

Protoplanet express, a video game based on hydrodynamical simulations

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High-resolution observations obtained during the last decade show that protoplanetary discs can be very complex objects. Rather than uniform discs, we see that they have large cavities, spiral arms, rings, gaps, and asymmetries. To understand these features, astrophysicists many times have to develop numerical simulations, in which planets or unseen stellar companions are added to reproduce the observed morphologies. While the spectacular observed images are popular in mainstream media, the simulation side is rarely known by the general public.

We have created “Protoplanet express”, a video game in which the user visits different known protoplanetary discs, which are rendered in 3D from actual hydrodynamical simulations. The user will encounter in the models the same features observed with ALMA and other telescopes, and their goal will be to find the reason for each of them. For example, the user completes a level once they find the planet causing an observable gap in the disc.

Please find a copy of the poster at https://jrcuadra.github.io/plaga/larim_ppe/ and a related article at <https://arxiv.org/abs/2303.17654>. The game is available at https://store.steampowered.com/app/2601120/Protoplanet_Express/

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Astronomy and non-formal education as promoters of scientific literacy: the case of the Rodolpho Caniato astronomical pole

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Astronomy is one of the Sciences that most causes fascination and curiosity in the general public, and thus, it can be used as a gateway to motivate the interest and participation of students and the general community in the scientific enterprise, thus enhancing the formation of scientifically literate citizens. , capable of making critical decisions about the world around them. As a way of working towards this cause, the use of Non-Formal Education spaces becomes an interesting alternative. In this sense, as a way of exemplifying how this relationship between Astronomy and the formation of scientifically literate citizens

occurs, this work presents an overview of the activities and research in teaching carried out within the scope of the Rodolpho Caniato Astronomical Pole, located at UTFPR Campus Campo Mourão, Brazil, to which scientific literacy indicators are associated and discussed.

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Proposal for teaching astronomy in Brazilian middle schools based on Gagné's learning theory

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Qualified teaching of Physics requires alignment between a learning theory (psychological, descriptive) and grounded methodologies (SILVA FILHO; FERREIRA, 2009). Gagné's theory, developed in the transition between behaviorists and cognitivist during the behaviorist AND cognitivist transition (MOREIRA, 2022), frames learning as hierarchical information processing. This structure involves: **a. Discrimination** (distinguishing stimuli), **b. Concepts** (classifying objects), **c. Rules** (applying symbols like math), and **d. Higher order rules** (problem-solving). A Brazilian high school Astronomy course (13 hours, six modules) operationalized this theory through nine instructional events, focusing on gravitation via reflective, theory-guided activities. Students synthesized learning by creating mental maps, analyzed using Novak and Gowin (1984) criteria: concept hierarchy, thematic scope, original ideas, and technique application. Results demonstrated that most students successfully organized concepts and established relational dependencies. The integration of Gagné's theory with the methodology promoted hierarchical, meaningful learning with critical and interdisciplinary components. Key indicators-autonomy, conceptual relationships, and hierarchy-validated the approaches effectiveness, supported by complementary epistemological and methodological frameworks. This case underscores the value of theory-driven pedagogy in fostering structured, engaged learning.

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Astronomical outreach activities at the Observatorio Astronómico Los Molinos

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In this poster we present the different outreach activities that take place at the Observatorio Astronómico Los Molinos (from here on, OALM), located at the outskirts of Montevideo, Uruguay. Face-to-face activities, as well as social networks interactions (which have noticeably increased after 2020) are shown, as a way to take Astronomy and related sciences to as many people as possible.

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A didactic experience in the study of the proper motion of stars in the classroom

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The proper motion of stars is a very important topic in an Astronomy course. In principle, it allows us to measure the spatial speed of the stars in relation to the Sun and, from this, determine distances and other stellar parameters, allowing us to probe the proximities of the solar neighborhood and the speed of the local stars in the galaxy. That is why a work carried out by the Physics teachers in the subject of Astronomy II of the “Héctor Medici” Institute is presented. The work unifies a historical view of how and what was interpreted in the year 1718 when Edmund Halley found that the stars Sirius, Arthur and Aldebaran had moved in the sky more than half a degree since the observations made by Hipparchos, along with a didactic sequence. That is where students, through actions, link their knowledge and previous experiences, with some question that comes from reality and with information about an object of knowledge, managing to differentiate the improper movements of the stars, in which the coordinates stars are affected to the same extent by the movement of precession, nutation and aberration of light, deducing that only the proper movement corresponds to the real movement of the stars. One of the examples that has been highlighted in class is the proper motion of Barnard’s Star moving 10.2”/year. One of the tools on which the work is based is the information from the Tycho catalog, as well as measurements made by Hipparchos and Gaia satellites.

