



Investigation of middle school students' thoughts about a mobile planetarium activity

Özlem Oktay, Atatürk University, Turkey, oktayozlm@gmail.com ORCID: 0000-0002-0207-1211

Serkan Ekinci, Hacettepe University, Turkey, serkanekinci@hacettepe.edu.tr ORCID: 0000-0001-8306-4605

Ahmet İlhan Şen, Hacettepe University, Turkey, ailhan@hacettepe.edu.tr ORCID: 0000-0002-9913-8573

Abstract. In this study, students' thoughts about a mobile planetarium activity were obtained through a letter writing exercise. Document analysis was used to analyse 163 letters by way of content analysis. The study group consisted of 163 students (5th, 6th, 7th and 8th grades) from a middle school in a disadvantaged area of Ankara, Turkey. Analysis of the letters was grouped as what was learnt from the planetarium activity, feelings and thoughts about the planetarium environment, benefits of the activity, and other feelings and thoughts. The students stated that they were generally satisfied with the event, that they enjoyed the activity, were excited, and found it to be extremely fun. Moreover, their interests and curiosity increased due to the activity. The students' thoughts about the out-of-class activity generated positive feedback and provided effective suggestions for the implementation of similar activities in the future.

Keywords: Mobile planetarium, out-of-class activity, middle school students, writing letter

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INTRODUCTION

Education is a process that involves an individual's interaction with their environment throughout life. In this way, the individual develops and constructs their personality. If this process is at the desired level, the individual benefits, as well as society in general and those around them. The quality of their educational training is vital in this context, with schools undoubtedly forming an important component of their education and training. In this process, which is defined as formal education, the student is educated in a controlled manner, with predetermined goals attained through a specific programme of instruction. Informal education, however, takes place spontaneously through everyday life, rather than intentional or planned as with formal education. For example, the information a student receives while watching TV or chatting with their friends falls within the scope of informal education. However, the connection between formal and informal education enriches their overall education and training (Eshach, 2007; Hannu, 1993). Informal learning environments offer students new and diverse experiences, enables them to test their experiences individually, provides authentic and interactive experiences, and helps them to develop individualised learning based on interests, knowledge and previous experiences (Behrendt, 2014). Educational activities carried out within informal environments are complementary and serve to enrich classroom-based education (Balkan-Kıyıcı & Atabek Yiğit, 2010).

Out-of-school learning environments can vary significantly. Science centres, school grounds, gyms, museums, zoos, planetariums, aquariums, industrial organisations, botanical parks, science camps, the mass media (e.g., television, magazines, newspapers, the Internet), health institutions, science cafes, and national parks are some of the many environments utilised for out-of-school learning.

When the studies in the literature are examined, it can be seen that activities conducted outside of the school environment can positively contribute to increased academic achievement (Bozdoğan, 2007), the understanding of scientific concepts (Rennie, 2014), positively impact

student motivation (Karademir, 2013), increase attitudes towards science teaching (Wulf, Mayhew, & Finkelstein, 2010), the recalling of information (Falk & Dierking, 1997), enabling students to relate subjects to daily life (Ertaş, Şen, & Parmaksızoğlu, 2011), developing students' cognitive, affective and psychomotor skills (Lindemann-Matthies & Knecht, 2011) and their social skills (Yavuz, 2012), creating environmental awareness (Berberoğlu & Uygun, 2013), reducing stress and behavioural disorders by affecting physical and mental health (Hagen, 2013), providing career choices and career awareness for students to develop the mental structure that keeps them active and with a long-lasting effect (Falk & Dierking, 1997), ensuring students learn by doing and experiencing (Türkmen, 2010), increasing their interest in science (Karppinen, 2012), building critical thinking disposition (Kılıç & Şen, 2014), understanding the nature of science (Bell, Blair, Crawford, & Lederman, 2003), and increasing their creativity (Kirkby, 1989).

Science education includes high-level skills such as problem solving, observing and analysing events through experiments, and reaching generalisations based on data. The learning environments mainly used in science teaching are the classroom, the laboratory, and out-of-school environments (Orion & Hofstein, 1994). It is very important that science teaching includes out-of-school activities via practice-oriented interactions with daily life. Given the three basic dimensions of the learning process; being a personal process, social interaction, and based on place, limiting the learning environment to only the classroom is considered deficient (Kısa, 2012). Science teaching is a field that allows students to learn and to explore abstract concepts by transferring them to daily life that could not otherwise be observed directly through a student-centred teaching approach. For this purpose, moving physically beyond the confines of the classroom, and providing subjects that cannot be experienced directly through real environments, are ways to make science learning easier for students.

Astronomy is one of the leading subjects of science teaching. It is considered very important for students to learn astronomy as it addresses their natural curiosity for discovery, provides a positive perspective towards science, and forms the basis for their scientific and engineering studies to incorporate the latest scientific and technological developments that facilitates the progress of a nation (Percy, 1997). Planetariums are generally preferred for the teaching of astronomy subjects. A planetarium is a building that provides a view of the sky through an optical projector that displays simulations on a dome-like screen. Planetariums are usually designed for the learning and understanding of astronomy and space, or for learning the content of other science subjects (Akoğlu, 2006). In the Turkish language, the term planetarium has also been named as the equivalent of 'sky house', 'star theatre', 'space house', 'star house', and 'planet house'. In addition to fixed planetariums, easy-to-move mobile planetariums are also employed. In addition to analogue planetariums, the introduction of digital systems have facilitated the application of different topics and demonstrations rather than traditional astronomy within these environments (Ateş, 2009).

Planetariums provide permanence in learning, supports school-based education, and include the element of entertainment (Yavuz, 2012). There are various studies to be found in the literature about the use of planetariums in education. In these studies, the effectiveness of these environments has been determined according to many aspects such as students' interest and attitude, the elimination of misconceptions, and conceptual learning by students (Bozdoğan & Ustaoglu, 2016; Lelingou & Plakitsi, 2009; Petrie, 2013; Plumber, 2009; Ridky, 1974; Sontay, Tutar, & Karamustafaoğlu, 2016; Türk & Kalkan, 2010; Yılmaz, 2018). Where studies using planetariums as an out-of-school learning environment are considered, Ridky (1974) investigated student success, as well as their perceptions and attitudes in relation to the concepts of astronomy within the planetarium. A statistically significant difference was observed in favour of the planetarium study group. In a case study and action research by Lelingou and Plakitsi (2009), a planetarium trip was organised. Data in the study were collected using video and through interviews. Educational scenarios, interactive shows, and 'astro parties' were included in the study. The results showed that a great majority of the students expressed that they really felt themselves as being in space, and consequently their interest in the natural sciences increased. Plumber (2009) investigated students' understanding of the motion

relations of the Sun, Moon and stars through kinaesthetic learning techniques in the planetarium. According to the results of the survey data, it was found that kinaesthetic and visual learning techniques were high in students and that the planetarium environment increased the students' meaningful learning. Türk and Kalkan (2010) observed changes in seventh-grade students after teaching the 'Solar System and Beyond: Space Puzzle' unit in the planetarium. As a result of a 14-question scale and interviews applied at both the beginning and end of the unit, it was seen that students working in the planetarium learned more conceptually than in the classroom environment. Petrie (2013) investigated the effect of the planetarium on children's early learning periods. The study also included family groups, with parents stating that their children would be interested in astronomy based on their own interest. The conceptual and behavioural effects of the planetarium trip were observed in the children. In their study, Bozdogan and Ustaoglu (2016) evaluated the impact of planetariums on the teaching of space and astronomy topics and concepts by taking the views of prospective teachers. A trip to the planetarium was organised with 31 candidate science teachers (22 females, nine males) studying in their fourth grade. According to the candidate teachers' views, planetariums are environments that enable meaningful learning in a short time and embody abstract science concepts. It was stated that the planetarium trips provided learning, increased motivation towards science, and were seen as both fun and interesting. The trips also had a positive effect by associating the trip with the corresponding classroom lessons. Sontay et al. (2016) organised a planetarium trip with 17 students from the eighth grade. Following the trip, the students stated that their motivation and interest towards their science course had increased, and that abstract science concepts became concrete and easier to learn. In addition, their curiosity reportedly increased and they expressed a love for science. Yilmaz (2018) conducted an action research with seventh-grade students. Both in-class activities and planetarium trips were conducted for the 'Solar System and Beyond: Space Puzzle' unit in order to increase students' interest in space and teaching concepts. When the study, which was conducted with 12 students, was investigated, positive changes were observed for this unit. It was seen that students' interest and curiosity towards space increased, their conceptual understanding developed, that the trips excited the students, and that participation in the course improved. Increased awareness of space-related occupations was also seen among the study results.

