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Planetaryum Gezisi ile Fen Bilgisi Öğretmen Adaylarının Astronomi Kavramlarındaki Değişimin İncelenmesi

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Özet – Günümüz eğitim öğretim etkinlikleri var olan olası tüm kaynakları kullanacak şekilde yaşam boyu devam eden, planlı öğrenme ortamları ile birlikte okul dışı öğrenme ortamları ve bu ortamlara (planetaryum, müze, hayvanat bahçesi vb.) planlanan alan gezilerini içermektedir. Bu tür etkinliklerde ise öğretmenlere önemli görevler düşmektedir. Bu bağlamda araştırmanın amacı okul dışı öğrenme ortamlarından biri olarak kabul edilen planetaryuma yapılan gezinin, fen bilgisi öğretmen adaylarının planetaryuma ilişkin tanımları ve bilgi düzeylerini; planetaryumlar ile fen ve astronomi eğitimine katkısına yönelik görüşlerini uygulanan ön ve son testler ile açığa çıkarmaktır. Nitel araştırma yöntemlerinden olgu bilim deseninin kullanıldığı çalışmanın ön testi 29 fen bilgisi öğretmen adayı (24 kız, 5 erkek), son testi 44 fen bilgisi öğretmen adayı (33 kız, 11 erkek) ile gerçekleştirilmiştir. Çalışmada araştırmacılar tarafından geliştirilen ve açık uçlu sorulardan oluşan Planetaryum Gezisi Anket Formu (PGAF) ön-son test olarak kullanılmıştır. Araştırma sonunda fen bilgisi öğretmen adaylarının planetaryum gezisi ile astronomi kavramlarında faydalı değişimler gözlemlenmiş, araştırmaya ve benzer çalışmalar yapacak araştırmacılara yönelik öneriler sunulmuştur.

Anahtar kelimeler: Fen eğitimi, astronomi kavramları, informal öğrenme, plenataryum, fen bilgisi öğretmen adayları

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Geniş Özet

Günümüz eğitim öğretim etkinliklerinin var olan olası tüm kaynakları kullanacak şekilde yaşam boyu devam eden bir sürece dönüştüğü görülmektedir. Eğitim alanyazınında yaşam boyu öğrenme olarak yer alan bu süreç, bireylerin kendi öğrenmelerini devam ettirebilmeleri için sahip olmaları gereken beceri ve yeterlikleri kazanmalarını sağlayan esnek

bir süreçtir. Yaşam boyu öğrenme olarak adlandırılan bu süreç okuryazar olma, bilgi edinme ve eleştirel düşünme gibi becerilerin kazandırılmasına olanak sağlayan bir araç olarak tanımlanmakla birlikte bireylerin ihtiyacı olan bilgiyi ihtiyaç duydukları zaman, ilgi alanlarına göre katıldıkları tüm öğrenme etkinlikleriyle erişmelerine olanak tanır. Okul dışı öğrenme ortamlarına yapılan alan gezileri okullarda yürütülen planlı eğitim ile birlikte kullanıldığında öğrenmede kalıcılığı sağlama, ilk elden somut deneyimler kazandırma, gözlem yapma olanağı sunma ve konuya yönelik farkındalık kazandırma becerileri açısından etkili bir yöntem olarak kabul edilmektedir. Planetaryumlar yukarıda tanımlanan okul dışı öğrenme ortamları arasında yer almaktadır. Planetaryumlar geliştirilen içerikleri ile astronomi ve uzay bilimlerini daha iyi öğrenmek ve kavramak için düşünülmüş, özel bir yansıtıcı aracılığı ile kürenin iç yüzü şeklinde tasarlanmış ekrana gerçekçi simülasyonlar sağlanan öğrenme ortamlarıdır. Okul dışı öğrenme ortamlarının okullardaki planlı eğitimi destekleyecek nitelikte düzenlenmesinde, eğitim öğretim sürecinin en temel ögelerinden öğretmenlere de önemli görevler düşmektedir. Güncellenen fen bilgisi öğretmen yetiştirme lisans programına okul dışı öğrenme ortamları dersi ile birlikte seçmeli dersi olarak okul dışı öğrenme ortamları dersi tanımlanmıştır. Bu bağlamda yapılan araştırmanın amacı okul dışı öğrenme ortamlarından olan planetaryuma yapılan gezinin, fen bilgisi öğretmen adaylarının planetaryuma ilişkin tanımları ve bilgi düzeylerini; planetaryumlar ile fen ve astronomi eğitimine katkısına yönelik görüşlerini uygulanan ön ve son testler ile açığa çıkarmaktır. Çalışmada nitel araştırma desenleri içerisinde yer alan olgu bilim kullanılmıştır. Araştırmanın katılımcılarını Orta Anadolu'da bir devlet üniversitesinde öğrenim görmekte olan son sınıf fen bilgisi öğretmen adayları oluşturmaktadır. Çalışmanın ön testi 29 fen bilgisi öğretmen adayı (24 kız, 5 erkek), son testi 44 fen bilgisi öğretmen adayı (33 kız, 11 erkek) ile gerçekleştirilmiştir. Çalışmada araştırmacılar tarafından geliştirilen ve açık uçlu sorulardan oluşan Planetaryum Gezisi Anket Formu (PGAF) kullanılmıştır. Araştırma sürecinde fen bilgisi öğretmen adayları düzenlenen bir bilimsel etkinlik ile planetaryum ve bilim merkezi gezisine götürülmüştür. Gezide planetaryum, planetaryum çalışanları ve ilgili öğretim üyeleri tarafından tanıtılmış, öğrencilerin örnek fen materyallerini incelemelerine olanak tanınmıştır. Ardından fen bilgisi öğretmen adayları planetaryumu ve gökbilimi tanıtan, evren ve Dünya'nın oluşumu ile ilgili iki adet film izlemişledir. Gezi öncesi fen bilgisi öğretmen adaylarına planetaryum ve fen eğitimindeki yeri ile ilgili sorular içeren bir ön test (PGAF-Ö) uygulanmış, gezinin ardından aynı sorulara üç adet sorunun eklenmesi ile son test (PGAF-S) uygulanmıştır. Elde edilen verilerin analizinde nitel analiz yöntemlerinden betimsel analiz ve içerik analizi kullanılmıştır. Fen bilgisi öğretmen

