THE EFFECT OF AUGMENTED REALITY SUPPORTED INSTRUCTIONAL ACTIVITIES ON GIFTED STUDENTS' ATTITUDES TOWARDS ASTRONOMY

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ABSTRACT

THE EFFECT OF AUGMENTED REALITY SUPPORTED INSTRUCTIONAL ACTIVITIES ON GIFTED STUDENTS' ATTITUDES TOWARDS ASTRONOMY

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This study aims to investigate the impact of Augmented Reality (AR) supported instructional activities on the attitudes of gifted students towards astronomy. For this reason, a mixed method study was conducted to examine the changes in the attitudes of students in a public Science and Art Center, which serves gifted learners, towards astronomy after using AR-supported instructional astronomy activities. For the qualitative part, one demographic and one perception survey consisting of 10 open-ended questions were given at the end of the science lesson to understand if AR-supported astronomy activities had an effect on the attitudes of students towards astronomy. The quantitative part was based on a pre-test and post-test design, including a survey with 25 Likert scale items to determine whether the adoption of AR applications shifted the perspectives of gifted students on astronomy. A total of 20 secondary school students participated in the study and were engaged in AR activities for two hours a week for a period of two weeks. The quantitative data were analyzed with paired sample t-tests, and thematic analysis was utilized for qualitative data. According to the findings, AR activities utilized during the astronomy courses had a positive effect on the attitude towards astronomy of gifted secondary school students. The qualitative data revealed that this was because of visualization, hands-on learning, learning by having fun, cooperative learning, concretizing abstract concepts and integrated technology-supported education methods.

Keywords: Augmented Reality, Gifted Students, Astronomy, Science Education

ÖZ

ARTIRILMIŞ GERÇEKLİK DESTEKLİ ÖĞRETİM ETKİNLİKLERİNİN ÖZEL YETENEKLİ ÖĞRENCİLERİN ASTRONOMİYE YÖNELİK TUTUMLARI ÜZERİNDEKİ ETKİSİ

Aktaş, Ayşenur
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Bu çalışma, Artırılmış Gerçeklik (AG) destekli öğretim etkinliklerinin özel yetenekli öğrencilerin astronomiye yönelik tutumları üzerindeki etkisini araştırmayı amaçlamaktadır. Bu nedenle, Türkiye'de özel yetenekli öğrencilere hizmet veren bir Bilim ve Sanat Merkezi öğrencilerin astronomiye yönelik tutumlarındaki değişimleri incelemek için, AG destekli öğretici astronomi etkinliklerinin kullanıldığı bir karma yöntem çalışması yapılmıştır. Çalışmanın başında verilen bir demografik ve çalışmanın sonunda verilen on açık uçlu sorudan oluşan görüşme sorularını içeren nitel bölüm, AG teknolojisinin ortaokul öğrencileri arasında astronomi bilimine yönelik tutumlarındaki olası değişimleri incelemektedir. Nicel kısım, AG uygulamalarının benimsenmesinin özel yetenekli öğrencilerin astronomiye bakış açılarını değiştirip değiştirmediğini belirlemek için yürütülen 25 Likert ölçeği sorusundan oluşan bir ön test ve son teste dayanmaktadır. Bunun yanında, 20 ortaokul öğrencisi haftada iki saat olmak üzere, iki hafta boyunca AG etkinliklerine katılmıştır. Nicel veriler eşleştirilmiş örneklem t-testleri ile analiz edilmiş ve nitel veriler için tematik analiz kullanılmıştır. Bulgulara göre, özel yetenekli ortaöğretim öğrencilerinin, astronomi dersleri sırasında kullandıkları AG etkinlikleri sayesinde astronomiye karşı olumlu bir tutum sergilediği sonucuna ulaşılmıştır. Nitel veriler öğrencilerin görselleştirme, uygulamalı öğrenme, eğlenerek öğrenme, işbirlikçi öğrenme, soyut kavramları somutlaştırma ve teknoloji destekli eğitim yöntemlerini derse entegre etme gibi nedenlerle olumlu bakış açısı geliştirdiğini açığa çıkarmıştır.

Anahtar Kelimeler: Artırılmış Gerçeklik, Özel Yetenek, Astronomi, Bilim Eğitimi

To my family for their endless support and encouragement throughout my pursuit for education.

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ABBREVIATIONS

AR - Augmented Reality

MoNE - Ministry of National Education (Türkiye)

BILSEM - Bilim ve Sanat Merkezi (Science and Art Center)

TUBITAK - The Scientific and Technological Research Council of Türkiye

CHAPTER 1

INTRODUCTION

In this chapter, the background of the study, problem statement, purpose and the research questions of the study, significance of the study, and definiton of terms will be presented respectively.

1.1 Introduction

Since the launch of the Sputnik-1 satellite by the Soviet Union in 1957, human interest and curiosity in space have evolved in response to various factors such as technological advancements, scientific innovations, and environmental conditions. The launch of Sputnik 1 into space marked the beginning of a new era for astronomy education across the globe, shifting astronomy education into another dimension (Çetin, 2021; Kalkan & Yener, 2022). After this period, worldwide competition for space exploration was initiated, prompting nations such as the United States and Russia to modify their educational programs to secure a position in international economic competition.

As we entered the 21st century, education systems have aimed to cultivate students who possess the necessary skills to shape the future, including proactivity, entrepreneurship, knowledge-building, cooperation, analytical and critical thinking, and problem-solving abilities by having shifted from a teacher-centered approach to a student-centered active learning approach (Güllü, & Akçay, 2022; Kalkan & Yener, 2022; Marché, 2002; Pekdoğan & Bozgün, 2017; Sirajudin, & Suratno, 2021; Yıldırım, 2021; Yüzgeç & Okuşluk, 2023). In the report of the Ministry of National Education (MoNE), the most notable aspect of the 2018 scientific education curriculum was the inclusion of engineering education in the curricular goals to respond to 21st-century human profiles, including critical thinking, problem-solving, engineering skills, etc. Merely incorporating science courses and scientific literacy skills into the secondary education curriculum might not suffice, as it is imperative for students to also cultivate an eager interest in science, particularly in astronomy.

It can be said that the efficacy of the traditional education approach in facilitating universal literacy and fostering the acquisition of 21st-century skills, which are improving rapidly, is limited; that is why these skills need to be acquired by individuals in line with global goals (Yıldırım & Gelmez-Burakgazi, 2020; Yüzgeç & Okuşluk, 2023). By running into challenges in everyday life and coming up with solutions, these students advance in science and technology in line with the pace of their country's progression (Kuo et al., 2019).

Over the recent years, MoNE has significantly emphasized astronomy's significance by modifying the curriculum (Yüzgeç & Okuşluk, 2023). This was further supported by The Scientific and Technological Research Council of Türkiye (TUBITAK) 2018-2022 strategic plan, which has aimed to promote the advancement of space technologies and astronomy. Subsequently, Türkiye demonstrated a keen interest in these research endeavors and established the Turkish Space Agency, thereby implementing the National Space Program (Kalkan et al., 2021).

Educators have a significant role in this regard because it is essential for them to develop flexible and dynamic teaching methods and curricula in order to recognize gifted students and develop their talents because the regular education programs which these pupils participate in do not provide them the chance to develop their abilities further (Kaya & Bayra, 2019). The aim is to cultivate a community engaging in critical analysis, inquiry, resolution of complex issues, imaginative thinking, and originality.

This research was carried out at Science and Art Centers (BILSEM), which have been places in Türkiye where academically talented students being offered extra-curricular activities during the evenings or on weekends. They participated in various activities and classes designed to help them develop their imagination, capacity, critical thinking abilities, and intelligence (Bilgiç et al., 2013; Pekdoğan & Bozgün, 2017). In order to provide gifted students in Türkiye a diversified education program that goes beyond the school curriculum, the first BİLSEM was founded in the academic year 1994-1995, so these students could realize their potential and contribute to both themselves and society with the differentiated education program (Sarıtaş et al., 2019).

In summary, there is a demanding need to make progress in the field of space science in order to fulfil the demands of the current era. The principal objective of this research is to demonstrate that utilizing AR-supported instructional activities among gifted students makes astronomy readily accessible, enjoyable, and comprehensible, intending to enhance students' motivation and, because of all these, foster a positive attitude towards astronomy. Participants were selected from a public Science and Art Center, an institution responding to gifted students in Türkiye.

1.2 Problem Statement

The competition among nations in the realm of science and technology on a global scale is driven by the desire to enter space and achieve advances in space exploration (Bilgiç et al., 2013). To remain competitive globally, it is imperative to equip students with 21st-century skills and incorporate science courses into the curriculum. As learning astronomy is essential for equipping students with the skills necessary for success in the 21st century, traditional methods of instruction might not be able to interest students or help them grasp challenging astronomical ideas completely; the need for differentiated education for gifted students has been repeatedly stated by many experts and researchers (Sarıtaş et al., 2019).

Before the research started, an interview was conducted at the Science and Art Center. It was seen that astronomy was perceived as a challenging subject for students. Accordinly, the rationale behind this phenomenon was the students' inability to engage with astronomy topics. The teachers believed that these subjects were not readily accessible, and the students had reservations due to their limited knowledge in this domain. Students have the potential to get inspired for learning astronomy and develop themselves without relying on a telescope and nighttime observation.

The integration of AR, which provides a variety of mobile applications that can potentially improve technology-supported education, is imperative for science education and the rapid expansion of related fields. As previously mentioned, the research on learning experiences has shown that AR not only makes abstract concepts concrete but also transforms the environment into an authentic environment, creating flexible and individual study/learning opportunities for students, increasing students' academic achievement, motivation and focus on the lesson (Abdüsselam, 2014; Chin et al., 2018a; Chin et al., 2018b; Chen et al., 2022; Di Serio et al., 2013; Gopalan et al., 2023; Guo et al., 2017; Dede, 2009; Kul & Berbe, 2022; Radu, 2012; Rosenbaum et al., 2007; Sotiriou & Bogner, 2008; Yen et al., 2013).

Consequently, it is essential to study this field to examine how gifted learners' attitudes towards astronomy may be nurtured. As a result, this study aims to investigate how the use of AR-supported instructional astronomy activities influences the attitudes of gifted students towards their astronomy subjects.

1.3 Purpose and Research Questions

This study aims to investigate the impact of Augmented Reality (AR) supported instructional activities on the attitudes and perceptions of gifted students towards astronomy by addressing three primary research questions.

Q1. How do gifted students perceive the utilization of Augmented Reality (AR) in their astronomy-related activities?

Q2. What are gifted students' perceptions regarding Augmented Reality (AR) mobile application use in science courses?

Q3. Is there any change in the attitudes of gifted students towards astronomy subject after the implementation of Augmented Reality (AR) supported instructional astronomy activities?

1.4 Significance of the Study

In the present context, significant investments have been allocated towards advancing technology-supported education. The significance of the study is that many astronomy concepts remain at an abstract and complex level for secondary students since astronomy concepts require night observations, and equipment like telescopes, as well as the topics are abstract and hard to discover. This study contributes positively to students' attitudes towards learning and exploring astronomy by providing concrete examples thanks to the Augmented Reality (AR) application and supporting active learning with hands-on experiments.

In many nations, scientific courses that contribute to science, such as physics, chemistry, biology, and astronomy, are taught by thoroughly comprehending several interdisciplinary subjects. The ability to simultaneously engage with many interdisciplinary fields is particularly advantageous in the education of astronomy courses. Astronomy entails a fusion of core principles of countless scientific disciplines, enabling students to grasp intricate concepts more effectively and put their knowledge to use more extensively.

This study aims to examine the use of AR-supported instructional astronomy activities' effect on gifted students' perspectives and attitudes toward astronomy. By understanding the impact of AR activities that integrate scientific experiences on skill development and the formation of scientific views among students, the study also seeks to assess the potential influence of such actions on students' attitudes and perceptions towards astronomy, thereby enhancing their educational experiences and identifying effective strategies to cultivate their interest in scientific exploration and having careers in science.

It is crucial to equip students with the necessary skills to tackle 21st-century challenges and become proficient, innovative, analytical, and proficient in technology (Çorlu et al., 2014; Güllü & Akçay, 2022; Kayan-Fadlelmula et al., 2022). In contrast to traditional teaching methods, they are used to, Augmented Reality (AR) applications provide students with differentiated experiences, and these students maintain a positive attitude towards the course content when using such methods (Kerawalla et al., 2006). It also provides the differentiated education that gifted students should receive. The present research is noteworthy since it is one of the few to specifically examine students' interest in astronomy and employ AR applications connected to technology-supported methods.

1.5 Definition of Terms

Augmented Reality (AR): In the process of observing the real-world environment using a variety of technological devices, Augmented Reality (AR) contributes to the real-world setting by bringing virtual items (such as text, animation, music, images, video, and 3D models, among other things) into harmony with them in a simultaneous way. It is possible to say that they can be used in all areas of life, from health to education, mainly because they are available on mobile phones.

Astronomy: Astronomy, one of the oldest scientific fields, is distinguished by its ongoing progression. The field of study involves the examination of the universe and all celestial bodies within the vastness of the celestial sphere.

Attitude Towards Astronomy: A range of cognitive practices that are used in scientific education is called attitudes towards astronomy. It involves embracing scientific research about the universe as a mode of thought, internalizing and adopting scientific principles used in astronomy in everyday life, taking pleasure in astronomy learning experiences, developing a greater interest in astronomy and activities related to astronomy, and desiring to pursue a career in astronomy.

Gifted children: These individuals exhibit superior comprehension, cognitive capacity, inquisitiveness, critical thinking abilities, emotional intelligence, artistic aptitude, memory retention, and self-awareness compared to their counterparts within the same age group. It is imperative to provide these children with the opportunity to cultivate their abilities by providing a specialized or differentiated education distinct from that of their classmates.

CHAPTER 2

LITERATURE REVIEW

In this chapter, a review of literature related to technology-supported learning, Augmented Reality (AR) in education, astronomy education, AR in astronomy education, gifted students, and attitudes towards astronomy will be presented.

2.1 Technology-Supported Learning

The use of technology is becoming increasingly common in education (Duralia, 2020), just like other disciplines as part of globalization (Inderawati et al., 2019). Numerous studies have been conducted on education supported by technology, particularly since the emergence of computers in our lives, followed by the rapid growth of the Internet. The impact of technological advancements has not only influenced human existence but has also brought significant transformations in the education sector. This evolution has been evident in various stages, necessitated by technological advancements, such as the shift from traditional chalkboards to interactive smart boards and subsequently to mobile learning, which encompasses Internet-based education delivery, enabling access to education from any location (Coşkun & Koç, 2021; Delialioğlu & Yıldırım, 2007; Moldovan et al., 2014). As stated in the OECD Report (2015), information and communication technologies support student-centered teaching and enhance learning by allowing students to reach the knowledge easily that they cannot find in coursebooks by diversifying the ways in which they can practice their knowledge.

Because students are facing lots of information, they need to find what is most relevant and useful for them by noticing outmoded assumptions and critically considering ways to change them, and technology may be beneficial to help them in this process (Vogel & Klassen, 2001). In order to have the 21st-century skills required, every child should receive an education that is constantly renewing itself and under the era’s requirements. This is possible with an education including up-to-date technological facilities (OECD, 2015; Wang, 2022). With the development of technology, almost all the audio, images, documents, and other resources used in the traditional method have been digitized and gathered in the field of Information and Communication Technologies (Fernández-Batanero et al., 2022; Mena et al., 2023). Students now have the opportunity to enhance their learning experiences by surpassing the limitations of traditional education by accessing an abundance of information through the use of tablets, phones, and other smart devices without being constrained by physical or temporal boundaries (Dabbagh et al., 2019).

Technology-enhanced learning relies heavily on an Internet connection. It offers a flexible educational experience to both learners and teachers. While advancements in educational technology continue to evolve, the availability of software and applications also significantly expands (Tzur et al., 2021). Students are able to autonomously access information and develop themselves independently from traditional education, which is organized in a teacher-to-student direction (Pelgrum, 2001). Learners could receive feedback while engaging in self-regulated learning to enhance their problem-solving skills, develop cognitive scaffolding, and enhance their abilities in collaboration and, when needed, communication (Schraw et al., 2006). Besides, technology-supported learning provides a flexible learning environment in a digital world, offering students adaptation content according to their backgrounds and desires via either online face-to-face classes or well-structured asynchronous classes (Blau et al., 2020) with computers, mobile devices, tablet PCs, smart boards, programs used in text-to-speech and speech to text, and artificial intelligence applications (Doğan & Delialioğlu, 2020).

