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Communicating Astronomy with the Public Conference 2018

CAP 2018 FUKUOKA JAPAN

COMMUNICATING ASTRONOMY WITH THE PUBLIC

世界天文コミュニケーション会議 2018 in 福岡

24-28 March 2018 Fukuoka, JAPAN

Communicating Astronomy with the Public Conference 2018

2nd Edition

Communicating Astronomy in Today's World: Purpose & Methods

NAOJ

NAOJ National Astronomical Observatory of Japan

福岡市 FUKUOKA CITY

International Astronomical Union Commission C2 Conference IAU

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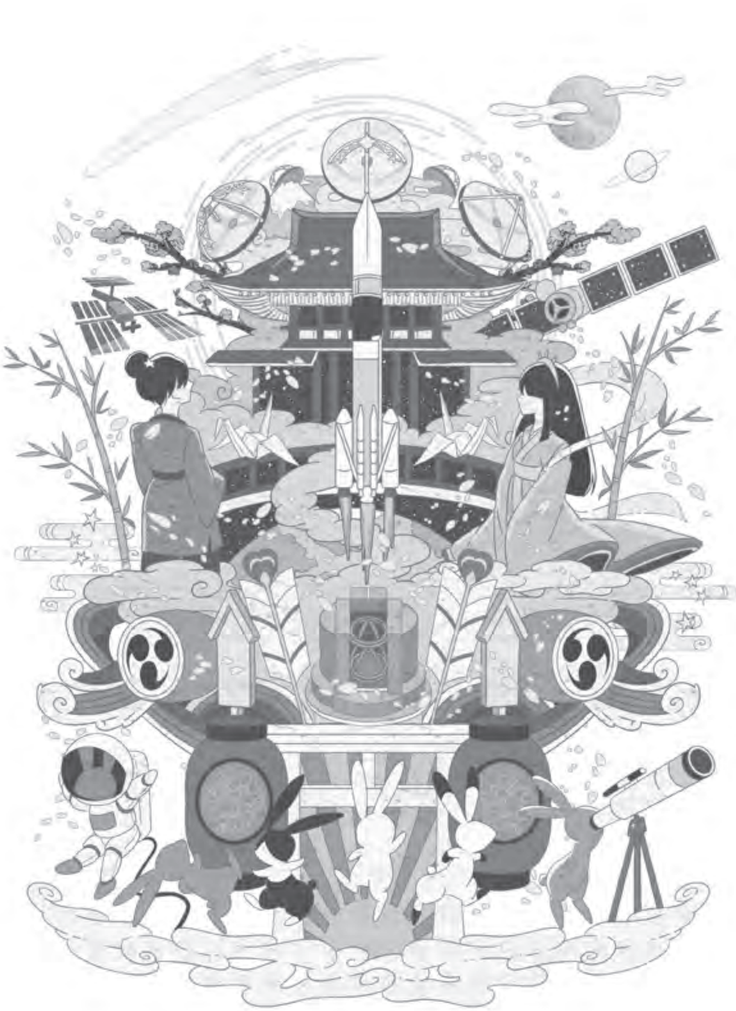

The main visual graphics in the cover of this publication were illustrated by ***chamooi***, a rising young illustrator who managed to perfectly balance the "Japanese pop culture" vibe-featuring the so-called "Cool Japan" without being too much "Japanimation nerdy." The many items represent both modern astronomy and Japanese traditions, with the global image figure resembling a "Hakata Gion Yamakasa" -- a characteristic festival car of the Fukuoka area, and the individual rabbits representing people gathering from all continents, much like what happened during CAP 2018 Conference, celebrating astronomy through tolerance, mutual respect and peace.

The CAP2018 logo followed the logo concept of previous CAP conferences, with sidereal motion as a motif, but customized the stellar trail and added cherry blossom petals adjacently in reference to the conference's location and season -- Fukuoka in March 2018. We are grateful to Hiromi Adachi [adachi design laboratory] for the valuable support in CAP2018 artwork .

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Preface

Communicating Astronomy with the Public (CAP) Conference series are organised by the International Astronomical Union (IAU), through Commission 2 — Communicating Astronomy with the Public. The IAU has more than 10,000 active members in 101 countries worldwide, and its mission is to promote and safeguard the science of Astronomy in all its aspects through international cooperation. Since 2005, CAP meetings have facilitated the exchange of ideas and best practices in Astronomy and Space Sciences communication and informal education. The Conference also helps to strengthen the local community of professionals by connecting them to the global network of Astronomy communicators and giving them access to the latest trends, lessons learnt, and ongoing projects.

In 2016, Fukuoka (Japan) was selected to host the 2018 edition of the CAP Conference, with the selections committee recognizing the proposal's value. With CAP 2018 the organization intended to reach the astronomy communication community in the Asia-Pacific region and strengthen collaborations between professionals with different backgrounds. By increasing the diversity of CAP Conference participants, we also hope to use this opportunity to promote Astronomy as a science paramount to the effort to disseminate tolerance and peace and to contribute to a more just society. CAP 2018 helps us all to better *Communicate Astronomy in Today's World*, not only by sharing methods and tools, but mainly by bringing new purposes to our work. We all need to work to bring Inclusion, Diversity, Equity, and Empathy to the core of (Communicating) Astronomy.

The numbers demonstrate 2018's success—from March 24 to 28, the conference hosted five plenary sessions with twenty-four plenary talks, including five invited speakers; 146 parallel sessions, including a session inside the planetarium; twenty unique workshop sessions; four unconference slots, 111 posters; and a special session dedicated to the 100 Year Anniversary of the IAU that will be celebrated in 2019. The venue received 446 participants from 53 countries around the world.

The CAP 2018 Conference's main theme was "Communicating Astronomy in Today's World: Purpose & Methods," compelling the community to reflect on the many challenges communicators face in the post-truth era we live in, and on the role of astronomy communication in this era. At the same time, the Conference was an opportunity to seek recommendations from communicators all around the globe as they came together to share insights and the lessons they've learnt.