adaylarına planetaryum gezisi ile astronomi kavramlarında olumlu değişimler olduğu gözlemlenmiştir. Gezi öncesinde fen bilgisi öğretmen adaylarının büyük çoğunluğunun planetaryumları daha önceki gezi deneyimleri, internet, okul etkinlikleri gibi kaynaklardan duymuş olduğu, gezi sonrasında ise neredeyse öğrencilerin tamamının planetaryum konusunda farkındalık kazandığı tespit edilmiştir. Analizler sonucunda fen bilgisi öğretmen adaylarına planetaryum gezisi ile astronomi kavramlarında olumlu değişimler olduğu gözlemlenmiştir. Gezi öncesinde fen bilgisi öğretmen adaylarının büyük çoğunluğunun planetaryumları daha önceki gezi deneyimleri, internet, okul etkinlikleri gibi kaynaklardan duymuş olduğu, gezi sonrasında ise neredeyse öğrencilerin tamamının planetaryum konusunda farkındalık kazandığı tespit edilmiştir. Yine planetaryum kavramının gezi öncesinde uzay gezegen, yapay gezegen gibi astronomi ile ilgili kavramlar ile birlikte biyoloji, canlı gibi doğrudan ilişkisi olmayan kavramları çağrıştırdığı görülmektedir. Gezinin ardından ise fen bilgisi öğretmen adaylarının aynı soruya vermiş oldukları cevapları incelendiğinde cevapların yapay gezegen ortamı, gezegen, astronomi ve öğrenme alanları gibi kavramlar üzerinde değiştiği görülmektedir. Fen bilgisi öğretmen adaylarının planetaryum kavramına eş anlam olarak verdikleri yanıtların astronomi, biyoloji, mekân, bilgi temaları altında sınıflandığı görülmektedir. Gezi sonrası fen bilgisi öğretmen adaylarının cevapları incelendiğinde cevaplarda çeşitlilik görülmekle birlikte bu çeşitliliğin öğrenme, görüntü/gösteri gibi temalar altında daha spesifik bir hal aldığı görülmektedir. Fen bilgisi öğretmen adaylarına planetaryum gezisi ile değişen astronomi kavramlarına bir diğer örnek planetaryum kavramının tanımına ilişkin anket sorusuyla ortaya çıkmıştır. Gezi öncesinde öğrencilerin büyük kısmının bu tanımı bilmedikleri, yanlış tanımlar verdikleri görülmekle birlikte sanal uzay ortamı ve uzay ile ilgili bilgi verme amaçlı yerler olduğunu ifade ettikleri tespit edilmiştir. Gezi sonrası fen bilgisi öğretmen adaylarının cevapları incelendiğinde ise cevaplardaki çeşitliliğin azaldığı, üç boyutlu sinema, sanal uzay ortamı, uzay ile ilgili bilgiler verme gibi cevaplara odaklanıldığı görülmektedir. Planetaryumların amacının sorulduğu bir başka soruda, gezi öncesi fen bilgisi öğretmen adaylarının cevapları incelendiğinde öğretim, bilgi, bilgim yok, ilişkisiz cevaplar, hayvanların yaşam alanlara rastlanmıştır. Gezi sonrası fen bilgisi öğretmen adaylarının vermiş oldukları cevaplar incelendiğinde ise cevapların öğretim, eğlenerek öğrenme, gerçeğe yakın ortam, görseller aracılığı ile öğretim, bilgi verme üzerinde odaklandığı görülmektedir. Anket ile fen bilgisi öğretmen adaylarına planetaryumlar ile fen arasındaki ilişki sorulduğunda öğretmen adaylarının gezi öncesinde öğretim, somut deneyim kazanma, fene yardımcı olma, neden-sonuç ilişkisi kurma, bilgi verme, hatalı olarak da canlıların öğretimi, canlıları inceleme gibi cevaplar vermiş oldukları görülmektedir. Gezi sonrasında fen bilgisi öğretmen adayları bu ilişkiyi fene yardımcı

olma, somutlaştırma, pekiştirme, kalıcılığı sağlama ile birlikte deney yapma, faydalanma, tamamlayıcı olma şeklinde ifade etmişlerdir. Yapılan araştırmayla fen bilgisi öğretmen adaylarının planetaryum gezisi ile astronomi kavramlarında faydalı değişimler gözlemlenmiş, araştırmaya ve benzer çalışmalar yapacak araştırmacılara yönelik öneriler sunulmuştur.

Investigation of the Preservice Science Teachers' Astronomy Conceptions via Planetarium Trip

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Abstract – Today's educational and teaching activities comprise of the planned learning environments, including the informal learning environments and the field trips planned to be made to these environments (planetarium, museum, zoo, etc.), continuing for the whole life in a manner using all the available resources. In such activities, the teachers play a key role. The objective of the study within this context is to reveal the definitions and knowledge levels of the preservice science teachers (PSTs), including their opinions on planetarium and the contribution to science and astronomy education with preliminary and final tests with regards to the trip made to the planetarium, which is accepted to be as an environment for informal learning environments. The preliminary test of the study, where the phenomenological pattern was used as one of the qualitative research methods was fulfilled with 29 preservice science teachers (24 female, 5 male), while the final test process was fulfilled with 44 preservice science teachers (33 female, 11 male). The Planetarium Trip Survey Form (PTSF), developed by the researchers and comprising of open-ended questions was used as the preliminary-final tests. At the end of the research, positive changes were observed on the concepts of planetarium trip and the astronomy for the preservice science teachers, as well as providing suggestions for the respective research and the researchers, who plan to carry out similar studies.

Key words: Science education, astronomy concepts, informal learning, planetarium, preservice science teachers

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Introduction

It is seen that education-training activities of our age has been turned into a lifelong process to use all available resources. This process is included in the education literature as lifelong learning is a flexible process that enables individuals to acquire the skills and competencies they need to have so that they would continue their own learning process. Lifelong learning is defined as a tool that enables learners to acquire skills such as literacy, information and critical thinking, and allows individuals to access the required information,

when they need the information, through all the learning activities they participate as per their areas of interests (Akkoyunlu, 2008; Candy, 2003; Demirel, 2012).

Schools should not be considered simply as a learning environment. Lifelong learning and informal learning environments, which are more flexible, natural and fun than this education, along with planned formal education offered to schools, diverge learning from the classroom environment and necessity of the classroom and book with the different content experiences and activities they present to the students; and it supports planned education in school (Bozdoğan, 2017; Noel, 2007; Taylor & Caldarelli, 2004). Wunder (2002) emphasizes the necessity of creating rich learning environments, using remarkable, curious and motivational elements, and realization of the activities revealing the preliminary information and experiences of the students related to the specified subjects and the events activating the students in learning environments other than schools like museums and natural habitats in learning activities so that the information learned would not be merely memorization but would be better interpreted and they have higher thinking skills. In this way, students will be able to lay the groundwork for the development of high thinking skills, critical thinking, and deeper questioning, as well as the development of cause-effect relations and reasoning skills.

The fact that informal learning environments are often enriched with materials offers the opportunity to appeal to individuals of all ages, to learn and to gain different experiences. Individuals come to these circles voluntarily and participate in different activities. Thanks to the availability of rich and concrete learning environments, it helps individuals build and understand their own cognitive structures. Informal learning environments include places such as zoos, botanical parks, planetarium, museums, nature centers, woodland areas, caves, coastal areas, sports centers, mass media such as newspapers, journals, and internet (Gerber & Marek, 2001; Salmi, 1993; Türkmen, 2010).

Field trips to informal learning environments are considered to be an effective method, when used together with planned education conducted in schools in terms of providing permanence to learning, providing concrete experiences from the first hand, providing opportunity to observe and acquiring awareness about the subject. However, when it is evaluated in terms of dimensions such as appropriate content selection, transportation provision, activity execution/management and pedagogical guidance, it is seen that there are limitations (Tatar & Bağrıyanık, 2012; Orion & Hofstein, 1994).

Planetariums can be considered among informal learning environments specified above. The planetariums are learning environments that provide realistic simulations (including sound

and visual elements) to the screen, designed with the contents to be developed, designed to better understand and learn astronomy and space sciences, and designed as an inner face that is rendered in a dark environment through a special reflector.

