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P. Di Matteo, O. Creevey, A. Crida, G. Kordopatis, J. Malzac, J.-B. Marquette, M. N'Diaye, O. Venot (eds)

EDUCOSMOS, LA RECHERCHE DANS LA SALLE DE CLASSE

O. Suarez[1], Q. Branchereau[1], L. Abe[2], Ph. Bendjoya[2], J.P. Rivet[2], D. Vernet[1] and A. Marcotto[1,2]

Abstract. EduCosmos is a singular citizen science project that allows high- and medium-school students to participate in scientific research. The classes participating in this program perform astronomical observations remotely, from their schools. They use a 1-meter telescope belonging to the Observatoire de la Cote d'Azur (OCA - Nice, France), located at the Plateau de Calern (alt. 1280m), 70 km away from Nice. Students get involved in the study of asteroids, observing mainly light curves that will be used by the OCA scientists to complete their research. A 2-day teacher-training is proposed to teachers involved in this program, and is carried out in partnership with the local education authorities. Teachers are formed to the scientific project, the observations and the data reduction. During the school year, the participating classes have the opportunity to meet the OCA scientists that will introduce them to the scientific program

Keywords: outreach, education, teaching skills, astronomy activities

1 Introduction

Science transmission to the public and particularly making secondary school students (12−18 years-old) aware of science, is mostly important to build a responsible and educated society. Moreover, students and teachers are one of the pillars where the improvement of the scientific culture of the society can start. In addition, scientific vocations usually start during secondary education. This range of age is the target of the EduCosmos project, that aims to bring science to secondary students thorough the participation in an astronomical research project.

Astronomy is a science that naturally interest general public and young people. It can be an easy way to introduce in the classroom notions that produce usually less excitement from youngsters, as physics or maths. The challenge of EduCosmos is to get students interested in science and to help them to integrate the scientific method used in research. This way they will be armed to fight against obscurantism or fake news, since they will be able to apply the scientific method to be critical with all the information they are receiving.

2 The scientific project

EduCosmos classes perform observations for several scientific projects. The aim is to imply students in a real research work, to increase their interest in science. The main subject is asteroids, since they have several advantages when studied in the classroom: they are solar system objects, and solar system is included in the school curriculum; moreover, it is easy to link asteroids with earth sciences, so the possibility of widening to other subjects than physics is easier; and finally, asteroids are fascinating for students due to the possibility of one of them falling into Earth!

Students usually observe asteroids in photometry, to obtain light curves. They are easy to understand and a simplified data reduction procedure is easy enough for them to perform (see section 3.6)

3 Phases of the project

EduCosmos has several phases that are essential to the project.

[1] Observatoire de la Côte d'Azur, 06304 Nice, France
[2] Université Côte d'Azur, CNRS, Observatoire de la Côte d'Azur, Laboratoire Lagrange, Nice, France

3.1 Teacher training

To ensure the proper functioning of EduCosmos, is it essential to form the teachers to this project. A two-day teacher training session is proposed at the beginning of the school year to all the teachers implied in the program. Teachers are invited to assist in pedagogical teams, to invest students in the project through different subjects.

There are not prerequisites in astronomy to participate to this training that is focused on science (maths, physique, earth sciences) teachers. Two parallel groups are organised concerning the observations, according to the teacher's level. Beginners learn the basics of astronomical observations, while the advanced group focuses in more technical questions. Both groups are reunited to study the astronomical concepts concerning the scientific program the students will work in. The pedagogical part, with the adaptation of the scientific subject to the school curriculum is conducted also with the plenary group.

3.2 Visit of C2PU telescope

The visit of the telescope is important to make students concretize the idea of the telescope they will use. A one-day visit to the site of Calern, of the Observatoire de la Côte d'Azur, is organised each year which each class participating to the program. Students have the opportunity to visit all the instruments of this observation site, located at 1200m altitude that contains several observation facilities.

The C2PU telescope is a 1-m telescope refurbished in 2010 for science and education (`http://c2pu.oca.eu`). It is fully remote-accessible and it has imaging and polarimetry capabilities.