When the science curriculum in Turkey is examined, students are seen as responsible for their own learning, and to actively participate through researching and questioning. In-class/school and out-of-school learning environments are designed according to the inquiry-based learning strategy, and also utilise informal learning environments such as science centres, school grounds, museums, and planetariums (Ministry of National Education [MoNE], 2017). Despite the aforementioned positive effects, it appears that teachers inadequately participate in out-of-school activities due to reasons (Carrier, 2009) such as their lack of knowledge, skills or self-efficacy on how to best use these environments, their concerns about not being able to assure student safety and discipline in these environments, lack of time and funding, bureaucratic obstacles, problems related to students' parents, and the control of students with special educational needs in these environments (Dillon et al., 2006).

In this context, a mobile planetarium activity was organised in order to address some of the problems mentioned related to the out-of-class setting, with student participation including those from disadvantaged areas. A mobile planetarium was taken to the participating schools where the students were studying. University-school cooperation was ensured, and teachers guided their students by way of undertaking an example activity. The aim of the activity, which was held within the boundaries of the school premises, was to eliminate barriers such as transportation, cost, permission, and security, and also to provide the highest level of benefit to the students. The current study aimed to complement the effects reported in the literature of a visit to a fixed planetarium within a mobile environment, and sought to answer the following research question through students' letter writing:

What thoughts did middle school students have towards the mobile planetarium activity?

METHODS

Research Design

In this study, document analysis, one of the qualitative research methods, was used in the analysis of letters written by the participant students. It includes the examining of all kinds of written materials that provide information on the subject under investigation (Yıldırım & Şimşek 2011). Furthermore, content analysis is a convenient way to analyse data obtained from data collection tools such as diaries, interviews and from written text (Patton, 2002). In the current study, the participants' letters were examined by content analysis method in which data were generated through canonical coding, summarised by forming categories, and then evaluated systematically (Büyüköztürk, 2009).

Study Group

The study group consisted of 163 students (5th, 6th, 7th and 8th grades) attending middle schools in a disadvantaged area of Ankara, Turkey. In total, 88 (54%) male and 75 (46%) female students participated in the study. Gender distribution of the participant students according to their grade level are presented in Table 1.

Table 1. Distribution of student gender by class grade

		Grade				Total
		5	6	7	8	
Gender	Frequency (<i>f</i>)	14	25	25	24	88
	Male					
	Gender %	15.9%	28.4%	28.4%	27.3%	100.0%
	Grade %	43.8%	80.6%	47.2%	51.1%	54.0%
	Female					
	Frequency (<i>f</i>)	18	6	28	23	75
Gender %	24.0%	8.0%	37.3%	30.7%	100.0%	
Grade %	56.3%	19.4%	52.8%	48.9%	46.0%	
Total	Frequency (<i>f</i>)	32	31	53	47	163

Data Collection Tool

Letter writing activity, one of the narrative skills, was employed in the study. Writing is holistic, planned, organised and permanent, when compared to verbal speech. It is an effective tool that enables correct expression of oneself (Keklik, 2016). Writing occurs as a product of what has been seen and read, and of thoughts and feelings within a multidimensional structure (Gökşen, 1994). Writing activities are an effective learning tool in the development of critical thinking skills (Tok, 2015), in ensuring the long-term persistence of knowledge (Klein, 2000), and in supporting logical thinking (Prain & Hand, 2006). In the current study, the students were given a blank piece of paper with an envelope and then asked to write a letter. The required information that had to be included in the letter was provided to the students as shown in Figure 1. A measure of controlled freedom was provided and attention was paid not to provide too much guidance to the students.

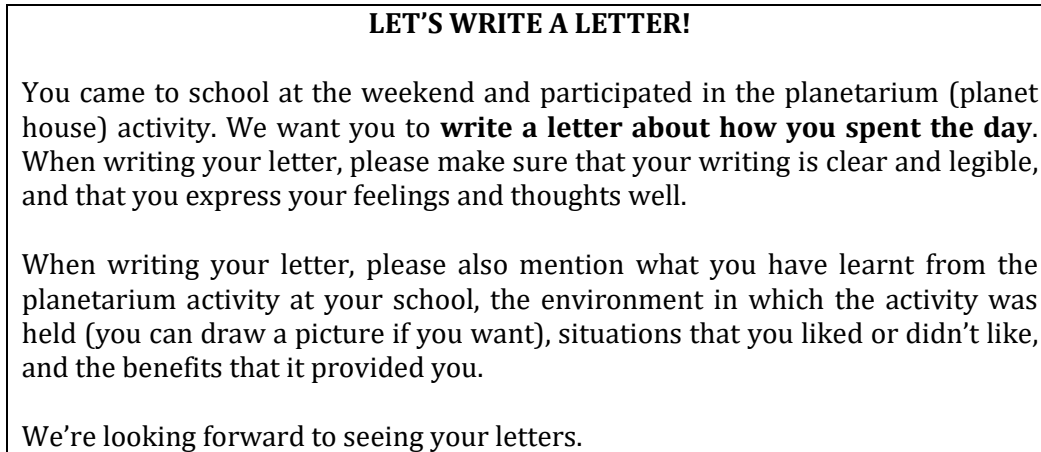


FIGURE 1. *Information requested in the letter*

The letter sheets and envelopes were distributed to the students immediately following completion of the mobile planetarium activity and were then collected by the students' teachers 1 week later.

Data Collection Process

Data obtained from a social responsibility project supported by the Scientific Research Projects Coordination Unit of a state university in Turkey were used in this study. The project was aimed at increasing the cultural awareness and multi-scientific perspectives of middle school students and their families through activities organised in a planetarium, which is considered as an informal learning environment. The project activities commenced in October 2016 and lasted for a total of 8 months, and were organised as 2 days held at the end of 1 week each month. One of the primary objectives of the project was to strengthen university-school-family relationships. Disadvantaged schools in Ankara were selected and the participation of students and families was facilitated by temporarily installing a mobile planetarium somewhere easily accessible such as the school grounds or in the sports hall of the school.

In the activities, basic information about astronomical concepts were discussed interactively by experts in the field, and the students then created a model Hubble space telescope together with their families. During the model activity, selected documentaries about astronomy were shown to the participants. In addition, the mobile planetarium enabled students to watch demonstrations along with their families and to communicate with experts in astronomy and space science through question and answer sessions.

Each mobile planetarium session lasted approximately 20-25 minutes. Demonstrations in the mobile planetarium consisted of content to parallel units of the 'World and Universe' subject area of the Turkish Middle School Science Curriculum. Since the research was conducted within the scope of a project supported by a state university, ethical permission was obtained from the related university for the application of the study. In addition, the schools where the mobile planetarium activity were to be held were determined in advance, along with the necessary permission taken from the Ministry of National Education. As the students participated in the weekend activity with their family members, both the students and their families were informed about the study at the same time, and were asked if they wished to participate voluntarily in the study. Students who did not want to write letters were not forced to do so, and only data collected from students who wrote letters were included in the study. Identifying personal and school information was not contained in the students' letters.

Data Analysis

The student letters were analysed using content analysis, one of the qualitative analysis methods. Frequency and percentage values were calculated in the analysis of numerical data. The letters were read more than once by three different researchers, and themes created

according to the students' grade level. The parts of the letters considered important were marked with coloured pen. After consensus was reached among the researchers on the codes used, common themes were then noted and also agreement sought. According to the reliability level formula (Miles & Huberman, 1994), the percentage of consistency in the coding performed by the three researchers was found to be 84%. The names of the participating students were replaced by pseudonyms, for example, S1 denotes 'Student Number 1'. Some excerpt examples selected from the letters were used as visual support to the qualitative data, with quotations given and sample explanations given for the relevant theme.