Planetariums are also used in the teaching of other subjects outside of astronomy with the improved projector structures, as well as contributing to the education and training processes by embodying scientific events in a realistic environment. Having a structure that can be used effectively in science education when it is considered from the point of view of disciplines, planetariums help to present an effective and fun learning environment to students by attracting their attention (Adams & Slater, 2000; Ertaş & Şen, 2011; Fisher, 1997; Plummer, 2009).

Informal learning environments are to be organized in a way that will support planned education in the schools, and teachers would have important duties in the most basic texts of the education and training period (Dillon, Rickinson, Teamey, Morris, Choi, Sanders & Benefield, 2006; Kete & Horasan, 2013; Sapsağlam & Kabadayı, 2011). When the studies conducted in this context are analyzed, it can be seen that teachers do not have sufficient pedagogical competence and experience in informal learning environments and trip planning; it is emphasized that they do not/ can not organize many trips to informal learning environments (Anderson, Bethan & Mayer-Smith, 2006; Anderson, Kisiel & Mayer-Smith, 2006; Bowker, 2004; Ferry, 1993; Griffin & Symington, 1997; Kisiel 2003; Kisiel, 2013; Michie, 1998; Olson, Cox-Petersen & Mc Comas, 2001). For example, DeWitt and Storksdieck (2008) conducted their work in the context of organized school trips and in their own real environment, with teacher and guides. They concluded with this work that field trips are effective in eliminating students' preliminary knowledge and provide opportunities for first-hand learning, exploration and experiencing by providing concrete learning experiences in the real environment of the event/phenomenon.

When researchers on teacher candidates and informal learning environments are reviewed, some studies are found showing that teacher candidates are provided with training related to informal learning environments and that these training produced positive results. (Bozdoğan, 2012; Catherine & Catherine, 2011; Chin, 2004; Munakata, 2005; Kisiel, 2013). For example, Bozdoğan (2012) provided a training on how to plan trips to no informal learning environments and how to teach teacher candidates about such activities. Following such training, he monitored, the teacher candidates in the implementation process and conducted face-to-face interviews related to the process.

At the end of the two-year research period, it was determined that the teacher candidates' candidates worked in a coordinated, planned and willing manner during the planning process;

supportive interviews have indicated that the previous training have reached the level of knowledge and confidence of the teacher candidates for trips and planning trips. It is thought in the related literature that the teacher candidates will be able to take lessons with similar content in this field before they start to work so that they will be able to use informal learning environments effectively in their subsequent professional experiences. (DeWitt & Storksdieck, 2008; Kisiel; 2013;). In relation to this, Kisiel (2013) investigated the effects of out-of-school trips on students' interest in science courses, information acquisition, discussion/participation in the classroom. At the end of the study, they stated that the teacher candidates can produce more active and subject-oriented questions in out-of-school trips and classroom applications. When the literature related to the trips conducted for scientific purposes are reviewed (Anderson, Kisiel & Mayer-Smith, 2006; Storksdieck, 2001; Tatar & Bağrıyanık, 2012), it is seen that these works are those including the opinions of students (Ertaş Kılıç & Şen, 2014; Köseoğlu, Soran & Storer; 2009; Rennie & McClafferty, 1995; Sonyat, Tutat & Karamustafaoğlu, 2016), teachers (Anderson, Kisiel & Mayer-Smith, 2006; Anderson & Zhang, 2003; Tatar & Bağrıyanık, 2012), and students-teachers (Storksdieck, 2001). For example, Köseoğlu, Soran and Storer's (2009) studies on the effects of informal learning environments practices on water and wastewater use knowledge and behaviors of the high school students have created educational contents and learning stations, where they use unnecessary water usage, water cycle, and wastewater treatment systems. In the interviews conducted within the scope of the study, it was stated that the students had more active participation in the class, they found the learning process fun and facilitated their learning and made their knowledge permanent. In another study, Ertas Kılıç and Şen (2014) conducted a study on the effect of informal learning environments on critical thinking of high school students. Researchers found that critical thinking-based physics teaching supported by out-of-school learning activities contributed to the development of critical thinking and supported positive attitudes towards physics lessons and that science centers and planetarium trips have influences on different dimensions such as learning styles and conceptual learning of students and concluded that planetariums become widespread. Rennie and McClafferty (1995) investigated the experiences of science experiments in students' attitudes towards science courses and activities in the field of interactive science and technology center and interactive visualizations. Such interactions can be included as a result of enhancing students' instructional learning, having fun and learning about them, and increasing the permanence of the subjects by presenting them through visuals. Sonyat, Tutat, and Karamustafaoglu (2016) studied the views

of eighth-grade students on their planetarium trip in their studies. For this purpose, they focused on pre-trip and after-trip views of the students on planetarium and trip, their effectiveness in navigating and their views on informal learning environments. 17 eighth grade students participated in the study conducted as per phenomenology design. Semi-structured interviews were made with students before and after the trips; the results of the analysis showed that the content of the students in the planetarium was consistent with the science course and contributed to the learning of the science, provided the permanence of the information, and informal learning environments such as the planetarium were fun. Storksdieck (2001) investigated the differences between teachers' and students' experiences in field trips and found that teachers were more informed about the subject, more and more experienced about the topic than the students who visited the field, had more convenience in finding material, and students have more positive attitudes and are willing to learn.

Braun and Reiss (2006) have also conducted informal learning activities in science studios, museums, zoos, botanical gardens to improve the attitudes and interests of the students in science lessons, who lost their tendency and interest. These activities have been determined in the context of physics, chemistry, and ecology with the content of nature of science and the history of science. At the end of the applications, it has been determined that the students have increased interest, attitude, and participation towards science courses, they have gained concrete and near-real experiences, and that the content provided by the permanent learner has positive developments in the subject knowledge of the students.

Hobson, Cabe Trundle and Sackes (2010) investigated the effects of films on astronomy concepts by showing planetarium-based films to children aged 7-9 years and students who visited the planetarium. At the end of the study, they concluded that the planetarium resulted in positive changes in the teaching of astronomical achievements expected to be achieved in the students, ensuring concretization in the teaching of the difficult concepts to provide students with appropriate content, and providing students with the convenience of learning scientific concepts that are difficult to learn and appropriate to their cognitive levels. Similarly, Plummer (2009) planned a planetarium trip for primary and secondary school students and benefited from kinesthetic learning and planetarium in teaching the achievements of moon phases. At the end of the research, it is concluded that the contents presented in the planetarium together with the rich learning environments contributed positively to the teaching of the related subject, and the interest and participation of the students were ensured.