According to scholarly literature, the implementation of the Science, Technology, Engineering, and Math (STEM) approach is highly compatible with the cognitive and affective requirements of these learners, as it fosters their divergent thinking abilities, thereby facilitating their capacity to generate innovative solutions to the complex challenges of contemporary life (Kayan-Fadlelmula et al., 2022; Sirajudin

& Suratno, 2021). STEM is an acronym for Science, Technology, Engineering, and Mathematics (Sirajudin & Suratno, 2021), endeavors to equip students with the necessary skills to tackle 21st-century challenges and become a proficient, innovative, analytical, and technologically adept workforce (Çorlu et al., 2014; Güllü & Akçay, 2022; Kayan-Fadlelmula et al., 2022). STEM enables students to realize their student-centered and extra-curricular learning goals (Elliniadou & Sofianopoulou, 2021). The integration of AR in STEM education has been found to enhance students' motivation, perspectives, participation, and interest in the fields of physics and astronomy (Elliniadou & Sofianopoulou, 2021; Önal & Önal, 2021; Yüzgeç & Okuşluk, 2023).

2.1.1 Augmented Reality (AR) in Education

Technological advancements have consistently sought novel and noteworthy pedagogical approaches in collaboration despite the adequacy of contemporary teaching methods (Herfana et al., 2019; Sırakaya, & Sırakaya, 2022). In particular, developments in innovative Industry 4.0 information technologies offer numerous options in education and communication. Augmented Reality (AR) has been one of the technologies that attracted the attention of researchers in recent years (Herfana et al., 2019; Iatsyshyn et al., 2020; Yıldırım, 2021). L. Frank Baum, a science fiction writer, initially proposed the idea of Augmented Reality (AR) in 1901 while referring to virtualizing the real world (Kapoor & Naik, 2020). Azuma (1997) provided the initial definition of AR, a virtual visualization technology derived from Virtual Reality (VR).

Three key criteria characterize AR technology, according to Azuma (1997): the integration of real and virtual worlds, real-time interaction, and 3D transfer of virtual and real worlds. Besides, AR can be characterized as a highly interactive representation of the virtual world that incorporates various multimedia elements such as sound, graphics, text, video, animation, and three-dimensional models, among other computer-generated images (Cheng & Tsai, 2013; Demirer & Erbaş, 2015; Emiroğlu & Kurt, 2017).

Kul ve Berbe (2022) characterized this innovation as the simultaneous and three-dimensional visualization of virtual items in the real world's environment. Educators employ AR to create an immersive learning environment, hence facilitating the presentation of content in a physical and realistic way, providing individuals to participate in authentic three-dimensional exchanges and fostering an immersive learning experience (Ebadi & Ashrafabadi, 2022; Zhufeng & Sitthiworachart, 2023). In particular, the attitude towards astronomy has been found to be noticeably higher in authentic learning environments according to the studies (Arslan et al., 2020). AR activities provide the authentic learning environment that students need by modeling and presenting the objects they have in their daily lives in the classroom (Gecu-Parmaksiz & Delialioğlu, 2020).

Although it is sometimes compared to VR technology, which puts the user completely inside the virtual environment (Garzón et al., 2019), according to Sırakaya & Sırakaya (2022), the use of technology that enables AR has a more significant number of benefits than VR does. As researchers indicate, one of the most essential advantages of AR is that it can be used to visualize concepts that are difficult to observe (Garzón et al., 2019).

AR technologies are utilized across various educational levels, ranging from primary schools to universities, and offer students an opportunity based on inquiry by enriching the learning environment and providing cognitive support while enabling course materials to be brought into the learning environment through multiple media (Akçayır & Akçayır, 2017; Chen et al., 2006; Fleck, & Simon, 2013; Lin & Yu, 2023; Özçakır & Çakıroğlu, 2022; Turhan et al., 2022; Wang et al., 2022). According to research, adding a digital environment of AR to an educational setting can enhance learning in minimum of three ways: by promoting contextual learning, various perspectives, and enabling to transfer (Dede, 2009).

According to Kul and Berbe's (2022) research, the implementation of AR in educational settings has been found to enhance motivation levels which play a role in improving students' learning outcomes, creativity, and overall quality of learning, with the promotion of collaboration, the visualization of abstract concepts, and the integration of potentially hazardous or challenging course materials into the classroom. Especially in science education, where there may be a large number of abstract concepts that require investigation, AR can be utilized to visualize them effectively (Wang, 2022). Making the teaching material visible by concretizing, it facilitates the student's understanding of the visual concept (Yen et al., 2013), and students also develop positive attitudes towards science (Çetin & Türkan, 2022). Zhao et al. (2023) showed in their study that the group using AR increased their interest and motivation in learning and paid higher attention to the given tasks, thus, it is plausible that an increase in motivation towards science education may be observed through this method (Akçayır et al., 2016; Chiang et al., 2014; Sırakaya & Sırakaya, 2018; Yıldırım, 2021). According to Kaur et al. (2020), the utilization of AR during problem-solving activities enables students to experience a virtual representation of the real world, fostering an active and engaged learning environment; as a result, the motivation of learners is improved. Yıldırım (2021) reached the conclusion that being able to reach the object in three-dimensional environments enables students to participate in the lesson more effectively and with fun, and in this way, the attitude and interest of students who can learn the subjects that they may have difficulty in learning more motivated and more straightforward and their attitude and interest in science increase with AR, underscored the need for further research to comprehensively recognize the impact of AR implementations on students' motivation, attitude, viewpoint, and accomplishment. In addition to all the benefits of AR, Di Serio et al. (2013) also stated that implementing AR increases the motivated participation of students in the lesson.

2.2 Astronomy Education

Astronomy, a fundamental branch of science, holds significant importance, and this fact must be duly recognized in the training of upcoming space scientists and astronomers. The emergence of astronomy, one of the oldest disciplines of science that examines the universe and its celestial bodies and their properties, is founded on the observation of bright celestial bodies in the night sky and the invention of the necessary instruments to satiate this curiosity (Kalkan et al., 2021; Koçak & Oralhan, 2022; Yavuz-Çiv et al., 2022). According to Percy (1998), astronomy's practical and philosophical uses have affected almost every civilization, including aspects such as seasons, timekeeping, navigation; long-term issues like climate change and biological evolution, promoting physics and other fields, addressing the origins of life, showing where we are in time and space and how we are connected to other Earth species, showing a vast universe, encouraging inquiry, invention, and shared discovery. The significance of seasons and the agricultural practices necessary for sedentary living have piqued the interest of scholars, and it is believed that early humans initially relied on celestial bodies for navigation and subsequently developed calendars (Koçak, & Oralhan, 2022; Yavuz-Çiv et al., 2022). Astronomy affects many parts of our everyday lives and is a science field that is constantly changing, but it also makes people more curious and more likely to want to explore and learn new things and be creative.

The inclusion of astronomy in the education and training programs of developed countries is due to its limitless scope (Ayvacı & Sezer, 2018) and its ability to facilitate the advancement of other scientific disciplines (Çevik & Önal, 2021), and the constant renewal of astronomy through technological advancements involves various scientific processes, such as observation and data collection (Kalkan & Yener, 2022; Tunca, 2002; Karaçam, et., 2022). Astronomy also exerts a reciprocal influence on sciences such as physics, chemistry, and biology, just as these sciences impact the field of astronomy (Karaçam et al., 2022; Koçak & Oralhan, 2022). Astronomy instruction aims to develop in students an interest in the field and equip them with astronomical knowledge and the ability to observe the night sky (Zhang et al., 2014).

2.2.1 AR in Astronomy Education

The integration of Augmented Reality (AR) applications into education facilitates the development of scientific literacy and fosters comprehension of complex environmental concepts. Compared to the majority of other scientific disciplines, the field of astronomy is inadequate in making observations, which is one of the requirements of science since observations must be conducted at night and outside with optimal weather conditions away from light pollution and it is not always possible to do so (Zhang et al., 2014). AR applications facilitate the exploration of the universe, enable the investigation of celestial objects in three dimensions, and simulate astronomical events, particularly in the field of astronomy (Lee, 2012). Notwithstanding the significance and specialization of astronomy as a scientific discipline, research indicates that learners may encounter challenges in comprehending astronomical topics due to the abstract and intricate nature of astronomical concepts (Önal & Önal, 2021; Yu & Sahami, 2007). Virtual applications utilizing AR overlay digital structural models onto tangible objects, offering students a secure and interactive substitute for conventional dissection practices. In order to overcome this challenge, scholarly research recommends that astronomy instruction should be augmented with the use of modeling and simulations, and ideally, resolutions should be derived through observation (Zhang et al., 2014); for this purpose, the technology of AR may be employed in a way that is both simple and effective to bring abstract astronomical concepts to life (Önal & Önal, 2021). In their study, Liu et al. (2007) underlined that AR is more practical and effective in enhancing attention and comprehension compared to the traditional didactic teaching method. In another study, Shelton and Hedley's use of AR to teach about planets was more efficient and cost-effective regarding material design than the traditional two-dimensional narrative method (2002). Chen et al. reached the same conclusion as others and stated that students who were taught astronomy with the Cosmos Planet Go AR application achieved higher success by visualizing abstract concepts than those who studied astronomy with the lecturing method (2022).

2.3 Gifted Students

Numerous studies have been conducted regarding the development of a trajectory for the education of gifted individuals who possess the potential to become future scientists, influential leaders, and a vital workforce for society (Önal & Önal, 2021; Watters & Diezmann, 2003) and these bring the potential to support the development of the country in every field (Kılıç, 2015; Kaya & Bayra, 2019). It is very difficult to reach a definite judgment when defining the concept of giftedness (Gagné, 1995) because there is no criterion yet to measure it completely (Trost, 2000). After 2010, the term "special talent" started to be used instead of terms such as "superior talent", "gifted", and "talented" by the Ministry of National Education in Türkiye since it is less categorizing (Ömeroğlu et al., 2017). The National Association for Gifted Children employs the term "gifted student" to refer to individuals who demonstrate exceptional abilities and talents or who exhibit advanced emotional and cognitive skills, such as superior language proficiency, an aptitude for reading, and innovative ways of expression, when compared to their peers, and also, these students possess increased analytical and perceptual capabilities (Bilgiç et al., 2013; NAGC, 2021). Gifted students are more advanced than their peers in high-level thinking skills, creativity, motivation, sense of duty, ability, and intelligence (Pekdoğan & Bozgün, 2017; Kaya & Bayra, 2019).

Similarly, it is crucial for educators to establish a non-traditional and permissive learning atmosphere for these learners, enabling them to investigate and enhance their cognitive and emotional capacities (Erol et al., 2023). Otherwise, environments designed for ordinary students, and repetitive curricula may be dull for gifted students (Kaplan-Sayı & Yurtseven, 2022). Consequently, pupils who encounter boredom during instructional sessions may encounter a decrease in their academic performance (Samardzija & Peterson, 2015), and as a consequence of facile learning, individuals may develop a sense of complacency, which may ultimately lead to a decline in their academic performance over time (Bilgiç et al., 2013).

Gifted students can be future scientists who shape and direct societies (Önal & Önal, 2021; Watters & Diezmann, 2003) by supporting the country's development in all areas (Kilic, 2015; Kaya & Bayra, 2019). There are various studies on how to follow a path in the education of gifted individuals. As Önal & Önal (2021) state in their article, it is crucial for these students to create concepts about astronomy at a young age and contribute to the future development of this technology. According to Chan (2001), compared to ordinary students, gifted students tend to be more self-motivated and independent in flexible learning activities without a rigid plan. In order for these students to show their full potential, differentiated training and methods suitable for their level should be used so that they can raise their skills above the existing ones (Alqahtani & Alqahtani, 2021; Olszewski-Kubilius et al., 2016) and contribute to themselves and the society by producing solutions to social and environmental problems (Cal & Demirkaya, 2020; Kaya & Bayra, 2019). As Bilgiç et al. (2013) stated, these talented individuals will become qualified and creative individuals who will contribute to scientific developments and technology by working in universities, factories, research laboratories, and development units. Aware that the level of development is parallel to the level of technology and education (Kaya & Bayra, 2019), in many developed countries of the world, such as the USA, the UK and Germany, substantial investments have been made, various institutions have been opened, and this issue has become a state policy in order for these students to receive a differentiated education (Erol et al., 2023; Kilic, 2015; Kaya & Bayra, 2019). For this reason, institutions should be diversified so that gifted students can receive differentiated and enriched education (Erol et al., 2023).

Bilim ve Sanat Merkezleri (BİLSEMs) or Science and Art Centers in English, educational establishments that offer supplementary instruction beyond regular school hours to enhance the abilities of talented students and afford them a chance to demonstrate their potential. This has been highlighted as a noteworthy feature that Türkiye may present to other nations, as noted by Kir and Akbaşlı (2021) in their article. To go even farther back in time, the Ottoman Empire established Enderun Schools in the 15th century with the purpose of educating talented kids. These schools provided education in science, art, and personality development in addition to educating differentially genius students who would be trained to become future managers and scientists (Kılıç, 2015). Following this, the relevant ministries, universities, non-governmental organizations, and The Scientific and Technological Research Council of Türkiye (TUBITAK) within the Republic of Türkiye addressed the issue of providing gifted children with an appropriate education (Bilgiç et al., 2013).

By providing engaging opportunities for active learning, gifted students at the Science and Art Centers can develop a positive disposition towards science and receive training to become future scientists and astronomers. These pupils exhibit a heightened level of curiosity, motivation, and eagerness to acquire knowledge in comparison to their peers; additionally, they possess artistic aptitude, demonstrate leadership qualities, exhibit proficiency in analytical thinking, particularly in mathematical domains, possess an extensive vocabulary, and display a tendency towards perfectionism (Bilgiç et al., 2013; Büyükkıdık & Şimşek, 2021; Erol et al., 2023) and in order to develop these skills, they should receive an education other than the traditional one offered in schools (Al-Dhamit & Kreishan, 2016).

By putting students in charge of conducting experiments within the context of a model of education that is both diverse and distinctive, the goal of BİLSEMs is to provide exceptionally talented students with the opportunity to discover new things by enhancing the students' capabilities in the areas of creativity, scientific inquiry, and critical thinking (Bilgiç et al., 2013; BILSEM Guidelines, 2007).

2.4 Attitudes Towards Astronomy

Due to the fact that science contains numerous abstract and complex issues, many students struggle to comprehend it and are unable to take part in and concentrate on it (Gerard et al., 2021). In addition to motivation, another factor influencing learning is the attitude, which can also be called a pre-disposition towards a subject (Coşkun, & Koç, 2021; Sırakaya & Sırakaya, 2018). Attitudes towards science may be related to the beliefs that they can be successful in science or the concepts of science, and the motivation to study science (Cheung, 2018). Students' attitude towards science is a subject that has been frequently researched in recent years (Elliniadou & Sofianopoulou, 2021).

Numerous students have a low success rate in science courses such as Physics, Chemistry, and Biology, as determined by studies; this is due to their fear of the course, their lack of prior knowledge, and the abstract nature of the subjects; therefore, new applications should be incorporated into the course to eliminate this failure (Timur et al., 2016; Önal & Önal, 2021). The utilization of AR in science education has been noted to enhance students' academic performance, foster an enjoyable learning experience, sustain their interest, attention, and curiosity, and cultivate a positive attitude towards science (Anıl, & Batdı, 2023; Çetin & Türkan, 2022; Önal & Önal, 2021; Rauschnabel et al., 2022; Sırakaya & Sırakaya, 2018; Şahin & Yılmaz, 2020). As a result of learning the lesson in an effective and easy way, students increase their interest first in the lesson and then in science (Chen & Liu, 2020).

Technology-integrated science courses are important in terms of attracting students' attention and increasing their motivation, as they offer the students active learning through their behaviors and hands-on experiences (Chen & Liu, 2020; Chiang et al., 2014). In support of this, it should not be overlooked that students' interest in science fields such as physics, chemistry, and biology has increased, and their interest in astronomy, which is one of the basic sciences, should be taken into consideration (Karaçam et al., 2022). The implementation of AR in science education has been found to enhance academic achievement, generate interest in the subject matter, and promote motivation by providing a more meaningful, comprehensible, coherent, authentic, and profound learning experience (Anıl & Batdı, 2023). The utilization of AR in the field of astronomy has the potential to enhance the comprehension of abstract concepts that are challenging to observe, thereby promoting effective learning (Coşkun & Koç, 2021).

