

## Astronomy Education and Teacher Training in Turkey: Brief Historical Overview

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### Abstract

In this study, education in the astronomy field and space sciences in the schools in Turkey as well as the activities to create awareness in these subjects will be discussed. A research that was done among youngsters, ages from 15 to 24, for measuring the scientific literacy showed that most attractive subjects to the Turkish youngsters were “internet” and “astronomy”. This result leads the authorities to take necessary measures to fill the gap especially in the teaching materials such as books and in the changes of curricula in high schools. Besides TUBITAK National Observatory, universities and Turkish Astronomical Society are giving every effort to create public awareness of space activities and space sciences. As for the teacher training in the astronomy field and space sciences, much has been done but the targeted success has not come yet. Astronomy subjects in are taught not by astronomers but some other specialists from other branches, such as physics and mathematics. Nevertheless, it must be emphasized that astronomers on every occasion are pushing forward to have the right formally about the training of astronomers to become a teacher to be hired by the Ministry of Education.

## Introduction

On the land where we live today, astronomical studies started at a very early age. An example to show this is the following tablet which goes back to 730 BC. It is believed that the picture represents a ceremonial occasion about a total solar eclipse that might have occurred in that era on the day of 15th of June 762 BC. This is a place near the present-day city of Urfa in the southeast part of Turkey.



**Figure 1.** The inscription by the moon-disk reads: "My Lord Ba'al of Harran" B.C. 730; (Bilgin, 2010)

Tradition in studying and education in astronomy among Turks dates back to Samarkand where Uluğ Bey established an observatory (1421 AD). It remained active until 1449.

Uluğ Bey was both a ruler and a scholar. He was deeply interested in astronomy and mathematics, and he interacted with these sciences during his lifetime. He took courses at the *madrasah* he established and participated in discussions as well as giving lectures. Uluğ Bey spent most of his time with scientists and gathered many scientists around him. He thus had the opportunity to learn from famous scientists such as Ghiyas al-Din Jamsid al-Kishi and Qaḏizade Rumi. In 1429, Uluğ Bey completed the construction of a large, round three-story observatory in his *madrasah*. Al-Kashi was the first director of the observatory, and Qaḏizade Rumi was appointed to that position after his death in 1429. However, Uluğ Bey always remained the head or the "holder of the observatory," and al-Kashi used the term "Holder of Observatory" for Uluğ Bey. Al-Qushi became the director of the observatory after Qaḏizade Rumi. The

Samarqand observatory is of note for the astronomical instruments that were used there. One of the most important devices used was the mural quadrant or sextant. We see a sextant of 30 m in diameter in the Observatory (Unat & Aydüz, 2013, 93).



**Figure 2.** 30 m diameter sextant in Semarkant Observatory (Established A.D. 1421)

Formally astronomy teaching in İstanbul-Turkey started with Ali Kuşçu who was with Uluğ Bey in Samarkand (d. 1474). He was appointed, as a professor by Fatih Sultan Mehmet in a Madrasah in İstanbul. After Uluğ Bey's death, Al-Qushi went to Herat, Tashkent, and finally Tabriz. The Ak Koyunlu ruler Uzun Hasan sent him as a delegate to the Ottoman Sultan Mehmed II. When he and his entourage approached Istanbul, Sultan Mehmed sent a group of scholars to welcome them. Al-Qushi spent the remaining two years of his life in Istanbul. He educated and influenced a large number of students, who, along with his writings were to have an enormous impact on future generations. He was buried in the cemetery of the Eyyüb mosque in Istanbul. Whereas he died in 1474 in Istanbul, Ottomans mathematics and astronomies raised by him, because he educated a few students who are important astronomers grown up after him. One of them is Taqī al-Dīn (Unat, 2019).