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Citizen science on the fireball detection network: Bóldos del Cono Sur (BOCOSUR)

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We have successfully established a national fireball detection network, comprising 20 stations strategically positioned to cover the entire Uruguayan territory. The primary challenge we encounter is managing the substantial volume of generated data, leading us to initiate a crucial Citizen Science project. To widely disseminate the BOCOSUR Project, we crafted a website featuring comprehensive information and a fireball report form. Concurrently, we installed stations in high schools nationwide and conducted over 30 talks, engaging with a diverse audience of over 1000 students. Additionally, we conducted 4 virtual training workshops tailored for high-school teachers and students eager to contribute to video analysis within the network. Each workshop comprised 3 sessions. The initial meetings focused on presenting the project and delving into essential theoretical concepts, showing station operations, and imparting manual video classification skills. The third session aimed at applying acquired knowledge to video classification. Across these editions, we had 141 participants, including 105 students and 36 teachers from 40 different institutions. Around 70 participants successfully completed all activities. In the latest edition, over 1400 videos were analyzed, uncovering 170 meteors. Recently, we concluded the first phase of developing a web app for swift video classification. This was tested in a workshop with 30 teachers from diverse institutions, resulting in the classification of 70 as meteors, from a pool of almost 400 videos. Building a comprehensive database, not limited to fireballs, is crucial for training the machine learning classification algorithm developed by the AutoBol group as an Electrical Engineering final project (Ballestrino et al. 2022).

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AstroMicro: astronomy arrives in micro to television

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In the summer of 2023, the educational channel of the Chilean television channel TVN broadcasted the first six episodes of the show “AstroMicro”. The event was a significant milestone for this interdisciplinary scientific communication project, bringing astronomers, animators, filmmakers, producers, writers, and project managers together. “AstroMicro”, jointly funded by the TV channel, the Chilean Astronomy Society, and the Chilean Agency for Research and Development (Agencia Chilena de Investigación y Desarrollo), occurs on a “micro” where all the astronomical concepts are revisited with simple but accurate jargon relating the different experiences of the diverse passengers to everyday experiences in a bus. This approach avoids hierarchical communication within the team from the very early stages of the project, fostering communication and avoiding outsourcing the creative components of the product. In this talk, we will share details of the story behind the production, from the original idea to the screening of the first episodes.

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RECA: Promoting career development opportunities in astronomy to students of Colombian institutions

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The Network of Colombian Astronomy Students (RECA) is a student-led association formed in 2014. It seeks to support the astronomy student community with the aim of 1) Connecting the astronomical community with the main goal of supporting early career astronomers in Colombia, and 2) overcoming systematic barriers in academia and research. Early career and senior Colombian astronomers conform to this collaborative community. We will highlight the work from 3 nodes. The RECA education program works with schools from all regions of Colombia, providing tools and interaction with Colombian professional astronomers, using virtual chats, connection to remote observations in large telescopes, or personal counseling. The RECA mentoring program connects undergraduate students with astronomers in advanced career stages.

They have personalized tutoring one-on-one, for career advice and guidance for applying to graduate programs in astronomy. Furthermore, the RECA summer internship program provides the opportunity for Colombian undergraduates to participate in astronomy research projects led by professional astronomers around the globe. All the programs are running their third version, and their successes have been seen with the positive impact of synergies within the Colombian student population of all academic levels. Funding for some programs has been obtained from national and international entities. The work of the RECA nodes highlights the importance of a student-led community both in connecting the astronomical community, and supporting beginning astronomers.

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The 0th Meridian of Buenos Aires **D. D. Carpintero^{1,2} and R. B. Orellana^{1,2}**

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The Buenos Aires meridian was used at the end of the 19th century as a reference origin to establish limits between the provinces and the then national territories. However, the exact position that materialized this meridian could never be established, with the consequent uncertainty in the limits that depended on it. In this work, we determine for the first time the exact position of the meridian of the city of Buenos Aires.