If the number of attendees is evidence of the conference's success, it is the focus of the sessions that can influence future generations of professional astronomers, with key sessions covering topics such as "Current Challenges in Astronomy Communication"; "Inclusion, Diversity, Equity, and Empathy in Communicating Astronomy"; "Astronomy Communication for a Better World"; to the various Media's role in Astronomy communication and general practices in Astronomy communication.

Following closely the Conference's original sessions, this book is composed into six main sections: General Practices in Astronomy Communication (Session I) that encompasses eight sub-categories with works concerning both best practices and research; Inclusion, Diversity, Equity and Empathy in Communicating Astronomy

(Session II), Astronomy Communication for a Better World (Session III), Media, Social Media, Multimedia, Immersive Environments and other Technologies for Public Engagement with Astronomy (Session IV); Current Challenges in Astronomy Communication (Session V) and a special section dedicated to the International Astronomical Union (IAU) 100-year celebrations.

This book compiles some of the works presented during CAP 2018, from the community for the community. The submitted works collected form 21 Plenary Talks, 106 Talks and 72 Posters including. The book also features special contents by invited speakers Norio Kaifu, Wanda Diaz-Merced, Hitoshi Murayama and Dominique Brossard, and the IAU 100 years session contributors.

We would like to extend our gratitude to the rest of the editorial and layout teams, to the Scientific Organizing Committee (SOC), the invited speakers, and the NAOJ staff, who have been extremely supportive over the years. Last but not least, a warm thank you to all the contributors who shared their work with us and made this book possible. Your work is an inspiration to the community.

Hidehiko Agata,
Chair of the CAP 2018 Local Organizing Committee
Pedro Russo,
IAU Commission C2 Communicating Astronomy with the Public President
Lina Canas,
Vice-Chair of the CAP 2018 Local Organizing Committee, Editor-in-Chief

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Communicating Astronomy
with the Public Conference 2018
SCENES

SESSION I:

General Practices in Astronomy Communication

Communicating Astronomy
with the Public Conference 2018

Astronomy in Society: Development and Practice in Japan

Norio KAIFU

Honorary Professor of the National Astronomical Observatory of Japan (NAOJ), and Advisor to the IAU

Allow me to start with some background history -- as you might know Japan opened its door to the world in 1868 after 300 years of being closed, therefore modern astronomy was formally introduced in Japan only 150 years ago. The first astronomical observatory was founded 10 years later; however, we needed 40 years to establish the Astronomical Society of Japan (ASJ) in 1908, waiting for the Japanese astronomers' community to grow. Then around ten years later, in 1919 Japan participated as a member of the eight International Astronomical Union (IAU) founding countries.

Nowadays, the number of the IAU Japanese individual members exceeds 700, ranking third country with highest number in the IAU, and with the Astronomical Society of Japan reaching 3000 members. However the members' growth chart of the Astronomical Society of Japan signals only after the World War II ended. As shown in Figure 1, the number of members grew about twenty times since then. You find some steps in the growth curve that can be explained by the construction of cutting-edge telescopes; Nobeyama Mm-wave Telescopes, 8.2m Subaru Telescope, and ALMA in Chile. After those big telescope projects the growth of the number of astronomers clearly accelerated. However, those telescopes couldn't be realized without the broad understanding and the support of the general public, because in Japan such large scientific projects have been 100% supported by government budget; i.e. by taxpayers.

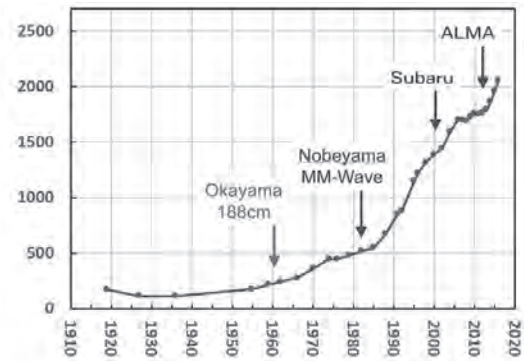

Figure 1. Growth curve of Astronomical Society of Japan. The vertical axis is number of formal member (mostly astronomers), and the horizontal axis is year.

Let me now address how such support by general public has been produced. In this connection it should be mentioned that the ASJ opened its membership to amateur astronomers since its establishment day, and it is still a tradition today. I like to emphasize the strong efforts of cooperation with citizen and amateur astronomers made by some researchers, especially by Professor Issei Yamamoto, University of Kyoto. He should be remembered as a founder of Japan's first several public observatories – by public observatories we mean observatories that are open to the general public--, and a founder of Oriental Astronomical Society for amateurs (1920). Since then more than 300 public observatories were founded throughout all Japan.

The first observatory for the public was established in 1926, in Kurashiki City in the middle of Japan, with a 32 cm reflector funded almost entirely by a private fund, but also by strong support of Prof. Yamamoto. He continuously helped and educated many amateur astronomers. Some of you may know the name Minoru Honda, who discovered many novae and comets -- he is a standing legacy for amateur astronomers. He was one of the pupils of Yamamoto and his home was the Kurashiki Observatory.

Based on data from the Japanese Association of Public Observatories (JAPOS), about five to twenty new telescopes for general public were founded each year starting from 1980's, and then we see a clear peak coinciding with Japan's big bubble in economy (Figure 2). When the local governments have money to spend, they are forced to use that funding to do something good for the public. There are so many ways to use the money, as you know, you could waste it very easily! However, in some local cities, where the amateur astronomers were strong, they pushed the government to build public observatories for education and for public citizens -- there was a pretty strong lobby from the amateur astronomers and citizens. After its establishment, the existing observatories should then refurbished and acquire new telescopes with a larger aperture, etc.