So, after almost 100 years later an observatory was founded in İstanbul by a decree of Sultan Murat II. Istanbul Observatory was established by him in 1575. But it was demolished in 1580 and after that Ottomans science has received a blow. He made lots of precise astronomical instruments, applied the clocks into astronomy, and used trigonometrically functions in astronomy. Constructed on a height in Tophane, on the European side of the Bosphorus strait, the observatory consisted of a large building, a small building, and a well (*çahiri raşad*) and housed a library devoted to astronomy and mathematics. It was operated by a team of sixteen people, including eight “observers” (*rāsīd*), four clerks, and four assistants. The astronomical instruments used at the observatory included many from the old Islamic observatories, which Taqī al-Dīn reproduced with great care, but also several that he invented. Interestingly, Taqī al-Dīn’s new and old instruments were similar but superior quality to those of his contemporary, the Danish astronomer Tycho Brahe (1546–1601), who had built an observatory on the island of Hven (Unat & Aydüz, 2013, 94).

Apart from the observatories that provide the development of astronomy in the Islamic World, madrasahs with educational institutions occupy an important place. Madrasahs are virtually academies of the Middle Ages. Although the tradition of establishing a madrasah in the Islamic World started with the Karahanli (840-1212), the first big madrasah was Nizamiye Madrasahs, which was opened by the vizier of Alparslan in 1067 during the Great Seljuks. The first Nizamiye madrasah was established in Nishabur in 1063. After that, madrasahs spread



rapidly, sultans, viziers, and gentlemen competed to build madrasahs; In a short time, many Islamic cities, especially Baghdad, are equipped with madrasahs. In these madrasahs, besides religious education, science education was also provided. We know that mental sciences such as logic, word, rhetoric, medicine, vocabulary, astronomy, geometry, mathematics, and philosophy were taught (Akyüz, 2008, s. 44).

Madrasahs reached the most advanced level in the reign of Fatih Sultan Mehmet. As we mentioned above, the programs of the madrasahs in the reign of Fatih Sultan Mehmet were prepared by Al-Qushi and mathematical sciences were started to be taught in the education complexes. Until this period, Ottoman madrasahs were poor in mathematical education. In the Ottoman period, astronomy had a special place, and many studies on astronomy had accepted from mathematics. In many madrasahs, astronomy education had considered as basic education. As modern astronomy studies intensified in the West in the 17<sup>th</sup> century, interest in modern astronomy increased in the Ottomans (Yavuz Unat, 2016, 2074-2075).

Astronomy began to be taught by the state itself after the foundation of Mühendishqne-i Bahri-i Humayun (The School of Naval Engineering) in 1773 and Mühendishane-i Berri-i Humayun (The School of Ground Forces Engineering) in 1793. Hüseyin Rıfki Tamani (d. 1817), who was the first principal of the Mühendishane-i Berri-i Humayun which was founded in the reign of Sultan Selim the III, had great efforts in the arrangement of the lessons in Mühendishane, and also he was one of the pioneers to divert the contemporary West science to the Ottomans by the help of his knowledge in English, French, Italian and Latin besides Arabic and Persian. However, the Ottomans began to accept modern astronomy studies exactly in the early 19<sup>th</sup> century (Unat, 2019).

After the Tanzimat reform era, astronomy education was in Idadi and Rüştiye. Proper astronomy teaching in schools started in about 1839 and continued as a separate course until 1937. Until 1937, it remained an independent course. Students were taking such lessons in the high school science branch under the name of cosmography (Yavuz Unat, 2016, 2075). In this context, the work of Ali Yar (Kosmographia), written in 1933 and taught in astronomy lessons until 1937, was evaluated. It has been determined that the subject integrity of the work and the way it handles astronomy are suitable for today's understanding (Yavuz Unat, 2016, 2075-276).

After 1937, astronomy courses were absorbed in the mathematics curriculum and it was taught by the mathematic teachers until 1974. In the universities, there were mathematics major and astronomy minor programs. In this period, astronomy was not only taught to science students but also to literature branch students. (Astronomi Dersleri: Edebiyat kolu için; Turan Tanın, Muhittin Erev, 1952). The Authors were mathematics teachers. Other textbooks written in this period are “Acunbetim” (1938) and “Astronomy for High Schools” (1947). When we were in the year 1974, astronomy was designed as a separate elective course in the high schools.



