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Closer to the sky: co-creating astronomical knowledge in the favela complex of Cantagalo Pavão Pavãozinho (PPG) in Rio de Janeiro

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Abstract. This project aims at co-producing scientific knowledge in collaboration between astronomers and artists/educators living in the PPG, for children, teenagers, and young adults of the community. We work in close collaboration with the social project 'Ninho das Águias', where classes and night sky observations will be held. Most of these children and teenagers attend public schools where in 2021, according to SAEB (gov.br), students do not reach a satisfactory level in Portuguese language and math. They hardly have access to after-school courses and do not tend to see themselves represented in the academic community. This produces a disadvantage in access to higher education and consequently in opportunities for decent employment. Offering extracurricular courses and cultural experiences to students in the PPG, we wish to enrich their school curriculum and strengthen the chance they wish to stay in education after secondary school. A key element of the courses is providing positive role models of scientists from Afrodescendant backgrounds, reinforced by the presence of local artists and educators, thus endorsing their role within the academic community. The project also creates decent work opportunities for local artists and educators, who will offer workshops rooted in favela culture, while at the same time creating novel, decolonial courseware based on contextualized science, i.e materials that use the context of marginalized societies as examples where we can understand, learn and make science. The material developed within the project will be shared as Open Educational Resources.

Resumo. Este projeto tem como objetivo co-produzir conhecimento científico em colaboração entre astrônomos e artistas/educadores residentes no PPG, voltado para crianças, adolescentes e jovens adultos da comunidade. Trabalhamos em estreita colaboração com o projeto social 'Ninho das Águias', onde serão realizadas aulas e observações do céu noturno. A maioria dessas crianças e adolescentes frequenta escolas públicas onde, em 2021, de acordo com o SAEB (gov.br), os estudantes não alcançaram um nível satisfatório em língua portuguesa e matemática. Eles raramente têm acesso a cursos extracurriculares e dificilmente se veem representados na comunidade acadêmica. Isso gera uma desvantagem no acesso ao ensino superior e, consequentemente, em oportunidades de emprego digno. Oferecendo cursos extracurriculares e experiências culturais aos estudantes do PPG, desejamos enriquecer o currículo escolar deles e fortalecer a chance de que desejem continuar na educação após o ensino médio. Um elemento-chave dos cursos é fornecer modelos positivos de cientistas de origem afrodescendente, reforçados pela presença de artistas e educadores locais, promovendo, assim, o papel deles dentro da comunidade acadêmica. O projeto também cria oportunidades de trabalho digno para artistas e educadores locais, que oferecerão oficinas enraizadas na cultura da favela, ao mesmo tempo que desenvolvem materiais pedagógicos inovadores e decoloniais baseados em ciência contextualizada, ou seja, materiais que utilizam o contexto de sociedades marginalizadas como exemplos para compreender, aprender e fazer ciência. Os materiais desenvolvidos no âmbito do projeto serão compartilhados como Recursos Educacionais Abertos.

Keywords. Teaching of Astronomy

1. Introduction

"Closer to the Sky" is a transformative initiative that brings together astronomers, artists, and educators in the Cantagalo-Pavão-Pavãozinho (PPG) favela of Rio de Janeiro. This project aims to provide scientific knowledge, cultural experiences, and English language education for children and young adults in the community. Through extracurricular courses, night sky observations, and highlighting role models among Afro-descendant scientists, the program fosters curiosity and learning. While primarily focused on Brazil, "Closer to the Sky" has expanded its reach with partner initiatives in India and collaborations with teams in Argentina, Chile, Italy, and the United Kingdom. Funding for the project comes from FAPERJ (Fundação de Amparo à Pesquisa do Estado do Rio de Janeiro), the Office of Astronomy for Development of the International Astronomical Union (OAD/IAU), and voluntary donations. The program's activities take place at the "Ninho das Águias", a cultural and educational space situated at the highest point of the Pavão-Pavãozinho favela. Once an open-air dump, this area was transformed in 2011 by artists Acme and Iani into a vibrant community learning hub. Today, it hosts a variety of activities, including tutoring, literature classes, English lessons, and breakdance.