RESULTS

How Satisfied Were You with The Planetarium Activity?

This question was considered based on the first part of each letter as the students had been tasked with providing their assessment. The students' responses are presented in Table 2 and Table 3).

Table 2. *Distribution of student satisfaction levels by grade*

Grade	Satisfaction level (f)					Total
	Unsatisfied	Slightly satisfied	Neutral	Satisfied	Highly satisfied	
5	2	2	2	6	20	32
6	2	0	4	13	12	31
7	4	2	11	11	25	53
8	1	0	4	20	22	47
Total	9	4	21	50	79	163

In total, 79 of the participant students stated that they were highly satisfied and 50 students were satisfied with the planetarium activity. On the other hand, a total of 13 students were slightly satisfied or unsatisfied. Of the nine unsatisfied students, four were seventh-grade students. Additionally, two students who were slightly satisfied with the activity were from the fifth grade, as well as two from the seventh grade. Whilst 25 of the 79 highly satisfied students were from the seventh grade, 12 sixth-grade students were highly satisfied. Of the 21 students who expressed a neutral opinion, 11 students were from the seventh grade.

Table 3. *Distribution of student satisfaction levels by gender*

Gender	Satisfaction level (f)					Total
	Unsatisfied	Slightly satisfied	Neutral	Satisfied	Highly satisfied	
Male	7	3	11	29	38	88
Female	2	1	10	21	41	75
Total	9	4	21	50	79	163

When the satisfaction levels were analysed according to gender, there were seven male participant students who were unsatisfied with the activity, whilst the number of female students was two. Of the 79 highly satisfied students, 38 were male and 41 female. From a total of 21 students who remained neutral, there were 11 male students and 10 female students, showing just a difference of one. In total, 29 male and 21 female students indicated that they were satisfied.

Who Did You Want to Write A Letter To?

The students were asked to whom they wanted to write a letter, with answers recorded according to their grade level. In the eighth grade, 26 wrote to their classmates, 14 students wrote to the activity organisers, two wrote to their mothers, two to their cousins, one student wrote to a sibling in the eighth grade, and two students left this blank. In the seventh grade, 22

students wrote letters to the organisers, 14 wrote to their friends, five to their siblings, four to their fathers, four to their mothers, two wrote to their uncles, whilst two students left this blank. In the sixth grade, 14 students wrote to their friends, 11 wrote to the activity organisers, five to their mothers, and one wrote to a sibling. In the fifth grade, 14 of the students stated that they wrote letters to the organisers, 11 of them wrote to their friends, two wrote to astronauts, two wrote to their teachers, and one student each wrote to a sibling, their mother, and a cousin.

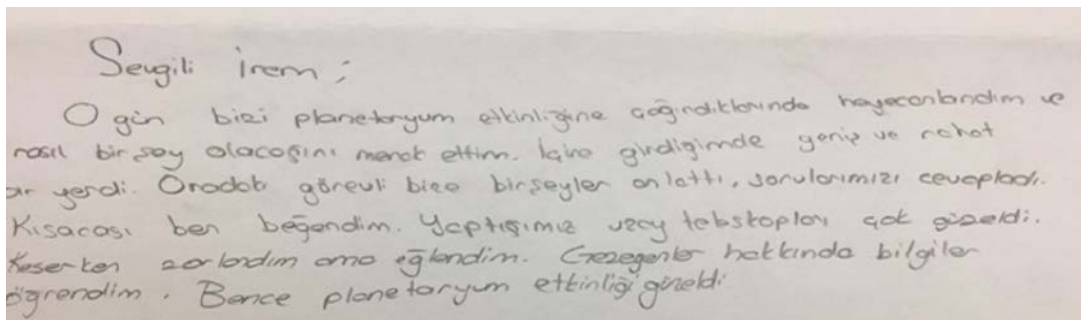
What You Learnt from The Planetarium Activity in Your School

When the planetarium activity was evaluated in terms of learning, the sub-dimensions formed were satellites, planets, and space, according to the expressions of the students.

Based on the sample explanations of the eighth-grade students, it was seen that detailed information about Jupiter's satellites and planets had been learnt, space-related information about the Moon and the Sun, and the Solar System had been introduced in some detail. An example letter from the planets sub-dimension is shown as Figure 2.

Table 4. Sub-dimensions and sample explanations (eighth grade)

Sub-dimension	(f)	Sample explanations
Space	26	I gained knowledge about space. (S45) I learnt about the Moon and the Sun. (S27) I got to know our solar system in three dimensions. (S52)
Planets	15	I learnt about the planets in the Milky Way, and the order of the planets in detail. (S19) I learnt about planets. (S28) I learnt about the characteristics of the planets and how mysterious they are. (S21) I learnt how our world was formed. (S36)
Satellites	6	I learnt about Jupiter's moons. (S13)



(Dear İrem;

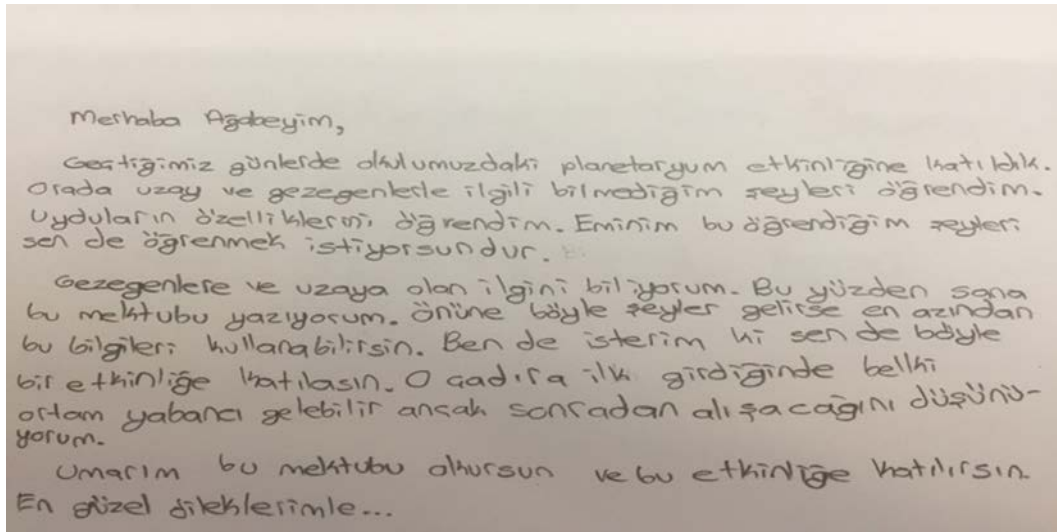
I was thrilled when they invited us to the planetarium activity that day and I wondered what it would be like. When I walked into it, it was spacious and comfortable. The officer there told us something, and answered our questions. In short, I liked it. The space telescopes we made were very nice. I had a hard time cutting it, but I had fun. I learnt about planets. I think the planetarium activity was good.)

FIGURE 2. Letter example (eighth grade, S28)

When the sample explanations were examined according to the sub-dimensions based on the seventh-grade students' letters, it was stated that the characteristics of satellites were learnt, detailed information about the planets and different information about the Moon were obtained, and the difference between astrology, astronomy, and the stars were covered. An example of a letter on the sub-dimension of satellites is shown in Figure 3.

