

Journey to the sky through the eyes of science

Dissemination of astronomy in the alto paraopeba region

K. B. V. Torres, T. Armond, K. Rodrigues, M. S. Gualberto, N. M. C. De Novaes & M. Reis

¹ Universidade Federal de São João Del Rei, MG; e-mail: kbtorres@ufs.j.edu.br, tina@ufs.j.edu.br
e-mail: kethorybarros@hotmail.com, marianasgualberto95@gmail.com, naaty.novaes@gmail.com, mresi@ufs.j.edu.br

Abstract. Journey to the Sky through the Eyes of Science is an institutional extension program of the Federal University of São João Del Rei – UFSJ (Alto Paraopeba Campus – CAP) that promotes Astronomy and related fields in the Alto Paraopeba region, around the Ouro Branco town – MG. It supports the teaching of astronomy in schools through their actions (seminars, workshops, lectures, sky observations, mini-courses, and tutoring lessons for young students who want to participate in the Brazilian Astronomy and Astronautics Olympiads – OBA), besides to support the UFSJ concerning the divulgation of their engineering courses proposed in the CAP.

Resumo. Viagem ao Céu pelo Olhar da Ciência é um programa de extensão da Universidade Federal de São João Del Rei (Campus Alto Paraopeba – CAP) que promove Astronomia e áreas afins na região do Alto Paraopeba, em torno da cidade de Ouro Branco – MG. O programa apoia o ensino de astronomia nas escolas através de suas ações (palestras, oficinas, palestras, observações noturnas e aulas para jovens estudantes que queiram participar das Olimpíadas Brasileira de Astronomia e Astronáutica - OBA), além de apoiar a UFSJ em relação à divulgação dos cursos de engenharia do CAP.

Keywords. Teaching of Astronomy

1. Introduction

Man's fascination with the universe has been present since the beginning of civilization. Initiated when our ancestors began to contemplate the celestial vault and let the imagination wander through its luminous points. Moving to draw symbolic figures in the sky, flourish in religion, folklore, and myths of different peoples around the world. From the observation of the sky allied to the reasoning, the man was able to establish calendars to organize plantations cultivation cycles and guide him in trips. Thus he began to establish the first astronomical discoveries that influenced the human life (Cardoso 1998). Besides, Astronomy have been given humanistic, educational and technological contributions of great value to society, along with the development of industry and medicine (Yun 2004).

Astronomy has a high interdisciplinary character. Its contents can favor the union of several areas of knowledge, allowing teachers to assist students in understanding of history, geography, mathematics, physics, chemistry, biology, art, languages, science and evolution of scientific and philosophical thinking, as well as characteristics of studies of the planet Earth (Bucciarelli 2011).

In practice, in relation to the astronomy teaching in the Brazilian basic education, there is no direct application of the National Curricular Parameters (PCN 1998) requirements in the elementary and high schools. The basic skills for the evolution of knowledge are not worked according to what is proposed in that document (Amarante 2010), indicating that the teaching of astronomy still needs support.

From this perspective, the extension program of the Alto Paraopeba Campus (CAP) at the Federal University of São João Del Rei (UFSJ), Minas Gerais state - Brazil, called *Journey to the sky through the eyes of science* was created. The main aim is to assist the astronomy teaching in schools and foment the astronomy knowledge and related fields for anyone. Their actions

have been permitting an integration with the region's community, started in 2014 and in development until now.

This program is based on the model proposed by the Federal University of Minas Gerais (UFMG) and the Federal Institute of Minas Gerais - Ouro Preto Campus (IFMG-OP). The UFMG's project resides in the Astronomical Observatory of the Serra da Piedade, in the Caeté town, MG, since 1986, where it regularly attends schools and public monthly visits. While the IFMG-OP's project, *The sky within reach of everyone*, offers astronomical observations and documentary shows to students of public schools around it.

This work presents all actions developed by this program since 2014, as well as their results.

