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ASTROPARAMO. SCIENCE CLUB OF PLANETARY HABITABILITY AND CLIMATE CHANGE

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ABSTRACT

We introduce Astropáramo: an initiative of science clubs in rural educational institutions in very remote regions of the Santurbán páramo. This initiative uses a mobile laboratory of didactic experiments initially developed by the University of Munich within the project "Climate change: understanding and acting". Taking advantage of the innate charisma for stars in the inhabitants of the mountainous areas of Colombia, we use the teaching of astronomy as a bridge to recognize our planet as the only home and understand the science and importance of climate change. The first version was developed with three educational institutions in the paramo area. The students had synchronous encounters with an instructor via WhatsApp: the only means that the pandemic allowed the connection of students in remote areas of the country. Thanks to this medium, the young people could share their experiences and doubts they encountered in the development of the experiments. Thus, despite the adverse conditions of the pandemic, favorable spaces were generated for debate and the construction of knowledge, demonstrating that science is inclusive, fun, and can be available to everyone.

RESUMEN

Presentamos Astropáramo: una iniciativa de clubes de ciencia en instituciones educativas rurales de regiones apartadas del páramo de Santurbán. Aprovechando el encanto por las estrellas innato en los habitantes de las zonas montañosas de Colombia, usamos la enseñanza de la astronomía como puente para reconocer nuestro planeta como único hogar, y comprender la ciencia e importancia del cambio climático. Esta iniciativa se vale de un laboratorio ambulante de experimentos didácticos desarrollado inicialmente por la Universidad de Munich en el marco del proyecto "Cambio climático: comprender y actuar". Un módulo de monitoreo climático acompañado de una estación meteorológica y un conjunto de podcast que orientan a los estudiantes en casa y colegios. La primera versión, se desarrolló en conjunto con tres instituciones educativas de la zona del páramo. Los estudiantes tenían encuentros sincrónicos con un instructor vía Whatsapp: el único medio que en la pandemia permitió la conexión de estudiantes en zonas apartadas del país. Gracias a este medio, los jóvenes pudieron compartir sus experiencias y las dudas que encontraban en el desarrollo de los experimentos. Así, a pesar de las condiciones adversas de la pandemia, se generaron espacios propicios para el debate y la construcción de conocimiento, demostrando así que la ciencia es inclusiva, divertida y puede estar al alcance de todos.

Key Words: Astroparamo — climate change — inclusive education — rural areas

1. INTRODUCTION

Climate change is currently a global concern. Everyday, we can see its destructive effects, and as time goes by, we have less time to solve this problem. Consequently, we started to wonder if it is possible to inhabit other worlds or how we could identify another Earth-like planet; in case ours is no longer habitable. So far, we know that the journey to other planets is not easy; therefore, it is essential to preserve our Earth. Being aware of this problem, the Halley astronomy group, from the Universidad Industrial de Santander in Colombia, developed an educational project called Astroparamo.

Astroparamo seeks to use the teaching of Astronomy as a bridge to raise awareness about climate change in children and young students from different educational institutions in the country. For the project's construction, the Klimawandel project manual, by its German name, was used as a reference. Through simple guides and experiments, it is an educational project that pursues to teach and raise awareness about climate change among young people, relying on Astronomy, especially astrobiology.

With the support of one of its creators, Dr. Cecilia Scorza, we translated the manual into Spanish

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and adapted the kits with all the teaching material (Scorza et al. 2019).

Another project involved is the RACIMO (Spanish acronym of Red Ambiental Ciudadana de Monitoreo project (Asorey et al. 2017; Peña-Rodríguez et al. 2022). This is a citizen science initiative that focuses on getting schoolchildren actively involved in collecting and analyzing environmental data using a weather station. With the basis of the project, we wanted to focus it initially on the rural population of our country, which represents around 20% of the total Colombian population.

2. PROJECT PERFORMANCE

Astroparamo is part of a larger project called "Natural Investigators" developed in the Universidad Industrial de Santander. Three municipalities in the department of Santander participated in this first version: Tona, Vetas, and Surata. They are small towns, far from big cities, with limited internet access and even poor mobile connection, but surrounded by the Páramo de Santurbán, a unique and enchanting ecosystem of vital importance and care for the villages around them.

3. SOCIO-ECONOMIC CONTEXT

Once we identified the population for our first version, we decided to understand some of the conditions and facilities of internet access, among other aspects of our participants.

The project started in August 2021, with 29 students (between the ages of thirteen and sixteen). One of our objectives was to guarantee the gender approach. For this, we required educational institutions to enroll at least 50% of female participants. In Fig. 1(left panel), we show the participation of 62% of women, achieving our objective. Girls are much more limited in participating in extracurricular activities. This limitation is due to gender stereotypes, such as the belief in some areas that "women should stay at home", in addition to dangers that girls may face outside their homes due to the social contexts in which they find themselves immersed. The Presidential Council for Women's Equality exposes this situation in the document "Panorama of gender equality for women in Colombia" (Presidential Council for Equity for Women 2021). To face this challenge, and due to the pandemic, the project was developed and monitored remotely. The methodology will be explained in the next section.