CHAPTER 3

METHODOLOGY

In this chapter, the research design with three research questions, information about the participants, data instruments, procedures, data analysis, and assumptions will be presented.

3.1 Research Design

The present study aims to provide an understanding of the influence of AR-supported instructional astronomy activities on the attitudes of gifted learners towards astronomy by evaluating a mixed methods research design, integrating both quantitative and qualitative data collection and analysis methods. For the current study, the utilization of a mixed methods design was decided as the most appropriate methodology for the investigation of this research. A mixed-methods study is a research design that combines qualitative and quantitative data collection and analysis techniques within a single study (Creswell, 1999; Fraenkel et al., 2012). The Astronomy Attitude Scale was used to administer both a pre-test, given to all of the students before the astronomy session that was delivered using AR, and a post-test, given after the topic was taught. Examining the astronomy activities and objectives of the science courses taught in Science and Art Centers was done in line with the research topic. At the end of the study, the students answered open-ended interview questions to enhance the reliability of the study with their opinions on AR-integrated astronomy activities.

The study was guided by research questions that aligned with its purposes. These questions were as follows:

Q1. How do gifted students perceive the utilization of Augmented Reality (AR) in their astronomy-related activities?

Q2. What are gifted students' perceptions regarding Augmented Reality (AR) mobile application use in science courses?

Q3. Is there any change in the attitudes of gifted students towards astronomy subject after the implementation of Augmented Reality (AR) supported instructional astronomy activities?

3.1.1 Participants

A sample of 20 secondary school children from 5th, 6th, 7th, and 8th grades who take science lessons were selected from the population of gifted students in Türkiye who are affiliated with a public Science and Art Center (BİLSEM). These institutions select the students in three steps who have been considered gifted and who have been nominated by their teachers. Firstly, they completed the observation forms in accordance with their capabilities. The steps continued as the application for group screening and, thirdly, individual assessment (Sarıtaş et al., 2019).

In the framework of this study, convenience sampling as a method of participant selection was used. Thus, the researcher accessed the sample easily to collect the data in a more simple and effective way. There was a total of eight female participants and 12 male participants. The current study had no control group, and all the students participated in the same intervention. The students participated in the study entirely voluntarily, granting participants the autonomy of choosing not to participate or withdraw from the study at any time. All the parents and students were provided with consent forms.

Table 3.1 Demographic Information

Demographic Information	***Responses***	***N***
Gender	Female	8
	Male	12
Age	10	5
	11	9
	12	4
	13	2
Purpose of using a smartphone	Never	4
	Game	5
	Social Media	6
	Music	1
	Homework	2
	Watching Videos	2
How long do you spend time on your smartphone in a day?	Never	3
	Not much	5
	30 mins	1
	1 hour	3
	2 hours	4
	3 hours	2
	6 hours and more	2
What do you know about AR?	Nothing	15
	Not much	3
	Higher level of AR	1
	To be very realistic	1
What do you expect from an AR environment?	Can be useful.	10
	No idea	8
	If the training is not face-to-face, it may not be fully understood.	1
	It can help us understand things we can't see with our eyes.	1

3.2 Data Instruments

Overall, the data collection process consists of three distinct stages. First, students completed a demographic questionnaire (See Appendix A) about their backgrounds. Subsequently, a Likert scale attitude survey, which provided the quantitative data for this study, was given to students at the onset of two weeks (two hours for a week) of AR-based astronomy lessons before the lessons started. Finally, following the completion of the two weeks, post-test interviews were conducted, including open-ended questions with the Likert scale (post-test) to elicit the attitudes of gifted students regarding the AR-integrated astronomy courses.

3.2.1 Demographic Survey

The demographic survey was utilized to gather demographic data from participants through open-ended questions before the AR-integrated astronomy lesson. This data included age, grade level, gender, and prior experience with VR and AR technologies. Based on the collected data, it was observed that the ages of the students were classified into four distinct categories, namely 10, 11, 12, and 13. Most of the student population, comprising nine individuals, were 11 years old, whereas two students were 13 years old.

The research included 20 secondary students (12 boys and eight girls). Two pupils used their phones for at least six hours each, compared to three students who did not use them at all. Nine pupils spent less than an hour. The majority of the students (11) preferred to use social media during this time. The sixth question aimed to ascertain the manner in which students allocate their time with mobile devices. Out of the total respondents, 11 students reported using their mobile phones for social media, whereas two students reported using them for schoolwork.

15 students responded that they knew nothing when asked what they knew about AR, while the other responses did not correspond to the right response such as “higher level of virtual reality”, or “to be very realistic”.

As requested in question 10, information about AR was being sought. A considerable proportion of the sample population (i.e., 15 students) reported a need for more familiarity with AR technology.

The 11th question was designed to ascertain the students’ anticipations regarding the AR integrated course prior to the commencement of the experiment. Specifically, the question posed was: “What are your expectations from the AR learning environment?" Eight students reported that they did not have any idea, whereas 10 students expressed positive expectations. One student expressed his/her expectation: "It can help us understand things we cannot see with our eyes.".

3.2.2 Astronomy Attitude Scale

The study did not involve the development of an entirely new attitude scale. Instead, permission was obtained (See Appendix B) to employ an existing astronomy attitude scale from the literature, which was subsequently modified to align with the demographics of the student group. In 2015, Türk and Kalkan created the Astronomy Attitude Scale (AAS) to evaluate the attitudes of secondary school students regarding the field of astronomy (See Appendix C). The points on the scale are graded from 1 to 5, with 1 indicating complete disagreement and 5 indicating complete agreement with the statement. The total number of items on the scale was 27, with 17 being positive and 10 being negative, while the Cronbach-Alpha internal consistency coefficient was 0.91. The present study involved a reduction in the number of items to 25 and minor modifications to the structure of selected items to ensure that their semantic content remained unchanged. The survey comprised two distinct categories of questions: Likert-scale and open-ended.

The previously mentioned section comprised a total of 25 items. It employed a Likert-type scale of 5 points, ranging from 1 (representing strong disagreement) to 5 (representing strong agreement), with the highest score being 5 and the lowest being 1. As the factor analysis mentioned in Türk and Kalkan's (2015) study shows, the Astronomy Attitude Scale (AAS) can be evaluated by dividing it into five main headings (2015). The first is Application (Q20), the second is Being Interested (Q2, Q3, Q11, Q12, Q18, and Q19), the third is Daily Life (Q4, Q8, Q13, Q15, Q16, Q21, Q22, Q23, Q24, and Q25), the fourth is Liking (Q1, Q6, and Q7), and the last is Self Confidence (Q5, Q9, Q10, Q14, and Q17).

3.2.3 Interview

The interviews were conducted in response to forthcoming two-week astronomy lessons incorporating Augmented Reality (AR) technology, each session lasting one hour. The pupils expressed their experience lasting two weeks, two hours a week, which was monitored by their educators. They participated in a structured interview consisting of 10 open-ended questions pre-designed by the researcher before the interview, through which they provided feedback regarding their learning experiences. The interview consisted of questions about AR experiences and the students' attitudes. (See Appendix D)

Table 3.2 Interview

N=20	***Interview Questions***
Q1	How did you find the Augmented Reality experience, and why?
Q2	How did the use of Augmented Reality in science lessons affect you? How did you feel?
Q3	How did the use of Augmented Reality in science lessons affect the learning process?
Q4	Has the expertise you gained through the Augmented Reality (AR) application helped you to solve the issues you face in your daily life?
Q5	Do you want Augmented Reality to be utilized in science lessons all the time?
Q6	Did you have any difficulty in processing the subject with Augmented Reality during science lessons astronomy lesson?
Q7	Do you think that Augmented Reality applications can be used as part of the astronomy learning curriculum?
Q8	On which subjects do you think such training could be effective?
Q9	On which subjects do you think such training could not be effective?
Q10	Is there anything else you would like to tell the researcher about your experiences in this study?

3.3 Procedures

The astronomy activities, which were delivered through the use of Augmented Reality (AR), spanned a duration of two hours over a period of two weeks. These lessons were conducted utilizing a mobile application specifically designed for smartphones running on the iOS operating system. Before the start of the instructional sessions, the researcher translated the lesson plans in the application into Turkish from English, as presented in Appendices E, F, G, and H. The first lesson teacher introduced the students to the Night Sky AR app, giving students time to explore the app. In the second lesson, he started to teach the lesson with the activity sheets in the hands of the students in accordance with the lesson plan. The students explored the questions and tried to solve them in groups. At the end of two weeks, which were taught as two hours of lessons in one week, the students' attitudes at the beginning and the end were compared.

To identify the most appropriate AR applications, approximately 10 applications compatible with Android and iOS operating systems were downloaded and evaluated to determine the optimal choice. The Night Sky application emerged as the ideal option after a comprehensive two-day selection process. This application offered free lesson plans customized to specific age groups and topics, facilitating convenient and efficient utilization of educational endeavors.

3.3.1 Instructional Materials

Under the guidance of their instructors, the pupils engaged in a lesson plan that involved utilizing the iOS Night Sky application while adhering to technology-supported pedagogical approaches incorporating AR. The application furnished exemplary lesson plans that were classified by age range and subject matter and implemented in collaboration with the instructor. Night Sky, an iOS software, helps users identify planets, stars, galaxies, and constellations by identifying them using an iPhone camera towards the sky at any time. The application provides an AR experience for students, enabling them to observe objects in greater detail and access associated information.

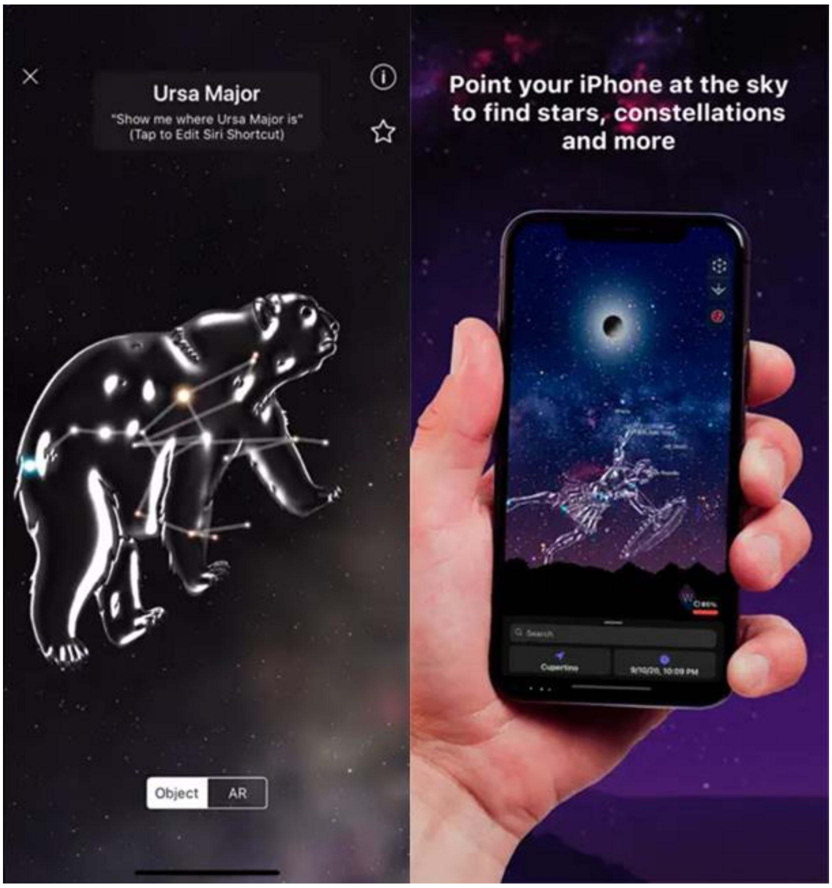


Figure 3.1 Night Sky Screenshots

Night Sky Application Screenshots, 2023, https://apps.apple.com/us/app/night-sky/id475772902 Copyright 2023 by iCandi Apps Ltd.

3.3.2 Data Collection

Prior to data collection, the research proposal was subjected to approval by the research committee and the Human Research Ethics Committee at Middle East Technical University (See Appendix I). Furthermore, necessary permissions were obtained from the Public Science and Art Center Directorate, the parents, and students via the consent forms presented in Appendix J and Appendix K, respectively. Consequently, data collection was initiated among students under the guidance of their educators.

Demographic data was collected through qualitative and quantitative methods following a two-hour astronomy lesson. The first data collection part involved a demographic survey, while the second utilized a Likert scale to assess differences in quantitative data. Subsequently, interviews were conducted to gather the students' perspectives on science, astronomy, and AR. The data collection ended with the execution of a qualitative investigation involving open-ended inquiries, which allowed participants to express their perspectives. Upon arrival at the Science and Art Center, the students were given a parent permission form to be signed by each of their parents during the initial week. Following the submission of the properly signed and authorized documents to their teachers, the individuals were given the Demographic Data survey before the lesson and proceeded to deliver a two-hour lecture on astronomy utilizing AR technology. Upon completion of the demographic questionnaire, the teacher promptly prepared students' smartphones and proceeded to implement the astronomy subject lesson plan that had been previously developed.

The instructor not only offered guidance but also monitored the students' progress throughout the session and aided in utilizing the application. At the onset of the lesson, the teacher provided a brief overview of the tabs and features of the Night Sky Augmented Reality software, which lasted for 5 minutes. Upon the conclusion of the two-week astronomy lesson, lasting one hour each week, the students were administered a Likert scale survey and subsequently participated in an interview session. The responses were entered into the computer system. The information collected via interviews and surveys was organized into files.

Table 3.3 First Week Lesson Plan

Topic: Discovering Space History *(1st Week)*				
Step	***Time***	***Tasks*** *(Teacher)*	***Tasks*** *(Students)*	***Purpose*** *(Students will be able to…)*
Greeting	3’	The teacher asks the students what they expect from the AR-integrated astronomy lesson.	The students tell their expectations on AR-integrated astronomy activities to the teacher.	get ready for the lesson.
Lead in	5’	The teacher briefly presents information about the history of space exploration to the students and divides the students into groups of 2 and tells them to make the application ready on their phones. The teacher introduces the menu and buttons of the application to the students. The teacher introduces the menu and buttons of the application to the students.	Students complete the activity in a group in a more comfortable and confident way.	use the Night Sky Application menu and commands.
Presentation	10’	The teacher asks the students to open the Night Sky app and enter the menu. In the Space Exploration Timeline, the activity prompts them to click on the icon and asks them to see what happened on the specified date. Then he transmits the other questions on the activity paper to the students along with the instructions.	Students open the application and answer the questions asked by following the commands of their teachers.	identify who were the pioneers of space exploration.
Practice	47’	The teacher asks other questions to the students as in the lesson plan and expects the students to discover the answers using the application.	Students explore the application together with their teammates and answer the activity questions asked by their teachers.	identify who were the pioneers of space exploration. name the first people to travel to the moon. gain knowledge about the planets visited by Voyager 2 and various kinds of satellites.
Discussion	10’	The teacher directs the discussion question to the students on the activity paper and asks the students to discuss the answer first with their teammates and then with the rest of the class.	Students share the answers they will give to the discussion question first with their partners and then with the class.	have comprehensive information on the subject by sharing their answers during the discussion and obtaining the missing parts from their peers.
Closure	5’	The teacher shares with the class what was processed during the lesson and what achievements were achieved in the lesson.	Students get a chance to see what they are doing in the lesson at the close of the lesson.	review the topics that they have gone over in the lesson by putting the information they've learned into their own minds in a meaningful context.