In studies conducted with teachers, Tatar and Bağrıyanık (2012) examined the views of science teachers on informal learning activities. The study was conducted by screening method

and 79 teachers participated. As a result of the analyzes, they concluded that teachers usually prefer reading publications (book/journal) about model/material preparation and science and technology topics; that they, minimum, prefer activities such as summer camps, visits to youth centers and aquarium visits, and they prefer these activities ensuring children to learn by living by doing, activities, and since they are effective in increasing interest, desire, and curiosity of students; and that they have certain difficulties such as the lack of possibilities in non-formal education applications, related to school managers, teachers, and parents. In a similar study, Anderson, Kisiel, and Mayer-Smith (2006) examined teachers' views on field trips to non-formal educational settings such as science centers and museums in America, Canada, and Germany. Field trips require specific qualifications for teachers, such as field knowledge, out-of-school activity, pedagogical competence, decision-making, and management. They found that planned field trips have positive aspects for the first-hand experience, where students in all three countries can see the topics in a broader perspective and allow them to embody the topic in planetarium-like environments as they cause difficulties to teachers in the areas of transportation and organization. Anderson and Zhang (2003) examined the opinions of teachers on arranging and implementing field trips. A scale for teachers' arrangements and applications was applied in the quantitative part of the study, as focus group interviews were made with teachers in qualitative part. It has been suggested in the study that the field trips of the teachers are important in the teaching of the subjects, especially in the teaching of the difficult subjects, that they are more permanent and funny than the classroom teaching, that they are the first time to gain experience and that it is easier for the teachers to find the material, and the teachers should have certain degree of pedagogical competencies for such processes.

Objective, Importance, and Rationale

The importance attached to informal learning environments have reflections on the education programs. For example, in the 25-teacher education graduate program updated in 2018, informal learning environments courses were defined as vocational knowledge elective course. Again, in the undergraduate curriculum for science teacher education, a selective course for non-formal education in science teaching was included. The content of this course, which is defined as field education and included in the eighth semester, is as follows: Scope of informal education, science teaching in out-of-school settings, teaching methods, techniques and materials suitable for informal learning environments (project-based learning, station technique, etc.), informal learning environments (museums, science centers, zoo gardens, botanical gardens, planetarium, industrial establishments, national parks, science festivals,

science camps, natural environments, etc.); planning, implementation and evaluation of non-formal education activities (Turkish Higher Education Council, 2018).

This study is related to the contributions of students to the conceptual development of planetarium, which may be considered among informal learning environments and field trips. When studies on this subject are examined, it is seen that field trips provide students with facilities in their respective learning areas and enable them to gain concrete experiences from the first hand and to think critically; for teachers, it is seen that some specific qualifications are required (Anderson, Kisiel & Mayer-Smith, 2006; Anderson & Zhang, 2003; Braund & Reiss, 2006; Rennie & Mcclaferry, 1995; Wunder, 2002). These studies also include findings on the ability of planetariums that are considered as one of the informal learning environments to provide learning processes with rich learning material support, fun learning, concretization, positive attitude development, retention and learning (Sonat, Tutat & Karamustafaoglu, 2016). In this context, the purpose of the research is to explore, by using preliminary and final tests, opinions of the teachers on contribution of the planetarium trips as one of the informal learning environments, on definition and knowledge levels of the teacher candidates regarding the planetarium; planetariums and their contribution to science and astronomy education.

Methodology

Research Design

The study was carried out under the qualitative research paradigm. Qualitative researchers seek to find answers to questions by exploring in a wide perspective on how much, how deep or how well the investigated subject is (Barbour, 2013; Büyüköztürk, Çakmak, Akgün, Karadeniz & Demirel, 2017; Patton, 2005; Silverman, 2016). In this study, phenomenology was used included in the qualitative research designs. Phenomenology studies present experiences of individuals towards a specific topic. The main objective of phenomenology studies is to try to explain the individual experiences of the phenomena/phenomena identified in a more general/universal quality. In this process, researchers first define phenomenon, then they open up the views/experiences of the individuals towards the specified subject. The resulting data is presented in a holistic description that reflects the whole of the research group (Creswell, 2013; Merriam, 2002).

During the research process, teacher candidates were taken to a planetarium and science center trip with a scientific event organized. In this trip, the planetarium was introduced by planetarium staff and related faculty members, allowing students to examine sample science materials. Subsequently, teacher candidates watched two films about the formation of the

universe and the Earth, which introduce the planetarium and astronomy. After the presentation of the films, the presentation of the science center was continued and the trip was completed sticking with the event schedule. Before the trip, a pre-test (PTSF-P) was applied to the candidates for the planetarium and the science education. After the trip, three questions were added to the same questions and the final (post)-test (PTSF-F) was applied.

Participants

The research was conducted with final year preservice science teachers from a state university in Central Anatolia. The preliminary test of the study consisted of 29 preservice science teachers (24 female, 5 male) and final test with 44 preservice science teachers (33 female, 11 male). The number of preservice science teachers who participated in both the preliminary and the number of final applications is 19. The reason for this difference is that some preservice science teachers do not come to school on the day the pre-test is applied, gave blank papers or non-coded data.

Data Collection

Planetarium Trip Survey Form (PTSF) developed by researchers and including open-ended questions was used in the study. In the process of developing the questions, the related literature was searched and the researchers started to write the questionnaire periodically. After the questions were prepared, the opinions of the three academicians in the field of science education were taken, and then the opinions of expert academicians in the field of Turkish education were taken in order to provide language validity. After all these processes, the questions reached the final format, and the implementation process as the next step was started. The PTSF pre-test applied before the field trip includes 6 open-ended questions aimed at bringing out the participants' preliminary information about the planetarium (what the planetarium is being used for, why it has been used in such an environment and relation of the planetariums to science education etc.). The PTSF final test, in addition to including articles in the preliminary test, consists of 9 questions with the aim of bringing to the students what the field trip adds to the students, the place and importance of the astronomy education, and the nature of experiences of the preservice science teachers.

Data Analysis

In the analysis of the data in the study, descriptive analysis and content analysis were used as qualitative analysis methods. In the descriptive analysis, the data obtained with the

interview, observation, written method etc. is reduced and interpreted in accordance with the themes determined. Cause-effect relations in the answers are examined. When the results obtained are presented, quotations are given to reflect the views of the participants (Silverman, 2016; Yıldırım & Şimşek, 2016). Content analysis is a technique to logically conceptualize the data that are converted into written words and to identify them under a common theme (Creswell, 2003).

The raw data obtained from the written data were analyzed by the researchers and categorized by inductive analysis. The data were then categorized under designated categories and made meaningful to the reader. The coding and categorization process was repeated by one of the researchers at regular intervals. In this regard, the problem of research and the purpose of the obsolete, unnecessary coding have been removed, while adding new sections to the necessary coding. In the naming of the categories, the researchers acted together. As a result, the data for each question was presented to the reader through the tables.

Findings

Findings obtained from the research were collected with data collection tools and by sub-problems. These findings obtained from the PTSF pretest and PTSF final -test are presented below in tabular form with their analysis for comparison. Accordingly, the answers given by the participants to the first question and the related content analyzes are given in Table 1.

Table 1: *Have you heard of the planetarium concept before? Please explain.* Content analysis findings related to the above question.