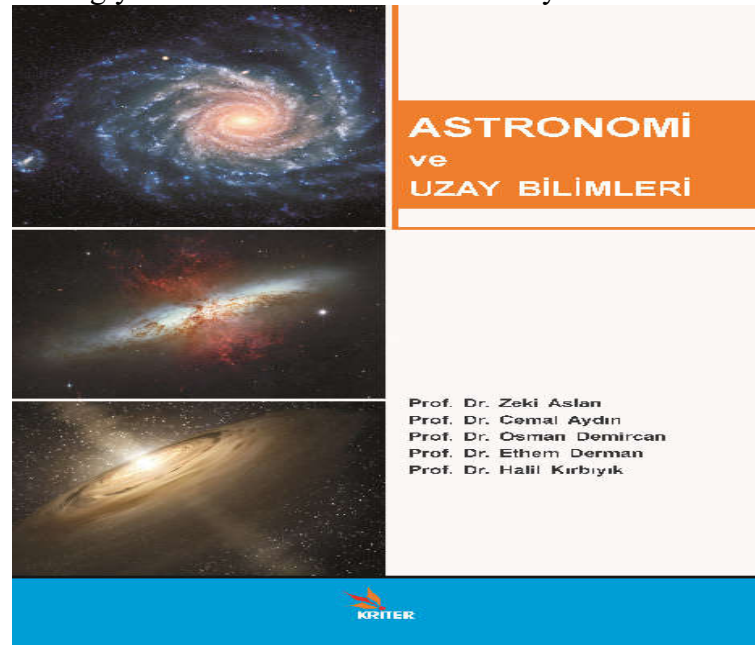
Figure 3. Astronomy Course Books used in 1933, 1938, 1947 and 1952 in Turkish Education System

After the 1950's a new era began. A kind of space-age started. We noticed the launch of Sputnik by the Soviet Union in 1957. The first man in space, Yuri Gagarin stepped out of his vehicle and stepped into space in 1961. This was followed by the landing of USA astronauts on the Moon. From there on very ambitious and intense space programs started.

Such developments arouse interest among people as well as in Governments. Note also that interdisciplinary studies gained impetus just in these years. A research was done among youngsters, ages from 15 to 24, for measuring the scientific literacy, and it showed that most attractive subjects to the Turkish youngsters were "internet" and "astronomy".

In fact, astronomy has always been an interesting and attractive subject throughout the history of mankind. It is an accepted reality that astronomy is very important in developing and strengthening the intellectual faculties and creating the imagination of a child. Looking at the number of students in the schools in Turkey, astronomy is extremely important and fundamental as a subject to teach. According to a report prepared by UNICEF (March 2012), there are 10.575.921 students in the primary school level (8 years) and 3.970.397 students (ages 15-19) in secondary schools (4 years).

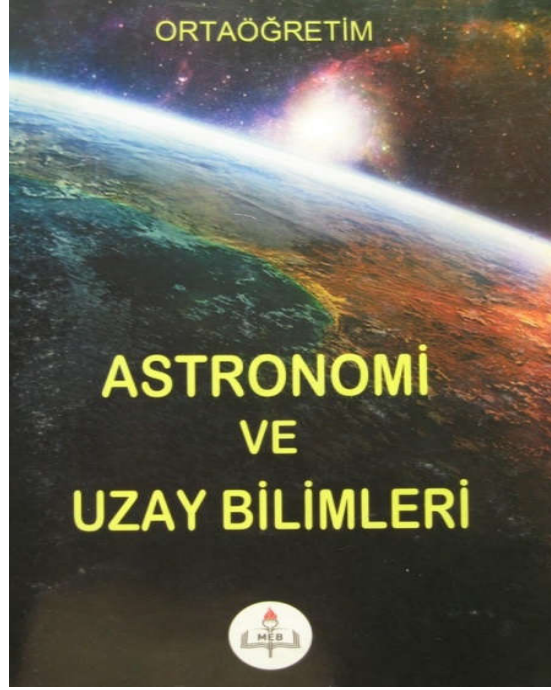
When we were in the year 1992 we saw that a change was introduced into the curriculum. The subject of astronomy was going to be taught under the name of "Astronomy and Space Sciences Course" accordingly a book was ordered to university scholars.



