUHEM?

2- How do instructors perceive their own self-efficacy in science teaching?

3- How do instructors perceive their own educational competence?

When the studies in the related literature were examined, it was discovered that, while there are many studies based on science centers (Bozdoğan, 2017; Çığrık, 2016; Çolakoğlu, 2017; Koyuncu & Kırgız, 2018), there are few studies on taking the opinions of science center instructors and evaluating the exhibition contents in this context. To that end, this study will contribute to the literature by obtaining detailed information about the performance of other science centers designed as thematic science centers in this manner, particularly GUHEM, as well as the instructor requirements. It will also show how advances in space and aviation are handled in thematic science centers, one of the most popular out-of-school learning environments.

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PROBLEMS
OF EDUCATION
IN THE 21st CENTURY
Vol. 80, No. 6, 2022

Research Methodology

Research Design

One of the qualitative research methodologies used in this study was the case study approach which makes it easier to explain a phenomenon in its context. This prevents focusing on the problem from a single perspective and offers a viewpoint that enables the phenomenon to be revealed and comprehended in various ways (Baxter & Jack, 2008). The study's focus was on the GUHEM instructors, as well as their opinions on the exhibition's themes, how the exhibition areas contribute to science education, the visitor types who visit the center, the degree to which they view their own pedagogical and professional expertise as sufficient, and the areas in which they would like support during this process. For these reasons, the case study approach was chosen as the most effective methodology.

Participants

Nine instructors that work for GUHEM took part in the study. Although the total number of instructors working in GUHEM was 14, only 9 of these instructors worked full-time. The remaining five instructors continued their duties on a part-time basis. Full-time instructors were included in the study because they spent more time with visitors and observed the environment for longer. In addition, seven of the instructors have previously visited another science center in Turkiye. Table 1 shows the instructors' demographic characteristics.

Table 1
Demographic Characteristics of Instructors

Gender	***f***
Female	5
Male	4
Age	
20-25 years	3
26-31 years	3
31-36 years	3
Profession	
Science Education	1
Biology Education	1
Physics Education	1
Aeronautical Engineering	1
Astronomy and Space Sciences/Science Communications	5

Procedures

The study's data-gathering tool comprised nine open-ended questions on an opinion form (GUHEM Instructors Opinion Form). The researcher created this form to ascertain the instructors' opinions about the age groups that frequently visit GUHEM, a science center themed around space and aviation, the available exhibition areas, and how these exhibition areas contribute to the teaching of science. In addition, it was prepared by the researcher to determine their views on the situations that forced them or caused the disruption of work during

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PROBLEMS
OF EDUCATION
IN THE 21st CENTURY
Vol. 80, No. 6, 2022

the visits to GUHEM and the situations in which they felt inadequate in guiding the visitors or they needed professional support. Two science educators who have experience visiting popular science centers in Turkiye (Konya Science Center, Bursa Science and Technology Museum), as well as science centers in cities like Lisbon (Pavilho do Conhecimento) and Copenhagen (Experimentarium) were asked for their professional opinions on the opinion form. As a result, the form's content validity was guaranteed. The instructors received the opinion form via email and had about a month to reply. It was created as an online form. The content of the opinion form is given in Appendix 1.

Data Analysis

Content analysis was used to analyze the data obtained through the opinion form. By grouping the obtained data under a particular topic or theme, the content analysis aims to conceptualize and interpret the data that are comparable to and connected to one another. In this method, data that have been logically arranged are presented in a way that the reader can comprehend (Yıldırım & Şimşek, 2011). Additionally, examples of expressions discovered using content analysis are included in the tables below, and the abbreviation 'I' was used for the instructor in the research. For example, I5 represents the fifth instructor.

Validity, Reliability, and Ethics

A qualitative researcher's strategies for ensuring consistency or reliability include triangulation, expert review, researcher position, and verification procedure (Richards, 2005). An expert opinion was obtained for the data collection tool prior to the study to ensure internal validity and credibility, and participants' voluntary participation was guaranteed. Multiple data sources were used for data triangulation. Two researchers recoded the study's data to verify coding reliability. According to Miles and Huberman (1994), there should be at least 80% consistency amongst coders for coding reliability and the internal consistency of the study. Following the simultaneous coding, the reliability of the coders was evaluated. Each researcher independently coded the data. Due to various discrepancies at the initial check, two researchers jointly examined the data, settled any code differences, and adjusted codes as necessary. They eventually reached an understanding of their coding. The intercoder agreement was 98% after the second check, and the coding procedure was reliable. The University Human Research Ethics Committee permitted the researchers to access instructors. The participants were assured that they had the freedom to leave the study at any moment, and their names were kept private.