PTSF-P			PTSF-F		
	Yes	No		Yes	No
Source	**Frequency**	**Frequency**	**Source**	**Frequency**	**Frequency**
	16	9	Trip	17	-
Trip	11		Friend	1	
School events	5		School environment	1	
Instructor Random	3		Astronomy course	1	
Internet	2		Book	1	
Book	1		Source yok	3	
Trip	1				
Astronomy course	1				
Physic course	1				
Social media	1				
TV	1				
Classroom environment	1				
	1				

The preservice science teachers were asked about their awareness of the planetarium concept before the trip. When the answers given by preservice science teachers were examined, most of the pre-trip preservice science teachers (f = 20) stated that they had heard this concept before and they heard it via internet, TV, social media, school activities, instructors or random

methods. The same question was asked again after the trip, when all of the preservice science teachers were aware of the planetarium concept, as a result of traveling as a resource. Some of the answers given by the preservice science teachers in the PTSF pre- and post-test (PTSF-P and PTSF-F) are given below as direct quote.

"Yes. When we went to the science center, I heard that the place we watched in the short film about science, or rather space related to NASA, was a planetarium." PST-35, PTSF-F
"I have heard it in an Astronomy course." PST-4, PTSF-P
"No, I had never heard it before. It was my first time and I liked it very much." PST-2, PTSF-F
"I had never heard of this concept before." PST-9, PTSF-P

Table 2: *What do you think when you hear planetarium concept?* Content analysis findings related to the above question.

PTSF-P		PTSF-F	
Concept	**Frequency**	**Concept**	**Frequency**
Space	6	Artificial planetary environment	11
Planet	5	Planet	10
Artificial planetary environment	3	Astronomy	6
Star	3	Learning area	6
Space images	3	Space images	5
Animation	3	Multiple dim. (3, 4, 5)	4
Biology	3	Moon / Sun	6
Live	4	Sun	
No response	4		
Virtual image	7		

When the preservice science teachers were asked what planetarium concept connotes for them, in general associations were determined from the review of their answers to the concepts such as astronomy, space, planet and the artificial planet as well as biology and life. When the answers of the preservice science teachers to the same question are examined, it is concluded that the most conceived concepts are a planet, artificial planet and learning field, and visuals. Some of the responses of the preservice science teachers to the PTSF-P and PTSF-F regarding this question are presented below as a direct quotation.

"6-7 dimensioned presentation on science." PST-11, PTSF-P
"Nothing was connotated before the trip. But after the trip, it reminds me round theater hall and allowed us to understand astronomy better." PST-18, PTSF-F
"3-D visual." PST-9, PTSF-P
"This concept reminds me of a place at where we may learn something fun." PST-21, PTSF-P

Table 3: *Write concepts equivalent to the planetarium concept.* Content analysis findings related to the above question

PTSF-P			PTSF-F		
Theme	**Code**	**Frequency**	**Theme**	**Code**	**Frequency**
	Space	1		Astronomy	7
	Sky	1		Planet house	5
	Star	1		Planet	5
	Astronomy	1		Space	5
	Planet	1		Celestial body	1
Astronomy	Anthem	1	*Astronomy*	Sky	2
	Jupiter	1		Universe	1
	Observatory	1		Planet observation	1
	Celestial body	1		Observation house	1
	Planetarium	1		Spaceship	1
	Skydome	1		Space science	1
	Sun	1		The world of planets	1
	Moon	1	*Display/Show*	Scientific Show	1
	Supernatural Event	1		Space show	1
Biology	Ecosystem	1		Virtual demonstration	1
	Habitat	1		Virtual image	1
	population	1		Movie theater	2
	Plant	1		3D Cinema	4
	Live	1	*Learning*	Learning area	2
Location	Virtual planet environment	1		Scientific Information (Nature of Science)	1
	Planet house	1			
	Zoo	1			
	3D Cinema	1			
	Space theater	1			
Information	Interesting	1			
	Give information	1			
	Arouse curiosity	1			
	Animated image	1			
	Virtual image	2			
No response / Non-codable		7	***No response/ Non-codable***		14
	Deuterium composition	1		Sphere	1
				New perspective	1
				Bell-glass	1
				CERN	1

In this question that asked preservice science teachers the concepts that have the same meaning as the planetarium concept, when the pre-trip answers of preservice science teachers are examined, it is seen that the concepts are mostly related to astronomy (space, sky, star, etc.); however, it is seen that the students have used synonyms of planetarium concept with biology concepts, and a student has mentioned synonymous concept of deuterium component (Table 3). When the answers of preservice science teachers after the trip were examined, it was determined that the frequency values of the concepts under astronomy were increased, a new theme was named in the image and the concepts related to learning were presented. Some of the answers given by preservice science teachers in the PTSF-P and PTSF-F regarding this question are given in the form of a direct quote.

"Planet house." PST-23, PTSF-P
"Space, planet, celestial bodies, astronomy." PST-41, PTSF-F
"Scientific demonstration-space-atom physics show." PST-40, PTSF-F

Table 4: *What is planetarium? Explain.* Content analysis findings related to the above question

PTSF-P		PTSF-F	
	Frequency		**Frequency**
Virtual space environment	7	Cinema (3D / Special design, space content)	17
I do not know / No response	7	Virtual space environment	12
Activity for information about space	4	Space information / Information	7
Place of animals/platform	2	Activity for information about space	5
(Space) Observatory	1	No response	5
Plane = Plant	1	Place of instruction	4
Information about space	1	Planet house	1
A newly discovered element	1	Space theaters	1
Information offering place	1	Planet science	1
Single-cell living	1	Variety of living	1
Astronomy	1		
Planet	1		

When preservice science teachers are asked to explain planetarium term, it is seen that there are answers explained with biology concepts although there are some students who do not know this concept before the trip (Table 4). When the answers of the preservice science teachers are examined again after the application, it is seen that the answer is given such as cinema, a platform informing about space, virtual space environment. Some of the responses of the preservice science teachers to the PTSF-P and PTSF-F regarding this question are presented below as a direct quotation.

"*Space and space events, astronauts' work, space-related work, as if it were real.*" P25, PTSF-F
"*It is an illustration that tells about space, planet, astronomy, astronomy, and movies that improve imagination.*" PST-41, PTSF-P
"*He works on things like Moon, Sun, Earth, Universe.*" PST-10, PTSF-F
"An eight-dimensional reflection of the film including planets, stars and celestial bodies on a domed ceiling." PTSF-P

Table 5: *What is the purpose of usage of planetarium? Explain.* Content analysis findings related to the above question

PTSF-P			PTSF-F		
Theme	**Code**	**Frequency**	**Theme**	**Code**	**Frequency**
	Arouse curiosity	1		Teaching through visuals (more detailed)	14

	Permanence	1		Teaching inside nature	1
Education	Realistic model	1	***Education***	Teaching with fun	3
	Developing imagination / creativity	1		Create a true-to-life environment	1
				Interesting	1
Information	Information	11	***Information***	Do not give detailed information	21
	Examination of planets	6		Sky review	1
No relation	Place where animals are exhibited	1	***No relation***	Building	1
	Information / sightseeing	1		Live review	1
	Survive	1		No response	2
	Show Living space	1			
	Use in platinum construction	1			
	Introducing the population	1			
No response		4			

When the preservice science teachers were asked regarding the purpose of the use of planetarium the answers were observed such as (space-related) information, analysis of planets; Among the answers of preservice science teachers after the trip, teaching through visuals, giving detailed information are the most frequently given answers (Table 5). When the answers of the preservice science teachers in PTSF-P and PTSF-F are compared, it is seen that answers to the question "to use in platinum construction, to introduce population, to show the habitat, to survive" are removed in the final test after the trip, leaving its place to the answers 'teaching by visuals, teaching with fun '. Some of the answers given by preservice science teachers in the PTSF-P and PTSF-F regarding this question are given in the form of a direct quote.

