Education and Heritage in the era of Big Data in Astronomy
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Classical Astronomy as an educational resource in a Faculty of Education

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Abstract. History, Maths and Astronomy are all mixed up in an innovative educational project that is being carried out in the Faculty of Education of the Universidad de La Laguna, in Spain. Students learn how to teach (to primary school students) about the shape of the Earth, the distances to the Moon, the Sun and other planets, collecting their own data with simple instrumentation and, most important, to connect ideas and different disciplines. The structure and contents of this project are presented, as well as examples of the activities that are carried out.

Keywords. Astronomy, pre-service teachers, primary school

1. Introduction

'Primary science learning resources' is a core project-based subject of the degree in primary education at the Universidad de La Laguna, Spain. This subject is divided into three projects: one devoted to life sciences, the second to energy and matter and the third one consists in an educational multilevel (from elementary school to research institutions) science project about Classical Astronomy. In this sense, our purpose is to expose pre-service education teachers to the potential of Astronomy as a multidisciplinary and engaging educational resource.

The work of Eratosthenes was chosen as the topic for the astronomy project that was carried out during the last quarter of 2020. Eratosthenes was able to measure the radius of the Earth, by analyzing the shadow cast by the sun during the summer solstice in two Egyptian cities, present-day Alexandria and Aswan. It has been widely used for educational purposes (e.g., Décamp & de Hosson (2010), Božić & Ducloy (2008) and Camino & Gangui (2012)), being an ideal experiment to learn and teach about triangulation, to make measurements, to control variables and to analyze data. Moreover, it is a good opportunity to understand the historical, cultural and social context behind scientific discoveries. Our work consisted of a set of activities covering contents from maths, social and natural sciences and museum studies. It was designed as an international collaboration

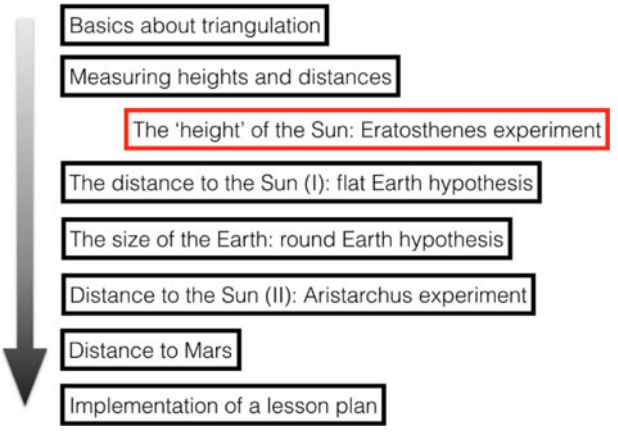

Figure 1. Set of activities contained within the Eratosthenes project.

between Spain (Tenerife), the USA (Cooperstown, NY) and Egypt, the country where Eratosthenes carried out his famous experiment. Besides the 120 pre-service teachers, the project involved students from the master's degree of museum studies (State University of New York), primary and secondary students from three schools in Tenerife and scientists from the Spanish Institute of Geosciences, Instituto de Astrofísica de Canarias and the Egyptian National Research Institute of Astronomy and Geophysics. In total, 300 primary, secondary, undergraduate and master's students participated in this initiative.

2. Implementation

The sequence of activities (two-week-long project) for pre-service teachers (Fig. 1) contains an introduction to triangulation and how to measure distances and heights to closely objects and to distant bodies (sun, moon, planets, etc...). The project also contains activities to expose the students to the general ideas of the scientific method by working on the flat and round Earth hypothesis. In this sense, the solar altitude might be used to infer the distance to the Sun (under the flat Earth and non-parallel sun rays hypothesis) or to derive the radius of the Earth (under the round Earth and parallel sun rays hypothesis).

Students from the different schools, pre- and in-service teachers, museum studies graduate students and scientist carried out a version of the famous Eratosthenes experiment by measuring the shadow cast by a rod at solar noon at different locations (latitudes) in the world (22 and 23 of october 2020). One of the most valuable aspects of this project is that we also include the original sites where Eratosthenes carried out the experiment, Alexandria-Cairo and Aswan. From all the data obtained at the different locations, it was obtained, under the Round Earth hypothesis, that the radius of the Earth ranges from 6200 to 6455 km, whereas, under the Flat Earth hypothesis, the distance from the Earth to the Sun ranges from 3200 to 3860 km. The pre-service teachers use the information and experience obtained with all these activities to design a final project for primary school students that conforms 35% of the final grading of the subject.

During the implementation of the project, the pre-service teachers found extremely motivating and educational these three aspects: to design activities that mix science, maths and history; the confrontation of hypothesis, in this case flat vs round Earth; the importance of error propagation in scientific measurements

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