Table 3.4 Second Week Lesson Plan

Topic: Discovering Mars *(2nd Week)*				
Step	***Time***	***Tasks*** *(Teacher)*	***Tasks*** *(Students)*	***Purpose*** *(Students will be able to…)*
Greeting	3’	The teacher asks the students what they know about Mars.	The students tell their pre-knowledge on Mars.	get ready for the lesson.
Lead in	5’	The teacher briefly presents information about the discovery of Mars to the students and divides the students into groups of 2 and tells them to make the application ready on their phones. The teacher introduces the menu and necessary buttons to the students.	Students complete the activity in a group in a more comfortable and confident way.	acquire the knowledge of the place of Mars in space.
Presentation	10’	The teacher asks the students to open the Night Sky app and enter the menu. In the Space Exploration Timeline, the activity prompts them to click on the icon on the sheet and asks them to see what happened on the specified date. Then he transmits the other questions on the activity paper to the students along with the instructions.	Students open the application and answer the questions asked by following the commands of their teachers.	use the Night Sky Application menu and commands.
Practice	47’	The teacher asks other questions to the students as in the lesson plan and expects the students to discover the answers using the application.	Students explore the application together with their teammates and answer the activity questions asked by their teachers.	identify the position, color and surface of Mars.
Discussion	10’	The teacher directs the discussion question to the students on the activity paper and asks the students to discuss the answer first with their teammates and then with the rest of the class.	Students share the answers they will give to the discussion question first with their partners and then with the class.	have comprehensive information on the subject by sharing their answers during the discussion and obtaining the missing parts from their peers.
Closure	5’	The teacher shares with the class what was processed during the lesson and what achievements were achieved in the lesson.	Students get a chance to see what they are doing in the lesson at the close of the lesson.	review the topics that they have gone over in the lesson by putting the information they've learned into their own minds in a meaningful context.

3.4 Data Analysis

In the process of observing the changes in student attitudes towards science, descriptive statistics of the quantitative method were employed to examine through the Likert scale. A paired-sample t-test was utilized to evaluate the statistical significance of observed differences. The interview transcripts conducted after the experiment underwent content analysis as a component of the qualitative data analysis procedure, which was utilized for figuring out how often themes, words, or ideas are repeated in a text, transcription of interviews, video recording, or document

(Mayring, 2004; Nagai, 2015). The transcripts included tagging and analysis to identify recurring themes and patterns associated with the students' perceptions and experiences of astronomy activities that utilize AR. As mentioned earlier, the themes and patterns were associated with the students' cognitive and affective responses to the instructional materials and pedagogical strategies employed in the learning process.

The study upheld ethical standards to safeguard participant confidentiality, informed consent, and data protection throughout the research process. Besides, it was carried out in compliance with the ethical guidelines prescribed by the institutional review board.

Table 3.5 Data Analysis Method

Research Question	***Data Source***	***Data Analysis***
Q1. How do gifted students perceive the utilization of Augmented Reality (AR) in their astronomy-related activities?	Demographic Survey & Interview	Content Analysis
Q2. What are gifted students' perceptions regarding Augmented Reality (AR) mobile application use in science courses?	Demographic Survey & Interview	Content Analysis
Q3. Is there any change in the attitudes of gifted students towards astronomy subject after the implementation of Augmented Reality (AR) supported instructional astronomy activities?	Astronomy Attitude Scale	Paired Sample T-test

3.4.1 Qualitative Data Analysis

Firstly, the data collected from the interviews and demographic survey given at the beginning were read and examined in a detailed way in the light of the research questions. The responses were documented on an Excel spreadsheet by hand to facilitate a comprehensive overview of the answers. Upon close examination of the responses, they were coded using thematic analysis, and the answers to the questions were categorized as "Fun, Different, Instructive, Positive, Negative, Interesting, Compelling" as the most frequent expressions of students were organized into emotional state themes inductively. The researcher utilized descriptive analyses to comment on the themes and codes generated.

3.4.2 Quantitative Data Analysis

The Likert scale collected quantitative data, including 25 items used as pre-test and post-test. After the researcher transferred the answers on the pre-test and post-test Likert scales she collected at the end of the second week into an Excel table, she evaluated whether there was a significant difference between the results using the Paired Sample T-test using SPSS (Green & Salkind, 2005). Firstly, the negative statements were changed to positive, and the overall scores of the students were compared to see whether there was a visible difference before and after the experiment. Subsequently, the responses for every item were assessed separately. Statistical analyses were conducted using the software program "IBM SPSS 23.0". The mean and standard deviation of the scores obtained by the students participating in the study were computed for both the pre-test and post-test. The research employed statistical analyses and accepted a significant value alpha of .05. The number of participants was insufficient for exploratory factor analysis. For this reason, the value of each item for the pre-test and post-test was analyzed and evaluated separately.

3.5 Assumptions

It was assumed that the students who participated in the study answered questions sincerely and accurately. 20 students were involved in all the lessons and data collection processes and there was no shortage of time.

CHAPTER 4

FINDINGS

This chapter will present the analysis of mixed method research design by providing the changes in the attitudes of the students towards astronomy after the treatment.

4.1 The Results of Qualitative Analysis

“Q1. How did you find the Augmented Reality (AR) experience and why?”

When the 20 answers given to the 1st question were examined, it was determined that all of the student’s experiences in the astronomy course taught using AR were "positive" nine students found their experiences "different", two students found it "instructional", and seven students found it "fun". Some of the answers were like in the table.

Table 4.1 Students' Responses to Q1

How did you find the Augmented Reality experience and why?		
Responses	***Theme***	***Frequency (f)***
"I'm thinking positively. This first experience for me was very unusual." *"I found it different, I think it was interesting."* *"Well, I've tried something new."* *"I found it different. It was nice."* *"It was a different experience, and I learned more about Augmented Reality."* *"I didn't expect that."*	Different	9
"It was a fun and beautiful experience. It was different from usual." *"It was fun, I tried it for the first time."* *"I loved it very much. It was a lot of fun."* *"This is the first time I've tried Augmented Reality. I think it was fun."* *"I didn't know I had something like this on my phone. It was excited."*	Fun	7
"Generally good. Sometimes it can be a distraction." *"I wish we had used it earlier."*	Positive	2
"It was fun. I've learned a lot of things." *"I found it good, I think it's easier to learn."*	Instructive	2

No complaints or criticisms were voiced by students, which suggested that participants were pleased with the Augmented Reality (AR) experience overall.

Table 4.2 Students' Responses to Q2

How did the use of Augmented Reality (AR) in science lessons affect you? How did you feel?		
Responses	***Theme***	***Frequency (f)***
"It didn't go like a lesson, and it was like a game." *"It was fun. I've learned a lot of things."* *"I liked it, it made us do more fun things in class."* *"It was fun the first time I tried."* *"The lesson has become more fun. I'm happy."*	Fun	9
"This is the first time I have had such an experience. I wish other classes were like this." *"I found it different, I think it was interesting."* *"I think we have learned lessons in a different way."* *"It was a different experience, I learned more about Augmented Reality."*	Different	5
"I quickly understood thanks to this method used in science lessons. I enjoyed the lesson." *"It was fun. I've learned a lot of things."* *"It increased my interest in the lesson."* *"I felt better to listen to the topic."*	Instructive	4
"I had a good time." *"He impressed the class and me well."*	Positive	4
"It made me more interested in the class." *"It was interesting, exciting."*	Interesting	3

The second question, "Q2. How did the use of Augmented Reality (AR) in science lessons affect you? How did you feel?" was aimed to see the feelings of students after the science lesson instructed with AR. All 20 responses included positive phrases such as "fun" (n=9), "instructional" (n=4), "interesting" (n=3), and "different" (n=5).

The result obtained from the table above indicated that the students in the science lesson taught using AR increased the teaching experience of the lesson. As the learning experience became more enjoyable and extraordinary, their interest in the lesson increased, and they had positive feelings towards a science lesson taught in this way.

The third question was "Q3. How did the use of Augmented Reality (AR) in science courses affect the learning process?". It aimed to ask the perceptions of the students on their learning process. While only one student mentioned that s/he had difficulty during the AR application, the rest stated that they did not have any difficulties. Student 12's response, "I learned more quickly through visualization." is noteworthy as it illuminates the fundamental objective of the study.

Table 4.3 Students' Responses to Q3

How did the use of Augmented Reality (AR) in science course affect the learning process?		
Responses	***Theme***	***Frequency (f)***
"It has influenced my learning well." *"I liked the lesson better."* *"Positively affected"* *"I think it has influenced my learning well."* *"Overall, it has had a positive impact."* *"It was easier to impress well."*	Positive	10
"It has positively affected my learning process. It was more effective." *"I felt like I was learning fast."* *"I learned more quickly through visualization."*	Instructive	5
"I was never bored in class." *"It made the lesson more interesting."*	Interesting	2
"It made science class more enjoyable than usual." *"I felt less bored."* *"I learned faster because I had fun."*	Fun	3

The fourth question was "Q4. Has the expertise you gained through the Augmented Reality (AR) application helped you to solve the issues you face in your daily life?".

This question aimed to compare the gains of students from the AR lesson with their daily life problems. Out of the total respondents, 16 students provided feedback on the question. Among them, nine students responded negatively, indicating that the method did not contribute to resolving their daily issues. On the other hand, seven students responded positively, affirming that the AR-supported lesson had a positive impact on their everyday problems. Four students provided a neutral response. When the answers were evaluated in general, it was insufficient for this question to say that AR gains have a direct effect on daily life problems. One possible explanation for this could be that students were still familiarizing themselves with the AR application and still needed to develop a comprehensive understanding of how it could be utilized in their daily routines.

The fifth question was “Q5. Do you want Augmented Reality (AR) to be utilized in science classes all of the time?” this question’s purpose was to figure out how students desire their future science classes, including AR. 14 students gave positive answers, including “I think it would be better because it’s more interesting that way.”, “It would be nice if it was like this in the future.”, “Yes, it’s more fun that way.”. Although four students provided a negative response, one student’s answer was in line with the goal of the research. The answer was, “If you use it all the time, it won’t be good. But it would be good to use it for things that don’t have any visuals.”. There were also two neutral answers.

The sixth question was “Q6. Did you have any difficulty processing the subject with Augmented Reality (AR) during the science class astronomy lesson?” to ensure students had the lesson safely. The question format included a negative phrase (difficulty), so answers were reversed before coding. In this way, it was seen that there were 13 positive and seven negative answers like “At first I had difficulties in setting up and learning, but I think I will not have this difficulty for the second time.”. Although the answers were generally positive, it was observed that the students had some problems getting used to the application.

The seventh question was “Q7. Do you think that Augmented Reality (AR) applications can be used as part of the astronomy learning curriculum?” to determine how students desired to see AR applications in their astronomy curriculum. In general, the answers were collected in 2 categories: “yes” (n=19) and “neutral” (n=1). It can be interpreted that these students are open to learning and not closed to innovations and new technologies.

The eighth question was “Q8. On which subjects do you think such training could be effective?” and the ninth question was “Q9. On which subjects do you think such training could not be effective?”. Students’ answers showed that they think this technology can be more effective in courses related to Biology (n=7), Astronomy (n=3), Circuits (n=1), Art (n=1), All topics (n=6), and Neutral (n=3). There were two noteworthy responses to the eighth question, both of which addressed the underlying motivations for using this application in the study. These were “This technology can be effective in subjects that do not have visuals and that we cannot think in our minds.”, “It can be effective in subjects that are difficult to imagine.” On the other hand, they asserted that this method could be ineffective in Math (n=5), Social Sciences (n=2), Science lessons (n=2) and, All topics (n=2). Two students’ answers were neutral. When asked how they found the research at its conclusion, the students’ responses, such as "Unusual," "Interesting," and "I wish we had used it before," were significantly impacted by the backgrounds of the participants. One student’s response to the question about what they expected from the AR environment in the demographic survey—"It can help us understand things that we cannot see."—unwittingly demonstrated the significance and usefulness of the work for the study’s goals.

4.2 The Results of Quantitative Analysis

The Astronomy Attitude Scale prepared by Türk & Kalkan (2015) was utilized for the quantitative data. When the Likert scale consisted of 25 items given to the students before, and after the study was examined, it was seen that the themes the items aimed to find answers to were divided into categories. These categories are Application (Q20), Being interested (Q2, Q3, Q11, Q12, Q18, Q19), Daily life (Q4, Q8, Q13, Q15, Q16, Q21, Q22, Q23, Q24, Q25), Liking (Q1, Q6, Q7) and Self-confidence (Q5, Q9, Q10, Q14, Q17). It was determined that there was a significant difference for some items in the answers given to the pre-test given before and the post-test given after the astronomy activities were processed using AR for two weeks.

Table 4.4 Quantitative Data Analysis

Item (N=25)	***Pre-test Mean***	***Pre-test SD***	***Post-test Mean***	***Post-test SD***	***Gain Mean***	***Gain SD***	***t score***	***p value***
1	4.40	.68	4.50	.69	-.1000	.4472	-1.000	.330
2	2.85	.99	3.70	1.03	-.8500	.8750	-4.344	**<.001***
3	3.00	.65	3.75	.79	-.7500	.6386	-5.252	**<.001***
4	4.40	.68	4.25	.64	.1500	.8750	.767	.453
5	3.80	1.32	4.15	.93	-.3500	.7451	-2.101	**.049***
6	3.95	1.36	4.40	.88	-.4500	.9445	-2.131	**.046***
7	4.05	1.00	4.55	.76	-.5000	1.1470	-1.949	.066
8	3.70	.98	4.15	.81	-.4500	.8870	-2.269	**.035***
9	3.65	.99	4.40	.60	-.7500	.6386	-5.252	**<.001***
10	3.60	.82	4.30	.73	-.7000	.5712	-5.480	**<.001***
11	2.70	1.13	2.45	1.00	.2500	1.0699	1.045	.309
12	3.00	1.17	3.05	1.23	-.0500	.8255	-.271	.789
13	3.50	1.19	4.15	.88	-.6500	.7451	-3.901	**<.001***
14	3.95	.83	4.40	.60	-.4500	.6048	-3.327	**.004***
15	3.90	1.21	4.35	.93	-.4500	.9445	-2.131	**.046***
16	3.35	1.04	3.75	.79	-.4000	.5982	-2.990	**.008***
17	3.00	1.17	3.65	.81	-.6500	.8750	-3.322	**.004***
18	3.50	.83	4.00	.73	-.5000	.6882	-3.249	**.004***
19	3.40	1.31	4.30	.73	-.9000	1.2937	-3.111	**.006***
20	4.20	.95	4.80	.52	-.6000	.7539	-3.559	**.002***
21	2.90	1.17	3.40	1.05	-.5000	.6882	-3.249	**.004***
22	2.30	1.22	3.30	1.08	-1.0000	.6488	-6.892	**<.001***
23	3.40	1.14	4.10	.91	-.7000	.6569	-4.765	**<.001***
24	2.95	1.15	4.00	.79	-1.0500	.6048	-7.764	**<.001***
25	3.40	1.39	4.10	1.17	-.7000	1.3803	-2.268	**.035***
Total	86.85	10.1632	99.95	9.3441				

A paired-sample t-test was conducted to evaluate whether students' attitudes towards science are higher with AR-supported instructional applications. The results of the analysis (Table 4.4) indicated that the mean of the post-test (M = 99.95, SD = 9.34) was significantly higher than the mean of the pre-test (M = 86.85, SD = 10.1632), t (19) = -8.551, p < .05.

Due to the insufficient number of participants, each item was evaluated individually by looking at the pre-test and post-test scores. At the same time, there was a significant increase in some of the post-test answers' mean given by the students to 25 items in their attitudes towards astronomy. Item 2, 3, 5, 6, 8, 9, 10, 13, 14, 15, 16, 17, 18, 19, 20, 21, 22, 23, 24, and 25 respectively (t=19)= -4.344, p < .05; (t=19)= -5.252, p < .05; (t=19)= -2.101, p < .05; (t=19)= -2.131, p < .05; (t=19)= -2.269, p < .05; (t=19)= -5.480, p < .05; (t=19)= -3.901, p < .05; (t=19)= -3.327, p < .05; (t=19)= -2.131, p < .05; (t=19)= -2.990, p < .05; (t=19)= -3.322, p < .05; (t=19)= -3.249, p < .05; (t=19)= -3.111, p < .05; (t=19)= -3.559, p < .05; (t=19)= -3.249, p < .05; (t=19)= -6.892, p < .05; (t=19)= -4.765, p < .05; (t=19)= -7.764, p < .05; (t=19)= -2.268, p < .05. These results indicated that gifted students had a positive attitude towards astronomy after two weeks of AR-supported instructional astronomy activities.

Table 4.5 Items with Significant Differences

#	Item
2	Astronomy is an easy science to learn for most people.
3	Astronomy topics are easy to understand.
5	I feel under stress in astronomy lesson.
6	I think I'll like astronomy.
8	I don't think knowing astronomy will help me in my professional life.
9	I have difficulty learning astronomy subjects.
10	I enjoy learning about astronomy.
13	It is easy to understand astronomy concepts.
14	I feel stressed while learning astronomy.
15	I have difficulty in understanding scientific subjects.
16	I use science in every aspect of my life.
17	I am assertive about the field of astronomy.
18	I forget the astronomy subjects I learned in a short time.
19	I don't enjoy talking about astronomy with my classmates.
20	I can better understand astronomy subjects when they are handled practically.
21	Astronomy is in every phase of daily life.
22	I follow the current developments in the field of astronomy.
23	Thanks to astronomy, my knowledge of nature increased.
24	I like to try to understand natural phenomena using astronomy.
25	Astronomy subjects increase my interest in science.