> "*It can be used as a terrific program for the expression of events such as the Milky Way, planetary systems, the formation of stars which we struggle to explain.*" PST- 31, PTSF-P
> "*Used for information purposes in the field of astronomy*." PST-2, PTSF-F
> "*Astronomy events benefit us better to recognize the planets. In the description of scientific events ...* "PST-15, PTSF-F
> "*To learn a topic. It gives you an idea of how to do it, what to do, any idea about a subject. Or design projects about him. It wonders, it can do experiments.* "PST-19, PTSF-F

Table 6: *How do you relate to planetarium and science? Please explain.*
Content analysis findings related to the above question

PTSF-P			**PTSF-F**		
Theme	**Code**	**Frequency**	**Theme**	**Code**	**Frequency**
	Concrete experience	8		Aid in science/concreting	10

	Aid in science	3		Ensuring permanence	7
Education	Establish cause-effect relation	2	***Education***	Strengthening	4
	Ensuring permanence	2		Presenting novelty	2
	Strengthening	1		Experimentation	1
	Modeling			Use	1
				Wonder	2
				complementarity	1
				Must be used at school	1
Information	Science covers space	10	***Information***	Recognizing space	1
	Information providing	4		Science covers space	23
	Covers nature of science	1			
Non-Codable	Presentation writings	1	***Non-Codable***	Achievement of big works	1
	Element education	1			
	Science living creatures, Planetarium analyses plants	1			
	Science analyses living creatures	1			
	Classification of living creatures	1			
No response		2			

Preservice science teachers were found to associate planetarium with science in terms of providing concrete experience, information, aid in science and ensuring permanence. When the answers of the preservice science teachers after the trip were examined, it was concluded that similar answers and answers about the covering of space in science were increased (Table 6). Some of the responses of the preservice science teachers to the PTSF-P and PTSF-F regarding this question are presented below as a direct quotation.

> *"Planetarium in science education should be used in schools. It should not be tied to science, and it must be completely related."* PST-3, PTSF-P
> *"I think there are two directions in relation to the planetarium. That is to say, a student thinks how unbelievable things are done and he will succeed in simple science writing. Another student might think, 'I shall do bigger things."* PST-40, PTSF-F
> *"It helps us concreting it while we are talking about a topic that we may not embody."* PST-23, PTSF-F
> *"Space, sky, planets are science subjects, and visiting planetarium after these subjects are told or learned shall ensure permanence."* PST-18, PTSF-F

Table 7: *What did you learn in planetarium trip? C* Content analysis findings related to the above question

PTSF-F

Theme	Code	Frequency
	Pure information acquisition	23
	Space studies	11
	Formation of the universe	9
	The formation of the world	2
	Discovery of space	4
	No answer	3
Astronomy	Development of astronomy	1
	Space-Astronomy relationship	1
	Concreting with model	2
	Facilitate learning	2
	Applied science teaching	1
	Preliminary information strengthening	1
	Butterfly Valley	1

With Planetarium trips to preservice science teachers, it is concluded that they acquired information usually about getting information about space studies and formation of the universe. (Table 7). Some of the answers given by the preservice science teachers in the PTSF-F regarding this question are given below as direct quote.

> *"I learned how dark objects are or why they are called dark object, particle collision experiments at CERN, and four particle types."* PST-40, PTSF-F
> *"I learned information on how to create a spacecraft, how and in what way they were launched to space, how they will reach the moon, what to look for in space, many spaces, like planets."* PST-18, PTSF-F
> *"We have information on a number of topics such as the tools that some countries have designed to go long, what they have in CERN, the structure of the Moon."* PST-13, PTSF-F
> *"Space, astronomy, the sun, the moon, and give me such feeling that I am in the space."* PST-25, PTSF-F
> *".... It made me happy to get information. I regretted why I had not gone there before."* PST-39, PTSF-F

Table 8: *Does planetarium trip meet your expectations?* Content analysis findings related to the above question

PTSF-F						
Yes			No		Partially	
Theme	**Code**	**Frequency**	**Code**	**Frequency**	**Code**	**Frequency**
	Information	12	Pure Information Acquisition	23	I went/ watched before	3

	Concreting	3	Space Studies	11
Cognitive	Realistic environment	10	Creation of the universe	9
	Interesting	10	Space discovery	4
	Strengthening	1	No answer	3
	Instant feedback (from employees)	1	Creation of the earth	2
	No detail	2	Development in astronomy	1
Non-codable	Unrelated answer	1	Space-Astronomy relation	1
	Open language	1	Concreting with model	2
			Facilitate learning	2
			Applied science teaching	1
			Preliminary information strengthening	1
			Butterfly Valley	1
	Impressed	7		
	Beyond expectations	7		
Affective	Have Fun	3		
	I like to go again	1		

When preservice science teachers were asked about whether the planetarium visit met their expectations, it was stated that the vast majority of the preservice science teachers were satisfied with the prospects for the trip. Preservice science teachers whose expectations have not been met criticized the visit in terms of including pure information, the formation of the universe and explanation of space studies (Table 8). Some of the answers that the preservice science teachers have given to PTSF-F regarding this question are presented below as a direct quote.

> "*Absolutely met. We certainly had the opportunity to closely monitor the CERN center."* PST-39, PTSF-F
> *"Yes, our observations are what we see in the courses. Strengthened"* PST-8, PTSF-F
> *"It exceeded my expectations. They were more interested, they answered every question we asked. They tried to explain everything as much as possible. "* PST-14, PTSF-F
> *"Yes, because I have seen such an activity in our school before. But the narration and the atmosphere did not satisfy me. It was small and stuffy. It is also not explanatory."* PST-40, PTSF-F

Table 9: *Explain the place of the planetarium in astronomy education. Content analysis findings* related to the above question

PTSF-F		
Theme	**Code**	**Frequency**

	Ensuring permanence	8
	Realistic model	9
	Concrete experience provision	5
	Attention	5
Learning	Provide visualization	3
	Creativity development	1
	Education strengthening	2
	Attention	5
	ingratiate	1
Teaching processes	Convenience to teacher	1
	Usefulness	1
	Preparation for an astronomy course	1
Information providing	Introduction of astronomy-planetarium	2
	Introducing space research	3
	Sky review	1
	Give detailed information	9
No idea/ no response		2
Not required		1

When preservice science teachers are asked about the place of planetariums in astronomy education it is seen that the responses given are generally combined as learning, teaching processes and information giving dimensions, providing ensuring permanence and close to reality models, giving concrete experiences and attracting attention (Table 9). Some of the answers given by the prospective teachers in the PTSF-F regarding this question are given below as direct quote.