**Figure 4.** Astronomy and Space Sciences Course Book (1992).

Another change in the curriculum was introduced by the Ministry of Education in 2010, but astronomy still remained as an elective course. The development of the new program was made by an official group, having members from the Ministry of Education, representatives of math. Teachers were consist of physics teachers, pedagogical educators, and a university professor. It was suggested as a two hours per week course and a book was written named "Astronomy and Space Sciences" (Milli Eğitim Bakanlığı, (MEB/MoE), Devlet Kitapları, Saray Matbaacılık, Ankara, 2013) to be used in the course (Aslan et.al. 1996).

According to the new program, students in secondary schools were responsible for the following subjects: i) astronomy and its development, ii) universe, iii) coordinate systems and apparent motion, iv) motion of the Moon and the Sun, v) time and calendar, vi) space sciences and space activities.



**Figure 5.** Astronomy and Space Sciences Course Book (MEB, 2013).

If it is done properly almost all astronomy and space sciences subjects can be covered in the 2-hours course per week.

It must be noted that apart from an elective astronomy course, there are some astronomy subjects introduced into the physics program of high schools (3rd year of lycee, i.e., 11th grade, lycee is 4 years now). Astronomy courses are taught under the title of “from stars to star likes”. Such a change was introduced in 2007. Topics covered are; the structure of stars, white dwarfs, supernovae, and brightness of stars, doppler effect, and expansion of the Universe. Another issue to emphasize is that there are astronomy subjects which are spread over the years up to the 7th grade of the primary school (Primary education is 8 years). These subjects are taught in the “Science and Technology” courses.

### *History of Teacher Training in Turkey*

Education as a social system contains 3 elements: students, teachers, and curriculum. Among them, the most important one is the teacher.

In the last 166 years, different models for training teachers have been employed. It must be noted that the need for teachers in elementary schools was first felt in the 13th century in Ottoman time. There were no proper teacher training schools at that time. In fact, new practices began in 18th and 19th centuries, there were primary and secondary schools (Rüştiye). For these school teachers were required. Thus the first teacher training school was opened in 1848 (Muallim Mektebi). It was for boys only. Graduates would teach in both elementary schools and secondary schools.

After 1860, there was a shortage of teachers. The problem was solved by appointing people who were not trained as teachers. For that matter, new education reform was introduced in 1870. Such a reform involves the training of new teachers who would teach in lycees (Sultani). For this purpose, a Teacher Training College was opened (Darülmualimin-i Aliye, 1870). The College offered 4 years of education after secondary schools (Akyüz, 2009).



(a)

Apart from the Teacher Training College (opened in 1870), the number of Teacher



(b)

Training Schools whose graduates teach in elementary schools increased to 31 by 1911.

**Figure 6. a) and b)** Two different astronomy lesson views from Teacher Training College in the 1890s

This year coincides with the opening of Kandilli Meteorological and Astronomical Observatory (Fatin Gökmen was the director).

After the proclamation of the Turkish Republic (1923) new reforms were introduced. For primary schools, teachers were trained for three years after secondary school (Ortaokul). This practice of teacher training has continued until 1973. Graduates of such schools teach in elementary or primary schools.



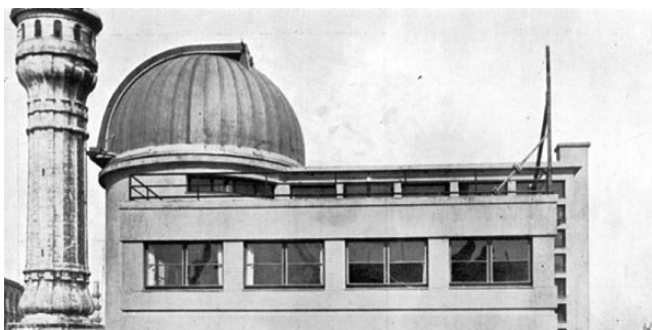
Another model was introduced to train teachers for secondary and high schools in 1926. They trained teachers for secondary schools (Orta Muallim Mektebi), but later on, some changes were made and music, arts and physical education programs were included and it became Gazi Eğitim Enstitüsü. Graduates of this Institute would teach in secondary schools and high schools. Following this, technical and vocational Colleges in which practical works dominated were opened (Erkek Teknik and Kız Teknik Okulları),(Karagözoğlu et al., 1993).