We inquired about the ease of transportation to their school, even though most children lived close to it. In Fig. 2(right panel), 14% of students took more

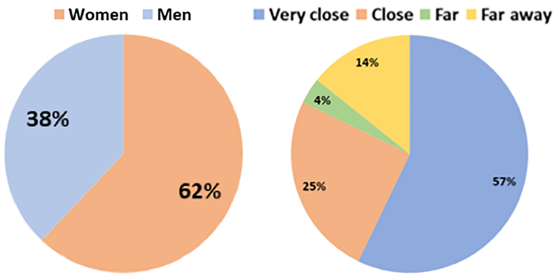

Fig. 1. Left: The proportion of boys and girls who participated in the project. Right: Proximity to school.

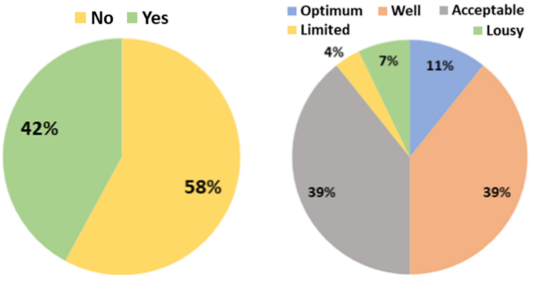

Fig. 2. Left: Presence of a computer at each participant's home. Right: Perception of internet connection of each participant.

than an hour to get to school, including by car. Furthermore, our team considered computer access and availability to connect to the internet. In Fig. 2(left panel), we realize that a significant portion, being 58% of the students, did not have a computer. In addition, in Fig. 2(right panel), we show that internet access was not optimal but limited or acceptable. During the project development, we evidenced that, on rainy days, many of them completely lost internet connection. They did not even have a mobile signal to receive or make calls.

According to Fig. 3(left panel), the internet connection in their homes was principally received by usng Wi-Fi or mobile data. Figure 6(right panel) illustrates that the number of devices to connect to Wi-Fi was one or two, and the whole family had to use them, but only 22% of them had a device to connect.

At the end of this program, some students experienced difficulties and could not fully complete it, as they did not have much time due to academic activities, or some had to work to help at home and preferred to quit.

4. EDUCATIONAL TOOLS AND METHODOLOGY

Based on the conditions described and the pandemic, we adapted to the needs of our participants and im-

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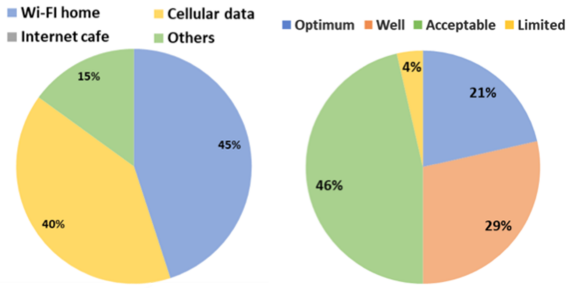

Fig. 3. Left: Type of internet connection of each participant. Right: Number of devices to connect to internet (Optimum: has 2 or more devices and at least 1 personal-Well: has 2 or more devices for family use. Acceptable: has at least 1 device for family use. Limited: does not have access to a device connected.

plemented four experiment kits from Klimawandel's original design (see Fig. 4). In the beginning, each student receives one of the kits, which is autonomous and has instrument packs and didactic guides to develop each proposed experiment.

Figure. 5 lists the content of kit 1 named "The astronomical observation of unknown worlds", equipped with 12 packages for 12 experiments, some simpler than others.

To illustrate, package 1 of this kit proposes the "earth translation movement" activity. It provides a two-page guilab (laboratory guide), as shown in Fig. 6, that explains the phenomenon in a didactic way. A scientific challenge (Fig. 7), which explains how to use the materials to experimentally observe the translation movement, is also included. In addition, the scientific challenge contains in-depth questions about the experiment, that children can answer in a follow-up blog that they write themselves. Each package of every kit contains its respective guilab and scientific challenge, accordingly. We invite you to visit the Astroparamo page to find more information about the other kits.

To follow up on the activities, solve questions that participant may have, we created WhatsApp groups in each municipality. Once a week, at a previously arranged time, the students could share their experiences and questions supervised by a tutor from the Astroparamo team. After two weeks, each student passed the kit to other participant, in order for everyone to completed the full training. Individual calls were sometimes necessary if one of the children did not report during the week. We also have a fifth module, accompanied by a climatic station called EVA (Spanish acronym for Estación para la Evaluación Ambiental). Provide by members from the RACIMO project, EVA measures climatic variables of temperature, humidity, precipitation, irradiance, and pressure. One student per municipality had this station accompanied by a Python Book called Venice, that allows visualizing daily changes in each of the measured variables (González Matoma 2021). The measurement of these environmental variables in the agricultural areas where we carry out the project is essential, since changes in the climate affect the final products of their harvest.

Fig. 4. Some of the kits sent to the participant (left image) containing the implements shown in the right image.