Research Results

Within the scope of the study, the first question asked to the instructors was, "What age range do you think the groups that visit GUHEM are in general?" appears in the form. When the responses to this question were evaluated, six instructors stated that the majority of visitors to the science center were between the ages of 6 and 11. In comparison, three instructors noted that most of the visitors were between the ages 11 and 15.

The instructors were then asked, "What do you believe is the cause or reason that visitors visit GUHEM?". Table 2 shows the themes, codes, and frequency values that were generated based on the responses to this question:

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PROBLEMS
OF EDUCATION
IN THE 21st CENTURY
Vol. 80, No. 6, 2022

Table 2
Reasons to Visit GUHEM

Theme	Codes	Instructors	*f*
Be a topic of interest	Space and aviation	I1, I3, I4, I5, I6, I9	6
The structure of the center	Learn by doing/trying	I2	1
Feature of the theme	Have media coverage	I8	1
	Being a work-in-progress	I7	1

According to Table 2, most instructors see children's interest in space and aviation themes as the primary motivation for visiting GUHEM. Apart from that, the trainers state that the center's structure allows visitors to learn by experimenting and doing, that developments in space and aviation are frequently shared through the media and that the progress we have made as a country in this field are also reasons for visiting GUHEM.

The third question in the opinion form is, "What do you think is the most fundamental trait or feature that distinguishes GUHEM from other thematic science institutions in Turkey and other countries?". Table 3 shows the themes, codes, and frequency values generated based on the responses to this question:

Table 3
Features that Make GUHEM Different from Other Science Centers

Theme	Codes	Instructors	*f*
Being a thematic science center	Themes in aviation and space	I2, I4, I6	3
	Be different in content	I1, I2, I5, I6, I8	5
	Being the largest center in Europe	I8, I9	2
	Associated with other disciplines	I7	1
The design is unique	A large number of interactive devices	I1, I3	2
Features of the instructors	Expertise in their field	I1	1

According to Table 3, most instructors noted that the fundamental feature distinguishing GUHEM from other thematic science centers is that the display sections in its content are related to space and aviation and are given to visitors in a certain flow. Besides that, GUHEM's technological features, high-level products, and interactive mechanisms draw attention not only to space and aviation themes but also to other disciplines. The fact that each of its instructors is an expert in their field is cited as a distinguishing characteristic. The following are some of the instructors' responses to the prominent codes:

> *"Thematically arranged mechanisms can be experienced in a specific flow and story dimension. (I6)", "The fact that there are many interactive mechanisms and that it is a newly opened, up-to-date science center. (I3)", "Employees are subject matter experts, there are several interaction mechanisms. There are simulators and laboratory facilities located beyond the exhibition area. (I1)".*

The fourth question in the opinion form is, "Which discipline or disciplines do you believe the GUHEM exhibition areas contribute to learning?". Table 4 shows the themes, codes,

and frequency values that emerged from the instructors' responses to this question, which are then reinforced by sample quotations.

Table 4
GUHEM and Related Disciplines

Theme	Codes	Instructors	*f*
Related disciplines	Astronomy	I1, I3, I4, I5, I6, I7, I9	7
	Aviation	I1, I3, I4, I5, I6, I7, I9	7
	Physics	I1, I3, I7, I8	4
	Biology	I3, I7, I8	3
	Chemistry	I1, I8	2
	Technology	I1, I3	2
	Astrobiology	I7	1
	Math	I7	1
	History	I8	1

According to Table 4, most instructors claimed that the mechanisms in GUHEM contribute to the teaching of astronomy and aviation subjects in general. In addition to these subjects, instructors have noted that GUHEM supports teaching science disciplines such as physics, biology, and chemistry. On the other hand, the instructors believe that astrobiology, a current topic area that has just recently begun to be studied alongside technology, history, and mathematics disciplines, can be assisted by the mechanisms in GUHEM and the activities carried out there. The following are some of the instructors' responses to the prominent codes:

> *"It contributes to basic sciences within the theme of astronomy and aviation. (I6)", "I think it contributes to the teaching of disciplines such as science, history, and mathematics. (I2)", "In addition to having a direct impact on very basic and comprehensive sciences like physics, biology, astronomy, engineering, aviation, mathematics, and chemistry, I believe it also contributes to the learning of astrobiology. (I7)".*

The fifth question in the opinion form is, "Which of the GUHEM exhibition areas do you believe attract the most attention? Why?". The themes, codes, and frequency values derived based on the instructors' responses to this question are displayed in Table 5 below and supported by sample quotations.