Looking at the answers of the students one by one, it was concluded that the subject of astronomy was seen as a relatively easy science, it was easier to understand, it was more enjoyable while learning astronomy, the learned astronomy subjects were remembered for a longer time, it was more enjoyable to learn astronomy lessons with classmates, astronomy subjects were more understandable when applied practically, the students followed the latest developments in astronomy more, and the students also increased their knowledge of nature thanks to astronomy.

After negative statements were converted to positive for analyzing and looking at their means, there was a decrease in two items (Q4. "I think Astronomy is useless in my daily life.", Q11. "Astronomy course requires many subjects to be remembered.".

CHAPTER 5

DISCUSSION AND CONCLUSION

In this study, the attitude of gifted students towards astronomy was examined using the Augmented Reality (AR) application, which was a part of technology-assisted education. The study used qualitative and quantitative data to determine that students formed a positive attitude towards astronomy after a two-week experiment. This chapter aims to compare the findings of three research questions with the previous studies. Then, it will follow the internal and external validity of the study, limitations of the study, implications for practice and recommendations for future research.

5.1 Discussion

A great deal of study has been conducted over a period of several years to investigate the advantages of Augmented Reality (AR) in the field of education. However, despite these efforts, definitive results have yet to be established. The present study aimed to examine the impact of an Augmented Reality sky observation application on the attitudes towards astronomy among gifted secondary school students. Specifically, the investigation focused on whether there was a noticeable shift in these students' attitudes towards astronomy following two weeks of incorporating the previously mentioned instructional AR app into their science classes.

The first research question was, "How do gifted students perceive the utilization of Augmented Reality (AR) in their astronomy-related activities?". It was related to the attitudes of gifted students towards AR-supported instructional activities in astronomy-related science courses. It has been determined in the research that many students have difficulty in science lessons due to a lack of knowledge and concretizing abstract concepts, and accordingly, they get low scores (Timur et al., 2016; Önal & Önal, 2021; Yu & Sahami, 2007). According to the researchers, some of the reasons for this have been that astronomy observations should be made at night and in the open field, weather conditions should be suitable, and appropriate equipment should be available, and accordingly, many astronomy concepts remain at the abstract level (Zhang et al., 2014). Before the study began, this problem was discussed in a one-on-one conversation with a science teacher at the Science and Art Center. The teacher said that astronomy was one of the subjects that the students had the most trouble with. Students had the chance to try the astronomy subjects that they were hesitant about with the AR application they encountered for the first time.

In this study, the attitudes of gifted students were particularly examined because it was essential for them to meet the requirements of their age in terms of the workforce and the potential they would create in the future. These students, who were more advanced and gifted in various areas than their peers, were viewed as the future scientists, leaders, and skilled labor force (Kaya & Bayra, 2019; Önal & Önal, 2021; Pekdoğan & Bozgün, 2017; Watters & Diezmann, 2003). Educators must develop flexible, differentiated, and dynamic teaching methods and nonrepetitive curricula to identify gifted students and develop their talents since regular education programs were not enough for them to do so (Erol et al., 2023; Kaplan-Sayı & Yurtseven, 2022; Kaya & Bayra, 2019). The significance of researching differentiated education for gifted students in astronomy, where students often encounter challenges, had considerable value. AR-supported technology can be integrated to differentiate astronomy instruction (Önal & Önal, 2021; Kerawalla et al., 2006; Zhang et al., 2014). For the sixth question, students were expected to answer which subjects they had difficulty with during AR-supported instructional astronomy activities, and some students expressed that they had difficulties with installation and getting used to the application commands. However, thanks to their teachers, they overcame these difficulties. It could be understood from this that it could be recommended that teachers be ready to support and guide students at any time before the activities. They should have examined the application in advance and come to the lesson ready. The qualitative data in the study showed a degree of overlap with the quantitative data without any visible contradiction.

The second research question employing qualitative data was “Q2. What are gifted students’ perceptions regarding Augmented Reality (AR) mobile application use in science courses?”. Considering that the students did not know about AR applications before the study, as seen in the Demographic Survey, they stated that processing astronomy activities with AR after the study was enjoyable, extraordinary, and instructive. All the answers were positive, and the students repeated that they had not expected to have so much fun. According to their statement, they learned more quickly and were more motivated during the lesson. Numerous students stated that they did not get bored, and the subject was more interesting than before. Studies on this subject also indicated that students’ motivation, success, attention, curiosity, and attitudes increased in AR-integrated science lessons (Anıl, & Batdı, 2023; Çetin & Türkan, 2022; Kerawalla et al., 2006; Önal & Önal, 2021; Rauschnabel et al., 2022; Sırakaya & Sırakaya, 2018; Şahin & Yılmaz, 2020). When they experienced AR for the first time together with the novelty effect, it might be suggested that the motivation and excitement that students had might have not only been because the application was very effective and successful (Jones, 2009). When the answers were evaluated, some students stated that AR was generally successful, but sometimes it could cause distraction.

When the students were asked how AR affected them during the science lesson, many of them said they enjoyed it very much and that the application was different, instructive, and interesting. Some of the students stated that the activity was like a game. Many previous studies have shown that learning by doing and experiencing increases students’ motivation, interest, and attention (Chen & Liu, 2020; Chiang et al., 2014). In the responses, it was found that some students wished that other courses would have been processed with AR in this way, which might lead to saying that the application positively increased students’ motivation not only towards astronomy but also towards learning other fields. The students also did not forget to mention that they focused better, and their interest increased greatly while listening to the science lesson.

In the 3rd question of the qualitative part, students were asked how AR activities affected their learning in science class, and the focus here was on asking students to focus on their learning process. All the answers were positive, and the students expressed that they learned faster, better, more effectively, and were more motivated this way. The purpose of the study could be noticed from the responses provided by certain students to this question. The students stated that they learned subjects that were not possible to see and observe faster thanks to the visualization provided by the AR application; as said by one of the students, "I learned more quickly through visualization.". Many studies have stated that thanks to the authentic environment provided by the AR application, students have the chance to concretize and visualize abstract concepts and learn in a motivated way by feeling as if they are in that environment (Abdüsselam, 2014; Anıl & Batdı, 2023; Arslan et al., 2020; Chin et al., 2018a; Chin et al., 2018b; Chen et al., 2022; Coşkun & Koç, 2021; Di Serio et al., 2013; Ebadi & Ashrafabadi; Gecu-Parmaksiz & Delialioğlu, 2020; Gopalan et al., 2023; Guo et al., 2017; Dede, 2009; Kul & Berbe, 2022; Radu, 2012; Rosenbaum et al., 2007; Sotiriou & Bogner, 2008; Wang, 2022; Yen et al., 2013; Zhufeng & Sitthiworachart, 2023).

The 4th question was aimed at learning whether the students' AR application could help solve their problems in daily life. Nine students answered this question negatively, stating that they did not believe that it would contribute to their daily lives. Interestingly, the answers given to the item in the quantitative part "I think Astronomy is useless in my daily life." showed also students had a belief that they would not encounter astronomy in daily life problems. One of the reasons for this might be that students were still seeing the astronomy app as part of the course and curriculum, and they were involuntarily trying to keep their daily life separate from school, or the students might not have fully grasped how they could integrate the application into their daily lives.

The 5th question was about the opinions on whether the students desired to have AR in their science classes all the time, and many students stated that they preferred to have AR applications in their science classes as it offered an interesting and fun overview of the subjects. One student's response corresponded to the purpose of the study in some way and showed other researchers and educators what kind of activities AR applications could be with: "If you use it all the time, it will not be good. But it would be good to use it for things that do not have any visuals.". It could be understood from this that AR observation allowed experiments to be performed on it, visualization of astronomy topics that were difficult to study, and observation so students could learn astronomy topics simply (Chen et al., 2022; Shelton and Hedley, 2002).

The quantitative part of the study was designed for the third research question, "Q3. Is there any change in the attitudes of gifted students towards astronomy subject after the implementation of Augmented Reality (AR) supported instructional astronomy activities?". The astronomy Attitude Scale prepared by Türk & Kalkan (2015) was utilized in the study. The scale had five subcategories: "Being Interested, Self Confidence, Application and Daily Life". Each item was analyzed individually regarding the reliability of the results, and the results that showed a significant difference between the pre-test and post-test were explained in detail in the Findings section. It was revealed in the quantitative data analysis that the students had difficulty learning astronomy before the study. Still, they thought they could understand astronomy more efficiently by doing it with hands-on learning after the experiment.

In addition, the students stated that they had more fun while studying the subject of astronomy and that learning together with their peers was more practical, considering the benefits of cooperative learning. Studies on this subject show that the problem-solving skills of students using AR have been increased by bringing the real world into the virtual world and experiencing active learning by collaborating, and the motivation of these students has increased (Kaur et al., 2020; Kul & Berbe, 2022). By accessing the course material in 3D environments, students participate more effectively in the lesson and comprehend the subject more quickly because, in this way, students have the chance to concretize abstract concepts that they have difficulty in grasping (Yen et al., 2013; Yıldırım, 2021). Many studies have shown that science lessons that are carried out by AR increase the motivation and attitude towards science of the students (Akçayır et al., 2016; Chiang et al., Çetin & Türkan, 2022; Di Serio et al., 2013; Sırakaya & Sırakaya, 2018; Yıldırım, 2021). Many students believed that astronomy topics had a higher likelihood of being retained in their long-term memory. Besides, the students stated that they enjoyed discussing astronomy topics with their classmates at the end of the study, and they started to enjoy following the developments in astronomy more at the end. According to Chen and Liu (2020), a positive correlation exists between students' enjoyment of science lessons and their level of interest in science. Students developed a scientific curiosity and interest after the application. Finally, the students gained the relationship between astronomy and nature by expressing that their knowledge of nature increased and that they could explain natural phenomena with astronomy.

On the other hand, on the Astronomy Attitude Scale, the students concluded that astronomy had too many memorable points and was a complex field. It was thought that this was because students encountered more information about astronomy in practice than they thought. Considering the AR-supported instructional astronomy activities, students reached that result in this study because they realized that astronomy was an intense and complex subject in the AR application, and they thought that they would not need to go into this depth in daily life.

5.2 Conclusion

Many studies have been conducted in the field of AR for decades. This study focuses on the use of AR in education and gifted students who have a significant role in the future and development of countries. AR provides many benefits to students in concretizing abstract concepts, bringing learning material to an authentic environment, learning by doing, distance learning, and collaborative learning. In addition to all these, AR-supported activities, which are a part of technologically supported education to provide the differentiated education that gifted students need, are discussed in the study, and aim to guide future studies, educators, and curriculum developers. The lesson plans used in the study were included in the Night Sky AR application. The students encountered AR for the first time during these activities and stated that they had no idea beforehand. It was also stated in the interview with the science teachers before the study that they were hesitant towards astronomy topics before the study. Having a positive attitude towards science has been extremely important for the future in terms of choosing a science-related profession and creating a workforce that will meet the needs of the age with this interest. The findings of the study revealed that the students showed a positive attitude towards astronomy-related activities after the AR-supported astronomy activities. They evaluated astronomy activities as fun, instructive, exciting, and different after the study. The students stated that they comprehended the subject faster and more effectively after these AR-supported activities, and the reason for this was that AR concretized abstract objects and concepts in astronomy subjects, made the lesson more interactive, and provided students with the opportunity to learn by doing and experiencing. The students' motivation towards science lessons increased after the activities, and their interest and desire to follow the developments in science and astronomy increased. Although the students stated that they started to understand astronomy topics that are difficult to understand and comprehend more efficiently and effectively, they stated that they might not be able to use these concepts in daily life. The qualitative data in the study showed a degree of overlap with the quantitative data without any visible contradiction.

In conclusion, this study presented the potential benefits of AR-supported instructional activities. Although integrating AR applications into lessons could be challenging for teachers and students in some regards, students' attitudes and opinions were generally positive.

5.3 Internal and External Validity of the Study

A mixed-methods study's validity depends on how well its qualitative and quantitative sections are employed and how well the two parts are engaged together (Creswell & Creswell, 2017). For the quantitative part, the Likert-scale items utilized in the student perception survey were derived from a previously validated questionnaire administered by Türk and Kalkan (2015) to ensure the survey's reliability and credibility. In addition to the quantitative part, interview questions were also asked as a part of the qualitative method to make the study more reliable as it provided open-ended questions to the students to make them express themselves in their own words in a detailed way.

The utilization of the convenience sampling method in the study has significance in relation to the study's external validity since it enables the generalization of study findings to other groups presenting similar features. According to Frankel et al. (2012), validity threads should be minimized, such as subject characteristics, meaning to have different demographic information of participants. The questions used in the studies were evaluated by three experts working in the department.

5.4 Limitations

The sample size of the participants needed to be increased. The duration of the AR-supported activities period could have been extended. Given the absence of exploratory factor analysis, the items were individually assessed using a scale. The study was limited to two astronomy topics: "Space History" and "Discovery of Mars".

5.5 Implications for Practice and Recommendations for Future Studies

In this study, it was seen that the AR application made the students enjoy the subject of astronomy more, and they were motivated to learn by perceiving the subject as enjoyable. Although the students used this application for the first time and did not have any idea about AR before, they expressed their positive reactions that they wished they had used it before. It might be thought that the longer-term version of this study may be more useful for observing the increase in students' attitudes towards astronomy.

When the students were asked their thoughts on using AR applications in the astronomy course curriculum in the seventh question of the qualitative part, they stated that this should happen with a large majority (n=19). Educators and curriculum preparers can integrate such technology-supported instructional AR activities into subjects that may be complex to visualize and comprehend, such as astronomy.

Especially teachers in Science and Art Centers should take advantage of this study and include AR-supported astronomy activities in their lesson plans when processing astronomy topics that may be difficult to visualize and observe for students. Furthermore, the findings from the conclusion should provide valuable insights to curriculum developers on the significance of incorporating an AR-supported astronomy course into the educational program as its benefits in terms of attitude towards science. Additionally, these results can shed light on strategies that can be employed to enhance students' engagement and enthusiasm towards the subject of astronomy. In order to catch up with the necessities of the era and be included in the space race, a new astronomy course curriculum should be developed that will increase students' interest in astronomy and lead them to have a profession or do research in this field. It is strongly advised to develop a scientific curriculum that is differentiated and supported by technology customized for gifted students according to their needs.

REFERENCES

Abdüsselam, M. S. (2014). Teachers' and students' views on using Augmented Reality environments in physics education: 11th grade magnetism topic example. *Pegem Journal of Education & Instruction*, 4(1), 59–74. https://doi.org/10.14527/pegegog.2014.004

Akçayır, M., Akçayır, G., Pektaş, H. M. ve Ocak, M. A. (2016). Augmented Reality in science laboratories: The effects of Augmented Reality on university students' laboratory skills and attitudes toward science laboratories. *Computers in Human Behavior,* 57, 334–342. http://doi.org/10.1016/j.chb.2015.12.054

Akçayir M, Akçayir G (2017) Advantages and challenges associated with Augmented Reality for education: a systematic review of the literature. Educ Res Rev 20:1–11. https://doi.org/10.1016/j.edurev.2016.11.002

Akkoyunlu, B. (2002). Teachers 'internet use and teachers' views on this issue. Hacettepe University Journal of Education Faculty, 22, 1-8.

Al-Dhamit, Y., & Kreishan, L. (2016). Gifted students' intrinsic and extrinsic motivations and parental influence on their motivation: from the self-determination theory perspective. *Journal of Research in Special Educational Needs*, 16(1), 13-23.

Alioon, Y., & Delialioğlu, Ö. (2019). The effect of authentic m-learning activities on student engagement and motivation. *British Journal of Educational Technology,* 50(2), 655-668.

Alqahtani, R., & Alqahtani, M. (2021). A Review of the Use of ICT Techniques for Teaching Gifted Students. *Revista Geintec-Gestao Inovacao E Tecnologias*, 11(4), 2358-2367.