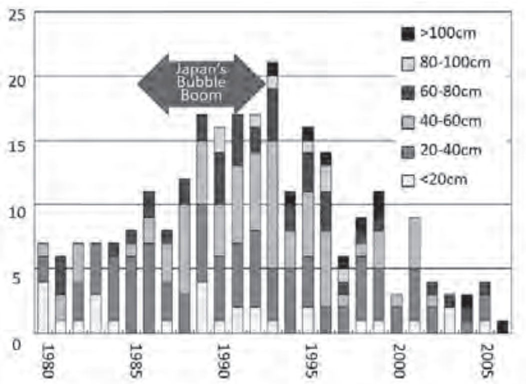

Figure 2. Number of foundation of public observatories per each year. (Public Observatories White Paper, 2006)

In the 2006 JAPOS report, among the 256 public observatories, cities clearly possess the majority of installments. Almost 84% of public observatories were founded by local governments. Most of them are also operated by local governments or some other agent transformed from a governmental organization. In terms of visitors, the total number in 2005 was about 15 million.

And what about planetariums? Again, in Japan, we have about 300 planetariums all throughout the country. 92% of those founded by the local government, according to the data by Japan Planetarium Association (JPA). This is again the same situation as for public observatories. There were only two planetariums in Japan before the World War II. After that many planetariums were founded and then reaching a peak during 1970's to 90's (Figure 3). Interestingly, if we compare it with the foundation of public telescopes in Figure 2, we see that telescopes came later on -- about ten years later than planetariums. Of course, a planetarium is considered important for education and most of the planetariums were used for education in elementary and middle schools, with many school pupils visiting. Because of this, most of planetariums have been operated by the local governments, and they have very good connection with the local schools.

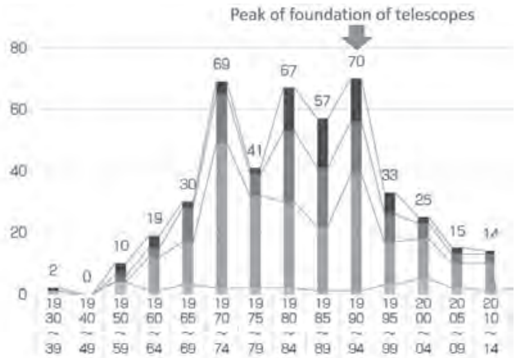

Figure 3. Yearly number of the foundation of planetariums, every 5 years. (Planetarium Data Book, 2015).

Why did this happened in Japan? It is not easy to answer. Again giving some historical background, I can say that education has been a Japanese tradition for many, many years, even throughout the Edo era (17^{th} – 19^{th} centuries) – the long period that Japan, as a country, was closed to the outside world. Another reason is the intense curiosity of general public; this does not only happen in Japan however. Probably the cooperation between astronomers and the public can be key. Only a small number of prominent astronomers were keen to cooperate with amateur astronomers and the public in the initial days of Japan's modern astronomy, but some efforts were put in place, as I mentioned before. The cooperation with the professional astronomers was important in early days, however later on the amateur groups organized a movement of their own, and press the local government into creating the planetariums and/or observatories. Economy is essentially important, of course. But even if the local government has money, they have to identify what is good for the public. Therefore in the background, the cooperation among the professional astronomers, amateurs and local governments could provide a happy solution in some cases -- I feel that that should be the most important issue.

We have numerous public astronomy activities now. I will briefly give you some examples. The *Tainai Star Festival*, it is probably Japan's largest star festival. Quite local, but it has a long history with 20,000 people participating each year and with many telescope industries exhibiting. The *Lights Off in Yamanashi* is also reaching the whole prefecture, and still growing. The *Star Festival in South Island* -- this is an annual island-wide activity with 10,000 visitors attending to enjoy the Milky Way for the occasion of *Tanabata*, the 7th of July star festival. National Institutes and Universities also contribute in a very relevant way. Every year in the days around *Tanabata* star festival, nearly 100 universities host the *Tanabata Lectures* for general public. It is a quite popular astronomy-driven activity by professional astronomers.

We have organized "Japan Conference for Astronomy" in 2008, as Japan's cooperation platform to support such activities, with all astronomy-related organizations; the public observatories, planetariums, museums, amateur astronomers, telescope manufacturers, astronomical society, NAOJ, ISAS, and Science Council of Japan, working together. It started for the International Year of Astronomy in 2009 (IYA2009) -- and now, ten years later, we are discussing the IAU 100 years anniversary.

Finally, let me move to some of the IAU points of view. Looking back the IAU history regarding national membership, we see a continuous grow. But if we go into details by region, we understand that the European region is almost flat concerning national members growth -- in the recent half-century, it increased only 30 % -- almost saturated. However, if we see the individual members, it is different; European region has grown five times in the same half century. The total number of individual member of the IAU has also grown about seven times in the same period. This is amazing, but it was shouldered mostly by European and North American regions, and recently by Asia-and-Pacific region too. When we look at the numbers of other regions (Latin American region, Mid-East and African region, and most of Asian region), the IAU is not growing so much. What does it mean? It means that the astronomical research is growing rapidly, but is mainly ongoing in the so-called developed world still. On the other hand in the most of developing world the scientific research remains in difficult situation. I have other statistics about the IAU regions that again show that the western world is progressing in research, but this doesn't happen yet in the developing world -- I will talk about this statistics in the Symposium 349, GA in Vienna this summer. The United Nation (UN) has 193 nations and the IAU national members only 73, less than 40%. This is a serious situation for the IAU. I like to add, however, that we know in the IAU 2009, formally registered nodes counted almost 150 countries, which is 77% of the UN!

Astronomy is an ideal "entrance door" into science in general. Indeed the IAU is a leading organization in education, outreach and communicating with public among many international science organizations. OAD for development, OAO for outreach, OYA for education and commissions C1 and C2; are rigid and wide IAU platforms for its worldwide campaign as a whole. We all have a common goal, and this is the reason we are gathered here today.