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Hands-on activities for studying light pollution: photometric measuring of zenith night sky brightness

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Night sky brightness (SB) is an important quantity to investigate light pollution contamination at a given site. It can be measured by different methods and apparatus, resulting in different forms of analysis and comprehension of the artificial light regime. The objective of this work is to present some of these measuring methods in order to elaborate hands-on scholar activities material. Two main methods were tested during the year of 2022 at the Observatório Abrahão de Moraes (Valinhos, SP, Brasil): by telescope with coupled CCD camera (the Argus telescope) and by IOS Dark Sky Meter (DSM) app.

Values for SB were found for the photometric Johnson B ($16,82 \pm 0,30$ mag/arcsec²) and V filters ($16,49 \pm 0,48$ mag/arcsec²), indicating that the sky at the observatory is highly light polluted, similar to big cities. The DSM app was consistent in its own scale to evaluate night sky brightness variations. However, it is roughly compatible with V or B bands from the UBV Johnson system, showing fainter magnitudes with 2,5 mag offset. The results were used to elaborate a script to conduct similar activities, both locally at a given observatory or remotely through the “Telescópios na Escola” project, allowing students to measure SB with the same Argus telescope used during the work. We also addressed experiments with the DSM app for light pollution teaching and outreach, in order to promote awareness and discussions about its impacts where the usage of astrometric apparatus is neither viable nor recommended.

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The scientific contributions of the first modern Colombian astronomer

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Astronomical interest within the current Colombian territory has its roots in the Botanical Expedition of the New Kingdom of Granada, which stimulated the creation of an astronomical observatory in 1803, the first one established in the New World to pursue systematic observations and meteorological studies. After the death in 1816 of its first director, Francisco José de Caldas, during the convulsive independence period, no major astronomical observations were made for decades, with few exceptions. In this work we delve into the contributions of the astronomer José María González Benito (JMGB), main reactivator of the National Astronomical Observatory of Colombia (OAN) in the second half of the 19th century, pointing out his pioneering efforts that put worldwide attention to it, and to his own private observatory. We have collected evidence supporting the fact that JMGB was one of the most important figures in the history of Colombian astronomy, not only due to the advances and discoveries that he achieved as a result of innumerable investigations and projects but also because of his unique sense of patriotism. As director of the OAN and of his private observatory (Flammarion Observatory), JMGB made numerous observations on different astronomical topics, being reports on comets among the most extended ones. In 1893 he observed the comet Rordame-Quénisset, nine days before the observations made from the US and France that were the ones designated as the official discovery. JMGB also observed meteor showers: the Leonids, on 14 Nov. 1867 and 13 Nov. 1899, and an unidentified one he reported on 24 Nov. 1872 in Andromeda. JMGB was a well-known astronomer in Europe and kept continuous communication with his colleague and friend Flammarion. Indeed, JMGB made observations from the Flammarion Observatory that had been completely unknown by the Colombian academic community until found by this research.

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Teaching astronomy basic concepts using smartphone sensors

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Smartphones are computers that, in addition to fitting in the palm of the hand, have the additional advantage of including several sensors that, with the appropriate knowledge, allow these devices to be transformed into very useful and economy portable laboratories for doing and teaching science.

In recent years, dozens of experiments have been proposed to teach science and to engage students by allowing them to do science on their own (Monteiro 2022), and in particular as valuable tools to teach astronomy (Monteiro 2020). Some activities can be carried out in basic courses of astronomy at high school and university. Using the smartphone's camera students can perform parallax stellar distance measurements on a scaled system to obtain the distance and the parallactic ellipse (Fitzgerald 2011). By using the light sensor of a smartphone, students are able to measure the light curve of a 3D printed scale asteroid to determine the period and shape factors (Ziffer 2019). Another useful activity with the same sensor aids to learn how to discover exoplanets by planetary transits in a scaled star system (Barrera-Garrido 2015).

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The Manuel Foster Observatory - History, science and new life of the first professional Observatory in Chile

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The history of the Manuel Foster Astronomical Observatory, affiliated with the Pontificia Universidad Católica de Chile and situated in the heart of Santiago's Metropolitan Park on top of San Cristóbal Hill, presents a prime opportunity to promote astronomy and natural sciences to the general public. Established in 1903, the observatory stands as one of the oldest in the Southern hemisphere. At the forefront of cutting-edge research in the early 20th century, it was designated a Historical Monument in 2010, and since then, it has garnered increasing attention from the public. Given the few million visitors and tourists who annually visit San Cristóbal Hill in Santiago, the Foster Observatory has undoubtedly become an essential stop on their journey. We highlight the scientific achievements, infrastructure and the recent transformation and repurposing of the

Foster Observatory into an astronomical museum and outreach center. Our goal is to preserve and educate using its unique and original historical assets. We offer weekly diurnal and nocturnal observations that pave the way for a regular visitor program, primarily targeting students from educational institutions across the region, country and the continent.

