Astronomical activities for all

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Abstract

We have developed a series of astronomical activities and tools specifically designed to help when teaching or communicating Astronomy to people with different kinds of disabilities. In particular, we will consider materials for people with cognitive disabilities, motor disabilities and vision impairments. We will present our most recent project: "A Touch of the Universe", a kit for the visually impaired. We would like also to note that all these materials are useful in regular astronomical activities, as they can help anyone by enhancing the learning process, regardless of their particular abilities.

Keywords

Astronomy, educational material, special needs audiences.

1. Introduction

Since 2003 our group has been developing astronomical outreach activities for groups of people with different disabilities. Here we will present a short description of the different tools we have created so far. The ones related to the International Year of Astronomy 2009 (IYA 2009) can be found in [1].

2. Interactive talks for public with cognitive disabilities

These were the first activities we developed and they were mainly short powerpoint presentations and hands-on activities related to those.

One of the presentations is mainly about astronomical images and the physical senses, and it is to be watched with sensorial stimula, the public touching cold, warm, soft things according to the presentation: touch ice when showing Europa's surface, or a baloon with warm water when showing Venus images. In this way thay make a connection between tha images and what they feel, smell or touch.

A second one is a trip from the Sun to the Cosmic Microwave Background, with images from the spaceships that travelled to the various planets. These two presentations are better shown with some relaxing music.

A third presentation is about a trip to the Moon and which means of transport one needs to get there. A few persons in the public are given a picture of different vehicles which they will be told later to append on a large poster for discussion.

Figure 1. *Building cardboard sundials and constellations with luminiscent stars.*

Along with the presentations we also organise some hands-on activities related to the topic covered. They include building a cardboard sundial, drawing constellations with luminiscent stars or building an astronomical mobile, depending on the abilities of each person and the topic of the presentation.

Figure 2. *Ladies showing their impressions about the life cicle of the stars*

Finally, we also created another talk, "The life of the Stars", in which the cicle of life of three different stars is told, from their formation in a protostellar cloud, to its final death, in an explosion, or quietly. The participants were told to make some drawings about the life of the stars, at the talk's midpoint. Those were lately used to make a book for people with cognitive problems [2]. Participants were also invited to observe the nearest of stars, the Sun.

Figure 3. *Observing the Sun*

3. Open source software for people with motor disabilities

Some people have motor problems, like those suffering from cerebral palsy or brain injury. Even speaking can be difficult for these persons.

A way to establish communication with the external world is through the use of a computer attached to the wheelchair, with a special software. The existent codes are not open source and have standard settings, so they cannot be adapted to the special characteristics of each person.

We have developed an easy-to-adapt open source software - "Astroadapt" - as an alternative to the regular market codes. In addition, our software includes astronomical contents in order to make astronomy more accessible to this group of people.

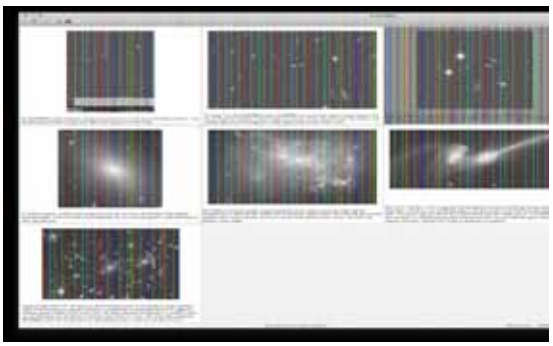

Figure 4. *Astroadapt: screen capture. The boxes are sequentially enhanced in colour.*

Figure 5. *Astroadapt: screen capture. When the user presses any key on the computer, the enhanced box is enlarged and a short explanation of the picture is provided.*

The software is on a multilingual platform, easy to translate into other languages. One can select the scan speed, colours, fonts, etc., according to the user preferences. It can save and reproduce sound files, and automatically read the texts.

4. Activities for people with visual impairments

Astronomy is a highly visual science, but there are ways to make it accesible to a visually impaired public. Here are some of the projects we developed in this field.

4.1 The Sky at Your Fingertips

Back in 2000, the Astronomical Observatory of Padova had the wonderful idea of creating a web page about astronomical concepts that could be read by the computer voice processor, along with figures specially designed to be printed in relief [3].