Anıl, Ö., & Batdı, V. (2023). Use of augmented reality in science education: A mixed-methods research with the multi-complementary approach. *Education and Information Technologies*, 28(5), 5147-5185.

Arslan, A., Keserci, G. ve Akyüz, A. (2020). Otantik öğrenme etkinliklerinin öğrencilerin fen bilimleri ve astronomiye yönelik tutumları ile çevre bilincine etkisinin incelenmesi. *Karaelmas Eğitim Bilimleri Dergisi*, 8(1).

Ayvacı, H. Ş., & Sezer, K. (2019). Astronomi ile ilgili yapılan çalışmalara yönelik betimsel içerik. *International e-Journal of Educational Studies,* 3(5), 47-57.

Baum, L. F. (1901). The master key an electrical fairy tale. Accessed 22 March, 2017. Retrieved from http://www.gutenberg.org/ebooks/436?msg=welcome_stranger

Beltozar-Clemente, S., Sierra-Liñan, F., Zapata-Paulini, J., & Cabanillas-Carbonell, M. (2022). Augmented Reality mobile application to improve the astronomy teaching-learning process. *Advances in Mobile Learning Educational Research*, 2(2), 464-474.

Bilgiç, N., Taştan, A., Kurukaya, G., Kaya, K., Avonoğlu, O., & Topal, T. (2013). Özel yetenekli bireylerin eğitimi strateji ve uygulama kılavuzu [Training strategy and implementation guide for gifted and talented individuals]. Milli Eğitim Bakanlığı Özel Eğitim Hizmetleri Genel Müdürlüğü.

Blau, I., Shamir-Inbal, T., & Avdiel, O. (2020). How does the pedagogical design of a technology-enhanced collaborative academic course promote digital literacies, self-regulation, and perceived learning of students?. *The Internet and Higher Education*, 45, 100722.

Büyükkıdık, S., & Şimşek, A. (2021). Scaling gifted children's dominant characteristics using pair-wise comparison method. *Ankara Üniversitesi Eğitim Bilimleri Fakültesi Özel Eğitim Dergisi*, 22(2), 439-463.

Cal, U. T., & Demirkaya, H. (2020). The role and importance of social studies in the education of gifted students. *Journal of History Culture and Art Research*, 9(2), 25-39. doi:http://dx.doi.org/10.7596/taksad.v9i2.2344

Chan, D. W. (2001). Learning styles of gifted and nongifted secondary students in Hong Kong. *Gifted Child Quarterl*y, 45(1), 35-44.

Chen, C. C., Chen, H. R., & Wang, T. Y. (2022). Creative situated augmented reality learning for astronomy curricula. *Educational Technology & Society*, 25(2), 148-162.

Chen C. H., Wu F.G., & Zhung S. K., 2006. Design and Augmented Reality Teaching System with Concept Mapping Technique, Proceedings of the 53rd annual conference of JSSD, pp. 250-251, Kanazawa, Japan.

Chen, S. Y., & Liu, S. Y. (2020). Using augmented reality to experiment with elements in a chemistry course. *Computers in Human Behavior*, 111, 106418.

Cheng, K.-H. ve Tsai, C.-C. (2013). Affordances of augmented reality in science learning: Suggestions for future research. *Journal of Science Education and Technology*, 22(4), 449–462.

Cheung, D. (2018). The key factors affecting students' individual interest in school science lessons. *International Journal of Science Education*, 40(1), 1-23. https://doi.org/10.1080/09500693.2017.1362711

Chiang, T. H. C., Yang, S. J., & Hwang, G. J. (2014). An augmented reality-based mobile learning system to improve students' learning achievements and motivations in natural science inquiry activities. *Educational Technology & Society*, 17(4), 352–365. https://www.jstor.org/stable/jeductechsoci.17.4.352

Chin, K. Y., Lee, K. F., & Chen, Y. L. (2018a). Using an interactive ubiquitous learning system to enhance authentic learning experiences in a cultural heritage course. *Interactive Learning Environments*, 26(4), 444-459.

Chin, K. Y., Wang, C. S., & Chen, Y. L. (2018b). Effects of an augmented reality-based mobile system on students' learning achievements and motivation for a liberal arts course. *Interactive Learning Environments*, 27(7), 927-941. https://doi.org/10.1080/10494820.2018.1504308

Coşkun, M., & Koç, Y. (2021). The effect of augmented reality and mobile application supported instruction related to different variables in 7th grade science lesson. *Psycho-Educational Research Reviews*, 10(2), 298-313.

Creswell, J. W. (1999). Mixed-method research: Introduction and application. In Handbook of educational policy (pp. 455-472). Academic press.

Creswell, J. W., & Creswell, J. D. (2017). Research design: Qualitative, quantitative, and mixed methods approaches (5th ed.). Sage publications.

Çetin, H., & Türkan, A. (2022). The Effect of augmented reality based applications on achievement and attitude towards science course in distance education process. *Education and Information Technologies*, 27(2), 1397-1415.

Çevik, E. E., & Önal, N. T. (2021). Thematic review of studies about preschool astronomy education in Turkey. *1. Kastamonu Eğitim Dergisi*, 29(2), 362-377.

Çorlu, M. S., Capraro, R. M. ve Capraro, M. M. (2014). Introducing STEM education: implications for educating our teachers for the age of innovation. *Eğitim ve Bilim*, 39 (171), 74-85.

Dabbagh, N., Fake, H., & Zhang, Z. (2019). Student perspectives of technology use for learning in higher education. *Revista Iberoamericana de Educación a Distancia*.

Dede, C. (2009). Immersive interfaces for engagement and learning. *Science*, 323(5910), 66-69.

Delialioglu, O., & Yildirim, Z. (2007). Students' perceptions on effective dimensions of interactive learning in a blended learning environment. *Journal of Educational Technology & Society*, 10(2), 133-146.

Demirer, V., & Erbaş, Ç. (2015). Mobil artırılmış gerçeklik uygulamalarının incelenmesi ve eğitimsel açıdan değerlendirilmesi. *Mersin Üniversitesi Eğitim Fakültesi Dergisi*, 11(3).

Di Serio, Á., Ibáñez, M. B., & Kloos, C. D. (2013). Impact of an augmented reality system on students' motivation for a visual art course. *Computers & Education*, 68, 586-596.

Doğan, S., & Delialioğlu, Ö. (2020). A systematic review on the use of technology in learning disabilities. *Ankara Üniversitesi Eğitim Bilimleri Fakültesi Özel Eğitim Dergisi*, 21(3), 611-638.

Duralia, D. (2020). Technology as a Support for Constructive Learning. *In International Conference Knowledge-Based Organization* (Vol. 26, No. 2, pp. 283-287).

EARGED (2011). MEB 21. Yüzyıl Öğrenci Profili, Ankara.

Ebadi, S., & Ashrafabadi, F. (2022). An exploration into the impact of augmented reality on EFL learners' reading comprehension. *Education and Information Technologies*, 27(7), 9745-9765.

Elliniadou, E., & Sofianopoulou, C. (2021). Students' attitudes towards science: where do we go from here. *In International Conference on Education and New Developments*.

Emiroğlu, B. G., & Kurt, A. A. (2017). Use of augmented reality in mobile devices for educational purposes. *In Mobile Technologies and Augmented Reality in Open Education* (pp. 95-117).

Erol, M., Gedik, O., & Demirtaş, B. (2023). Sınıf öğretmenlerinin üstün yetenekli öğrencileri belirleme, bilim ve sanat merkezlerine aday gösterme sürecine ilişkin deneyimleri. *Özel Egitim Dergisi*, 24(2), 275-289A.

Fernández-Batanero, J. M., Montenegro-Rueda, M., Fernández-Cerero, J., & García-Martínez, I. (2022). Digital competences for teacher professional development: systematic review. *European Journal of Teacher Education*, 45(4), 513-531.

Fleck, S., & Simon, G. (2013). An augmented reality environment for astronomy learning in elementary grades: an exploratory study. *In Proceedings of the 25th Conference on l'Interaction Homme-Machine* (pp. 14-22).

Fraenkel, J. R., Wallen, N. E., & Hyun, H. H. (2012). How to design and evaluate research in education (Vol. 7, p. 429). New York: McGraw-hill.

Gagné, F. (1995) From giftedness to talent: a developmental model and its impact on the language of the field. *Roeper Review,* 18(2), 103-111.

Garzón, J., Pavón, J., & Baldiris, S. (2019). Systematic review and meta-analysis of augmented reality in educational settings. *Virtual Reality,* 23(4), 447-459.

Gecu-Parmaksız, Z., & Delialioğlu, Ö. (2020). The effect of augmented reality activities on improving preschool children's spatial skills. *Interactive Learning Environments,* 28(7), 876-889.

Gerard, L., Linn, M. C., & Berkeley, U. C. (2021). Computer-based guidance to support students' revision of their science explanations. *Computers & Education,* 176, 104351. https://doi.org/10.1016/j.compedu.2021.104351

Gopalan, V., Bakar, J. A. A., & Zulkifli, A. N. (2023). Systematic literature review on critical success factors in implementing Augmented Reality for science learning environment (2006–2021). Education and Information Technologies, 1-28.

Green, S. B., & Salkind, N. J. (2005). Using SPSS for Windows and Macintosh : Analyzing and understanding data (4th ed.). Upper Saddle River, NJ: Pearson/Prentice Hall.

Guo, W., Xue, Y., Sun, H., Chen, W., & Long, S. (2017). Utilizing Augmented Reality to Support Students' Learning in Popular Science Courses. In 2017 International Conference of Educational Innovation through Technology (EITT) (pp. 311-315). IEEE.

Güllü, H., & Akçay, A. O. (2022). Sınıf öğretmenlerinin 21. yüzyıl becerileri ile Fetemm farkindaliklari arasındaki ilişkinin incelenmesi. *Uşak Üniversitesi Sosyal Bilimler Dergisi,* 15(1), 1-15.

Herfana, P., Nasir, M., & Prastowo, R. (2019). Augmented reality applied in astronomy subject. *In Journal of Physics: Conference Series* (Vol. 1351, No. 1, p. 012058). IOP Publishing.

Iatsyshyn, A. V., Kovach, V. O., Romanenko, Y. O., Deinega, I. I., Iatsyshyn, A. V., Popov, O. O., ... & Lytvynova, S. H. (2020). Application of augmented reality technologies for preparation of specialists of new technological era.

Inderawati, R., Sofendi, M. E. P., Vianty, M., & Suhendi, D. (2019). Students' engagement in utilizing technology for learning support. *Academic Journal of English Language and Education,* 3(2).

Jones, B. D. (2009). Motivating students to engage in learning: The MUSIC model of academic motivation. *International Journal of Teaching and Learning in Higher Education*, 21(2), 272-285.

Kalkan, K., & Yener, D. (2022). Astronomi öğretiminde materyal ve model destekli etkinliklerin öğrenci başarısı ve tutuma etkisi. *Fen Bilimleri Öğretimi Dergisi*, 10 (2), 406-441. https://doi.org/10.56423/fbod.1182074

Kalkan, Ö., Tuncay, Tunç, & Özcan, H. (2021). Cumhuriyetten günümüze fen öğretim programlarında yer alan astronomi ve yer bilimleri konularının karşılaştırılmalı incelenmesi. *Turkish Journal of Educational Studies*, 8(2), 215-240.

Kaplan Sayı, A., & Yurtseven, N. (2022). How do gifted students learn? Their learning styles and dispositions towards learning. *Education*, 3-13, 50(8), 1031-1045.

Kapoor, V., & Naik, P. (2020). Augmented reality-enabled education for middle schools. *SN Computer Science*, 1, 1-7.

Karaçam, S., Yener, D., Bilici, S. C., Çakır, Ç. Ş., & Yürük, N. (2022). Fen bilgisi öğretmen adaylarının astronomiye yönelik tutumlarının ve astronomi öğretimi özyeterlik inançlarının incelenmesi: Çevrim içi astronomi eğitimi. *Atatürk Üniversitesi Kazım Karabekir Eğitim Fakültesi Dergisi*, (46), 71-84.

Kaur, D. P., Mantri, A., & Horan, B. (2020). Enhancing student motivation with use of augmented reality for interactive learning in engineering education. *Procedia Computer Science*, 172, 881-885.

Kaya, Z. & Bayra, E. (2019). Özel yetenekli öğrencilerin üst düzey düşünme becerileri. *Sinop Üniversitesi Sosyal Bilimler Dergisi*, 3(2), 49-76.

Kayan-Fadlelmula, F., Sellami, A., Abdelkader, N., & Umer, S. (2022). A systematic review of STEM education research in the GCC countries: Trends, gaps and barriers. *International Journal of STEM Education*, 9(1), 1-24.

Kerawalla, L., Luckin, R., Seljeflot, S., & Woolard, A. (2006). "Making it real": Exploring the potential of augmented reality for teaching primary school science. *Virtual Reality*, 10, 163-174.

Kılıç, V. C. (2015). Türkiye'de üstün ve özel yetenekli çocuklara yönelik bir eğitim politikası oluşturulamaması sorunu üzerine bir değerlendirme. *21. Yüzyılda Eğitim ve Toplum Eğitim Bilimleri ve Sosyal Araştırmalar Dergisi*, 4(12).

Kir, S., & Akbaşlı, S. (2021). Being a teacher in BİLSEM: A sample from Ankara. *Journal of Hasan Ali Yücel Faculty of Education*, 18(2).

Koçak, S., & Oralhan, İ. A. (2022). Astronomi eğitiminde bazı doğru bilinen yanlışlar. *Turkish Journal of Astronomy and Astrophysics*, 3(3), 72-80.

Kul, H. H., & Berbe, A. (2022). The effects of augmented reality in a 7th-grade science lesson on students' academic achievement and motivation. *Journal of Science Learning*, 5(2), 193-203.

Kuo, H. C., Tseng, Y. C., & Yang, Y. T. C. (2019). Promoting college student's learning motivation and creativity through a STEM interdisciplinary PBL human-computer interaction system design and development course. *Thinking Skills and Creativity*, 31, 1-10.

Lee, K. (2012). Augmented reality in education and training. *TechTrends*, 56, 13-21.

Lin, Y., & Yu, Z. (2023). A meta-analysis of the effects of augmented reality technologies in interactive learning environments (2012–2022). *Computer Applications in Engineering Education*.

Liu, W., Cheok, A., Mei-Ling, C., & Theng, Y. 2007. Mixed reality classroom: learning from entertainment. Paper presented at the proceedings of the 2nd international conference on digital interactive media in entertainment and arts, Perth, Australia.

Marché, J. D. (2002). Mental discipline, curricular reform, and the decline of US astronomy education, 1893-1920. *Astronomy Education Review*, 1(1).

Mayring, P. (2004). Qualitative content analysis. A companion to qualitative research, 1(2), 159-176.

Mena, J., Estrada-Molina, O., & Pérez-Calvo, E. (2023). Teachers' professional training through augmented reality: A literature review. *Education Sciences*, 13(5), 517.

Milli Eğitim Bakanlığı (MEB). (2018a). Kazanım merkezli STEM uygulamaları. http://ttkb.meb.gov.tr

Milli Eğitim Bakanlığı (MEB). (2018b). Fen bilimleri dersi öğretim programı (ilkokul ve ortaokul 3, 4, 5, 6, 7 ve 8. sınıflar). http://ttkb.meb.gov.tr

Moldovan, A. N., Weibelzahl, S., & Muntean, C. H. (2013). Energy-aware mobile learning: Opportunities and challenges. *IEEE Communications Surveys & Tutorials*, 16(1), 234-265.

NAGC. (2021). What is Giftedness? *National Association for Gifted Children.* https://www.nagc.org/resources-publications/resources/what-giftedness

Night Sky Visualization. (n.d.). Retrieved July 24, 2023, from https://apps.apple.com/us/app/night-sky/id475772902?platform=iphone

Organisation for Economic Co-operation and Development, Statistical Office of the European Communities, Luxembourg, & OECD iLibrary. (2015). Students, computers and learning: Making the connection. PISA: OECD publishing.

Olszewski-Kubilius, P., Subotnik, R. F., & Worrell, F. C. (2016). Aiming talent development toward creative eminence in the 21st century. *Roeper Review*, 38(3), 140-152.

Ömeroğlu, E., Sarikaya, R., Dağlıoğlu, E.H., Çakmak, E., KarataǤ, S., Bulut, S., ġahin, M.G., Sabancı, O., Kukul, V., Doğan, A., & Basit, O. (2017). The terms used in gifted education in Turkey, relevant legal framework and educational practices. I*nternational Journal of Early Childhood Special Education (INT-JECSE)*, 9(1), 1-16.

