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How Can We Use the Astrolabe in Education to Inspire A New Generation?

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The astrolabe is one of the most prominent examples of mathematical ingenuity and craftsmanship in the Islamic scientific tradition. The astrolabe is a portable instrument with which the (apparent) movements of the sun and stars around the Earth can be represented. The main application of the astrolabe is the determination of time. Other applications include finding the position of the sun and stars, with respect to both the horizon and the meridian, and determining the prayer times and qibla. Ottoman astronomers used the astrolabe until the beginning of the 20th century. The instrument can be found in the inventory lists of military engineering academies even in the period of modernisation.

In this workshop we primarily focus on the astrolabe in the early modern Ottoman scientific tradition and explore together how the astrolabe can be made accessible to a non-expert audience, especially to school pupils and university students, in Turkey, and elsewhere.

In the first part of this workshop (15 minutes) we discuss the astrolabe in the early modern Ottoman scientific tradition and list the extant astrolabes.

In the second part of this workshop (45 minutes) we expose the participants to the astrolabe workshop. In the astrolabe workshop the participants receive a plastic and paper model of the astrolabe of Abū Maḥmūd Khujandī made in 985 CE, together with a handout with exercises. The model has been recomputed for the latitude of Istanbul, that is for 41 degrees North. We chose the astrolabe of Khujandī to base the model on, since it is not only one of the oldest extant astrolabes, but also the first one that was designed in an artistic way. The astrolabe is currently displayed at the Museum of Islamic Art in Doha, Qatar.

After an introduction, the participants will work on the handout exercises, preferably in groups of up to 4 participants, and under supervision of the workshop instructors, to determine the length of the day and the local time, and find the direction of the sun and the qibla. In doing these exercises, the participants will realise the depth of the astrolabe from their own experience. The participants may also learn some mathematics and astronomy on the way. The astrolabe workshop does not require previous knowledge of mathematics and astronomy.

In the third part of this workshop (30 minutes) the participants reflect on the astrolabe workshop in groups. As a workshop instructor, I will share my own experiences with performing astrolabe workshops for a variety of audiences, most notably for university students and high school students in Turkey, but also for a variety of groups in other countries, such as Algeria, Syria, Saudi Arabia, Iran, Pakistan, Tajikistan, over the years 2006-2025. I will discuss how in my view to best perform these workshops and tailor the materials, i.e., the astrolabe model and the handout exercises, to specific audiences. These audiences can be a general public without any background in mathematics, school pupils, university students, astronomy enthusiasts, an expert audience of mathematicians, people from different cultural backgrounds, and more. I would like to hear from the participants how in their view the astrolabe can be used as an educational tool and source of inspiration for pupils and students in history of science, mathematics and astronomy. Together with the participants, we may also discuss potential other and new ways to perform workshops with the astrolabe. And ultimately, what astrolabe from the early modern Ottoman scientific tradition would be the best choice to base an astrolabe model on.

Time permitting, I will also explain how the astrolabe workshop can be a first element of a multi-day programme about the astrolabe. Other workshops in this programme could deal with the Arabic alphabetic

numeral system called abjad and involve reading and interpreting the abjad numbers on an astrolabe. The workshop series could culminate in having the participants draw their own astrolabe on a sheet of paper.

I can also explain how the teaching philosophy of the astrolabe workshop can be extended to similar workshops about other instruments from the Islamic scientific tradition.

Keywords

Early modern Ottoman scientific tradition, astrolabes, outreach activities, teaching methods, mathematical and astronomical instruments

E-mail

w.f.degraaf@uu.nl

Affiliation

Utrecht University

Position

External PhD candidate

Short Biography

Wilfred de Graaf holds master's degrees from Utrecht University, The Netherlands, in mathematics, theoretical physics and mathematics teaching. He is currently employed at the Mathematical Institute of Utrecht University as education coordinator. He is working as an external candidate on a PhD thesis with a primary focus on the navicula sundial. His interests are in astrolabes, timekeeping and other mathematical and astronomical instruments from the medieval and early modern European and Islamic scientific traditions, and how to effectively use these instruments in university and high school teaching and outreach activities.

Primary author: Willem de Graaf (Utrecht University)

Presenter: Willem de Graaf (Utrecht University)

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