Kit 1- The astronomical observation to unknown worlds

Package 1
- 4 blue planets with bases
- Bulb base
- Yellow Bulb

Package 2
- Eclipse model base
- Sliver (4)
- Planet and moon model

Package 3
- 6 vinyl jars

Package 4
- Sheet of paper (1)
- Compass string

Package 5
- Sheet of paper (2)

Package 6
- Envelope of masks Monday, earth, and ropes

Package 7
- Exoplanets Pack

Package 8
- Simulator Envelope

Package 9
- Flashlight

Package 10
- Rule
- Pencil
- Square
- Glue
- Pair of scissors
- Counter paper roll
- Compass
- Brushes

Package 11
- 15 Styrofoam balls

Package 12
- Alcohol spray

Fig. 5. Content of kit 1.

Unfortunately, due to a fault in the installation, the EVA station of each municipality did not collect data that could be used by the students to plot and analyze. However, those with access to computers received training on their use.

It is necessary to emphasize measuring these environmental variables in these agricultural areas

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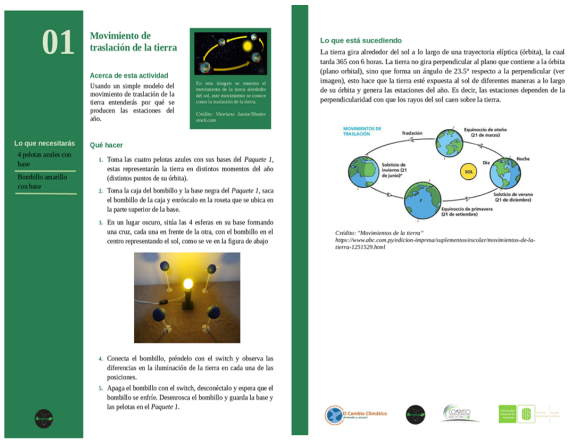

Fig. 6. Guilab package.

where we carry out the project, where changes in the weather affect the final products of their harvest.

In November 2021, still under the pandemic conditions, we managed to visit the towns, meeting and interacting personally with the students. The project was well-received by the students and teachers, and they expressed their will to continue and, if possible, include more students from other schools.

5. CONCLUSIONS

The Colombian rural population lives in difficult conditions and it corresponds to a significant percentage of Colombian residents. Therefore, it is crucial to develop initiatives that reduce the gaps in access to education, and astronomy can be a way to start.

Figure 7 displays a collage with some photos of evidence that the students sent through the WhatsApp group. Below we share a fragment of the experience of one of the participating girls, whose name we keep anonymous: "Astroparamo has been an interesting and great project. It aroused my curiosity and has allowed me to approach science by experimenting, reviewing, and concluding with the experiments. Each experiment has contributed to my knowledge of science (...). It has allowed me to be brave when presenting a new topic. It is an experience that I did not expect to have. Finally, the project has helped me obtain concepts that I have been able to apply in my daily routine, by putting them into practice. I have been noticing a big improvement in my life."

In the project context, it was fundamental, and we had good results by establishing a minimum quota for female participation from a gender perspective. In this first version, despite the challenges of communication via Whatsapp, the distant locations of students, the withdrawal of some of them,

Fig. 7. Scientific challenge, package 1, kit 1.

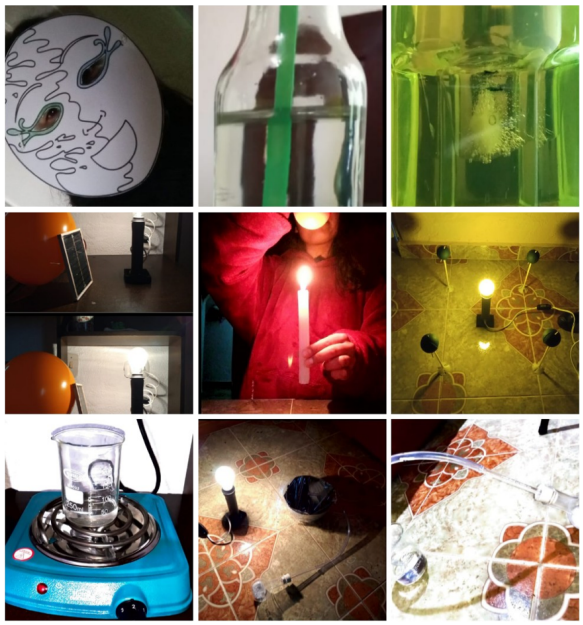

Fig. 8. Some pictures taken by the participants during the experiments.

and the damage to the EVA station, Astroparamo allowed the scientific approach by encouraging their curiosity about some natural phenomena and applying knowledge to their daily lives. In addition to bringing the public university closer to areas forgot-

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ten by the state where young people do not envisage it as an option for the future.

By 2022, we plan to continue growing the Astroparamo project, increasing the closeness with the participants and providing them with facilities to participate, improving the material and the EVA station. In the same way, we want to focus more and more on the needs of each municipality to generate a long-lasting impact.

We will continue working on easy-to-assemble didactic material and conclude the creation of our website where you can find all the material: https://halley.uis.edu.co/astroparamo/

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