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QUBIC Observatory: Education, Outreach and Culture connected with the origin of the Universe

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The link of the human being with the cosmos is ancient. However, the approach to knowing what the universe is like has changed remarkably over time. New projects, with avant-garde instrumentation, are installed in astronomically exceptional regions, where the ancestral culture of native peoples has existed for centuries. Such is the case of QUBIC (Q-U Bolometric Interferometer for Cosmology), an instrument that aims to detect evidence of the time of universal inflation, installed in November 2022 in the Puna of Salta, land of the Kolla, Kolla del Desierto, Atacamas peoples, among others. At this crossroads between ancestral knowledge and modern science, QUBIC has developed, even before its realization, a link with the local inhabitants and seeks to establish a bridge between both cultures where, in addition, art has its space. In this presentation we seek to show a possible way to address the issues of education and dissemination of astronomy and astrophysics, living with them and transmitting their ideas to the world, maintaining the complex balance between these two cultures, to ensure that local communities take ownership of scientific developments that, without a doubt, contribute to the progress of not only of science, but also of the sites that host them and the local populations.

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Education and astronomical diffusion activities in Bolivia

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The activities of education and dissemination of astronomy in Bolivia, intend to reflect the work done with students, teachers, amateur astronomers, and the general public in the different regions of Bolivia, both in rural and urban areas. sharing the objectives of the IAU, with a public that for the most part is still unaware of this important institution. work that motivates us to continue growing.

¹NOC NAEC BOLIVIA International Astronomical Union.

A Journey to the Moon: exploring multisensory resources in the teaching and learning of Astronomy

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Astronomy education has the potential to inspire students to be engaged in STEM. However, to achieve this in the classroom is essential to promote equal access to information for everyone. Historically, Astronomy teaching uses mostly visual information as a resource. Given this, blind and visually impaired (BVI) students may encounter educational barriers in accessing information, as they need teaching materials adapted to their specific educational needs. Thus, the *Universo Acessível* project, located at the Valongo Observatory (UFRJ) in partnership with the Instituto Benjamin Constant, aims to develop didactic resources to improve the teaching and learning process of Astronomy for BVI students. The Brazilian Basic Education curriculum, focusing on Earth and the Universe, encourages students to reflect on the characteristics and position of celestial objects and the human species in the cosmos. Therefore, Astronomy Teaching plays a crucial role in students recognizing their position and role in the Universe. In this work, we present three multisensory resources for teaching about the Moon: tactile models, booklets, and a talking book. This initiative responds to challenges identified through qualitative research with Brazilian teachers, addressing difficulties in understanding astronomical concepts within the school curriculum. The Moon, along with related concepts, is a key component in most basic science education curricula. Each resource presents its specificity by engaging students through minds-on, hands-on and hearts-on interactions. The integration of multisensory resources fosters autonomy and inclusion. This

approach contextualizes the learned content, instilling in teachers and encouraging critical thinking by highlighting historical and social backgrounds. It promotes interdisciplinary exploration and facilitates the exchange of personal experiences. Extending beyond people with disabilities, it reaches a diverse audience, ensuring proper usability and specificity for each resource. Active user participation is crucial to understand their real needs, overcome barriers, and seek new ways to make Astronomy accessible. In essence, these actions help to make the Universe, everyone's home, accessible.

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Bridging Astronomical heritage and society in a science museum: Historical scientific instruments as a tool to preserve our history

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Building bridges between society and historic scientific instruments (HSIs) in a museum collection is a challenging task, due to the different historical and sociocultural backgrounds involved in the construction of Brazilian society. Creating an environment that encourages dialogues about heritage and learning the history of national Astronomy through these artifacts requires the use of methodologies that foster the connection between the public and the objects. In this work, we aim to share some of the educational practices developed and applied using the astronomical artifacts from the collection of the Museum of Astronomy and Related Sciences (MAST), exploring not only their role in history or pedagogical dimensions but also their role in the process of constructing society, promoting dialogues and critical reflections on scientific culture. Through activities such as mediated guided visits, the project follows four main pillars: (1) models and modeling, (2) three-way interactivity (hands-on, minds-on, hearts-on), (3) museum education, and (4) horizontal teaching and learning. These aspects promoted the exploration of the HSIs from the collection that played an essential role in the development of Brazilian Astronomy, giving them a new meaning that transcends the walls of an exhibition. Using them as a powerful tool to bridge Astronomical heritage and society, it is possible to expand the socio-pedagogical dimension of the collection, promoting the process of identifying the public, since our memories, culture, and history as a society are also intangible heritage to be preserved.