Table 5. Sub-dimensions and sample explanations (seventh grade)

Sub-dimension	(f)	Sample explanations
Planets	32	I learnt that some planets are gas. (S59) (S76) I learnt the planets and their viability in detail. (S62) (S67) (S68) We got some interesting information about the planets, it was really impressive. For example, we learnt that Mercury is very hot because it is the closest planet to the Sun, what are light-years, and that there are moons for Neptune and Uranus. Of these, what I found most interesting was that the Sun was a star and it was located around the Galaxy and why Mars was called the red planet, this impressed me a lot. (S65) The planets were Mercury, Venus, Earth, Mars, Jupiter, Saturn, and Uranus. Information about whether these planets are hot or cold was given, for example Mars is hot. (S73) I learnt a lot of interesting information there, like Pluto wasn't actually a planet, and has been removed from the planet class. (S82) What I liked the most was what was inside the planets. (S78) I recognised the planets. I learnt that some planets are made up of gases, and some may have life. (S88)
Space	17	Why do we always see the same face when the Moon turns? I thought about it when I was asked the question, but when I was told the answer, I knew I was wrong. (S75) I learnt the difference between astrology and astronomy, and the stars. (S87)
Satellites	4	I learnt the properties of satellites. (S71)



(Hi my brother,

We recently participated in the planetarium activity in our school. I learnt things there that I didn't know about space and planets. I learnt the properties of satellites. I'm sure you'd want to know what I've learnt.

I know your interest in planets and space. Therefore, I am writing this letter to you. You can use the information at least if you get in the way of things like that. I would like you to attend an event like this. When you first go into the tent, maybe it might seem strange, but I think you will soon be comfortable with it.

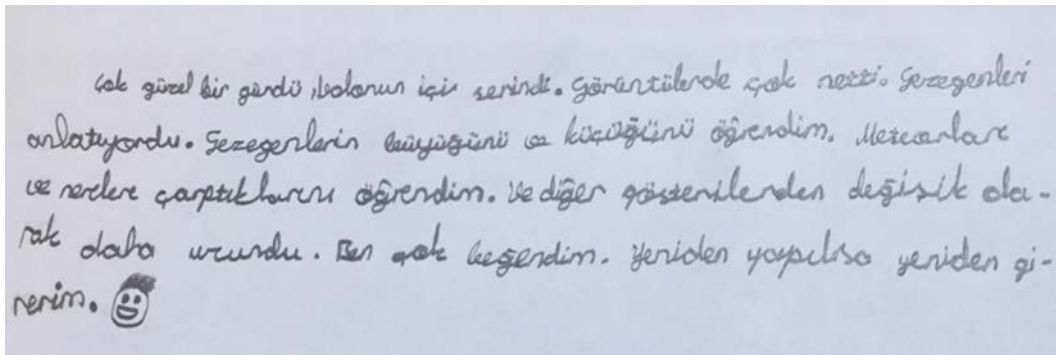
I hope you will read this letter and attend the activity. Best wishes...)

FIGURE 3. Letter example (seventh grade, S71)

Just the planets and space sub-dimensions were formed according to the sixth-graders' letters. What was learnt under these sub-dimensions was the planets and their formations, information about the Moon, and also about the lives of astronauts. An example of a letter from the planets sub-dimension is presented as Figure 4.

Table 6. Sub-dimensions and sample explanations (sixth grade)

Sub-dimension	(f)	Sample explanations
Space	19	I learnt that the pits on the moon are 'craters'. (S143) I have gained some insight into how astronauts live in space. (S4) I got information about astronauts. (S8)
Planets	12	I've seen planets that I'd never seen before. (S142) I learnt about planets and their formation. (S146) I learnt about planets; that they grow and shrink and that meteors can hit them. (S150) I know the planets very well now. (S154) (S157)



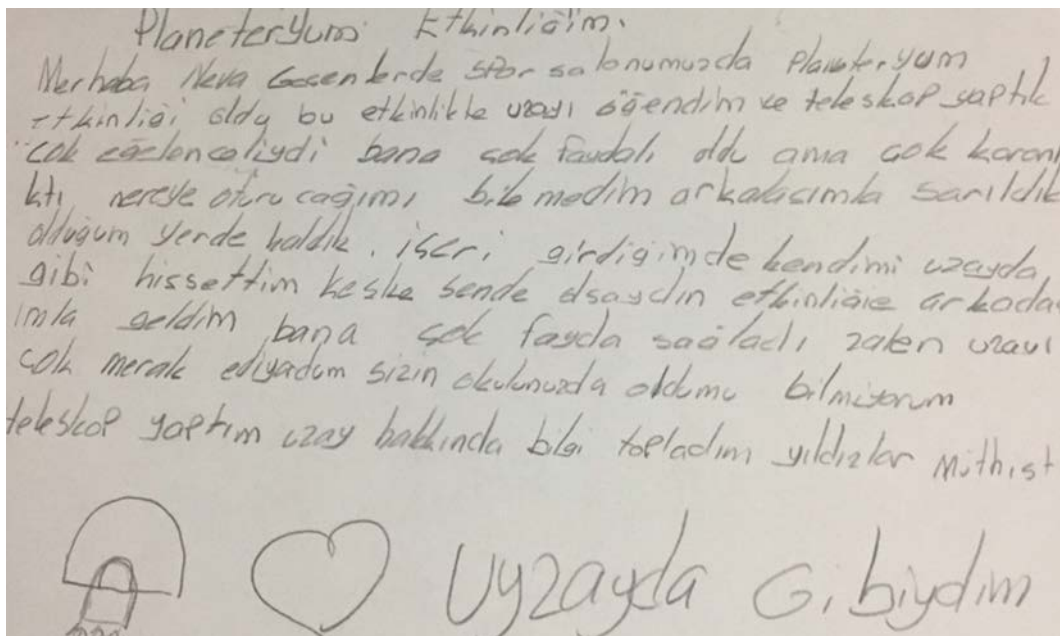
(It was a beautiful day, the bubble was cool. It described planets. I learnt the big and the small planets. I found out about meteors and where they hit, and it was longer than other shows. I liked it very much. If it is ever here again, I'd go again.)

FIGURE 4. Letter example (sixth grade, S150)

According to Table 7, the sub-dimensions obtained from the letters of the fifth-graders were planets and space. The students stated being familiar with the planets and that they gained detailed information. They indicated that they learnt about the Solar System. An example of a letter included in the space sub-dimension is shown as Figure 5.

Table 7. Sub-dimensions and sample explanations (fifth grade)

Sub-dimension	(f)	Sample explanations
Space	17	I learnt about the solar system. (S121) I learnt about space in this activity. (S123) When our teacher said that the seventh-grade subject was space, I had already learnt information about it. (S131)
Planets	15	I learnt about the planet Saturn. (S116) We saw the planets and got to know about them. (S118) I know the planets very well. (S126) I've learnt new things about the planet Mars. (S127) I knew the planets, the stars, the solar system, I knew the planets, but I didn't know it that well before. (S128) I found out that some of the planets are gas. They taught us a lot of planetary names. (S134) I learnt the names of the planets. I learnt that Neptune took its name from the god of the sea. (S136) I learnt about the planets in the planetarium, the properties of the planets, and about space. (S111)



(My planetarium activity,

Hi Neva, the planetarium activity was held in our gym recently. I learnt about space and made a telescope in this activity. It was so much fun and was very useful to me, but it was very dark and I didn't know where to sit so I hugged my friend and stayed there when I went in. I felt like I was in space and I wish you were there. I went to the activity with my friends and it benefited me a lot as I was already curious about space. I don't know if it [planetarium activity] happened at your school yet. I made a telescope and I gathered information about space. The stars were awesome; it was like I was in space.)