SESSION I.1:

Using Entertainment to Communicate Science

The Real Music of the Stars

Sylvie D. VAUCLAIR*[1]

Abstract. The recent discovery of the real acoustic oscillations of stars has completely modified and boosted the old relationship between music and astronomy. Music is often used, in a symbolic way, to help transmitting scientific knowledge. We can find rhythms everywhere in space, and any rhythm can be translated into music. This is fun but it suffers from important drawbacks that may lead to real misunderstanding. We must be aware that listening to music inspired by a nebula does not help people understanding what a nebula is. We now know that many stars, including the Sun, do behave like musical instruments. Real sound waves that propagate in their interiors make them resonate. This sound is not audible directly but the astrophysicists are able to detect and analyze the induced light variations of the stars. This represents a wonderful tool for communication in astronomy. It may be used to explain scientific questions, as well as create original stellar music. This relies on real stellar harmonics that are transposed by the number of octaves needed to make them audible. People who would not go to scientific popular talks come to listen to the music and they learn real science!

1. Introduction

In the ancient Greece, Music represented all the attributes of the nine Muses, both in art and science. Among them stood Euterpe (arts of the sounds), Terpsichore (dancing and singing) as well as Urania (Astronomy). Art and science were closely linked… and Astronomy was part of Music!

The relationship between astronomy and music is interesting in many aspects. It enlightens the way scientific knowledge evolves. It is often used to help people getting involved in scientific questions they would not address otherwise. One must be careful however when using music in astronomy. It may lead to strong misunderstandings. It makes people dream, but may be far from reality. If not used correctly, this may be the open door to esoterism, as it leads people to mix the imaginary and rigorous approaches.

The recent discovery of the real stellar vibrations, induced by real sound waves that propagate inside them and make them resonate, is a wonderful tool for communication with the public. It may be used for original musical compositions, and it is the opportunity of explaining real science.

2. Music and Astronomy in old times

For the ancient Greek philosophers, like Pythagoras, Plato and Aristotle, the musical theory was conceived in symbiosis with their representations of the global world.

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Their knowledge of the sky and the universe was limited to what could be seen with naked eyes. They separated stellar objects in two classes, the “fixed stars”, which came back every night with a time delay but at the same place with respect to each other, and the “planets”, which moved among the other stars. These planets included the Moon and the Sun, so that there were seven of them as a whole. They were classified according to their distance to the Earth, which was evaluated from their celestial motions: Moon, Mercury, Venus, Sun, Mars, Jupiter, and Saturn. The Sun stood in a particular position, right in the middle, as a central pillar of the whole system.

The structure of the universe was conceived with a spirit of harmony, order and plenitude. All planets were perfect spheres, moving along perfect circular orbits around the Earth. This representation of the universe persisted until the end of the middle ages in Europe, in spite of the visionary theories of other philosophers like Aristarchus of Samos, who already proposed a heliocentric vision of the world.

In parallel with their own description of the world, the Pythagoreans studied mathematics and music. They were especially interested in the characteristic sounds obtained with vibrating strings and found interesting musical intervals when dividing the string length by precise numbers, from two to four.

They discovered the basic musical intervals, the “fourth”, obtained with a string limited to the three fourth of its length, and the “fifth”, obtained with a string limited to the two thirds. Using these intervals, they built a musical scale that, with some modification, is still the one used in occidental music.

The scale included seven musical notes; there were seven planets in the sky. The temptation to associate each note to each planet was strong, and the Pythagoreans did it. The "Music of the Spheres" was born. It came as an expression of their will to be surrounded by a perfect and harmonious universe.

3. The Real Music of the Stars

Perfection does not exist in the real world and we now know that the antique "Music of the Spheres" does not exist. Neither the Earth nor the Sun are at the center of the world. There is nothing indeed like the center of the world.

Then came, as a great surprise, the evidence of the acoustic oscillations that take place inside the Sun. They were first observed in 1961, as a small vibration in the solar light, and explained ten years later, in terms of acoustic resonance of the stellar spheres. Later on, the acoustic oscillations of solar-type stars were also detected, which was the beginning of a new astronomical science, Asteroseismology.

The stellar spheres ring because of the acoustic waves induced by the convective zones that are present in their outer layers. The convective motions make noise and create sound waves inside the stars. These waves make the stars vibrate like the resonance chambers of musical instruments. The scientific analysis of these vibrations leads to unprecedented precision on the determination of the stellar masses, radii, temperatures, ages and even internal structure.

For the Sun, tens of millions of harmonics are detected, which leads to a precision of one for one thousand on the values of the depth of the convective zone, the pressure, the density and so on. For the other stars, which are more difficult to observe, a few tens of harmonics only may be observed at the present time,

The sounds of the stars are not audible for two main reasons. The first one is that space is emptier than the most extreme void that we can have on Earth. Contrary to light, sound waves cannot propagate in the void. The second reason is that the stellar sounds are very grave, much below the possibilities of the human ears. Astronomers cannot listen to these sounds, but they do observe them by analyzing the stellar light.

Stars vibrate like musical instruments. They do not play music by themselves, but they can be used in musical creations. It is possible to transpose the observed stellar frequencies and reach the domain audible by the human ear. I decided to choose twelve well observed stars including the Sun and transpose their real frequencies by eighteen octaves, with their real amplitudes. With this new stellar scale, the French musician Claude-Samuel Levine composed new pieces of music. This is the new "Music of the Spheres"!

4. Music, Astronomy and outreach

The music of the stars is a wonderful tool for communicating astronomy with the public. It may be used for describing the evolution of knowledge in connection with societies and human psychology. It shows that the important discoveries are done at the border of disciplines, and often by chance: you are searching for something you expect, and you find something else by chance and serendipity.

It also leads to an opening of the minds, showing how the physical senses are limited (vision and audition) and how technology helps going far beyond our original possibilities.

It gives access to some new physical concepts, like spherical harmonics that are quite different from the linear harmonics of vibrating strings, which are at the basis of occidental music. The stellar sounds are "intra-tonal", in-between successive notes of the piano. The timbre of the sounds, specific for each stars, is also quite different from that of usual musical instruments.