In 2014, the space expanded to include the PPG Community Library, a dedicated area for studying and educational initiatives. Astronomy classes for children began in 2022, and in 2023, classes were also introduced for adolescents and young adults. Plans are underway for a three-year program to certify students as astronomical guides through the OAD/IAU. The curriculum covers key topics in astronomy, such as the Solar System, stars, galaxies, cosmology, and cultural astronomy, with a focus on diverse cultural understandings of the cosmos, moving beyond the traditional Eurocentric narrative often seen in science education.

2. Challenges

Currently, four students are part of the program, including one with an intellectual disability. During the first year of OAD/IAU fundings, we faced significant challenges, particularly with female dropout rates. This was largely due to a lack of encouragement for young women to continue their education and the added burden of domestic responsibilities. To address this issue, we are introducing a retention incentive program, providing finan-

Figure 1. A group of students participating in the "Closer to the Sky" project.

cial aid to support their continued participation and ease these pressures.

In addition to dropout rates, students struggled with grasping abstract concepts and maintaining focus during lessons. To overcome these challenges, we are developing a reference booklet to reinforce learning and support independent study. Students were also encouraged to conduct their own research on topics of interest, fostering curiosity and personal investment in their education. Lessons are designed to be interactive and engaging, incorporating hands-on activities to make the material more accessible and enjoyable.

The curriculum blends theoretical and practical approaches to maximize student engagement. Concepts are introduced in theoretical lessons through methods like whiteboard teaching, videos, and visual presentations. Practical activities are essential, involving interactive exercises, experiments, and astronomical observations using telescopes and remote systems. Field trips to the Planetarium of Rio de Janeiro and the Valongo Observatory immerse students in real-world scientific environments. Guest lectures by experts cover topics such as the Solar System, galaxies, dark matter, stellar evolution, and the importance of outreach in astronomy.

By integrating these strategies, the program not only imparts scientific knowledge but also nurtures critical thinking skills and deepens students' appreciation for science, empowering them to see themselves as part of the scientific community.

The program introduces astronomy while addressing gaps in traditional school curricula by exploring topics like creating astronomical color images. This approach challenges students to engage with complex subjects, fostering a deeper scientific understanding. The initiative also ignites curiosity and motivates students to excel academically.

Learning English is emphasized as essential for future academic success and career opportunities. Additionally, the project introduces programming skills, preparing students for fields with promising professional growth. A dedicated website is being developed, featuring reliable sources and easily understandable videos. Plans are also underway to publish a physical resource, such as a book, thoroughly covering the project's content.

Beyond academic knowledge, 'Closer to the Sky' fosters a passion for learning and a sense of belonging within the scientific community. Participants have reported increased happiness and motivation to pursue their studies. We report here that one student enrolled in university this year, and another, who is starting high school, is eager to study astronomy at university.

Figure 2. The first image shows a night sky observation event held at "Ninho das Águias". The second image captures a collaborative street observation activity conducted with `@telescopioderua`.

3. Connecting Science with Everyday Living

The program connects scientific inquiry with students' personal experiences, creating a dynamic learning environment beyond the classroom. By linking scientific concepts to everyday life, students develop a lasting appreciation for knowledge and cultivate a critical understanding of the world. This model shows that science is not an abstract subject, but an essential part of their lives.

"Closer to the Sky" addresses the disconnection between science and society in Brazil, bridging this gap by bringing science directly to underserved communities. It emphasizes the scientific method as a tool for critical thinking.

The initiative aims to redefine science's role by fostering inclusivity, curiosity, and lifelong learning, cultivating a new generation of scientifically literate, culturally aware, and socially responsible thinkers and leaders.

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