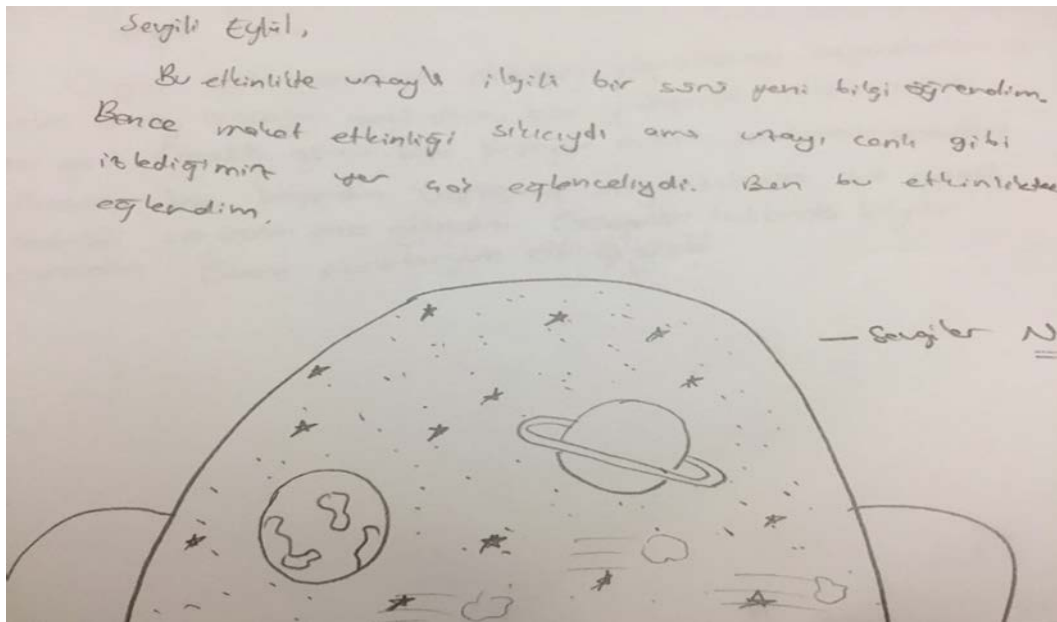
FIGURE 5. Letter example (fifth grade, S123)

Your Feelings and Thoughts About the Planetarium Environments

The favoured situations expressed in the letters of the eighth-grade students were stated as feeling like they had been to the planets, seeing the planets, watching videos, and having fun inside the (planetarium) tent. The disfavoured situations can be listed as a rather long planetarium activity, perceived as boring, and involved childish model-making. An example of an eighth-grader's letter is shown as Figure 6.

Table 8. *Sub-dimensions and sample explanations (eighth grade)*

Sub-dimension	(f)	Sample explanations
Favoured situations	44	I felt like I've made an interplanetary journey. (S13) When I came out of the planetarium, I felt like I'd come from outer space. (S14) (S12) (S37) When I saw the moon, I felt as if I had gone there. (S15) I liked seeing the planets. (S18) I really enjoyed it when I came down like an inflatable balloon. (S21) It was the most fun to watch a video of the planets inside the inflatable tent. (S26) (S29) (S34) (S53) The planetarium tent was a spacious and comfortable place. (S28) The place where we watched space come alive was so much fun. (S22) (S25) (S37) (S46)
Disfavoured situations	7	The planetarium activity seemed quite long. (S14) Making models was boring. (S22) (S30) The modelling event was a little childish. (S25) The modelling activity was not very exciting or fun. (S24) It was so hard to glue and stick the model together. (S27) It wasn't nice trying to make the model for such a long time. (S53)



(Dear Eylül,

I learnt a lot of new information about space at this activity. I think the model activity was boring, but it was so much fun when we watched space live. I had fun at this activity.

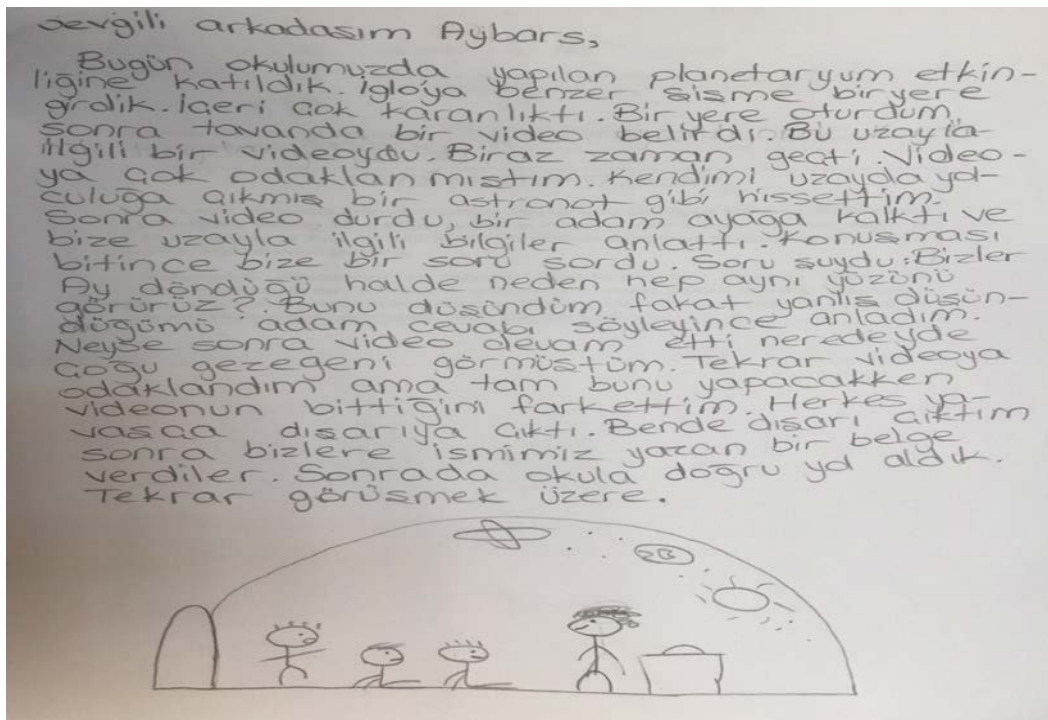
Love)

FIGURE 6. Letter example (eighth grade, S22)

According to Table 9, the favoured situations for the seventh-grade students were the impressive view of the planetarium, the film they watched, the inner view of the planetarium, and the production of a model. Their disfavoured situations were expressed as the lack of air in the tent, an insufficient number of mattresses, the short documentary, and the short model making time. An example letter from these students is shown in Figure 7.

Table 9. *Sub-dimensions and sample explanations (seventh grade)*

Sub-dimension	(f)	Sample explanations
Favoured situations	47	<p>It was the most beautiful space animation I'd ever seen. (S59)</p> <p>The planetarium had a comprehensive and impressive appearance. (S60)</p> <p>It was fun to look at space in a spherical area; as if I was really looking at it. (S62)</p> <p>The movie we watched was very impressive. (S64)</p> <p>When you paid attention in the planetarium, it's like you're really there and you're walking around. (S66) (S106) (S101) (S107) (S109)</p> <p>I was so focused on the video that I felt like an astronaut travelling through space. (S75)</p> <p>That was so much fun. (S83) (S84)</p> <p>I liked watching it, sitting on the fluffy pillows in the planetarium. (S89)</p> <p>The animation inside the tent we entered was very nice. (S92)</p> <p>I had so much fun making the model. (S63) (S79)</p> <p>I had the chance to examine a telescope close-up with the telescope model. (S88)</p> <p>I liked the video part where we watched the planets. (S94)</p> <p>The model was great. (S93)</p>
Disfavoured situations	8	<p>The inside of the planetarium was a bit airless. (S61) (S74) (S59)</p> <p>One problem was a lack of mattresses in the planetarium. Some of my friends had to sit on the empty floor instead of on a mattress. (S67) (S76)</p> <p>The documentary was short, I wish it had been longer. (S65) (S89)</p> <p>There was not enough time for me and many friends to make models. (S91)</p>



(Dear Aybars,

Today we participated in the planetarium activity held at our school. We entered a

globe like an igloo. It was too dark in there. A video appeared on the ceiling after I sat down. It was a video about space. A little time passed by and I was very focused on the video. I felt like an astronaut travelling through space. Then the video stopped and a man stood up and told us all about space. He asked us a question when he finished. The question was: 'Why do we always see the same face when the Moon turns?' I thought about it, but I got it wrong when the guy said the answer. Anyway, then the video continued. I've seen almost all the planets. I focused on the video again, but just as I was about to do it, I realised it was over. Everyone went out slowly. I then left too. Then they gave us a certificate with our name written on it. Then we went back to school.

See you later.)