Another development was that a university reform was done in 1933. Universities were modernized with the help of a group of scholars fled from Germany. Astronomy was included in the university structure for the first time as a separate discipline. The first Astronomy Institute was opened in İstanbul University (1936). (İshakoğlu-Kadıoğlu, 1998)

Back again to teacher training schools, the government concentrated on educating all her citizens including the ones in rural areas. Thus a special model for village schools was introduced in 1937. Successful sergeants from military service were trained for 6 to 8 months and send to their villages to educate elementary school children and help peasants to improve their lives.

The practice has continued for about 10 years (1936-1946). Within this period, about eight thousand sergeants were trained and sent to villages. Youngsters ages 9 to 14 were enrolled in schools to be educated by these trained sergeants.

However, this was a temporary solution for the education of villagers. It was realized by the government that a new system is needed for villages because most of the population in Turkey was settled in rural areas. Proper teachers would be trained in so-called “Village Institutes” (Köy Enstitüleri, in Turkish) to send to rural areas, i.e., villages to educate students in elementary schools and improve the life of peasants. They were opened in 1940 and continued until 1953. The training lasted for 6 years after primary school. Then they were sent to villages as elementary school teachers, but they also knew about how to do deal with agricultural matters modernising of which would improve the life in villages. This practice was a revolutionary attempt to deal with illiteracy in rural areas. Unfortunately, they were converted to only to Primary Teacher Training Schools. Teachers would only teach how to read and how to write and hence becoming a simple bureaucrat. They would not contribute to the improvement of the villagers’ life in terms of cultural and agricultural activities (Kirby, 1962).



**Figure 7. a) upper;** Astronomy Institute of Istanbul University **b) bottom;** An amphitheater at Faculty of Science







**Figure 8.** Students in a village Institute rehearsing in violin playing



**Figure 9.** Students in a village institute are working in a garden

A radical change occurred in teacher training in 1981. A new law (2547) was enforced (YÖK) and the whole higher education system was integrated into universities. Accordingly, secondary and high school teachers would be trained in four years of Education Faculties. Ministry of Education was not responsible anymore. Additionally, not only Education Faculty graduates but also Arts and Science Faculty graduates could become teachers, if they take additional pedagogical courses (teaching certificate), (Koçer and Teker, 2014).

However, Astronomy Departments were not given the right of offering their graduates teaching certificate programs.

In February 2014, a by-law was released by the Ministry of Education stating that astronomy and space sciences course will be taught by science and technology and physics teachers in schools (both in primary and lycées)