On occasion of the IYA2009, the site was renewed and we translated the web page into Spanish and printed a book with their contents, that was sent to different blind organizations, libraries and universities.

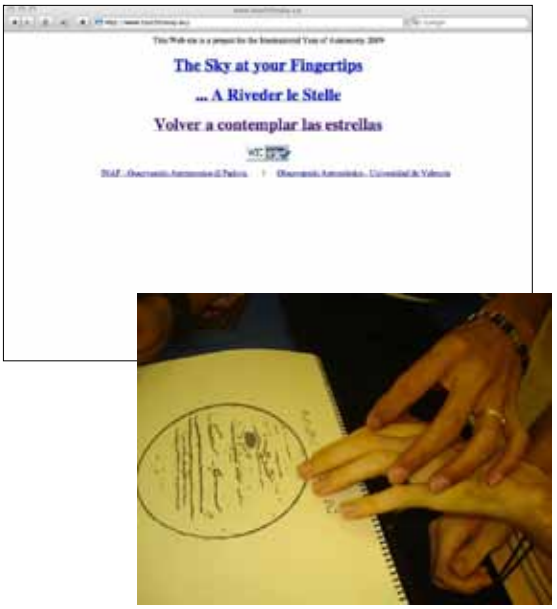

Figure 6. The Sky at Your Fingertips website (top) and the book in an exhibition at the University of Puerto Rico (bottom).

4.2 The Sky in Your Hands: a planetarium show for the visually impaired

Based on a previous experience by Sebastian Musso in Argentina, we wrote an original script, and every constellation or object was linked to its own sound effect. The soundtrack has seven channels and in this way we can have the sound of a particular object coming from the position on the dome where it is being projected.

We also designed a tactile hemisphere with constellations engraved in a way such that the

person holding it could touch the shape of the constellation and follow the script throughout the sky (see Figure 4). For this we used different sizes of ``stars'' and kinds of lines engraved on the spheres.

Therefore, we needed two narrators, one for the Astronomy program, the other one to guide the public through the half-sphere so they could find the sequence of objects that were explained in the program.

The show has been shown so far at planetaria in Valencia, Porto and Lisbon and some other small venues, like inflatable planetaria. It has been recently translated into English too and we are open to more people who wish to translate it into their own language.

Figure 7. *Premiere of the planetarium show "The Sky in Your Hands" at the Hemisfèric theatre in Valencia.*

The hemisphere has been selected to make part of the IYA 2009 Legacy collection at the Museum of Sciences in London

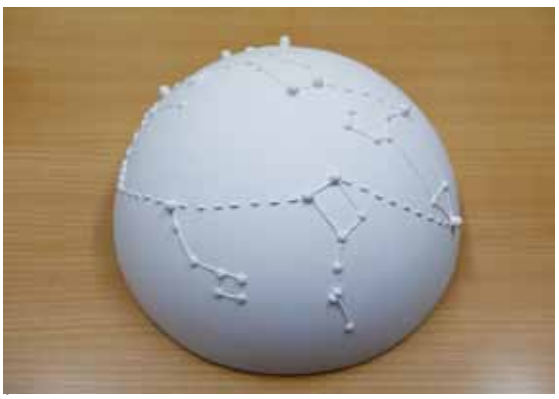

Figure 8. *Half-sphere for the planetarium show "The Sky in Your Hands".*

4.3 A tactile experience of the Moon

The Moon is, together with the Sun, the very first astronomical object that we experience in our life. As this is an exclusively visual experience, people with visual impairments need to follow a different path to experience it too. We have designed and tested a tactile 3D Moon sphere whose goal is to reproduce on a tactile support the experience of observing the Moon visually.

We have used imaging data obtained by NASA's mission Clementine, along with free image processing and 3D rendering software. This method is also useful to produce other artifacts that can be employed in the communication of astronomy to all kinds of public.

Our goal was that of conveying the visual impression that we have when looking at the Moon. We did not look for a mere topographical representation. Therefore, we build a model in which visual features were enhanced (regardless their real relief, like crater rays), smoothing out less important features for the sake of clarity. We associated a Braille letter to a selected number of terrain accidents, and an acompanying document in Braille lets the user know what does each letter stand for.