PROBLEMS
OF EDUCATION
IN THE 21st CENTURY
Vol. 80, No. 6, 2022

Table 5
Interesting Exhibition Areas in GUHEM

Theme	Codes	Instructors	*f*
Space and astronomy	Planets	I1, I2, I3	3
	Doppler effect	I1, I3	2
	Robot arm	I1, I3	2
	Space technologies	I3	1
	Thermal camera	I1	1
Aviation	Simulators	I6	1
	A-320 Airbus	I7	1
	Delta wing	I1	1

According to Table 5, the majority of the instructors stated that the interesting exhibition areas in GUHEM are those related to space and astronomy. The instructors also noted that the simulators exhibited under the aviation theme, the exhibition space developed with a cross-section taken from a real A-320 Airbus, and the delta wing construction drew visitors' attention. I4, I5, I8, and I9 coded instructors, on the other hand, did not expressly mention an exhibition area, though they did state that space and astronomy were popular. The following are some examples of instructor responses:

> *"Space and astronomy because space has always piqued humanity's interest, and most people have dreamed about going to space. Humans are more interested in planets, stars, and galaxies. (I2)", "The exhibition area, built from parts of a real airliner named the A-320 Airbus, draws the greatest attention. I think the reason is that passenger jets, which are difficult to study in detail despite being utilized for travel in real life, can be presented in depth and immediately observed and tested. (I7)".*

The sixth question in the opinion form is, "Can you give an example of an interactive workshop activity with GUHEM visitors?". Table 6 shows the themes, codes, and frequency values that arose from the instructor's responses to this question, which are then reinforced by sample quotations.

Table 6
Interactive Workshops Held at GUHEM

Theme	Codes	Instructors	*f*
Workshops related to aviation	Paper (Model) airplane activity	I4, I5, I6, I8	4
	Flight adventure	I2, I3, I8	3
Workshops related to astronomy	Rocket competition	I1, I3, I5, I9	4
	Life on the Moon	I1, I7	2
	Soilless agriculture	I1, I3	2
	Amateur meteorite fishing	I3	1

According to Table 6, the instructors' perspectives on the interactive workshops offered at GUHEM were organized into two themes: aviation and astronomy. The flight adventure

workshops, which were presented in the form of creating paper airplanes and having participants experience flying in the presence of simulators, stood out among the workshops stated under the aviation theme. On the other hand, the astronomy workshops include rocket competitions, life on the moon, soilless agriculture, and amateur meteorite searching. Some of the instructors' responses are as follows:

> *"A flight adventure: Following the aviation presentation, participants fly with Cessna simulators." Following that, a model airplane workshop is held. (I7)", "Rocket competition: Participants create their own rockets and then launch them from the launch pad to compare the results. (I9)", "Agriculture and plant orientation motions in space: Hydroponic farming is used in a chemistry-biology laboratory. (I3)".*

The seventh question in the opinion form is, "Can you offer us any instances of science concepts that visitors to GUHEM learn in a short period?". Table 7 shows the themes, codes, and frequency values that stand out concerning the instructors' responses to this question, which are then reinforced by sample quotations.

Table 7
Science Concepts that Can be Learned in GUHEM

Theme	Codes	Instructors	*f*
Astronomy	Solar system and planets	I1, I2, I3, I6	4
	Gravity	I3, I8	2
	Eclipses of the Moon and Sun	I9	1
Physics	Pressure	I4, I5, I7, I8	4
	Simple machines	I1, I5	2
	Air friction and buoyancy	I7, I8	2
	Bernoulli's principle	I1, I5	2
Material science	Properties of materials	I1	1

According to Table 7, instructors stated that the exhibition areas in GUHEM contributed to teaching many science concepts. These concepts are gathered under the disciplines of astronomy, physics and materials science. The instructors frequently addressed the themes "Solar System and Planets" and "Pressure". In addition to these concepts, it was discovered that the instructors expressed some definitions such as gravity, basic machines, air friction and buoyancy, Bernoulli's principle, lunar and solar eclipses, and material qualities. Some of the instructor's responses are as follows:

> *"... Solar system, stars, planets, meteorites, Mars and Moon studies. (I1)", "Use of pressure difference in aviation. (I4)", "Gravity, artificial satellites, buoyancy, pressure, and friction are a few examples. (I8)", "Simple machines, Newton's law, pressure, Bernoulli's principle. (I5)".*

The eighth question in the opinion form is, "Are there any situations that force or disrupt their visits to GUHEM?". Table 8 shows the theme, codes, and frequency values derived from the instructors' responses to this question, which are then supported by sample quotations.

PROBLEMS
OF EDUCATION
IN THE 21st CENTURY
Vol. 80, No. 6, 2022

Table 8
Instructors' Problems Encountered during Visits

Theme	Codes	Instructors	*f*
Problems caused by visitors	The anxiety of not fulfilling expectations	I2, I3	2
Not encounter any difficulties		I1, I4, I5, I6, I7, I8, I9	7

According to Table 8, the majority of the instructors indicated that they did not experience any issues or that the work did not go wrong during their visits to GUHEM. However, I2 and I3 coded trainers reported difficulty due to worries such as feeling insufficient in fulfilling the visitors' expectations, not being impressive in front of them, and decreased engagement with students, particularly in school groups. Instructor responses to this code are as follows:

> "*It can be challenging to simultaneously please each guest in the same way. We can meet people of varied styles and see how some people approach things differently. This can occasionally cause difficulties. (I2)", "Reducing interaction with students in school groups through intensive visits and attempting to convey information by competing with time. The fear of "influencing" the participant takes precedence over the motivation to provide information and the participant's curiosity. (I3)".*

The last question in the opinion form is, "As an instructor, are there times when you feel incompetent in leading visitors to GUHEM or when you want professional assistance?". Table 9 shows the themes, codes, and frequency values defined based on the instructors' responses to this question, which are then supported by sample quotations.

Table 9
Situations in Which Instructors Feel Insufficient

Theme	Codes	Instructors	*f*
Feeling insufficient	Failure to master the subject	I3, I4, I5	3
Inability to exert dominance over visitors		I2	1
	Inability to respond to various questions	I8	1
Not feeling insufficient		I1, I6, I7, I9	4

According to Table 9, during several of the visits to GUHEM, some of the instructors felt inadequate. One of these circumstances is a lack of precise knowledge of specific subject areas. Furthermore, the instructors identified weaknesses in themselves, such as having difficulties establishing dominance over packed visitor groups and not being able to respond adequately to unexpected questions from visitors. The following are some examples of inadequate situations:

> *"I occasionally feel insufficient to dominate large group visits. (I2)", "Aeronautics and biochemistry are areas where I fall short as an astronomer. I think I have little understanding in this sector and, more significantly, that I am ineffective at communicating my current knowledge to people of all ages. (I3)", "When asked really specific questions, I sometimes feel inadequate. (I8)".*

Furthermore, instructors with codes I1, I6, I7, and I9 reported that they never felt inadequate during the visits at GUHEM.

When GUHEM instructors were asked about their previous visits to science centers, it was determined that most of the instructors visited popular science centers in Turkey such as Bursa Science and Technology Center, Konya Science Center and Feza Gürsey Science Center.

Table 10
Experience of Science Center Visiting

Theme	Codes	Instructors	*f*
Visiting another science center	Feza Gürsey Science Center	I3, I4, I5	3
	Konya Science Center	I6, I9	2
	Bursa Science and Technology Center	I1, I8	2
Not visiting another science center		I2, I7	2