FIGURE 7. Letter example (seventh grade, S75)

According to Table 10, the favoured situations for the sixth-grade students can be summarised as the appearance of the Moon and the Earth, the model making, and the beauty of the interior of the planetarium. The disfavoured situations were expressed as inadequate sound, and being airless and dark inside the planetarium. An example letter is shown in Figure 8.

Table 10. Sub-dimensions and sample explanations (sixth grade)

Sub-dimension	(f)	Sample explanations
Favoured situations	29	I liked to see the Moon and the Earth. (S137) I liked it when it was like we were passing through a meteor shower. (S140) Model making was so much fun. (S146) (S2) (S4) The inside of the balloon was cool and the images were very clear. (S150) The knowledge and the model I made has since made me more curious about the science of space. (S136) The inside was very large and very nice. The outside was very soft too. You were watching space looking at the ceiling. (S143) There was a playhouse filled with air similar to an igloo in the hall. When we came in, I saw the pillows, I just loved it. (S163)
Disfavoured situations	4	The sound level was a little low. (S144) (S138) It was airless in there. (S145) I was scared of the dark. (S142)

Sevgili Annem, 31/05/2017

Biliyorsun ki Cumartesi günleri Rusça dersi alıyorum. Yine bir gün Rusça kursuna gittim. Hocanın bize bir sürprizi olduğunu hoca açıkladınca anladım. Sürpriz ise Planetarium'a gitmek idi. Gitmek derken serviste değil, aşağıda ki ilkokullara açılan sokak amaçlı salona gittik. Salonunda igloya benzer hava ile doldurulmuş bir oyun evi vardı. İçeri girdiğimizde yastıkları gördüm. Sonra bir adam içeri girdi. İçeride gezegenler hakkında bilgiler anlattı. Hatta bizim merak ettiğimiz sorulara bile cevapladı. Sonradan bir projeksiyon ile her yere gezegenler görüldü. Hepsisi çok güzeldi. Anneciğim, bu olayı sana anlatmak istedim seni çok seviyorum.

Sevgilerle Oğlum

(Dear mother,

You know that I take Russian lessons on Saturdays. One day I went to the Russian course and the teacher explained they had a surprise for us. The surprise was to go to

the planetarium. We went to the multipurpose hall allocated to the primary schools below, so we did not need to go by school service. The hall had a playhouse filled with air similar to an igloo. When we walked in, I saw the pillows. Then a man came in. He told us some information about the planets inside. He even answered questions we were curious about. Afterwards, the planets were seen everywhere with a projector. It was all very nice. Mummy, I wanted to tell you all about this. Love you so much.

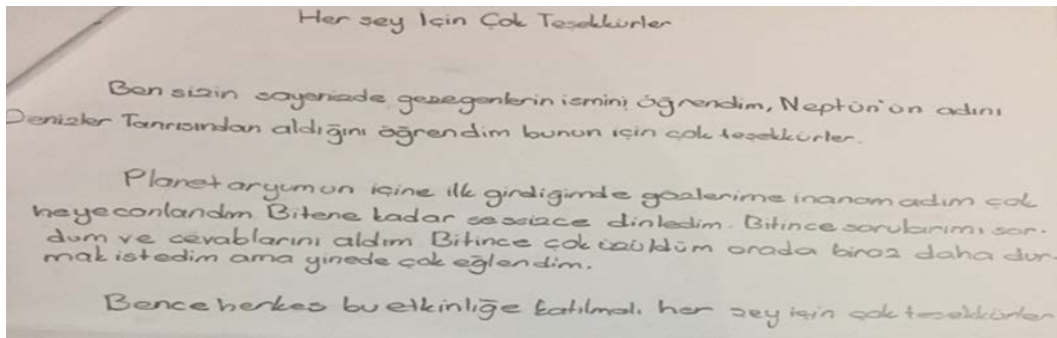
with love, your son)

FIGURE 8. Letter example (sixth grade, S163)

According to Table 11, the favoured situations for the fifth-grade students were liking the environment, feeling like they were going to space, and making models. The disfavoured situations for the planetarium were it being slightly dark and not very large. An example of a fifth-graders letter is shown in Figure 9.

Table 11. Sub-dimensions and sample explanations (fifth grade)

Sub-dimension	(f)	Sample explanations
Favoured situations	32	The environment was nice. (S116) We made the telescope and it was very exciting. (S123) (S127) (S128) (S111) (S116) (S132) (S130) (S134) When I walked in, I felt like I was in space. (S124) When I first entered the planetarium, I couldn't believe my eyes. I was so excited. I listened quietly until it was over. I asked my questions and I got some answers. I was so sorry when it was over. I wanted to be in there a little longer, but I still had so much fun. (S136) I felt like an astronaut. (S3) I wish I had everything real. (S3) (S131)
Disfavoured situations	2	The tent we entered was very different. I watched standing up because the room was a little dark. A little light would have been nice. I was a bit scared. (S113) The tent could have been a bit wider. (S117)



(Thank you so much for everything.

Thanks to you, I learnt the name of the planets. I learnt that Neptune was named from the god of the sea. Thanks so much for that.

I couldn't believe my eyes when I first entered the planetarium. I was so excited. I listened quietly until it was over. When it was over, I asked my questions and got some answers. I was so sorry when it was over. I wanted to be in there a little longer, but I still had a lot of fun.

I think everyone should attend this event. Thank you so much for everything.)

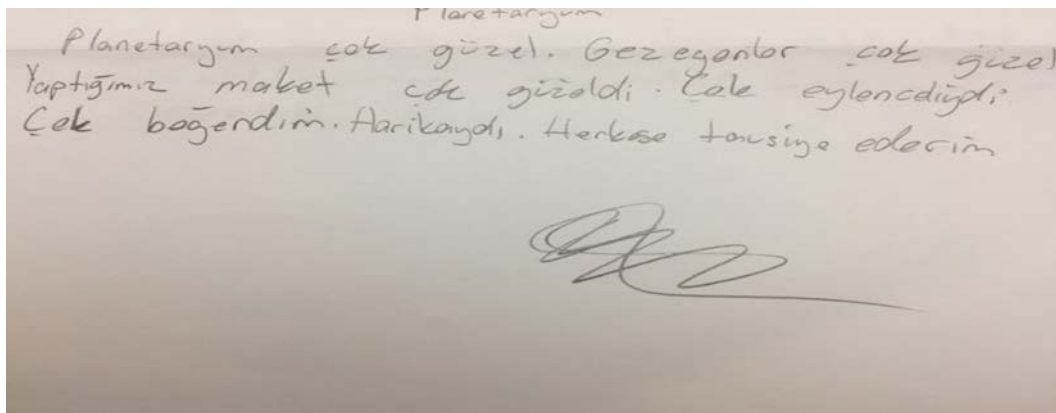
FIGURE 9. Letter example (fifth grade, S136)

Benefits of The Activity

According to Table 12, when the letters in the eighth grade were categorised according to the perceived benefits of the activity, the sub-dimensions formed are interest, curiosity, learning, and entertainment. In the sub-dimension of interest, the students stated that their interest in planets, space, and astronomy had all increased. They expressed that they felt as if they had discovered space in the sub-dimension of curiosity too, and that their curiosity towards space had increased. They wrote that they had acquired information in the learning sub-dimension, and that the activity was seen as good and fun in the entertainment sub-dimension. An example of a letter related to the entertainment sub-dimension is given in Figure 10.