2. Methodology

This program has two lines of action: (a) one focused on young students from the public and private schools of Ouro Branco town, where it is intended, through the study of astronomy, to arouse interest and curiosity in science and mathematics, to further increase the demand for exact sciences courses at universities. (b) another aspect focus on senior citizens, where our work aims to rescue their curiosity on the subject, and to bring them specific knowledge that many have not had an opportunity to obtain throughout their life.

For the first target audience, schools are invited to participate and are presented with the activities we provide. They can choose which actions they would like to engage and when. All actions proposed here are developed at the school's building, except the university tours, which is happening at the CAP/UFSJ. For the second group (senior citizens) the Astronomy and Astrophysics Introductory course is developed in the Açominas Association of Retirees (AAA).

The actions proposed in this program are (a) tutoring lessons for those who want to participate in the Brazilian Astronomy and



FIGURE 1. OBA lectures provided to the students of the Batista School (left) and Municipal School *Livramento* (right), both held in 2016. Source: Authors

Astronautics Olympiad (OBA 2018) ; (b) astronomical workshops; (c) technical visits into the CAP/UFSJ's buildings (classrooms; physics, chemistry and computation labs; library, and restaurant). During the visits in the labs they may perform experimental practices themselves with academic monitor helpers; (d) seminars in schools and/or CAP; (e) observations of the sky, with the support of the Amateur Astronomers of Ouro Branco, and the IFMG – OP Project called *The Sky within Reach of Everyone* (f) Astronomy and Astrophysics Introductory course for senior citizens.

The Brazilian Astronomy and Astronautics Olympiad is an annual open event destined to Brazilian students (of elementary and high schools), whose purpose is to stimulate the interest of young people in astronomy, astronautics, and related sciences through the dissemination of basic knowledge in a playful way (OBA (2018)). For this action, the target audience is quite broad, comprising students from the first year of elementary school through the senior year of high school. The event takes place within the school itself, in a single phase (usually in April) and the tests are applied at four different levels. The program described here offers tutoring lessons for public and private schools in the Ouro Branco town (Fig. 1). The number of tutoring lessons will depend on the possibilities and needs of each school. The lessons are based on the review of the contents proposed by the Olympic Committee and solution of questions from the previous years. The didactic material includes classes in digital resources, prepared by the program staff. The classes are conducted in an environment where it preserves the dialogical interaction between the program staff and the students.

The astronomical workshops consist of a playful method of teaching science and astronomy for children and adolescents in a happy way. The program offers workshops in planetary art, celestial rotating planisphere, solar clock, and constellation drawing.

Technical visits to the CAP/UFSJ (including activities in the chemistry, physics and computations labs) seek to promote a close interaction between students and university (CAP/UFSJ), through a first contact with the campus environment. At this moment, it is sought to attract teachers and students to take interest in the engineering courses offered by it. Visits are conducted in a way that introduces visitors (teachers and students) to a physico-chemical and computing contents that applies not only to the laboratories but also to their daily life, in a playful and open space so that doubts are healed (Fig. 2). The university visit starts with a one-hour tour in the company of the scholarship students and volunteers of this program.

For the celestial planisphere workshop, a rotating celestial planisphere is set up for the local latitude, showing the image of the visible local sky at a certain time. The goal is to develop a student's creative ability, identify the constellations of the sky, find the cardinal points and learn how to make and handle it. The



FIGURE 2. Technical visit to the computer (left) and Biotechnology (right) labs. Source: Authors.



FIGURE 3. Celestial planisphere workshop held in 2016 at the *Comes to be Project* (left). Planetary art workshops held in 2015 at the Arquidiocesano School of Ouro Branco (right) Source: Authors.



FIGURE 4. Mercury transit observation carried in May 2016 (left) and Black Holes Seminar, both carried out at the CAP/UFSJ. Source: Authors.

activity carried out in a day has a duration of 2h, the attending public encompasses all elementary school (Fig. 3).

For the planetary art workshop, the target audience is the 5th to 9th-grade elementary school. The goal is to awaken students' interest in astronomy through a model of the solar system which planets are made from papier mâché. In reproducing the planets, students are able to identify them, determine their main characteristics and their location within the solar system (Fig. 3).