Önal, N. T., & Önal, N. (2021). The effect of augmented reality on the astronomy achievement and interest level of gifted students. *Education and Information Technologies*, 26(4), 4573-4599.

Özçakır, B., & Çakıroğlu, E. (2022). Fostering spatial abilities of middle school students through augmented reality: Spatial strategies. *Education and Information Technologies*, 27(3), 2977-3010.

Pelgrum, W. J. (2001). Obstacles to the integration of ICT in education: Results from a worldwide educational assessment. *Computers & Education*, 37(2), 163-178.

Percy, J. R. (1998). Astronomy education: An international perspective. *In International Astronomical Union Colloquium*, (Vol. 162, pp. 2-6). Cambridge University Press.

Pekdoğan, S., & Bozgün, K. (2017). Examination of postgraduate dissertations within the field of gifted education in Turkey: Content analysis study. *Journal for the Education of Gifted Young Scientists*, 5(4), 59-70. DOI: http://dx.doi.org/10.17478/JEGYS.2017.70

Radu, I. (2012). Why should my students use AR? A comparative review of the educational impacts of augmented-reality. *In 2012 IEEE International Symposium on Mixed and Augmented Reality (ISMAR)*, (pp.313-314). IEEE.

Rauschnabel, P. A., Felix, R., Hinsch, C., Shahab, H., & Alt, F. (2022). What is XR? Towards a framework for augmented and virtual reality. *Computers In Human Behavior*, 133, 107289.

Rosenbaum, E., Klopfer, E., & Perry, J. (2007). On location learning: Authentic applied science with networked augmented realities. *Journal of Science Education and Technology*, 16, 31-45.

Samardzija, N., & Peterson, J. S. (2015). Learning and classroom preferences of gifted eighth graders: A qualitative study. *Journal for the Education of the Gifted*, 38(3), 233-256.

Sarıtaş, E., Şahin, Ü., & Çatalbaş, G. (2019). Velilerin gözüyle BİLSEM. *Eğitimde Nitel Araştırmalar Dergisi*, 7(1), 114-133.

Schraw, G., Crippen, K. J., & Hartley, K. (2006). Promoting self-regulation in science education: Metacognition as part of a broader perspective on learning. *Research In Science Education*, 36, 111-139.

Shelton, B. E., & Hedley, N. R. 2002. Using AR for teaching earth-sun relationships to undergraduate geography students. *Paper Presented at the 1st IEEE Int. ARToolkit Workshop, Darmstadt, Germany.*

Sırakaya, M., & Sırakaya, D. A. (2022). A case study: What attracts teachers to augmented reality. *Participatory Educational Research*, 9(6), 192-205.

Sirajudin, N., & Suratno, J. (2021). Developing creativity through STEM education. *In Journal of Physics: Conference Series*, (Vol. 1806, No. 1, p. 012211). IOP Publishing.

Sotiriou, S., & Bogner, F. X. (2008). Visualizing the invisible: Augmented reality as an innovative science education scheme. *Advanced Science Letters*, 1, 114–122. http://dx.doi.org/10.1166/asl.2008.012.

Şahin, D., & Yılmaz, R. M. (2020). The effect of augmented reality technology on middle school students' achievements and attitudes towards science education. *Computers & Education*, 144, 103710.

Timur, B., Timur, S., Özdemir, M., & Şen, C. (2016). Challenges encountered in the teaching of units in the primary science course curriculum solution and recommendation. *Eğitimde Kuram ve Uygulama*.

Trost, G. (2000). Prediction of excellence in school, higher education, and work. U. K. Heller, F. Mönks, R. Sternberg, & R. Subotnik (Eds.), *International Handbook of Giftedness and Talent*, (2nd ed.; pp. 317-330). Pergamon.

Tunca, Z. (2002). Türkiyede ilk ve orta öğretimde astronomi eğitim öğretiminin dünü, bugünü. *V. Fen Bilimleri ve Matematik Eğitimi Kongresi, Bildiriler Kitabı*, s. 252-253, Ankara.

Turhan, M. E., Metin, M., & Çevik, E. E. (2022). A content analysis of studies published in the field of Augmented reality in education. *Journal of Educational Technology and Online Learning*, 5(1), 243-262.

Tzur, S., Katz, A., & Davidovich, N. (2021). Learning supported by technology: Effectiveness with educational software. *European Journal of Educational Research*, 10(3), 1137-1156. https://doi.org/10.12973/eu-jer.10.3.1139

Türk, C., & Kalkan, H. (2015). Astronomy attitude scale: Development, validity and reliability. *Journal of Studies in Education*, 5(4), 23-50.

Vogel, D., & Klassen, J. (2001). Technology-supported learning: status, issues and trends. *Journal of Computer Assisted Learning*, 17(1), 104-114.

Wang, L. H., Chen, B., Hwang, G. J., Guan, J. Q., & Wang, Y. Q. (2022). Effects of digital game-based STEM education on students' learning achievement: A meta-analysis. *International Journal of STEM Education*, 9(1), 1-13.

Wang, Y. (2022). Effects of Augmented Reality game-based learning on students' engagement. *International Journal of Science Education*, Part B, 12(3), 254-270.

Watters, J. J., & Diezmann, C. M. (2003). The gifted student in science: Fulfilling potential. *Australian Science Teachers Journal*, 49(3), 46-53. https://search.informit.org/doi/epdf/10.3316/aeipt.131835

Yavuz Çiv, Y., Saka, Y., & Koray, Ö. (2022). Prof. Dr. Zeki Aslan'ın değerlendirmeleriyle Türkiye'de astronomi eğitimi. *Cumhuriyet International Journal of Education*, 11(3): 500-511

Yen, J.-C., Tsai, C.-H. ve Wu, M. (2013). Augmented reality in the higher education: Students' science concept learning and academic achievement in astronomy. *Procedia-Social and Behavioral Sciences*, 103, 165–173. http://doi.org/10.1016/j.sbspro.2013.10.322

Yıldırım, F. S. (2021). Effectiveness of augmented reality implementation methods in teaching science to middle school students: Effectiveness of augmented reality implementation methods. *International Journal of Curriculum and Instruction*, 13(2), 1024-1038.

Yıldırım, H. & Gelmez-Burakgazi, S. (2020). Türkiye'de STEM eğitimi konusunda yapılan çalışmalar üzerine bir araştırma: Meta-sentez çalışması. *Pamukkale Üniversitesi Eğitim Fakültesi Dergisi*, 1-24. DOI: 10.9779/pauefd.590319.

Yu, K. C., & Sahami, K. (2007). Visuospatial astronomy education in immersive digital planetariums. *Communicating Astronomy with the Public*, 242–245.

Yüzgeç, S., & Okuşluk, F. (2023). The impact of STEM-based astronomy activities on secondary school students' attitudes towards STEM and astronomy. *Eğitim Kuram ve Uygulama Araştırmaları Dergisi*, 9(1), 1-13.

Zhang, J., Sung, Y. T., Hou, H. T., & Chang, K. E. (2014). The development and evaluation of an augmented reality-based armillary sphere for astronomical observation instruction. *Computers & Education*, 73, 178-188.

Zhao, G., Zhang, L., Chu, J., Zhu, W., Hu, B., He, H., & Yang, L. (2023). An augmented reality based mobile photography application to improve learning gain, decrease cognitive load, and achieve better emotional state. *International Journal of Human–Computer Interaction*, 39(3), 643-658. doi:10.1080/10447318.2022.2041911

Zhufeng, Y., & Sitthiworachart, J. (2023). Effect of augmented reality technology on learning behavior and attitudes of preschool students in science activities. *Education and Information Technologies*, 1-22.

APPENDICES

A. Demographic Survey

Araştırma Soruları:

Bölüm 1

Sevgili öğrenciler,

Bu anket Fen Bilimleri dersinde kullanılan Artırılmış Gerçeklik teknolojisi konulu bir araştırma için kullanılacaktır. Görüşleriniz sadece bilimsel araştırma için kullanılaca olup çalışma sonundaki raporda isminiz kesinlikle kullanılmayacaktır. Katkılarınız için teşekkür ederiz.

1- Lütfen isminizi yazın.

____

2- Lütfen doğum tarihinizi belirtin.

…/…/……

3- Lütfen cinsyetinizi belirtin.
   - o Erkek
   - o Kadın
   - o Belirtmek istemiyorum

4- Akıllı telefonunuzun işletim sistemi, marka ve modeli nedir? (IOS-Iphone, Android)

____

5- Gün içerisinde ne sıklıkta telefon ile ilgileniyorsunuz?

____

6- Akıllı telefonunuzda sıklıkla nasıl zaman geçiriyorsunuz? (Sosyal medya, oyun, diğer)

____

7- İngilizce yeterliğiniz nedir? (A1, A2, B1, B2, C1, C2)

____

8- Bilgisayarınızı / dizüstü bilgisayarınızı / tabletinizi boş zamanlarınızda günde kaç saat kullanıyorsunuz?

____

9- Sanal Gerçeklik hakkında ne biliyorsunuz?47

____

10- Artırılmış Gerçeklik hakkında ne biliyorsunuz?

____

11- Artırılmış gerçeklik öğrenme ortamından beklentileriniz nelerdir?

____

12- Fen Bilimleri derslerinde hangi konuların Sanal Gerçeklik uygulamaları ile daha etkili öğrenileceğini düşünüyorsunuz?

____

B. Permission for Attitudes Towards Astronomy Scale

Yanıtla Toplu Yanıtla İlet Sil İstenmeyen İşaretle Diğer

Re: Astronomi Tutum Ölçeği Hakkında

Cumhur Türk göndericisinden 2023-06-07 13:43 tarihinde

Ayrıntılar Düz Metin

Merhaba Ayşenur hanım ölçeği kullanmanız uygundur çalışmanızda başarılar dilerim

7 Haz 2023 Çar, saat 13:18 tarihinde e226168 <aysenur.aktas@metu.edu.tr> şunu yazdı:

> Sayın Cumhur Hocam,
>
> Ben Ayşenur AKTAŞ. Orta Doğu Teknik Üniversitesi'nde Bilgisayar ve Öğretim Teknolojileri Eğitimi Bölümü'nde Yüksek Lisans öğrencisiyim. Tez çalışmam kapsamında, Bilim ve Sanat Merkezleri'nde Artırılmış Gerçeklik teknolojisi kullanılarak işlenen Astronomi derslerinin öğrencilerin astronomiye ve bilime karşı tutumları üzerindeki etkisini araştırmaktayım.
> Bu doğrultuda, hazırlamış olduğunuz Astronomi Tutum Ölçeğinizi (Cumhur, T. ve Kalkan, H. (2015). Astronomy attitude scale: Development, validity and reliability. Journal of Studies in Education, 5(4), 23-50) inceledim ve eğer kabul ederseniz tez çalışmamda kullanmak üzere bu konuda izninizi istiyorum.
> Ölçeği kullanırken, telif hakkı ve intihal konularına saygı göstereceğimi ve çalışmanızın referansını doğru bir şekilde belirteceğimi bilmenizi istiyorum.
> Şimdiden zamanınız ve ilginiz için çok teşekkür ederim.
>
> Saygılarımla,
>
> Ayşenur AKTAŞ

C. Astronomy Attitude Scale

Bölüm 2

1- Sevgili öğrenciler,
Aşağıda gördüğünüz ölçek bilimsel bir çalışma için hazurlanmıştır. Astronomi konuları (Güneş sistemi, Gezegenler ve Yıldızlar vb.) ile ilgili düşüncelerinizi ifade eden cümlelerle ilgili bir dizi ifade okuyacaksınız. Ölçekte yer alan sorulara verdiğiniz yanıtlar, kesinlikle size not vermek ya da sizi eleştirmek amacıyla kullanılmayacaktır.Lütfen aşağıdaki ölçekleri kullanarak her bir ifadeye ne kadar katıldığınızı veya katılmadığınızı belirten kutuya "X" yazın.

[1]	[2]	[3]	[4]	[5]
Kesinlikle Katılmıyorum	**Katılmıyorum**	**Fikrim yok**	**Katılıyorum**	**Kesinlikle Katılıyorum**

		1	2	3	4	5
1.	Bilimi seviyorum.					
2.	Astronomi çoğu insan tarafından öğrenilmesi kolay bir bilimdir.					
3.	Astronomi konuları anlaşılması kolaydır.					
4.	Astronomi hayatımda işime yaramaz.					
5.	Astronomi konularını öğrenirken stres altında hissediyorum.					
6.	Astronomi hakkında en ufak bir fikrim yok.					
7.	Astronomiyi seveceğimi düşünüyorum.					
8.	Astronomi bilmenin iş hayatımda işime yaramayacağını düşünüyorum.					
9.	Astronomi konularını öğrenirken zorluk çekiyorum.					
10.	Astronomi konularını öğrenirken keyif alıyorum.					
11.	Astronomi dersi birçok konunun hatırlanmasını gerektiriyor.					
12.	Astronomi karmaşık bir konudur.					
13.	Astronomi konularını kolayca öğrenebileceğimi düşünüyorum.					
14.	Astronomi öğrenirken strese giriyorum.					
15.	Bilimsel konuları anlarken zorlanıyorum.					
16.	Hayatımın her alanında bilimi kullanıyorum.					
17.	Astronomi dersinde iddialı olduğumu düşünüyorum.					
18.	Öğrendiğim astronomi konularını kısa süre içinde unuturum.					
19.	Sınıf arkadaşlarımla astronomi konularını konuşmaktan keyif almam.					
20.	Astronomi konularını uygulamalı olarak işlendiğinde daha iyi anlarım.					
21.	Astronomi günlük yaşantımızın her yerinde vardır.					
22.	Astronomi alanındaki güncel gelişmeleri takip ederim.					
23.	Astronomi sayesinde doğaya dair bilgim artar.					
24.	Doğa olaylarını astronomi kullanarak anlamaya çalışmak hoşuma gider.					
25.	Astronomi konuları fen dersine olan ilgimi artırır.					

Tüm cevaplarınız kesinlikle gizli tutulacaktır. Teşekkürler.

D. Interview

Bölüm 3
Çalışma Sonu Değerlendirme

Sevgili öğrenciler,
Bu anket Fen Bilimleri dersinde kullanılan Artırılmış Gerçeklik teknolojisi konulu bir araştırma için kullanılacaktır. Görüşleriniz sadece bilimsel araştırma için kullanılaca olup çalışma sonundaki raporda isminiz kesinlikle kullanılmayacaktır. Katkılarınız için teşekkür ederiz.

1- Artırılmış Gerçeklik deneyimini nasıl buldunuz? Neden?

2- Artırılmış gerçekliğin Fen Bilimleri dersinde kullanımı seni nasıl etkiledi? Neler hissettin?

3- Fen Bilimleri dersinde Artırılmış Gerçeklik kullanılması öğrenme sürecini nasıl etkiledi?

4- Artırılmış Gerçeklik uygulamasında edindiğin kazanımlar günlük hayatta karşılaştığın problemleri çözmende etkili oldu mu?

5- Artırılmış Gerçekliğin Fen Bilimleri derslerinde her zaman kullanılmasını ister misiniz?

6- Fen Bilimleri dersi astronomi dersi sırasında konuyu Artırılmış Gerçeklik ile işlemek konusunda zorluk çektiniz mi?

7- Artırılmış gerçeklik uygulamalarının astronomi öğrenimi müfredatının bir parçası olarak kullanılabileceğini düşünüyor musunuz?

8- Bu tür bir eğitimin hangi konularda etkili olabileceğini düşünüyorsunuz?

9- Bu tür bir eğitimin hangi konularda etkisiz olabileceğini düşünüyorsunuz?

10- Bu çalışmada edindiğiniz deneyimleriniz hakkında araştırmacıya anlatmak istediğiniz başka bir şey var mı?

Tüm cevaplarınız kesinlikle gizli tutulacaktır. Teşekkürler.

E. Lesson Plan Activity Sheet (First Week)

Discovering Space History - Activities (Ages 8-11)

Today we are going to investigate:

- The first people in space
- The first landing on the Moon
- The Voyager 2 mission
- Satellites around the Earth

Activities

1 The first satellite, Sputnik 1, was launched into orbit in the year 1957 and people have been exploring space ever since. Today we are going to use Night Sky to discover important events in the history of space. Open Night Sky and go to the Menu. Scroll down until you get to the Space Exploration Timeline and tap on the icon. The timeline begins on April 12, 1961, look at the event for this date.