3.3 Astronomy sessions in the classroom

To prepare the students for the participation to the scientific project, several astronomy sessions in the classroom are organised. They have usually a duration of 2h and are organised in two parts: during the first part the astronomical notions are provided in an interactive way by an astronomer. The second part is devoted to games or activities related to the given notions.

These sessions introduce students to astronomy and they allow them to understand the context and the importance of the observations they will perform.

A special session is organised to prepare students to the observations with C2PU. A game conceived by our team is used to fix the different steps needed for a correct observation.

Fig. 1. Left: The C2PU telescope. **Right**: The EduCosmos observing-game.

3.4 First direct sky observation

Even if it is not a part of the astronomical research it is important to let students become familiar with the night sky. Moreover, since the EduCosmos program is often carried out with students from disadvantaged areas, many of them have never gazed at the night sky and this is their first experience under the stars.

We organise a night session in an educational institution, the International Center of Valbonne, where the OCA has installed an amateur 40-cm telescope. Part of this evening is devoted to the visual discovery of the

night sky, while during the other part students understand the working of a telescope and they observe through it.

3.5 Remote observation with the C2PU telescope

One remote-observation session is organised with each class participating to EduCosmos. They spend about 3 hours, including the calibrations (pointing and focus) and the scientific observations. Several groups are formed for the observation, each taking care of a particular task.

Two computers are needed at the school, with internet access. They connect to the telescope control software and to the camera control software and allow students to manage the telescope remotely. A webcam has been installed in the telescope dome to follow the movement of the telescope and to make students realize that they are really controlling it. The images taken by the telescope are seen by students in real-time.

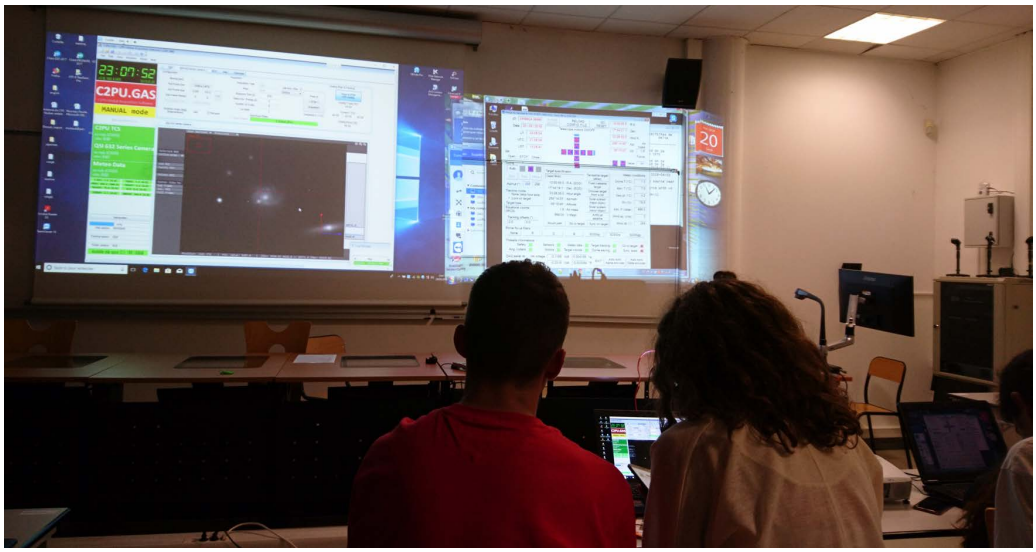

Fig. 2. Observation with the C2PU telescope from the *Lycée Estienne d'Orves* at Nice.

3.6 Data reduction

We train students to perform the data reduction of the light curves they have observed. We have developed a playful activity where students arrange several images of a rotating asteroid (Itokawa's images), and they reconstruct a fictitious light-curve, by measuring the illuminated area in each image. This is useful for them to understand the meaning of a light curve and how it is related to the morphology of the asteroid.