The observation of the sky aims to recognize some celestial bodies in the sky (stars, planets, and clusters), identify constellations using the Stellarium Software, and to learn how to handle telescopes. Eventually, daytime observations such as the Mercury transit was observed in 2016. This activity counts with the support of the Amateur Astronomers of Ouro Branco and the IFMG - OP project *The Sky within Reach of Everyone* (Fig. 4).

The seminars offered at CAP/UFSJ and schools aim to disseminate scientific knowledge in Astronomy and Astrophysics (Fig. 4).

The Astronomy and Astrophysics Introductory course for senior citizens was offered in 2016, in partnership with the Açominas Association of Retirees (AAA). The course lasts for 12 hours, including topics on: Astronomy before the telescopes; Modern telescopes and Instruments; The Solar System; Stars: Measurements, Classification and Evolution; Stars: Birth and Death, Interstellar Medium; The Milky Way; Galaxies and Universe; Institutes and Research Laboratories in Brazil. The course aims to satisfy the curiosity of people interested in Astronomy, who did not have the opportunity to obtain such knowledge during their school education.

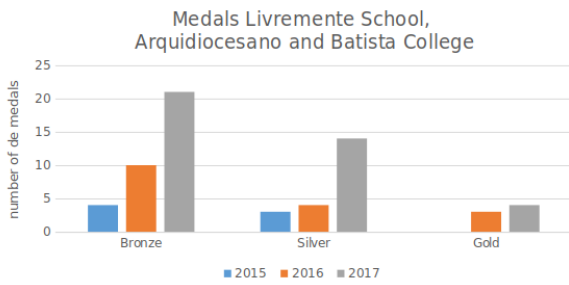


FIGURE 5. Number of medals obtained at the OBA event, for the Livramento School, Batista School, and Arquidiocesano School, from 2015 until 2017. Source: Authors.

3. Results

Our results consist mainly in the number of students and institutions attended by the program, as well as the analysis of the students' performance in the Brazilian Astronautics Astronomy Olympics before and after participating in the monitoring.

During these three years, a total of 11 institutions were attended: CAP/UFSJ, Arquidiocesano School, Batista Mineiro School, Livramento Municipal School, Cônego Luiz Vieira da Silva State School, Levindo Costa Carvalho State School, Pio XII Municipal School, Raimundo Campos Municipal School, and the *Come and Be Project* (all located in Ouro Branco town) and the Narciso de Queiroz State School (located in Conselheiro Lafaiete town).

In 2015, 360 people were assisted by our actions; 291 in 2016, and 748 in 2017. It can be seen that in a short period of time the number of people supported by this program has doubled in comparison with 2015.

From 2014 until 2017, three schools of Ouro Branco town has participated in the OBA Olympic evaluation. They are Arquidiocesano School, Batista Mineiro School, and Livramento Municipal School, evidencing an expressive increase in grades obtained for each school since the program's beginning, as well as the number of medals and the number of participants in the OBA event (Fig. 6).

In 2014, 30 students subscribed to take the OBA test, and the highest grade was 8.4; in 2015, 58 students registered, and the highest result was 8.8; in 2016, 88 students took the test and the highest grade was 9.0.

In 2017, the program reached the maximum of their results. The Batista Mineiro School's students got 4 gold, 2 silver, and 9 bronze medals, totaling 15 medals. The Livramento Municipal School's students obtained 5 bronze, and 3 silver medals, totaling 8 medals. The Arquideocesano School obtained 9 silver and 7 bronze, totaling 16 medals (Fig. 6). In addition, more than 60% of the grades obtained were above the mean value required (Fig. 5).

In 2015 and 2016, 38 people aged 55 years old, participated in the Astronomy and Astrophysics Introductory course for senior citizens.

In 2017, 693 people were assisted by this program activities. Four Schools, (2 private schools and 2 public schools) joined us in our actions; 43% participated in the tutoring for the OBA; 21% participated in the workshops, 24% participated in the seminars; 12% participated in the technical visit at CAP/UFSJ University.