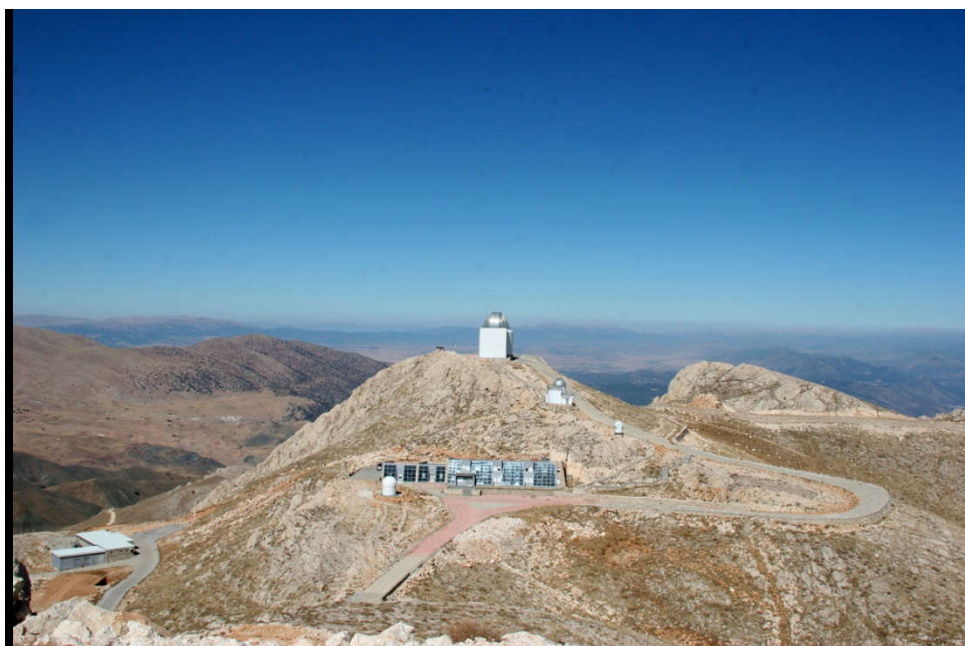
The assignments of teachers were done by the Ministry of Education. For a while, it was done on the basis of an exam introduced in 1985 (Teacher Qualification Exam). However, this was abandoned in 1992, and assignments afterward were done on computer lots.

Finally, it must be stated that there are numerous Astronomy and Space Sciences Departments in universities (İstanbul University (1936), Ankara University (1954), Ege University (1963), Erciyes University (2004), Atatürk University (2013), İnönü University (2011) and two Space Sciences and Technologies Departments (ÇOMU University, Akdeniz University) where astronomy and space sciences are studied and taught. Besides there are other universities in which astronomy and astrophysics minor programs or courses being offered basically in physics departments (Eker et al, 2012).

For research and education purposes main astronomy departments have university observatories while there is a National Observatory known as TUBITAK National Observatory (TUG). National Observatory houses have several telescopes the largest being the RTT150, 150

cm aperture reflector, T100, and T60 robotic one. It is situated on top of the mountain Bakırlitepe, at an altitude of 2500 m in Antalya. TUG telescopes contribute successfully to the education and training of who would be astronomy teacher candidates by offering successful senior students an opportunity to work at the observatory for a week or so. In addition, TUG allows 3<sup>rd</sup>-year university students to work at the observatory for about a month to do their practical training.

Astronomy departments educate and train their students by supporting students' theoretical background with heavy practical work in their own observatories.



**Figure 10.** A panoramic view of the TUBITAK National Observatory at an altitude of 2500 m, in Antalya.

It is also important to note that there is another astronomical project which is in the process of realization. It is known as DAG (Eastern Anatolian Observatory) owned by the Atatürk University in Erzurum. It is an infrared telescope of aperture 4 meters and will be in service within 2 years. The observatory site is at an altitude of 3100 meters. It will create a new excitement among Turkish astronomers when finished.

### **Astronomy Teaching in Schools in Practice**

Astronomy and Space Sciences course is an elective course in high schools, but as one teacher in the seminar mentioned below mentioned “students must be led to elect”. This is a problem because there is no question asked from astronomy in the university entrance exam. On one side students must have a very special interest in the subject to select it, and on the other side as it has been discussed in previous sections that astronomy and space sciences teaching in schools depends on the teacher’s personnel interest, enthusiasm, and responsibility (Yetkiner and Taner, 2020).

The situation being so, the solution to the problem of training the teachers is left to astronomers. Generally, it is independently, but sometimes collaborating with the MoE seminars and/or a kind of in-service programs are organized by professional astronomers and educators (Taşcan and Unal, 2015).