Table 12. Sub-dimensions and sample explanations (eighth grade)

Sub-dimension	(f)	Sample explanations
Entertainment	30	It was a nice activity and fun. (S10) (S12) (S14) (S17) (S16) (S19) (S18) (S24) (S23) (S26) (S28) (S31) (S36) (S41) (S50) (S52)
Learning	26	I felt quite informed that day. (S34) In addition to the training, we were given some very nice examples from the website, it was beautiful. (S37)
Curiosity	5	I felt like I discovered space, I was curious. (S23) I was curious about space, and my curiosity has increased. (S24) (S42)
Interest	2	My interest in the planets has increased. (S21) I was interested in space, and that has increased a lot since this activity. (S25) My passion for astronomy has increased, and I have gained direction on how to proceed in this field. (S49)



(Planetarium

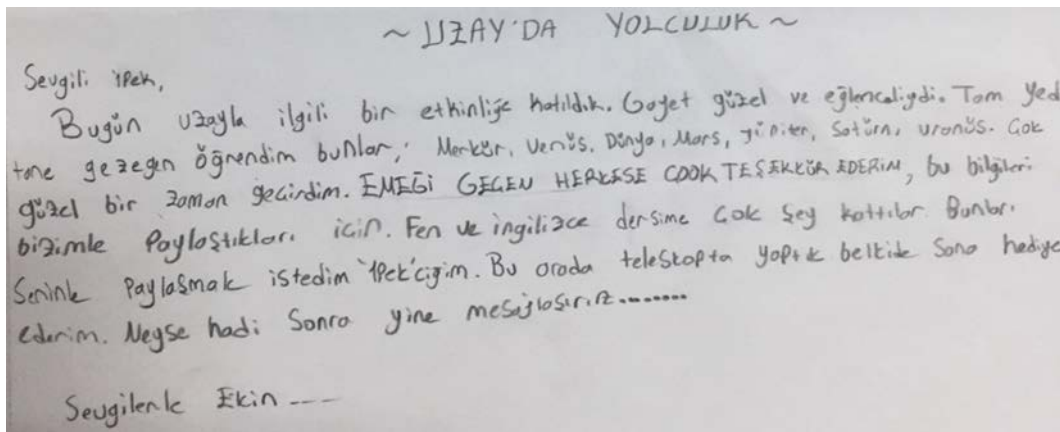
The planetarium was very beautiful and the planets were very beautiful. The model we made was very nice. That was so much fun. I really liked. It was great. I would recommend it to everyone.)

FIGURE 10. Letter example (eighth grade, S17)

In the seventh grade, interest, learning, entertainment, pleasure, and surprise sub-dimensions were formed under the dimension of the benefits of the activity. Under the interest sub-dimension, students stated that their interest towards the planets and to space had increased. They stated that they learnt new information and that the activity was fun. They said that they enjoyed it very much and that the planetarium was an astonishing place at first sight. An example of a letter by a seventh-grader for the entertainment sub-dimension is shown as Figure 11.

Table 13. Sub-dimensions and sample explanations (seventh grade)

Sub-dimension	(f)	Sample explanations
Learning	40	We learnt new information. (S81) (S105)
Entertainment	37	It was so much fun. (S58) (S59) (S61) (S73) (S64) (S67) (S78) (S82) (S84) (S85) (S87) (S91) (S93) (S97) (S99) (S100) (S103)
Surprise	9	I was surprised when I first saw it because we went into something big. (S81)
Pleasure	8	I rather enjoyed it. (S69) (S109)
Interest	6	My interest in planets has increased. (S64) (S107) Although I had no interest in space, my interest has increased. (S83) I was so intrigued the first time I went, I wish it was longer. I got carried away because I was so interested. (S79)



(TRAVEL IN SPACE)

Dear İpek,

We participated in a space-related activity today. It was very nice and really fun. I learnt about seven planets. These were Mercury, Venus, Earth, Mars, Jupiter, Saturn, and Uranus. I had a very nice time. THANK YOU VERY MUCH TO EVERYONE WHO CONTRIBUTED, and for sharing this information with us. They added a lot of contributions to my Science and English lessons. I wanted to share these with you. By the way, we made a telescope, maybe I could give it to you. Anyway I'll text again later.....

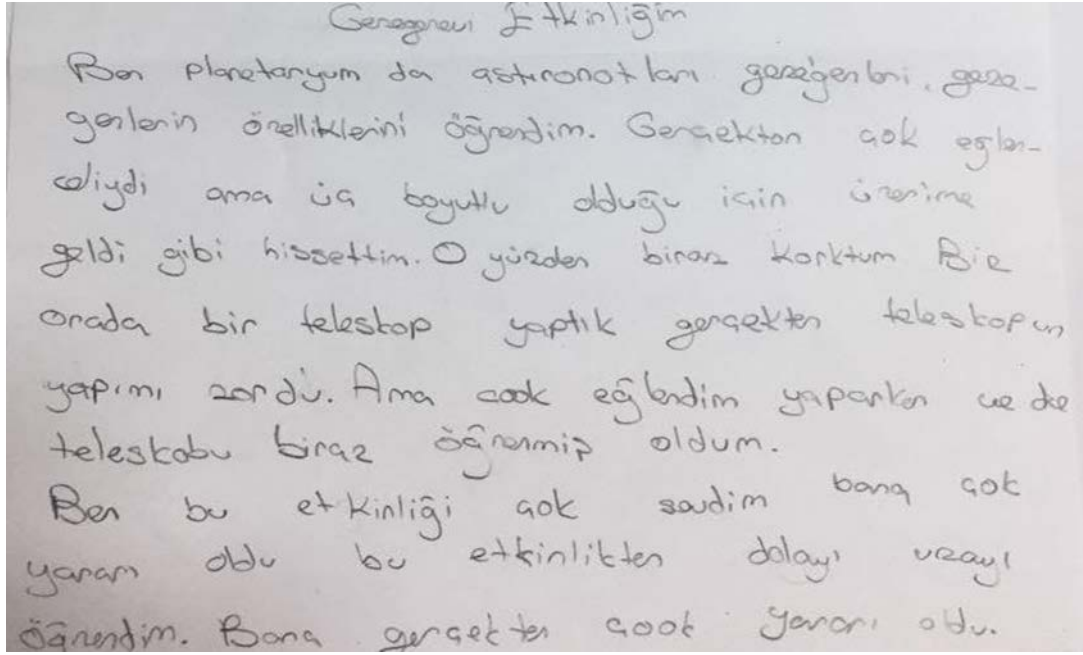
With love Ekin

FIGURE 11. Letter example (seventh grade, S85)

The sub-dimensions of the letters obtained from the sixth-grade students were learning, entertainment and pleasure. The results from the letters showed it as a teaching activity, that the activity was fun, that the planetarium was beautiful, and that it was enjoyable. An example of a letter about the entertainment sub-dimension is shown as Figure 12.

Table 14. Sub-dimensions and sample explanations (sixth grade)

Sub-dimension	(f)	Sample explanations
Learning	25	It was a teaching activity. (S161)
Entertainment	21	It was fun. (S111) (S141) (S140) (S138) (S147) (S148) (S149) (S162) (S2) (S4) (S8)
Pleasure	4	The planetarium was pleasant and very nice. (S142)



(My planetary activity)

I learnt about astronauts, planets, and the properties of the planets in the planetarium. It was really fun, but it felt overwhelming because it was three-dimensional. Therefore, I was a little scared. We made a telescope, but the construction of the telescope was really hard. I had so much fun doing the telescope though, and I learnt a little bit about telescopes.

I liked this activity very much. It was very useful to me as I learnt about space because of this activity. It really helped me a lot.)

FIGURE 12. Letter example (sixth grade, S111)

According to the results in Table 15, the sub-dimensions of the letters for the fifth graders were interest, curiosity, entertainment, fear, pleasure, and surprise. Among the data obtained from the letters were increasing interest levels towards planets, starting to become curious about space, that the activity was fun, experiencing some fear from the environment, that the activity was beautiful and enjoyable, and that the information about space caused some surprises. An example of a letter involving the surprise sub-dimension is shown in Figure 13.