> *"A planetarium is a tool increasing recognition of the planets, stars, the Earth and the Universe we talk about."* PST-3, PTSF-F
> *"I think we can provide astronomy education in an effective, beautiful, and permanent way with the planetarium."* PST-35, PTSF-F
> *"It is important for astronomy ... Not everyone has the opportunity to go to space, but there is a chance to review and watch it in the planetarium. Such a rich narrative can be preferred rather than simple narration. "* PST-39, PTSF-F

Discussion, Conclusion, and Suggestions

It is observed that positive changes occurred in astronomy concepts with planetarium trip by preservice science teachers. It has been determined that the majority of the teacher candidates have heard about the planetarium from previous trip experiences, internet, school activities; and almost all of the students became aware of the planetarium after the trip. It is also seen that, before the trip, the concept of planetarium evokes concepts not directly related with astronomy like biology, living things in addition to space, planet, artificial planet is directly related to astronomy. When the responses of the preservice science teachers to the same question are examined after the trip, it is seen that the answers changed on concepts such as

artificial planet environment, planet, astronomy and learning areas. It is seen that the responses of the preservice science teachers, for synonymous concepts with the concept of the planetarium, are classified under the themes of astronomy, biology, space, and information. When the answers of the preservice science teachers after the trip are examined, it is seen that the diversity is more specific under the themes such as learning, image/demonstration, although the answers diversify. Another example to astronomical concepts changing with planetarium trip to preservice science teachers comes up with the question of the survey about the definition of the concept of the planetarium. Although it was seen that most of the students did not know this definition and they gave wrong answers before the trip, they know that they are places to give information about virtual space environment and space. When the answers of the preservice science teachers are examined after the trip, it is seen that the diversity is decreased and answers are focused on answers such as three-dimensional cinema, virtual space environment, and giving information about space. In another question asked about the purpose of planetariums, when the pre-trip answers of preservice science teachers were examined, there were areas found such as teaching, knowledge, "I don't know", unrelated answers, and living places of animals. When the after-the trip- answers of preservice science teachers are examined, it is seen that the answers are focused on teaching, learning with fun, near-reality environment, teaching and giving information through visuals. When questionnaires are asked before the trip about the relationship between planetarium and science, it is seen that preservice science teachers have given answers such as teaching, concrete experience acquisition, aid in science, cause-effect relationship formation, giving information, in addition to wrong answers such as the teaching of living things and examining living things. After the trip, the preservice science teachers stated that this association as aid is science, concreting, strengthening, making an experiment with providing permanence, benefiting, complementary.

On the other hand, when preservice science teachers are asked on what they have learnt with the trip it is seen from the questions they give that they learned information about astronomy, space studies, the formation of the universe, the formation of the earth, the discovery of space, which reveals a positive change in the concepts of astronomy. Again, the answers given by the students on the satisfaction of the expectations of the expectant and inquiries in the last test are grouped as "yes", "no" and "partly". The students whose expectations were met received information about the planetariums acquired concrete experiences in the near-reality environment, and they stated that they saw a structure is interesting for them and had fun. The students whose expectations were not met stated that the contents of the planetarium contained

pure information. Students who are partly satisfied with their expectations stated that they had participated in such a trip before and for this reason, it was not very interesting for them. In the final test, the questionnaire for preservice science teachers was asked to explain the place of the planetarium in astronomy education. It is found for the preservice science teachers that planetariums offer a realistic environment for learning and teaching, embody the concept, offer it with rich material and provide information; as some students have no idea about it.

Findings from this study support the literature, showing that planetariums provide fun and rich learning environments for learners, as well as facilitating and concretizing learning (Anderson, Kisiel & Mayer-Smith, 2006; Anderson & Zhang, 2003; Braund & Reiss, 2006; Köseoğlu, Soran & Stoner, 2009; Rennie & McClafery, 1995; Sonyat, Tutat & Karamustafaoğlu, 2016). Nevertheless, when the answers given by prospective teachers as a whole are taken from a holistic view, it is possible to see some of the incorrect information clusters and constructions related to the concept of planetarium (e.g., living under the biology theme, living space of living beings, answers such as place where animals are displayed). This may be due to the fact that students have never heard of this concept in formal or informal learning environments that have been carried out in schools, have not taken astronomical courses, have not learned what informal learning environments are and have not had first-hand experiences with these environments.

It is seen that field trips organized for preservice science teachers and contents provided in planetarium contents increase the information, provide concreting through the use of rich materials, and facilitation in learning. Similar findings have been reported in the studies by Anderson and Zhang (2003), Anderson, Kisiel and Mayer-Smith (2006), Braund and Reiss (2006), Plummer (2009), Ertas Kılıç and Şen (2014) and Sonyat, Tutat and Karamustafaoglu in which that they express the fact that they provide convenience in learning and permanence together therewith.

Informal learning environments provide positive contributions to learning since the information provided in such environments are interesting, carry motivational components for the topic, and positive contributions to learning in fun form, and providing attendance without turning students off (Braund & Reiss, 2006; Köseoğlu, Soran & Stoner, 2009; Rennie & McClaffery, 1995; Sonyat, Tutat & Karamustafaoğlu, 2016). In this research, it is seen in their post-trip explanations of preservice science teachers that planetariums, being one of the informal learning environments may be used to teach science and astronomy topics, to reinforce the learning through the visuals and to provide updated information about the space researches to the students. However, for using of out of school activities in the learning process, specific

pedagogical orientations, field knowledge, and some competences such as organizing and managing trips and coping with the difficulties encountered in the application are needed (Anderson, Kisiel & Mayer-Smith, 2006; Anderson & Zhang, 2003; Tatar & Bağrıyanık, 2012).

With this study, beneficial changes were observed in astronomy concepts of preservice science teachers after the planetarium trip; and the following suggestions are presented for researchers, who shall conduct similar studies:

- More students should participate in the field trips to be organized. In addition, the informal learning environments and the quality and quantity of planetarium trips should be increased.
- Out-of-school trips should have more place in in the learning-teaching process in order to increase the permanence of the information provided in the planetarium.
- Planetarium, out-of-school trips and learning environments may also be applied for courses other than science class.
- Informal learning environments given to prospective teachers should be presented with, along with field knowledge about informal learning environments and field trips.
- Pedagogical approaches are to be provided with the field information related to informal learning environments and field trips, reviewing the content of the courses of informal learning environments provided to the teacher candidates.

References

Adams, J. P. & Slater, T. F. (2000). Astronomy in the national science education standards. *Journal of Geoscience Education*, *48*(1), 39-45.

Akkoyunlu, B. (2008). *Bilgi okuryazarlığı ve yaşam boyu öğrenme*. Eskişehir Anadolu Üniversitesi: International Educational Technology Conference (IECT).

Anderson, D., Bethan, L. & Mayer-Smith, J. (2006). Investigating the impact of practicum experience in an aquarium on preservice teachers. *teaching education. 17*, 341–353.

Anderson, D., Kisiel, J. & Storksdieck, M. (2006). Understanding teachers' perspectives on field trips: discovering common ground in three countries. *Curator: The Museum Journal*, *49*(3), 365- 386.

Anderson, D., & Zhang, Z. (2003). Teacher perceptions of field-trip planning and implementation. *Visitor Studies Today*, *6*(3), 6-11.

Barbour, R. (2013). *Introducing qualitative research: a student's guide*. Sage.

Bowker, R. (2004). Children's perceptions of plants following their visit to the Eden Project. *Research in Science and Technological Education. 22*(2), 227-243.