Discussion

Astronomy is a science that incorporates and is centered on physics, chemistry, geology, mathematics, and other sciences. The advancement of astronomy and the improvement of other sciences show parallelism. Astronomy can be used to teach students subjects such as physics, mathematics, and chemistry. For example, in chemistry class, he can explain how elements are formed using the subject of stellar evolution; in physics class, he can easily use astronomy to explain the Doppler effect and the expansion of the universe. Just as anatomy is required to understand the human body, astronomy is necessary to understand the universe (Koçak, 2022). These relationships between astronomy, aviation, and other disciplines require individuals to learn astronomy concepts accurately and concretely from an early age. Concepts in astronomy are frequently abstract, making learning and comprehending basic astronomy concepts difficult (Yu, 2005). Many studies have shown that both adults (Mant & Summers, 1993; Sharp, 1996; Trundle et al. 2002;) and students (Kalkan & Kıroğlu, 2007; Trumper, 2000) have many misconceptions and incorrect mental models of fundamental astronomy concepts. To address this issue, developed countries have prioritized astronomy training and education, establishing planetariums, observatories, and science centers in nearly every city across the country. In light of all of these studies, this study, which was conducted to obtain the opinions of the instructors working at GUHEM, was able to reveal what kind of contributions can be made to the teaching of other science subjects, particularly astronomy and aviation, as well as what the instructors' needs are in carrying out activities at GUHEM and similar thematic science centers.

Plummer (2009) used kinesthetic learning techniques to investigate how students' understanding of apparent celestial motion changed after participating in a planetarium program. Participants ($N = 63$) from the first and second-grade students were interviewed before and after the study. It was determined that students' knowledge of all visible celestial motion fields covered by the planetarium program improved significantly. This result demonstrated that students in the early stages of primary school could learn the correct definition of apparent celestial motion. The findings also show the importance of kinesthetic learning techniques and the planetarium's rich visual environment to understand celestial motion better. Türk and Kalkan (2015) sought to ascertain students' knowledge of specific astronomy concepts as well as the impact of a planetarium environment on teaching. Students in the seventh grade (12-13 years old) are included in the study. The study included 240 students of various socioeconomic and cultural

PROBLEMS
OF EDUCATION
IN THE 21st CENTURY
Vol. 80, No. 6, 2022

levels from six schools. The study used the experimental method, and the "Solar System and Beyond" unit was preferred. The current study's findings revealed that teaching astronomical concepts in a planetarium environment is more effective than in a classroom setting. The study also found that students in the planetarium-supported group performed better than the control group in subjects that required 3-dimensional thinking, changing time, and observing periodic motion. Similarly, according to the findings of this study, visitors have detailed knowledge of the solar system and planets thanks to the exhibitions at GUHEM and the guides' explanations. (Table 7). Doğru et al. (2019) analyzed studies on astronomy education. As a result of the study in which theses and articles were examined, it was revealed that astronomy education was mostly carried out in out-of-school learning environments and planetariums. On the other hand, these studies were mainly carried out with secondary school students focused on the realization of conceptual teaching. In this context, in this study, GUHEM has been shown by the instructors as an out-of-school learning environment for teaching astronomy and aviation concepts in detail.

In contrast to GUHEM, numerous studies on science centers operating in Turkey have been conducted. By discussing research that assesses science centers and their effects from many angles, Gürsoy (2022) highlighted the significance of science centers in science education. According to Yalkın Şentuna (2019) research findings, 90 experimental sets in the Kocaeli Science Center Dynamic World Gallery resulted in the acquisition of 57 Our World and the Universe learning area successes. Kocaeli Science Center Dynamic World Gallery must have been created based on the outcomes of the science course curriculum. The majority of studies were conducted with an emphasis on science center exhibition areas and how they helped with science teaching. Still, few studies examined the opinions of science center instructors. In this study, the instructors at GUHEM, a thematically designed science center, were asked about the exhibition areas and how they support science teaching, as well as about the visitor demographics and their own educational backgrounds. For this reason, several viewpoints were considered while comparing the data collected and the findings of related studies in the literature.

According to instructors, primary school pupils between the ages of 6 and 11 make up the majority of GUHEM's visitors. In light of this finding, the interactive activities in this space and aviation-themed center will help young visitors include goals like becoming scientists in their career plans and engage in space studies, as well as get closer to the breakthroughs that Turkiye intends to achieve within the framework of the "National Space Program". Some basic concepts of astronomy, such as natural cycles, are taught in grade one (age 6), but the primary "dose" of astronomy occurs in grade six (age 11), when astronomy and space account for one-fifth of the science curriculum - at least in theory (Percy, 2009). The contents of the exhibition areas at GUHEM have been considered to be closely related to the primary and secondary science curriculum. In reality, GUHEM mechanisms can aid in teaching a wide range of courses and concepts, from the third-grade science curriculum to the eighth-grade. These subjects begin in third grade with "Let's Get to Know Our Planet," fourth grade with "The Earth's Crust and the Movements of Our Earth," fifth grade with "Sun, Earth, and Moon," sixth grade with "Solar System and Eclipses," seventh grade with "Solar System and Beyond," and eighth grade with "Seasons and Climate" (MoNE, 2018). Similarly, it is believed that GUHEM mechanisms can be highly effective in teaching concepts such as energy conservation, friction and kinetic energy loss, and air and water resistance, which are covered in the "Energy Transformations" subject taught in the 7th-grade science course curriculum. Babaoğlu (2016) revealed how they describe astronomy concepts in students' minds, and their cognitive representations before and after the activities carried out within the scope of the 6th-grade unit in a secondary school in the Çumra district of Konya. As a result of the focus group meeting, it aimed to get their opinions on the experience and contribution to the concepts of astronomy. The study revealed that students'