Data reduction continues with real data. We have developed a tutorial to facilitate the use of the image analysis package "AstroImageJ". Without substantial problems, following this tutorial, students get a light curve from the raw images in 30 or 40 minutes.

The goal of making pupils reduce the data is to show them that observational research in astronomy does not consist in looking at the sky, but in understanding the information we can obtain from the different observed objects.

4 Funding and participation

EduCosmos project is supported by the Observatoire de la Côte d'Azur which provides the telescopes and the personal. The participation of classes and additional personal is funded every year with the funds of different

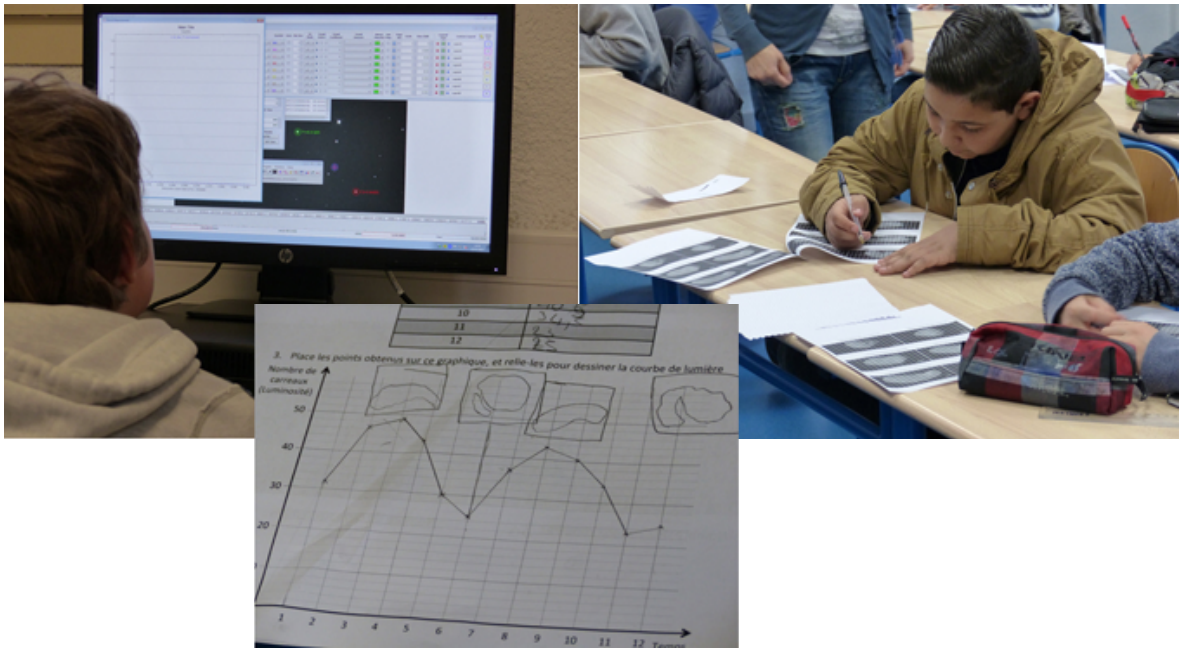

Fig. 3. Data reduction process and exercice.

calls released by the Provence-Côte d'Azur Region (project APERLA), the Alpes Maritimes Departement, or the national project *Cordées de la réussite*. In the past, it has also been funded by the *MEDITES* project, belonging to the French Government program *Investissements d'Avenir*.

Several of these programs are devoted to students in underprivileged areas. The local education authorities (*Rectorat*) help us to select the classes belonging to this population. The capacity of EduCosmos is 10 classes per school year. Over this number it is difficult for us to provide all the different activities related to the program.

The project started in 2012 with a pilot school, and up to know a total of 60 different classes, making some 1500 students have participated.

5 Conclusions

EduCosmos is a project that allow students to participate to a research project by the observations with a professional telescope. This project has several phases that have been detailed here.

A total of 10 classes (∼250) students per year can participate to this project, with about 1500 students having participated from the beginning of the project in 2012.