Bozdoğan, A. E. (2012). The practice of prospective science teachers regarding the planning of education-based trips: Evaluation of six different field trips. *Educational Sciences: Theory &Practice. 12*(2), 1049-1072.

Bozdoğan, A. E. (2017). "Fen Eğitiminde İnformal Öğrenme Ortamları" Dersine Yönelik Öğretmen Adaylarının Görüşleri. *Uluslararası Türk Eğitim Bilimleri Dergisi*, (8), 1-17.

Braund, M. & Reiss, M. (2006). Towards a more authentic science curriculum: The contribution of out-of-school learning. *International Journal of Science Education, 28*(12), 1373-1388.

Büyüköztürk, Ş., Çakmak, E. K., Akgün, Ö. E., Karadeniz, Ş. & Demirel, F. (2017). *Bilimsel araştırma yöntemleri.* Pegem Yayıncılık. Ankara.

Candy, P. C. (2003). Lifelong learning and information literacy. Report for U.S. national commission on libraries and information science and national forum on information literacy.

Catherine, M. S. & Catherine E. M. (2011). The "Science" behind a successful field trip to the zoo. *Science Activities: Classroom Projects and Curriculum Ideas, 48*(1), 29-38. DOI: 10.1080/00368121.2010.496814.

Chin, C. (2004). Museum experience-A resource for science teacher education. *International Journal of Science and Mathematics Education, 2*, 63-90.

Creswell, J. W. (2002). *Educational research: Planning, conducting, and evaluating quantitative* (pp. 146-166). Upper Saddle River, NJ: Prentice Hall.

DeWitt, J. & Storksdieck, M. (2008). A short review of school field trips: Key findings from the past and implications for the future. *Visitor Studies*, *11*(2), 181-197.

Dillon, J., Rickinson, M., Teamey, K., Morris, M., Choi, M. Y., Sanders, D., & Benefield, P. (2006). The value of outdoor learning: Evidence from research in the UK and elsewhere. *School Science Review, 87*(320), 107.

Demirel, Ö. (2012). Eğitimde program geliştirme kuramdan uygulamaya (18. Baskı). Ankara: Pegem A Yayıncılık.

Ertaş Kılıç, H. & Şen, A. İ. (2014). Okul dışı öğrenme etkinliklerine ve eleştirel düşünmeye dayalı fizik öğretiminin öğrenci tutumlarına etkisi. *Eğitim ve Bilim*, *39*(176), 13-30.

Fisher, M. S. (1997). The effect of humor on learning in a planetarium. *Science Education, 81*(6), 703-713.

Ferry, B. (1993). Science centers and outdoor education centers provide valuable experience for preservice teachers. *Journal of Science Teacher Education, 4*, 85–88.

Gerber, B. L. & Marek, E. A. (2001). Development of an informal learning opportunities assay. *International Journal of Science Education, 23*(6), 569-583.

Griffin, J. & Symington, D. (1997). Moving from task-oriented to learning-oriented strategies on school excursions to museums. *Science Education, 81*(6), 763–779.

Kisiel, J. (2003). Teachers, museums, and worksheets: A closer look at learning experience. *Journal of Science Teacher Education, 14*, 3-21.

Hobson, S. M., Trundle, K. C. & Saçkes, M. (2010). Using a planetarium software program to promote conceptual change with young children. *Journal of Science Education and Technology*, *19*(2), 165-176.

Kisiel, J. (2013). Introducing future teachers to science beyond the classroom. *Journal of Science Teacher Education*, *24*(1), 67-91.

Köseoğlu, P., Soran, H. & Storer, J. (2009). Developing learning stations for the purification of waste water. *Procedia-Social and Behavioral Sciences*, *1*(1), 210-214.

Merriam, S. B. (2002). *Qualitative research in practice: Examples for discussion and analysis*. Jossey-Bass Inc Pub.

Michie, M. (1998). Factors influencing secondary science teachers to organize and conduct field trips. *Australian Science Teacher Journal, 44*, 43-50.

Munakata, M. (2005). Exploring mathematics outside the classroom through the field trip assignment. *PRIMUS: Problems, Resources, and Issues in Mathematics Undergraduate Studies, 15*(2), 117-123. DOI:10.1080/10511970508984112.

Noel, A. M. (2007). Elements of a winning field trip, *Kappa Delta Pi Record, 44*(1), 42-44. DOI: 10.1080/00228958.2007.10516491.

Olson, J. K.; Cox-Petersen, A. M. & Mc-Comas, W. F. (2001). The inclusion of informal environments in science teacher preparation. *Journal of Science Teacher Education, 12*, 155-173.

Orion, N. & Hofstein, A. (1994). Factors that influence learning during a scientific field trip in a natural environment. *Journal of Research in Science Teaching, 31*(10), 1097-1119.

Patton, M. Q. (2005). *Qualitative research*. John Wiley & Sons, Ltd.

Plummer, J. D. (2009). Early elementary students' development of astronomy concepts in the planetarium. *Journal of Research in Science Teaching*, *46*(2), 192-209.

Rennie, L. & McClafferty, T. (1995). Using visits to interactive science and technology centers, museums, aquaria, and zoos to promote learning in science. *Journal of Science Teacher Education*, *6*(4), 175-185.

Salmi, H. S. (1993). *Science centre education: motivation and learning in ınformal education.* Unpublished doctoral thesis. Helsinki University, Finland.

Silverman, D. (2016). *Qualitative research*. Sage.

Sontay, G., Tutar, M. & Karamustafaoğlu, O. (2016). "Okul dışı öğrenme ortamları ile fen öğretimi" hakkında öğrenci görüşleri: Planetaryum gezisi. *İnformal Ortamlarda Araştırmalar Dergisi (İAD), 1*(1), 1-24.

Storksdieck, M. (2001). Differences in teachers' and students' museum field-trip experiences. *Visitor Studies Today*, *4*(1), 8-12.

Tatar, N. & Bağrıyanık, K. E. (2012). Fen ve teknoloji dersi öğretmenlerinin okul dışı eğitime yönelik görüşleri. *İlköğretim Online, 11*(4), 883-896.

Taylor, E. W. & Caldarelli, M. (2004). Teaching beliefs of non-formal environmental educators: A perspective from state and local parks in the United States. *Environmental Education Research*, *10*(4), 451-469.

Turkish Council of Higher Education (YÖK) (2018). *Yeni Öğretmen Yetiştirme Lisans Programları/Fen Bilgisi Öğretmenliği Lisans Programı*. Retrieved from http://www.yok.gov.tr/web/guest/icerik/-/journal_content/56_INSTANCE_rEHF8BIsfYRx/10279/41807946

Türkmen, H. (2010). İnformal (Sınıf-Dışı) Fen bilgisi eğitimine tarihsel bakış ve eğitimimize entegrasyonu. *Çukurova Üniversitesi Eğitim Fakültesi Dergisi*, *3*(39), 46-59.

Wunder, S. (2002). Learning to teach for historical understanding: Preservice teachers at a hands-on museum. *The Social Studies, 93*(4), 159-163. DOI: 10.1080/00377990209599902.

Yıldırım, A. & Şimşek, H. (2016). *Sosyal bilimlerde nitel araştırma yöntemleri*. Seçkin Yayıncılık.