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Astronomy and sustainable cultural tourism. A proposal for the construction of the first cultural planetarium in Soacha-Colombia

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Commune VI of Soacha, Cundinamarca, faces challenges impacting its population. In areas like Altos de la Florida, existing tourist attractions could alleviate difficulties for residents, mainly families displaced by violence. The main community issues include limited formal education access, social stigmatization, and informal employment. Despite significant tourist potential in the municipality's hills, issues persist. There is a drive to promote a positive image through astronomical tourism, developing Soacha's first planetarium. This initiative aims to foster respect for nature and stars, promoting education and enhancing quality through astronomy programs. The planetarium, as the municipality's first, enriches infrastructure and provides community astronomy training. The primary goal is to educate the community, leveraging a nonprofit group's scientific outreach expertise. The planetarium complements this effort, promoting science in areas with rich indigenous traditions. Ultimately, this social integration for scientific knowledge appropriation could serve as an example for Latin American regions facing similar issues and undiscovered cultural richness.

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Asteroid District: Extending citizen science from Bogotá-Colombia

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Asteroid District is a citizen science program started by the District University for the promotion and appropriation of knowledge and scientific dissemination, focus its attention on the study of Near-Earth Asteroids (NEA). It's important to show the academic community the results of the training and projections carried out as a didactic strategy that develops complex thinking and the systemic vision of science, allowing conceptual approaches, it makes that the search for asteroids activity is constituted as a socio-scientific issue.

The Astronomical Observatory "LatitUD" of the Faculty of Engineering of District University has organized since 2021 Asteroid District, asteroid search campaigns framed in "The International Astronomical Search Collaboration (IASC)"; It has allowed more than 1200 people to participate to do researching and making discoveries from main belt asteroids and trans-Neptunian objects.

This research shows the activities carried out by project, their potential of these campaigns in the social appropriation of knowledge and scientific procedures, results, tensions and prospects, seeking to develop citizen science from astronomy, as an axis of construction of critical thinking, for making informed decisions, the development of scientific vocations and learning of the sciences. In this way, the importance of learning from non-formal educational settings and the inter-institutional collaboration becomes evident.

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Ethnoastronomy of the Curripaco, Piapoco, Puinave, Sikuani and Cubeo ethnic groups

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In this collaborative research with students from a school in Colombia, we have explored and documented the rich tradition of indigenous astronomy from five ethnic groups: Curripaco, Piapoco, Puinave, Sikuani, and Cubeo. Our main objective was to rescue and preserve the unique astronomical knowledge of these communities, which has been transmitted through oral tradition and is at risk of being lost in the modern era. Throughout the process, we worked closely with respected members of each ethnic group, who shared with us their ancestral stories related to constellations and cosmos. Through extensive interviews and intercultural dialogues, identified the significant constellations for each ethnic group and documented the stories that accompany them. These stories not only hold astronomical value but are also intricately woven with beliefs, traditions, and ways of life of each community. Furthermore, we have created a unique star map that depicts the constellations of these ethnic groups, labeling individual stars with their scientific names and their corresponding names in indigenous languages. This map acts as a bridge between ancestral knowledge and contemporary science, enabling a deeper understanding the connections between both perspectives. One of the most striking findings of our research is how constellations are intricately linked with everyday practices, such as food agriculture. Each ethnic group has developed its own worldview that reflects its natural environment and its relationship with the land and the sky. Ultimately, our research not only highlights the importance of preserving these valuable traditions but also underscores the richness and diversity of human knowledge about the universe. By sharing these stories and insights with the global astronomy community at this international event, we hope to foster a greater appreciation for the connection between science culture, as well as inspire ongoing efforts to safeguard the voices and perspectives of indigenous communities in modern world.

¹ Colegio La Primavera- Guainia- Colombia.