Some volunteered professionals from universities organize seminars for teachers who teach astronomy in schools. We learn the very real state of astronomy teaching in schools at

these meetings. In seminars, experienced astronomy teachers and scholars from universities give talks on topics related to updating the teachers' knowledge on astronomy and space sciences as well as on problems of dealing with difficulties that teachers encounter in their lives (Taner et.al., 2017)

There was a meeting held on 24-25th of October 2009, at Kuşadası, Aydın, its participants were from among university professors and high school teachers. This was on the occasion of the "Astronomy Year in 2009". Similarly, another such meeting was held in Antalya and 26 different cities until today, 2019. Among participants, there were astronomers, science and technology teachers, physics, and mathematics teachers. Astronomers, as we were told, are employed as part-time teachers about which they feel very unhappy. However so, they try to use every opportunity to create awareness about astronomy and space sciences in students. One astronomer who teaches in a school says "in spite of all unsatisfactory situations there are good things to do. For example, in the 7th grade, there is a chapter titled as Solar System in which some related astronomical topics can be taught. Light pollution may be discussed." (IYA, 2010)



**Figure 11.** A picture of the participants of the Astronomy Teachers' Seminar, in Antalya, in 2014 (Taner, 2014)

Astronomy teachers point out that they do not feel the lack of textbooks, because there are not only tailored ones for astronomy courses in high schools but also many general astronomy books translated into Turkish from basically English (Eker et.al.,2013)

One physics teacher's comment is extremely important. She says "Teachers start to get irritated as chapters on astronomy and space sciences approach, and this obviously dangers the teaching of astronomy in schools." This alone tells us how important to push forward to have for the astronomers the right of becoming teachers in schools (Taner, 2014).

Turkish astronomers take advantage of every occasion to create awareness about astronomy and astronomy teaching. For example, during the event of the total solar eclipse which was observed best from Antalya in 2006, TUG in collaboration with the MoE organized a kind of in-service training for a large number of teachers working in high schools. Another activity that TUG regularly is involved in is a yearly event of a few days of observation festivals.

TUG near its campus holds a 3-4 days activity containing astronomy and space sciences conferences, night observations of interesting celestial objects, and social as well as scientific activities for kids. Statistics show that there is an ever-increasing demand for such activities.



Universities, TUBITAK National Observatory, Turkish Astronomical Society, and amateur groups take the advantage of important astronomical events such as solar eclipse, lunar eclipse, Venus transit, Astronomical year to the memory of Galileo (2009) to create an awareness of astronomy and space sciences in the country.



**Figure 12.** TUBITAK-TUG Astronomy festival in Antalya, 2013



**Figure 13.** Another astronomical event which astronomers popularised throughout the country was the transit of Venus across the solar disc in 2012.

## **Results and Conclusion**

The Conclusion is Turkish public demands more about astronomy and space sciences, but officials' response to that is not as prompt as astronomers would like to have. Starting from the 1970s, the use of astronomy as a tool in science education and the introduction of rich laboratories to students starting from primary school took a widespread form. Information technology-supported astronomy education programs have started to play a pioneering role in



popularizing the basic science courses in physics, chemistry, and biology and in "comprehending" the scientific side of these courses (Taşcan and Unal, 2015). CLEA in France and STAR in the USA are the most striking examples of these programs. In our country, unfortunately, astronomy, which was removed from compulsory course status in high schools in 1979, has been abandoned in a sense, and astronomy subjects interspersed with primary science books have become a source of false and incomplete information in terms of both quantity and quality. There are two important dimensions to the correct delivery of astronomy education, and especially the elementary school students' increased interest in astronomy education and astronomy in general, and their understanding of science and science in general. The first is to teach astronomy lessons correctly in primary education, and the second is to train teachers who teach astronomy lessons in primary education to know the subject well.

However, astronomers are trying to push forward to educate and train youngsters both in astronomy and space sciences and create public awareness in space sciences. Turkish astronomers are constantly pursuing the issue of convincing the MoE to give astronomers the right of becoming a teacher.

In this context, Turkish astronomers agree on conducting local astronomy meetings and teacher training, using adequate resources and constantly renewing information sharing, preparing astronomy textbooks by astronomers, supporting astronomy education packages for teacher high schools by MoE, and increasing the hours of astronomy education courses in education faculties.

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