The "music of the stars", originally composed electronically, was also recently played by a young orchestra with acoustic instruments, except for the stellar sounds, of course played by the computer. I gave a talk to accompany the performance. The public was essentially composed of the families and friends of the musicians. It was a surprise for them to hear a talk about stars and stellar structure and they liked it.

5. Summary

The music of the stars is a very useful tool to bring people to some understanding of astronomy. More information, pictures and listening to the sounds of the stars and to the musical composition may be found on the websites below. A 52' TV documentary in French with English subtitles is available on request.

References

All references and contact pages may be found on the websites:
www.sylvievauclair.fr or www.sylvievauclair.com.

|Parallel Session|

Astronomy Popularization Through Art and Ethnoastronomy

Pecier Paul C. DECIERDO*1

Abstract. One peculiar barrier to popularizing astronomy to certain audiences are its association with foreign, often Western traditions. In an attempt to break down this barrier, we at The Mind Museum in the Philippines have partnered with a popular art museum to try and bridge the gap between astronomy, art, history, and culture. We did this by facilitating astronomy camps in the art museum. During the amps, we used arts, crafts, and ethnoastrnomy to illustrate the link between astronomy and culture. Participants of the camps have said that linking arts and making with studying astronomy has improved the recall of certain astronomy concepts. Furthermore, learning about the importance of astronomy in indigenous cultures and ways of life has increased their appreciation for the humanity of astronomy.

1. Introduction

People are naturally fascinated by astronomy. However, many view astronomy as an alien curiosity far removed from everyday life. There is also the feeling among some members of the public that astronomy, along with most of science, is "foreign", even "Western". This might be due to a strong Western bias in many astronomy education materials.

As a result of these views, when educators and popularizers advocate for the public's investment in space science, there is a hesitance in the part of the public to support such investments. Among students, there is also a lack of appreciation for the practical side of astronomy. This results in the dissociation between the theory of astronomy and their everyday experiences.

To address these concerns, we at The Mind Museum have developed a space camp program that marries astronomy with culture, in particular with art and ethnoastronomy. To do this, we hosted our latest space camps in an art museum very popular among Filipino millennials.

2. Art and Astronomy

Holding our astronomy camps at a popular art museum added a draw to young people. Because of our collaboration with an art museum, our reach within certain segments of the millennial generation widened. This is especially true for young people who do not see themselves as "science people" and who might get intimidated by an event that seemed "sciencey".

The art museum also has the advantage of houses several works of art that are inspired by observations of the night sky, some of which are indigenous works of art. This choice of location for the astronomy camp makes the link between astronomy and art more salient.

3. Ethnoastronomy

To strengthen the link between astronomy and culture, we include an introduction to Filipino ethnoastronomy during the camp. This enhances the participants' appreciation of the universality of the urge to understand the universe and our place in it.

To further strengthen the participants' sense of "ownership" of the sky, we facilitate hands-on activities where they can use the sky as a canvass for their imagination by drawing their own asterisms and making their own star lore. They present their creations via works of art that they create together with their friends and families.

This mix of creativity and personal interaction during these activities have improved the recall of constellations and asterisms in thy night sky, according to the reports of the participants as well as the observations of the facilitators. Participants easily recognize star patterns in the sky that correspond to the asterism they themselves made.

4. Summary

We have observed that by linking astronomy with cultural practices such as art and ethnoastronomy, our Filipino audiences have a greater sense of "ownership" of the sky that inspires them to learn more about it. It also makes them realize that astronomy is a deeply human endeavor, one that is done by humans just like them. By humanizing the field, we were able to deepen our audience's appreciation of astronomy as measured by our surveys.

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How an Astronomical Facility Like ALMA Has Become a Magnet for Artists and Musicians

Valeria FONCEA[*1] and Nicolás LIRA[*2]

Abstract: The general public does not easily find a connection with concepts of radio astronomy, which means that imagination plays a key role in helping astronomy reach a broader audience. Artists and musicians do not normally form part of the ALMA observatory's audience, but those of us who work in the EPO department realized there is a certain attraction, or magnet, that is common to both audiences. Artists and astronomers, after all, share the same curiosity and desire to understand and transcend the Universe.

1. When science meets art…or art meets science

There are two sides to every coin, as is the case with science and art. Science reaches out to art but art also tries to interact with science. An astronomical facility like ALMA has a certain pull, becoming a magnet for artists and musicians interested in creating works of art at ALMA because of its innovation and research. Likewise, art and music are very interesting outlets for astronomy and science outreach with people in terms everyone can understand.

This has made ALMA the stage for several art installations:

1) For anyone working at ALMA, surely one of the most lasting impressions was the day several years ago when someone appeared with a vacuum cleaner next to the antennas at 5000 meters (16,000 feet) above sea level. This unusual visitor was Venezuelan artist Ernesto Klar, who drew a poetic parallel between ALMA observations and the constitution of our planet, made up mainly of dust.

Figure 1: Venezuelan artist Ernesto Klar at ALMA

2) On a later date, engineers working at the antenna site were surprised by another visitor: a gigantic ball. Polish artist Dagmara Wyskiel worked on a project that involved the introduction of an enigmatic object into different empty spaces in the landscape, such as ALMA, simulating the result of the exploration of signals and waves from space.

Figure 2: Polish artist Dagmara Wyskiel at ALMA

It may not have been precisely what we had in mind as the response to our interest in the Universe. But it was a response nevertheless.

3) More recently, François Ronsiaux shot a photographic sequence, on exhibit at the Grand Palais in Paris, which was an allegory of conspiracy theories and the modern system of manipulating people.

4) Finally, another French artist placed laser beams at ALMA. Used in astronomic observation for positioning in the Cosmos, in this case the artist uses lasers as a drawing tool "to establish a relationship of simultaneity between the space that is created and what moves the Earth."

These special visits, as well as another from renowned Japanese artist Norimichi Hirakawa, involve a great deal of effort from the scientific community because artists need to understand firsthand how equipment works and the purpose of the research, before they are

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able to make their own interpretations and find inspiration for their work.