Question: What is the name of the space explorer in the picture and why is he so famous?

2 Touch the date and swipe it sideways with your finger to reveal more historic events by moving along the timeline. Scroll through the events until you find a space mission called Vostok 6 which took place in 1963 (Tip: if you go too far, you can scroll back).

Question: Why is the person who flew into space on this mission so important?

3 Scroll through events in the 1960s. If you see a picture or story you find interesting and you want to know more about it just stop and tap Read Article. When you are finished tap on the to go back to the timeline. As you go along the Timeline, search the events for the names of the first humans to visit the Moon. You will see one of their names inspired the name of a famous movie character.

Page 1

Discovering Space History - Activities (Ages 8-11)

Question: Who was this movie character?

a) Luke Skywalker b) Buzz Lightyear c) Lightning McQueen

4 Voyager 2 is one of the greatest space missions ever launched. It is a robot space explorer that left Earth long ago to study planets and is still sending information back to scientists on Earth. Let's use the timeline to find out more about Voyager 2. It was launched on August 20, 1977 and visited its last planet 12 years later.

Questions: How many years has Voyager 2 been in space on August 20 this year?

What were the four planets that Voyager 2 visited?

5 As you scroll along the timeline, watch the Earth globe at the bottom. See how many more satellites gradually appear around the Earth as the years go by. Satellites are very helpful to us for many reasons. For example, they help us study the stars, forecast the weather and transmit TV and internet data around the world.

Discussion Question: Can you think of any problems having more and more satellites orbiting around our planet might cause?

What we have discovered:

- Who were the first people in space
- Who were the first people to go to the Moon
- Which planets were visited by Voyager 2
- Some of the uses of satellites

Well done!

You're a Night Sky Superstar!

F. Lesson Plan Educators Guide (First Week)

Discovering Space History - Educator's Guide (Ages 8-11)

At the end of these Night Sky activities students will understand:

- Humans have been exploring space for more than 60 years
- Yuri Gagarin was the first person in space
- Neil Armstrong and Buzz Aldrin were the first people on the Moon
- There are now thousands of satellites in orbit

Astronomy background information

The first satellite placed in orbit was Sputnik 1, launched by the Soviet Union (USSR) in 1957. The first event listed in the timeline is the Vostok 1 flight of Yuri Gagarin. On April 12, 1961 Gagarin became the first human in space.

Valentina Tereshkova, pilot of the Vostok 6 spacecraft, was the first woman in space. In 1983, Sally Ride became the third woman and first American woman in space.

In the 1960s the US and USSR competed to be first to land people on the Moon in the "Space Race". American astronaut Neil Armstrong was the first man on the Moon on July 20, 1969. Buzz Aldrin was the other astronaut on the Apollo 11 mission to walk on the Moon. Five more successful Apollo landings followed and the final missions carried out very ambitious explorations, driving a rover to sites on the Moon.

Robot probes have hugely increased our knowledge of the Solar System. One of the most important of these is Voyager 2 (launched in 1977 *before* Voyager 1). Voyager 2's trajectory took advantage of a rare alignment of the outer planets to visit Jupiter, Saturn, Uranus and Neptune between 1979 and 1989. The spacecraft is on its way out of the Solar System but is still returning data to Earth every week.

The number of functioning satellites in orbit has increased from one in 1957 to 7,389 satellites in April 2021. There are also thousands of 'dead' satellites and space junk fragments in orbit. Although many satellites benefit us, there are now genuine reasons for concern about the number of them. Already satellites are spoiling astronomers' view of deep space objects while the chance of a disastrous chain reaction of satellites collisions is growing.

Accessible Learning:

- Text size can be increased in the Preferences section
- Star numbers can be reduced by sliding two fingers down the screen

App Essential Settings

No essential settings are required for this activity.

G. Lesson Plan Activity Sheet (Second Week)

Discovering Mars - Activities (Ages 8-11)

Today we are going to investigate:

- How to find Mars in the sky
- What gives Mars its colour
- Features on the Martian surface

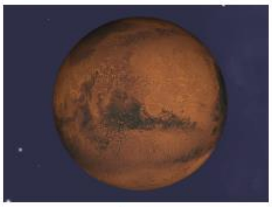
Activities

1 Start up Night Sky and use your finger to move around the sky. Look for the Sun and planets. Find the planet Mars (Tip: If you can't see it, type Mars into the Search box at the top of the menu).

Question: How would you describe the colour of Mars?

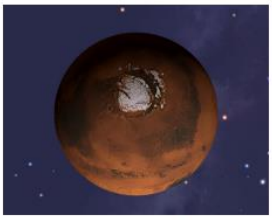
Question: Do you know what the nickname for Mars is?

2 Double tap on the planet Mars. This will bring up a 3D view of the planet which you can rotate with you finger. When you do this, see how one side of the planet is bright while the other is in darkness.



Question: Why is one side bright while the other is dark?

3 Use your finger to spin Mars around and explore the surface. Find two white areas (Tip: One is much smaller than the other)



Question: What do you think covers the ground to make these areas white?

Page 1

Discovering Mars - Activities (Ages 8-11)

4 You can see that most of Mars looks orange. The planet is this colour because the rocks and dust on its surface are full of iron oxide. You probably know a common type of iron oxide we get on Earth.

Question: What is iron oxide better known as (Tip: you may get it on your bike if you leave it outside in the rain!)

5 You can see that Mars does not have any oceans or lakes on its surface. Its surface is a dry desert. However, it does have a group of four large extinct volcanoes. One of them is the tallest volcano in the Solar System. It is called Olympus Mons.

Question: Can you can find Olympus Mons?

Tip: If you can't find the volcano it may be on the dark side of the planet. To fix this open the Space Travel tab and select the hour number by tapping on it. Swipe your finger along the bottom row of numbers to change the time of day. Watch Mars as you do this and you will see the sunlight move across, revealing the rest of the planet.

What we have discovered:

- Mars is orange because it has iron oxide on its surface
- Mars has day and night just like Earth
- Mars has two polar ice caps
- Mars has the largest extinct volcano in the Solar System

Well done!
You're a Night Sky Superstar!

H. Lesson Plan Educators Guide (Second Week)

Discovering Mars - Educator's Guide (Ages 8-11)

At the end of these Night Sky activities students will understand:

- Mars is an orange-coloured planet
- This colour comes from iron oxide on the planet's surface
- Mars has ice caps at its poles
- Mars has surface features including a giant volcano

Astronomy background information

Mars is the fourth planet from the Sun in the Solar System. Often called the Red Planet, it appears noticeably orange in the sky. Orange was once regarded as a shade of red rather than a colour in its own right. Mars is about half as wide as Earth and is covered with pale desert areas with darker mountainous regions. There are ice caps at the planet's North and South Poles. Like Earth, Mars has a day and night cycle. Its day lasts just over 24 hours.

Mars is very cold and has a thin and unbreathable atmosphere. Like the Moon, Mars is covered in craters from meteoroid impacts. Space missions have discovered that the planet was less hostile in the past when its atmosphere was thicker. Large lakes and rivers once existed on Mars but its surface is now completely dry. Its colour comes from minerals which are rich in iron oxide just like rusty metal.

Mars has several huge inactive volcanoes. A group of four of these are very clearly visible in an area called Tharsis. One of these, Olympus Mons is the tallest known volcano in the Solar System. At 21 km high it is more than twice the height of Mt Everest.

Night Sky App Essential Settings

Go to Night Sky Settings and make sure the following Preferences are set.

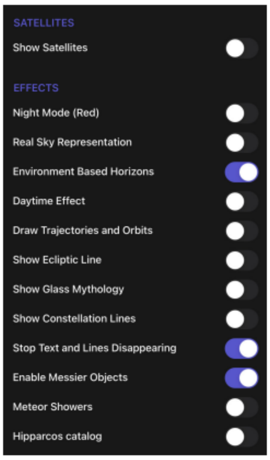
Turn On these Effects:

N/A

Turn Off these Effects:
Show Satellites
Show Glass Mythology
Show Constellation
Real Sky Representation

Accessible Learning:

- Text size can be increased in the Preferences section
- Star numbers can be reduced by sliding two fingers down the screen



I. Approval for Ethical Committee

UYGULAMALI ETİK ARAŞTIRMA MERKEZİ
APPLIED ETHICS RESEARCH CENTER

ORTA DOĞU TEKNİK ÜNİVERSİTESİ
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19 HAZİRAN 2023

Konu: Değerlendirme Sonucu

Gönderen: ODTÜ İnsan Araştırmaları Etik Kurulu (İAEK)

İlgi: İnsan Araştırmaları Etik Kurulu Başvurusu

Sayın Ömer DELİALİOĞLU

Danışmanlığını yürüttüğünüz Ayşenur AKTAŞ'ın ***"Özel yetenekli Öğrencilerin Bilime Karşı Tutumunda Artırılmış gerçeklik Teknolojisinin Etkisi"*** başlıklı araştırmanız İnsan Araştırmaları Etik Kurulu tarafından uygun görülerek **0296-ODTUİAEK-2023** protokol numarası ile onaylanmıştır.

Bilgilerinize saygılarımla sunarım.

Prof. Dr. Ş. Halil TURAN
Başkan

Prof.Dr. I. Semih AKÇOMAK
Üye

Doç. Dr. Ali Emre Turgut
Üye

Doç. Dr. Şerife SEVİNÇ
Üye

Doç.Dr. Murat Perit ÇAKIR
Üye

Dr. Öğretim Üyesi Süreyya ÖZCAN KABASAKAL
Üye

Dr. Öğretim Üyesi Müge GÜNDÜZ
Üye

J. Parent Consent Form

Veli Onay Formu

Sevgili Anne/Baba,

Bu çalışma Orta Doğu Teknik Üniversitesi yüksek lisans öğrencisi Ayşenur AKTAŞ tarafından yürütülmektedir.

Bu çalışmanın amacı nedir? Araştırmalar, STEM eğitiminin amacının 21. yüzyılın iş gücü ihtiyaçlarına uygun nitelikte kişiler yetiştirmek olduğunu ve öğrenci merkezli fen eğitiminin motivasyonu arttırdığını ve bu motivasyonun başarıyı getirdiğini göstermektedir. Bu çalışmanın amacı, artırılmış gerçeklik kullanarak işlenen STEM eğitimini içinde barındıran astronomi derslerinin özel yetenekli öğrencilerin astronomi bilimine olan tutumlarını ne ölçüde değiştireceğini ortaya çıkarmaktır.

Çocuğunuzun katılımcı olarak ne yapmasını istiyoruz?: Bu amaç doğrultusunda, çocuğunuzdan dağıtılacak motivasyon tutum ölçeği'ni cevaplamasını isteyeceğiz ve cevaplarını yazılı biçiminde toplayacağız. Sizden çocuğunuzun katılımcı olmasıyla ilgili izin istediğimiz gibi, çalışmaya başlamadan çocuğunuzdan da sözlü olarak katılımıyla ilgili rızası mutlaka alınacak.

Çocuğunuzdan alınan bilgiler ne amaçla ve nasıl kullanılacak?: Çocuğunuzdan alacağımız cevaplar tamamen gizli tutulacak ve sadece araştırmacılar tarafından değerlendirilecektir. Elde edilecek bilgiler sadece bilimsel amaçla kullanılacak, çocuğunuzun ya da sizin ismi ve kimlik bilgileriniz, hiçbir şekilde kimseyle paylaşılmayacaktır.

Çocuğunuz ya da siz çalışmayı yarıda kesmek isterseniz ne yapmalısınız?: Katılım sırasında sorulan sorulardan ya da herhangi bir uygulama ile ilgili başka bir nedenden ötürü çocuğunuz kendisini rahatsız hissettiğini belirtirse, ya da kendi belirtmese de araştırmacı çocuğun rahatsız olduğunu öngörürse, çalışmaya sorular tamamlanmadan ve derhal son verilecektir. Şayet siz çocuğunuzun rahatsız olduğunu hissederseniz, böyle bir durumda çalışmadan sorumlu kişiye çocuğunuzun çalışmadan ayrılmasını istediğinizi söylemeniz yeterli olacaktır.

Bu çalışmayla ilgili daha fazla bilgi almak isterseniz: Çalışmaya katılımınızın sonrasında, bu çalışmayla ilgili sorularınız yazılı biçimde cevaplandırılacaktır. Çalışma hakkında daha fazla bilgi almak için Bilgisayar ve Öğretim Teknolojileri Eğitimi öğretim elemanlarından Ömer DELİALİOĞLU ile (e-posta: omerd@metu.edu.tr) ile iletişim kurabilirsiniz. Bu çalışmaya katılımınız için şimdiden teşekkür ederiz.

Yukarıdaki bilgileri okudum ve çocuğumun bu çalışmada yer almasını onaylıyorum (Lütfen alttaki iki seçenekten birini işaretleyiniz.

Evet onaylıyorum___ ***Hayır, onaylamıyorum___***

Annenin adı-soyadı: ______________ Bugünün Tarihi:________________

Çocuğun adı soyadı ve doğum tarihi:________________

(Formu doldurup imzaladıktan sonra araştırmacıya ulaştırınız).

K. Student Consent Form

ARAŞTIRMAYA GÖNÜLLÜ KATILIM FORMU

Bu çalışma Orta Doğu Teknik Üniversitesi yüksek lisans öğrencisi Ayşenur AKTAŞ tarafından yürütülmektedir.

Çalışmanın Amacı Nedir?

Araştırmalar, STEM eğitiminin amacının 21. yüzyılın iş gücü ihtiyaçlarına uygun nitelikte kişiler yetiştirmek olduğunu ve öğrenci merkezli fen eğitiminin motivasyonu arttırdığını ve bu motivasyonun başarıyı getirdiğini göstermektedir. Bu çalışmanın amacı, artırılmış gerçeklik kullanarak işlenen STEM eğitimini içinde barındıran astronomi derslerinin özel yetenekli öğrencilerin astronomi bilimine olan tutumlarını ne ölçüde değiştireceğini ortaya çıkarmaktır.

Bize Nasıl Yardımcı Olmanızı İsteyeceğiz?

Araştırmaya katılmayı kabul ederseniz, bu amaç doğrultusunda, sizden artırılmış gerçeklik kullanarak işlenen astronomi derslerinin öncesinde ve sonrasında dağıtılacak motivasyon tutum ölçeği'ni cevaplamanızı isteyeceğiz ve cevaplarınızı yazılı biçiminde toplayacağız.

Sizden Topladığımız Bilgileri Nasıl Kullanacağız?

Araştırmaya katılımınız tamamen gönüllülük temelinde olmalıdır. Çalıştayda sizden kimlik veya çalıştığınız kurum/bölüm/birim belirleyici hiçbir bilgi istenmemektedir. Cevaplarınız tamamıyla gizli tutulacak, sadece araştırmacılar tarafından değerlendirilecektir. Katılımcılardan elde edilecek bilgiler toplu halde değerlendirilecek ve bilimsel yayımlarda kullanılacaktır. Sağladığınız veriler gönüllü katılım formlarında toplanan kimlik bilgileri ile eşleştirilmeyecektir.

Katılımınızla ilgili bilmeniz gerekenler:

Çalışma, genel olarak kişisel rahatsızlık verecek sorular içermemektedir. Ancak, katılım sırasında sorulardan ya da herhangi başka bir nedenden ötürü kendinizi rahatsız hissederseniz cevaplama işini yarıda bırakıp çıkmakta serbestsiniz. Böyle bir durumda çalışmayı uygulayan kişiye, çalışmadan çıkmak istediğinizi söylemek yeterli olacaktır.

Araştırmayla ilgili daha fazla bilgi almak isterseniz:

Çalışmaya katılımınızın sonrasında, bu çalışmayla ilgili sorularınız yazılı biçimde cevaplandırılacaktır. Çalışma hakkında daha fazla bilgi almak için Bilgisayar ve Öğretim Teknolojileri Eğitimi öğretim elemanlarından Ömer DELİALİOĞLU ile (e-posta: omerd@metu.edu.tr) ile iletişim kurabilirsiniz. Bu çalışmaya katılımınız için şimdiden teşekkür ederiz.

Yukarıdaki bilgileri okudum ve bu çalışmaya tamamen gönüllü olarak katılıyorum.

(Formu doldurup imzaladıktan sonra uygulayıcıya geri veriniz).

İsim Soyad   Tarih

İmza

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