The North pole has been marked by a 'T', and the vertical line of this 'T' is pointing to the near side of the Moon. A meridian marks the separation between the near and far sides. The South pole is marked by a smooth cap.

Figure 9. *Tactile moon (left) and the document with the moon's map legend (right).*

We made the Moon in an easy to share format to make the model available worldwide - a standard 3D printing format "stl" that we can easily send anywhere.

As this was a completely new project, we conducted several tests before coming up with the final design. The tests were carried out all over the world by Gloria Maria Isidro (University of Puerto Rico, Puerto Rico), Raquel Rodrigo and Maria Jose Espinaco (University of Valencia, Spain), Deirdre Kelleghan (Astronomers without Borders, Ireland), Sebastian Musso (Centro de Estudios Astronomicos, Argentina), M. Mani (AID-India), Virgina Mello Alves (Brazil), Peggy Walker (Astronomers without Borders, USA), Emilio Garcia Caro (Instituto de Astrofisica de Andalucia, Spain), Caterina Boccato (Osservatorio Astronomico di Padova, Italy), Monica Sperandio and Stefano Sandrelli (Osservatorio Astronomico di Brera, Italy).

A more detailed description of the project can be found in [4].

Figure 10. *Tactile moon testing in India. Screen capture from the VideoTube video "3D Moon Journey for Visually challenged...!" by Makkal Sevagan.*

The tactile Moon project for the blind has been funded partially by the 2011 Europlanet Outreach Funding Scheme and FECYT.

4.4 "A Touch of the Universe"

In 2012 we were awarded some funds from the International Astronomical Union's Office of Astronomy for Development to create a kit of educational astronomical materials for blind children that was to be delivered to educators in developing countries. So, the "A Touch of the Universe" project was born [5].

Our goal is to produce 30 kits for the non-profit "A Touch of The Universe" project under the framework of Universal Design of Learning (UDL) and distribute them among educators and teachers in underdeveloped countries in the Americas, Asia and Africa. We seek to help children and young adults in these countries to learn about astronomy, specially if they are visually impaired. Our mission is to alleviate the lack of inclusive educational materials in these regions.

The kit contains several items: (1) Half-sphere and soundtrack of the planetarium show "The Sky in Your Hands" (2) Tactile moon (3) Booklet with activities to be carried out with the half-sphere and the tactile moon (in Braille and normal print) (4) 30 sets of "From Earth to the Universe (FETTU)" tactile Braille prints (5) Book in Braille about the Moon, in Spanish and English, "The Little Moon Phase Book", by Noreen Grice.

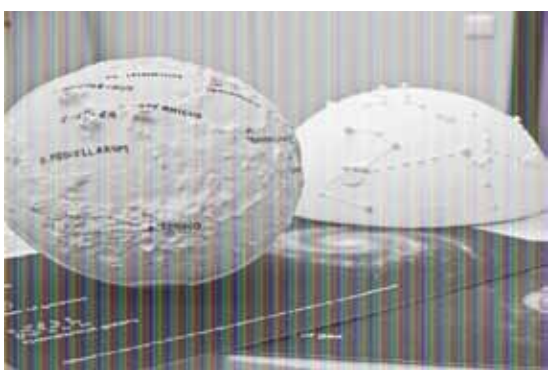

Figure 11. *Some of the materials included in the "A Touch of the Universe" kit: Chandra's braille prints, half-sphere with constellations and tactile Moon.*

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Spanish Society (SEA), EurAstro, the Galileo Mobile project, and the Chandra X-ray Observatory (NASA).

5. The future

We have recently won an ESA challenge on 3D printing with a tactile model of Mars. The prize was a tactile printer, and we expect to start using it soon, to 3D print this Mars globe.

6. Conclusions

We have developed and used different tools to reach a number of publics with various special needs. Appart from the Braille texts, all these materials can be used to support the learning in any kind of audience: the goal is to produce materials that can be used by a wider range of publics, accessible in differet ways simultaneously.

We also seek to help educators who might not have had any previous experience with this kinds of public, or who lack educational resources of this type. All materials here outlined have been created under a Creative Commons license and are freely available to download from the Astronomical Observatory of the University of Valencia webpage (http://observatori.uv.es) or upon request to amelia.ortiz@uv.es.

7. Acknowledgements

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