Figure 2: French artist François Ronsiaux

However, we believe it is worth the effort. Due to the significant demand from artists, we have started to develop an agreement for artist "residencies" at ALMA, a project initially set up by CERN and ALMA, with support from the Swiss culture agency Prohelvetia.

2. Audiovisual fascination with the Cosmos

Musicians and audiovisual artists are also fascinated by the Cosmos. Chilean artist Olaf Tone used astronomical data provided by ALMA to create an immersive audiovisual installation, offering a sensory experience of events occurring in protoplanetary disks. Through this type of experience, artists help us to explain the complexity of our Universe.

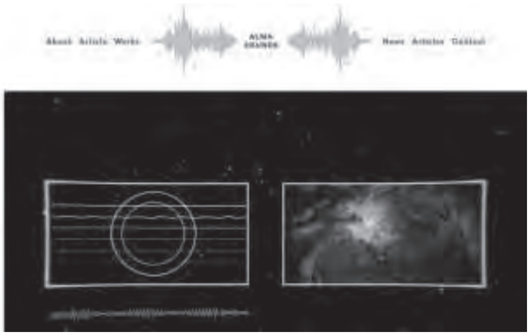
We are always aware of the commercial side of projects our name is associated with in the name of outreach, as some use this association with the ALMA name in order to sell products or promote their brand.

An example of this is a bank that gave its exclusive clients a book by Chilean-French artist Roberto Matta, which was inspired by the cosmological imagination. The book is a dialogue involving the mysteries of the Universe, between science and art, the micro and macro Cosmos, juxtaposing his paintings against photographs of the Universe captured by ALMA. Some ALMA astronomers participated with their text and interpretations of this juxtaposition.

For us, all audiences matter. And the result can be farther-reaching if we take our work beyond science and art and also engage with indigenous communities. With the support of ALMA, students of the astronomy academy of San Pedro de Atacama in northern Chile made a stop motion video explaining the myth of Yakana, the constellation of the llama seen in the night skies.

Whether art meets science or vice versa, ALMA has been proactive in opening new channels of creativity with children and adults. ALMA also supported Lyra group and Astromanía Foundation with the English version of songs for kids – from the planets of the Solar System to Halley's Comet (http://kids.alma.cl/?lang=en) .

Considering that the general public does not easily find a connection with concepts of radio astronomy, a team made up of an astronomer, an engineer, a curator, a music producer and the ALMA EPO team created ALMA Sounds (http://www.almasounds.org) to expand its reach. Although the waves captured by ALMA are completely different than the raw material musicians usually work with, the team developed a method to transform frequencies from the Universe into sounds that are currently being used by artists around the world to compose, share and create community.



Conclusion

Radio astronomy and the arts both provide a channel through which we can explore our existence: what it means to be human and where is our place in the Universe.

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The #SotonAstroArt Project

Sadie JONES*1

Abstract. The #SotonAstroArt project engages the general public and artists with research techniques which astronomers used back in the 1980's with clear links to how astrophysics research is done today! The project came about by accident as the University of Southampton (UoS) Astronomy department had over 4,000 POSS/SRC photographic plates that mapped the whole of the celestial night sky that were about to be destroyed. These beautiful relics of astronomy could have been lost forever. However, we managed to save them and instead 'gave away the whole Universe to artists'.

1. Introduction

It is generally quite easy to get people engaged with the subjects of space and astronomy, however, as astronomy outreach professional we often struggle to design `hands-on' demonstrations that allow people to feel a `physical connection' to astronomy research.

Each of the photographic plates is different and even though the plates are no longer used by professional astronomers they all have lots of scientific data on them and this data still has meaning today. By giving these photographic negatives of the celestial sky away to artists we have given them each a piece of the Universe to hold in their hands and this has inspired them to create very innovative art pieces.

We predict that by 'the act' of making their art they have become more engaged in astronomy research. Then in turn by exhibiting their pieces and writing about them on our website the general public and the astronomers are also engaged.

The story of the plates and the artwork that has been created is shown on our #SotonAstroArt project website at https://sotonastroart.wordpress.com/ and on social media using the hashtag #SotonAstroArt.

The artists first got the opportunity to exhibit their work on the University of Southampton campus in November 2017, this was in combination with a bespoke planetarium show, and we are planning other exhibits, in Winchester, UK in July and in London, UK before the end of September 2018. At these exhibits the artists will be part of the whole process, they will curate the exhibit and assist the academics to decide which information about their research is most relevant to the public. The artists will also be invited to interact with the public who attend the exhibit.

We plan to give everyone who attends the exhibit a printed leaflet/booklet, which has further information on the artwork, the artists themselves, and finally UoS astronomy research from past and present and how it relates to the photographic plates.

The project was recently awarded £1k from the University Public Engagement with Research Unit (PERu) to link to Dark Energy Survey (DES) research which is being carried out in the Physics and Astronomy department at the UoS. We therefore plan to provide information about this research at future exhibits and write bespoke planetarium shows on the DES research.

2. The Story

In 2017, in my role as the 'Outreach Leader in Astronomy' within the Physics and Astronomy department at UoS I was approached by the build-ing manager regarding three filing cabinets filled full of 4,000 astronomical photographic plates. They explained that based on new health and safety fire regulations that these three large cabi-nets, which were also the main fire exit route from the large lecture theatre, would need to be removed and the contents destroyed. I was horri-fied to learn that these plates, which were individ-ually all beautiful images that together mapped the whole of the sky, were going to be destroyed. I began to think of ways that they could be saved and started by posting a picture of a plate onto social media, and asked that the post to be re-posted such that artists and other interested pub-lics might see it. The post was reposted hundreds of times over a few days and I was instantly bombarded with emails from interested artists from

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all over the world. As a result we successful gave away 'the whole universe', all of these 4,000 photographic plates, many to local artists, but some as far away from the UK as America and Sweden. These plates not only represent a piece of research history but also were a great opportunity for people to get a very rare experience, a `hands-on' encounter with astrophysics research.