PROBLEMS
OF EDUCATION
IN THE 21st CENTURY
Vol. 80, No. 6, 2022

views of astronomy ideas varied in a good way when the drawings they drew before and after the activity were compared. From this vantage point, it is expected that GUHEM, which is themed on space and aviation, will increase students' awareness of astronomy.

Each student group is accompanied by an exhibition guide and an education guide, and the visits run for about two hours. The touch-and-discover technique is mostly used, with students visiting exhibition areas and attending workshops. Visitors have the opportunity to learn firsthand by participating in scientific events in exhibition areas and instructional sessions in GUHEM. Visitors also have the chance to see astronomical occurrences in this atmosphere quickly, but it typically takes days or years to happen. Given all these benefits, it is believed that GUHEM will continue operating as a thematic science center with significant educational value. The key characteristic that sets GUHEM apart from other science centers, according to the instructors' responses, is that it has a different content. Erçetin and Görgülü (2018) investigated the perspectives of sixth-grade visitors to Konya Science Centers regarding the Science course. Twenty students were chosen from a state school in Konya for this study, and they took part in a field trip to the Konya Science Center while being informed of the study's goals. If we were to outline the issues and findings of the study, it was discovered that most of the students went on the field trip to the science center to learn new things. Özcan et al. (2019) aimed to get secondary school students' opinions after their Konya Science Center trip. According to sixth-grade students, one of the stated motivations for visiting the science center was to learn more in-depth information about the solar system and space. In this context, it may be claimed that students have similar reasons for visiting GUHEM.

Similarly, astronomy and aviation were answered in the first place to the question of what disciplines are related to the exhibition areas in GUHEM. The instructors also mentioned the subdisciplines of science, mathematics, history, and astrobiology in addition to their responses. Even though GUHEM is a specialized science center, it features exhibition spaces for subjects like other sciences that are relevant to education. Paper (model) airplane construction for aviation and rocket competition for astronomy are the two activities that take center stage at the start of the interactive workshops in GUHEM. Both activities draw interest from children between the ages of 6 and 11. It is believed that encouraging children to visit science centers with engaging activities will surely have a good impact on their attitudes toward science. Balçın and Şeker (2019) aimed to get the opinions of 14 secondary school students about travel and astronomy after they visited Kocaeli Science Center. The students claimed that the science center had benefited them in several ways, including providing information, fostering an atmosphere of entertainment, exploration, and experimentation, encouraging the development of their imaginations, and contributing to science. They also claimed that the knowledge they had gained about the cosmos would be useful to them in school, in the future, and their careers.

The idea of not meeting visitors' expectations and being unable to understand the subject was stated when the instructors' opinions on the problems were analyzed. Kim and Song's (2003) study looked into the characteristics of the exhibitions in three Seoul science museums and centers and gathered student feedback on the displays. The research's findings showed that while most students claimed that interactive exhibits captured their interest and that the exhibition's explanation panels had helped them comprehend its workings, 20% claimed that they had never read the panels. Additionally, students claimed that the guides' verbal explanations were more understandable than the written ones on the panels. In this situation, it will be more beneficial for the guides to look after the tourists and direct them in accordance with their areas of specialization. It will also help the guides develop their sense of self-efficacy.

PROBLEMS
OF EDUCATION
IN THE 21st CENTURY
Vol. 80, No. 6, 2022

Conclusions and Implications

This case study is crucial to understanding GUHEM, a thematic science center, and identifying the educational challenges the trainers face. Individuals visit GUHEM mainly due to the thematic area's interest in space and astronomy.