Table 15. Sub-dimensions and sample explanations (fifth grade)

Sub-dimension	(f)	Sample explanations
Entertainment	22	It was fun. (S110) (S113) (S119) (S129) (S131) (S133) (S134)
Interest	7	My interest in planets has increased. (S116) (S133) (S124)
Pleasure	6	The activity was very nice, I enjoyed it. (S120) (S121)
Surprise	6	I was very surprised to hear about space. (S135)
Curiosity	5	I'm starting to get more curious about space. (S119) (S123) (S3) (S126)
Fear	4	It felt a bit overwhelmed because it was three-dimensional. Therefore, I was a little scared. (S111)

Sayın Planetaryum Etkinliği Yetkililerine;

Bu etkinliğin adını ilk kez duyuyordum. İlk başta garipsedim ve ne olduğunu merak ettim. Babam ve arkadaşım ile okula gittim. Bizi bir sınıfa aldılar. Önümüzde maket parçaları koydular. Bu parçaları teker teker kestik. Zor oldu ve babamdan yardım aldım. Kestikten sonra uzun uğraşlar sonucunda parçaları birleştirdik. Karşımıza bir uzay teleskobu çıktı. Daha sonra bizi çadırda aldılar. Bu çadırda uzay ile alakalı bilgiler verildi. Bu bilgileri duyduğum zaman çok şaşındım.

Sonuç olarak bu etkinlik sayesinde uzay ile ilgili yeni bilgiler öğrendim. Bu etkinliği yaptığınız için çok teşekkür ederim.

(Dear Planetarium activity officials;

I heard the name of this activity for the first time. At first I found it strange and I wondered what it would be. I went to school with my dad and my friend. They took us to a class. They put model pieces in front of us, then we cut these pieces one by one. It was difficult and I got help from my dad. After cutting, we put all the pieces together after a great deal of effort. We made a space telescope. Then they took us into the tent. Space-related information was given to us in this tent. I was very surprised when I heard this information. As a result of this activity, I learnt new information about space. Thank you so much for doing this activity.)

FIGURE 13. Letter example (fifth grade, S135)

Other Feelings and Thoughts You Want to Add

In addition to the letters expressed by the students, it was observed that they expressed their appreciation for the organisational part of the activity, and that they expected/hoped it to happen again and frequently. They also had recommendations for others to go to this event, and also to the person they wrote their letter to. Sample expressions for each student grade level are as follows:

'The organisers were very experienced and kind, thank you'. (S15, eighth grade)

'I highly recommend attending this beautiful and informative activity'. (S67, seventh grade)

'I wish we could do this activity every week'. (S8, sixth grade)

'I liked this activity very much. I hope it happens in future years. If it happens again, I will watch with great pleasure'. (S121, fifth grade).

DISCUSSION and CONCLUSION

In this study, an attempt was made to reveal the thoughts of middle school students who participated in a mobile planetarium activity. Content analysis of 163 letters written by the

participant students was conducted through document analysis. Analysis results of the letters were formed into groupings or dimensions as what was learnt from the planetarium activity, the students' feelings and thoughts about the environment in which the activity was held, the benefits of the activity, and other feelings and thoughts that the students raised. Data were then divided into sub-dimensions and expressed in sample explanations according to student grade levels.

The sub-dimensions for what was learnt from the planetarium activity were satellites, planets, and space for Grade 7 and Grade 8 students, while it was planets and space sub-dimensions for those in Grade 6 and Grade 5. What was learnt in the eighth and seventh grades was expressed in more detail in the letters. The satellites of the planets, planets in the Milky Way, characteristics of the planets, formation of the Earth, the Moon, and the Sun, and the Solar System were all listed as having been learnt by the eighth-grade students. The seventh-graders stated that they gained knowledge about the gas formation of some planets, their habitability, the planets and their properties, the satellites of some planets, that planets were hot or cold, and the differences between astrology and astronomy. The sixth-grade students stated that they learnt a great deal about the planets, their formation, growth or shrinking, the concept of craters, as well as the lives of astronauts. The fifth-graders stated that they had gained information about the planets (Mars, Saturn), the Solar System, that some of the planets were gas and found out other information about the planets. It is expected that the students would therefore be more excited and willing to learn when they next encounter a different learning environment outside of the classroom (Braund & Reiss, 2006).

As for the feelings and thoughts of the students, these were divided into sub-dimensions of favoured situations and disfavoured situations. Students from all four grade levels (5th, 6th, 7th, and 8th) expressed that they felt as if they went into space within the planetarium environment. A similar result was obtained in a study by Lelingou and Plakitsi (2009), where students at all grade levels found the video watched at the planetarium to be fun and impressive. Regarding the characteristics of the environment, the eighth-grade and seventh-grade students in the current study stated that they liked the environment very much in terms of its physical properties. Some students from the sixth grade stated that they physically resembled the planetarium tent to that of an igloo (snow house). On the other hand, some students from the fifth grade stated that they felt themselves like astronauts in the planetarium. However, some of the eighth-grade students stated that they were a little bored, that they found the activity to be childish, and did not feel enthusiastic about making the model telescopes, which was based on manual dexterity, cutting and gluing for its construction. As the grade level decreased, there was a corresponding increase seen in the number of students who found the model making to be a fun and enjoyable exercise. In the seventh and sixth grades, there were students who found the atmosphere inside of the planetarium to be a bit airless.

In terms of the benefits of the activity, the learning sub-dimension was common for the eighth, seventh, and sixth grades. While the curiosity sub-dimension was common in the eighth and fifth grades, the interest sub-dimension emerged in the seventh and fifth grades. In the seventh, sixth and fifth grades, the sub-dimension pleasure was found to be common. While the sub-dimension of surprise was common in the seventh and fifth grades, the fear sub-dimension emerged only in the fifth grade. Across all student grade levels, the entertainment sub-dimension was found to be common.

Out-of-school environments are active environments which create curiosity and foster interest (Akcan, 2010). As to the benefits of the activity, at the lower grade level, the learning sub-dimension was not found to be prevalent, but the fear sub-dimension was. Overall, across all grade levels, the students loved the planetarium activity and found it to be entertaining. There were opinions also supporting this view found in the literature (e.g., Lakin, 2006; Sontay et al., 2016). In the current study, the mobile planetarium activity was held to enable students from schools considered to be disadvantaged at the socioeconomic level to benefit from and functionally utilise an out-of-school environment. It is clear that the socioeconomic condition is

an important variable in the realisation of activities when organising educational trips (Koosimile, 2004). Negative economic impacts, administrative difficulties, and negative family attitudes are just some of the problems that teachers may face in schools.

When the letters written by the students in the current study were taken into consideration, it can be said that the planetarium activity achieved its purpose. Thanks to the activity, the trip environment was instead brought to the students, with part of the aim being to provide support to overcome socioeconomically related obstacles. Increased cooperation between university-school-family was attempted with students attending the activity along with their families. The activity was organised with planned and scheduled content, along with the participation of academic experts in the field through a social responsibility project of a state university. In the literature, evidence can be found with regards to educational trips that were not well-planned and not associated with an existing school programme not being considered as useful or beneficial (Tal, Bamberger, & Morag, 2005).

In terms of the methodological results of the current study, it can be said that a letter writing activity is more effective as the participant ages decrease. Letters written by eighth-grade students were found to be short, sloppy, and lacking any letter writing quality. As the grade level increases, a corresponding decrease in written expression skills was also found in the literature (e.g., Yılmaz, 2011). It should also be noted that writing is a skill-demanding process, and that this skill can be used by teachers across different activities (e.g., story writing, diary keeping) and should therefore be developed and encouraged. Particular attention should be paid to the process of sharing post-trip writing. Seminars and training can be given to teachers to utilise writing activities for different purposes such as learning and for receiving student feedback. Seeking out students' ideas and thoughts about out-of-school educational events they attend may elicit positive opinions and provide effective suggestions for the implementation of similar activities in the future. Teachers who organise trips to out-of-school environments should be encouraged to actively participate in the process, and efforts should be focused on increased cooperation between schools and universities in this area. Teachers and school administrators are advised to appraise and trial practices that can create out-of-school environments for their schools. In areas where low socioeconomic levels exist, it may be possible to arrange out-of-school environments such as the mobile planetarium seen in the current study in order to hold events in close proximity to the target learners (e.g., the school grounds) in order to support the success potential of such activities.

The current study was conducted with of middle school students (grades 5 to 8), and with a limited number of participants at a public school in Ankara, Turkey. Out-of-class activities could be conducted with a wider sample across different age levels, with different subject areas, and in different environments. In addition, experimental studies could be conducted in order to measure the effect of writing activities on students in terms of various variables.

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