Our aim is to promote, through art, current UoS astrophysics research, specifically that of the Dark Energy Survey (DES). We want to show how UoS astronomers would have used the photographic negatives of the night sky back in the 1980s. We hope that this will create a new forum for artists and astronomers to communicate and inspire each other.

3. The Surveys

The first attempt to survey the 'whole sky' was the Palomar Observatory Sky Survey (POSS) survey in the 1950s. Each part of the sky was imaged in 2 filters, blue (B) and red (R). This survey mapped from +90° to -30°. Each image from the survey was made into a 14 inch square photographic plate which covered 6 degrees of the sky (along each side) for use by astronomers. In the 1980s there was a second version of this survey which was called the Northern Sky Survey (POSS II), this covered for declinations 0° to +90°. And in the 1990's these two surveys, POSS and POSS II were converted into digital format and became easily accessible on the Internet, hence why they are now obsolete and the department wanted us to get rid of them. There are also additional surveys the European Southern Observatory (ESO) made the Southern Sky Survey (SRC) for declinations < -20°, in Blue (B) and Red (R). Finally, in the UK the Schmidt Equatorial Sky Survey (SERC) covered declinations between 0° and -15° in Blue (B) and Red (R).

4. The Impact

The project will have an impact on the artists, the astronomers and the public. The main challenge is to be able to quantify this impact on these three groups of people. We predict that the artists will benefit from the project through working with a new medium and they will learn about past and current astronomy research from both the website and direct contact with the astronomers.

The astronomy academics will learn what the public and the artists find most interesting about their research and this will benefit their future public engagement talks and the research itself. Also, myself and the academics in my outreach team will learn more about how this new group of diverse people run their art businesses, how they create their art and how they organise and curate an art exhibit.

They will come to understand what is the most inspiring aspects of these 'old' plates from the artists perspectives, as opposed to that of the scientist/astronomer who is trained to see something very different. The predicted result of this interaction with outreach professionals is that they design more creative outreach and public engagement activities in the future. Finally, the public will be able to engage, perhaps unexpectedly, with astronomy research through an interest in art. This might lead them to think about the creative nature of the Universe and how it can be interpreted in different ways.

5. Summary

The #SotonAstroArt project has grown naturally from a need to distribute astronomical survey plates to a location where they are not potentially hazardous. The wordpress website is the best place to look for up to date information on the #SotonAstroArt project: https://sotonastroart.wordpress.com/

The main challenges we face regarding the future success of this project is the lack of funding. All 4,000 plates have been distributed to over 40 artists across the world. Our last exhibit involved 7 artists, so we are confident the next exhibit will be even bigger, given that there has been more time for the artists to complete their art work. Throughout the project we need to ensure there are clear links to UoS DES research and we specifically need to look at methods for tracking the impact the work has had on the artists by interviewing them at different stages throughout the project.

Science and Entertainment: How Astronomers Use Pop Culture references for Science Communication

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Abstract. With the existing gap between what scientists believe is true and what the public believes, in particular regarding controversial topics such as climate change [1], scientists need to find strategies that engage the audience in a conversation and use a mutual ground between the public and themselves to share information. In this study I examine the use of pop culture references at the Adler Planetarium as a mutual ground between scientists and the public in science communication. I conducted 11 interviews with scientists at the planetarium and did 384 hours of observation. Results show that pop culture references, both movies with accurate science or inaccurate science, can play a valuable role in eliciting curiosity and engaging the audience and are used by scientists to build a visual and verbal mutual ground and to connect with their audience. These references are mainly used as a tool for educating the audience. This study shows the importance of the use of mutual grounds to connect to the audience and engage them and provides a different view toward using movies with inaccurate representation of science as a tool for education.

1. Introduction

Engaging the audience in a scientific conversation as described by the dialogue model of communication [2] and gaining the audience's trust is advocated by the NAS [3] for more effective communication. Thus, we need to consider connecting with the public and use mutual grounds between the public and the scientists for education [4] and to build a human connection. Movies are a frame of reference familiar to the public to talk about complex scientific concepts.

In this paper I examine how pop culture references are used by scientists and the audience at the Adler Planetarium in face-to-face conversations with scientists. I describe how and why pop culture references can build a mutual and how they foster engagement and education. Results of this study can help scientists identify strategies that can help them connect to the public and engage them in a conversation. It also lets them know what to expect from the use of mutual grounds and prepare accordingly.

2. Literature Review

Pop culture references, mainly sci-fi movies, have been praised in multiple studies for their role in education. Sci-fi and movies provide a mutual reference point [4].

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Cavanaugh (2002) for example notes that he uses these references in his class to create a shared experience and reference point and they can go as far as having the capacity to help the audience connect to the characters, and their emotions [5].

While there is multiple research looking at the use of sci-fi in classrooms to improve interest and grades [e.g. 6] there are not studies looking at the existing dynamics to establish the mutual ground and why they are used. They also don't move beyond the classroom. So, I have the following research questions considering the gap in literature:

RQ1: Why do scientists use pop culture references?
RQ2: What are the modes in which scientists use pop culture references?
RQ3: How do scientists and the audience generate a mutual ground through interactions about pop culture?

3. Method

I conducted 384 hours of observation at the Space Visualization Lab of Adler Planetarium (figure 1) where every day 2 scientists spend an hour each, having an "Astronomy Conversation" with the museum attendees. I have also interviewed 11 presenters at the Lab (5 female, 6 male) with majors ranging from astronomy, to physics and engineering. Data were collected and analyzed through the Grounded Theory were the content were coded and explored to find existing patterns.

Fig. 1. A scientist engaging in "Astronomy Conversation" at Space Visualization Lab.

4. Results

Results from the interviews show that there are three main ways that scientist believe pop culture references can be used. To build 1. a visual mutual ground, 2. a verbal mutual ground, 3. connection.

For example, in the movie *Armageddon* where an asteroid is about to hit Earth, the audience can visualize the asteroid (visual mutuality), is familiar with the term asteroid (verbal mutuality), and due to being familiar with the movie, has a point of connection with the scientist.