Besides, four lectures on Astronomy and Astrophysics were given in 2017, titled *Stars* (taught by the scholarship students of the project staff), *Black Holes* (taught by PhD T. Armond - DEFIM/CAP/UFSJ - see Fig. 4); *Galactic Archaeology: The*

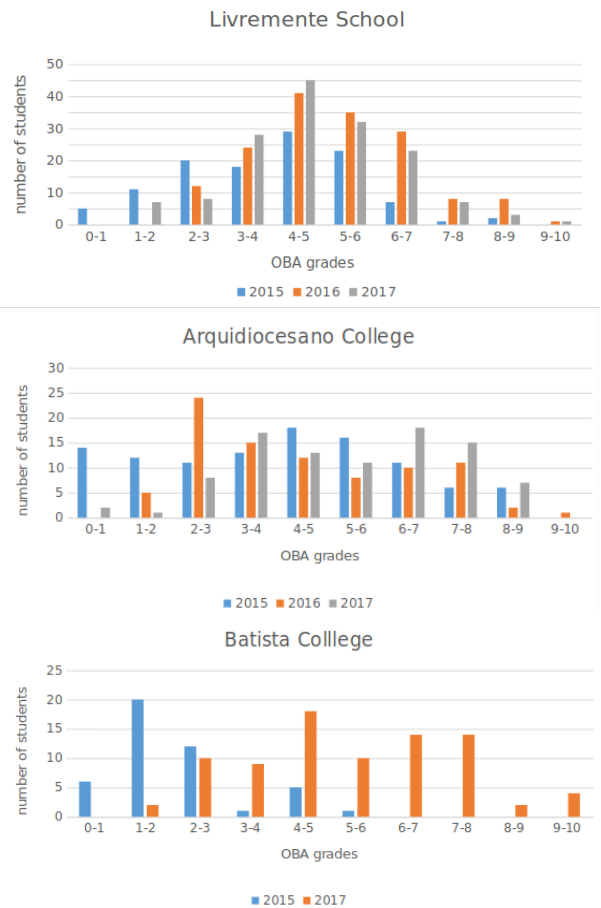


FIGURE 6. Grades obtained at the OBA event for the Livramento School, Batista School, and Arquidiocesano School. Source: Authors.

Search for the Oldest Stars in the Galaxy (by PhD S. Daflon - National Observatory - RJ); *Engineering in Astronomy* (by PhD V. Bawden - National Laboratory of Astrophysics).

During this program execution, it was verified that the private schools obtained better results in the OBA event, then the public schools. Possibly, it is due to a greater support of the school staff and greater commitment with the delivery of the OBA's grade results to the program.

Concerning the public schools of the region, only one was interested in the tutoring for the OBA event (Livramento Municipal School, which had the participation of all their students). The other public schools in the region only attended workshops held throughout the year, since they were not willing to participate in the tutoring action.

4. Conclusion

Since the creation of this program, it has been possible to verify the impact of their actions in the community, which shows a quantitative increase of people interested in Astronomy and Astrophysics, as well as an increase in the number of participants and medalists in the OBA event. The program provided the opportunity for diffusion of new knowledge in Astronomy, Astrophysics, Sciences, and Engineering, through seminars, mini-courses, tutoring, workshops, and technical visits. It is aimed, from now on, the optimization of the methods to publicize its actions, and increase the number of people benefited by this program.

In a social context, for young students of a high level of socioeconomic vulnerability, the actions proposed here gave the possibility of a new perspective for a future academic study (never thought before). Concerning students of private schools, these actions constitute a different opportunity, among those already available for them.

Regarding the teaching of Astronomy and Astrophysics in schools, it is noticed that the little-studied is in the curriculum. Students have little knowledge about the theoretical basis of the study, its importance in everyday life and also in the scientific knowledge currently developed.

Through this extension program, the engineering students (who worked as scholarship or volunteer holders) have the opportunity to put into practice the academic knowledge acquired, verify the application of engineering in astronomy, organize scientific events, workshops, and technical visits. Besides, they may get abilities to teaching and didactic skills for high school and elementary students.

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