The Solar System material in GUHEM, which depicts the planets scaled according to the size variable, comparatively, as can be observed from the instructors' answers, is one of the most remarkable astronomy-related processes. It is worth observing the feelings of surprise and curiosity that children and young people experience as they examine and compare the planets when they come across the scaled three-dimensional macro solar system model, even though they have learned the information from textbooks and while teaching astronomy-related science topics. Visitors are more receptive to learning, asking questions, and gaining in-depth knowledge when they see all the solar system's components at scale and have the chance to move around, touch them, and view them from all angles. At this point, GUHEM's most significant role as a center for thematic science learning begins to emerge. On the other hand, GUHEM distinguished itself from other science centers by encouraging visitors to grow their interest in science through interactive programs.

According to the study's findings, each GUHEM instructor who participated in disseminating knowledge about the mechanics connected to the space and aviation topic overlapped with the exhibition areas. Despite this, it is an interesting finding that instructors worry about not being able to master the material and not being able to live up to visitors' expectations. It also serves as a reminder to teachers that content knowledge is not enough for educational activities; additionally, pedagogical competencies are needed. It is believed that external support should be provided as a result.

Science centers are mainly ineffective for students who are ill-equipped, uninterested, or unmotivated. For this reason, it is believed that visits done with prior knowledge will positively impact the students' learning. Teachers are expected to coordinate with the instructors as they describe the things seen and their scientific significance, and to contrast the knowledge from their areas of expertise-such as astronomy and the history of science-with that found in the textbooks. When a student observes that his teacher and the instructor are not in harmony and cooperation in any subject, his willingness to study is undermined, and his "learning confidence" regarding any new information deteriorates. Primary and high school teachers that teach astronomy have a limited understanding of the subject. As a result, the teacher and the guide must have complimentary communication. Teachers can utilize astronomy to discuss topics linked to basic sciences since astronomy and aviation are multidisciplinary fields of study. Teachers and astronomers can get together before they talk and conduct cooperative research on the topics. It is advised to obtain the necessary assistance from academicians working in this field to resolve the educational challenges and issues educators face and to present mixed communities of teachers and trainers seminars tailored to their requirements.

Astronomy education is critical for directing young people studying in a country toward science and technology and stimulating their curiosity and imagination. The most developed countries are still working to establish space-based life centers. Serious research into space mining has begun. After the moon, humanity may set foot on Mars in the next 20 years. We, as Turkey, should provide more accurate astronomy and space education and train qualified personnel in the field of space technology. It is recommended that these and similar studies contribute to training the instructors working in GUHEM, designed around the space and aviation theme, as qualified personnel.

Declaration of Interest

The author declares no competing interest.

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PROBLEMS
OF EDUCATION
IN THE 21st CENTURY
Vol. 80, No. 6, 2022

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PROBLEMS
OF EDUCATION
IN THE 21st CENTURY
Vol. 80, No. 6, 2022

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Appendix 1.

Dear Instructors,

This form collects information about the exhibition areas at GUHEM, such as which disciplines these exhibition areas contribute to learning, your views on visitor profiles, and so on. The information gathered will be invaluable in revealing GUHEM's potential and your requirements as an instructor.
Thank you in advance for your answers and best wishes.

Assist. Prof. Dr. Ayşegül ASLAN
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1- What age range do you believe the majority of visitors to GUHEM are?	o *3-6 ages* o *6-11 ages* o *11-15 ages* o *15-18 ages* o *18-23 ages* o *23-35 ages* o *35 years and older*

2- What do you believe are the main reasons why people visit GUHEM?

3- What do you believe is the most fundamental feature or features that distinguishes GUHEM from other thematic science centers in Turkey and other countries?

4- Which discipline or disciplines do you think contribute to the learning of the exhibition areas in GUHEM?

5- Which of the exhibition areas in GUHEM do you think attracts the most attention? Why?

6- Can you give an example of workshop activities held interactively with visitors to GUHEM?

7- Can you give examples of the science concepts that the visitors of GUHEM learned in a short time?

8- Are there any situations that force you during the visits in GUHEM and cause disruptions in business? If your answer is yes, can you explain?

9- Are there any situations where you feel inadequate in guiding visitors as an instructor, or do you need professional support? If your answer is yes, can you explain?

10- Have you visited a science center in Turkey or in a different country before? If your answer is yes, can you explain?

PROBLEMS
OF EDUCATION
IN THE 21st CENTURY
Vol. 80, No. 6, 2022

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