An observation worth exploring in this study was the ability of pop culture to elicit curiosity due to the possible following reasons. Three of the main factors that contribute to the attention we pay to topics are importance of the topic, the salience of the topic, and it being surprising [7]. Pop culture references also seem to have these attributes.

They are important since they address topic related to our survival such as alien attacks or asteroid's collision with Earth. They are salient, i.e. as movies, and shows they all around us in ads, theaters, posters, and a topic of everyday conversation. And finally, they can be surprising.

Surprise in sci-fi can result in from the movies defying expectations, e.g. a movie being very realistic but not scientifically accurate can surprise us. On the other hand, a movie can seem very unreal, but can be scientific, e.g. in *Star Wars* planet Tatooine has two Suns and scientists have discovered planets outside our solar system that orbit more than one star.

Pop culture references are used to educate the audience. Scientists use examples similar to science and examples with inaccuracies to debunk them.

For example, after debunking that blowing up the asteroid in the movie *Armageddon* would still result in the destruction of Earth, the scientist follows with talking about possible ways to deflect an asteroid.

Pop culture references can be used as a mutual ground to build knowledge based on. This process starts with the audience asking a question about a movie or by the scientists bringing up one. The initial question from the audience is usually one about general opinions and accuracy "what do you think of the Martian? Was it scientifically accurate?"

The following questions become more detailed and a reason to encourage prolonged conversation with the audience. Through the initial question, the scientist bases the mutual ground and builds the rest of the conversation on, using the existing mutual visual and verbal knowledge.

Scientists then explain the similarity of examples in the movie and science or debunks why the example is not scientific. Then the conversation might move on to another topic or the audience might follow-up with more questions. Alternatively, the scientist will stay on the topic and elaborate further about the topic.

5. Discussion

It seems that pop culture references are useful tools not only to connect with the audience and engage them, it can also help scientists educate the public by having a mutual visual and verbal frame of reference. In addition, this study shows the benefits of using movies with inaccurate science to elicit curiosity and educate the public.

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Astrophotography as a Tool for Astronomy Education from Northern Chile

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Abstract. The north of Chile is a great destination for astronomy, where both professionals and amateurs can take advantage of the dark and clear skies of the Atacama desert, turning astronomy education into a visual resource and the reason of why so many observatories are located in this area. This presentation comprises several examples of experiences and techniques to teach astronomy through astrophotography, as a discipline able to combine art and science, facilitating the engagement of different audiences to explore more about the Universe and how to understand the "behavior" of the sky at night.

1. Introduction

What is astrophotography? Basically a discipline where you are able to capture the night sky through your camera, using several techniques. You can find many great pictures from different people around the world, and probably you saw and *liked* some of them when surfing the Internet. But this activity can be used in many other ways for education, since a *picture is worth a thousand words*, and astronomy in many aspects is a *visual science*. This presentation explore examples about how to use astrophotography as a tool to teach astronomy to the public, taking advantage of the dark skies in the North of Chile.

2. Context

The Antofagasta region, in the North of Chile, has a lot of professional observatories but also a lot of people interested in astronomy (some of them coming from countries very far away), wanting to take advantage of the dark and clear skies in the Atacama desert. While some people just enjoy watching the sky from his/her balcony, others like to use binoculars or a telescope, and many others also like to include a camera to capture the fascinating starry nights. The author of this presentation has more than five years of experience taking this kind of pictures, and uses his own work to help others to understand astronomy concepts. However, it is important to note some common misunderstandings about the minimum requirements to begin practice.

3. What do I need?

A beginner do not need exactly superb skies and a very expensive equipment to get familiar with astrophotography. Even polluted skies can offer some opportunities to capture stellar light and astronomical phenomena. A Full Moon is a good option if the objective is to take a sequence and then stack a pile of photos; scattered clouds are not so bad if the objective is a time-lapse.

Regarding equipment, many compact (small "point&shoot" devices) and "bridge" (half-way between compact and reflex) cameras are able to expose up to 15 or 30 seconds, enough time to capture the light from the stars. Digital reflex cameras, on the other hand, are the most popular option among photographers because of its great flexibility to adjust parameters, including ISO sensitivity, aperture and any exposure time, to get the finest details in each picture.

4. How to inspire others?

It is possible to identify several ways to use astrophotography for learning astronomy (and/or photography), but this document will only mention the most important ones.

- Adding value to astrotourism

For all those places with presence of professional or amateur observatories, or where astronomy/space sciences are a relevant topic, the astrotourism is sa good option to show a different face of a city, and being able to take night pictures from the place can be a great addition to the whole experience (for example, pictures of the visitors with a starry background, souvenirs with a printed pictures like mugs, postcards, keychains, etc.).

Teach/practice with students

There are many courses, workshops and online tutorials about astrophotography around the world. For educators, this is a great opportunity to develop a similar activity with students, or different audiences. Take advantage of the benefits of a good picture to teach about astronomy concepts that sometimes are *difficult* to explain with other methods or techniques (for example, the celestial sphere, celestial poles,

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conjunctions, planetary alignments, etc.).

- Use a meaningful learning

When educators teach astronomy through astrophotography, using prior knowledge about astronomy, the student/user can assign meaning to what is being learned, and make it significant. This theory was developed by David Paul Ausubel, and says that a potentially significant material, it is every one that is “likely to relate to the relevant ideas anchored in the cognitive structure of the learner”[1]. Since the practice of astrophotography requires some prior knowledge about astronomy, and those astronomy concepts are relevant to know how to take the pictures, and the user will eventually connect both knowledges, all these factors will facilitate their meaningful learning and obtain successful results.

- Use your creativity

Taking attractive pictures not only depends on how starry is your sky, but also on how you want to show that sky, and this only requires your creativity. This technique is combining art and science, and there is a lot of artistic ways to show the sky while taking advantage of long exposure pictures, the current illumination conditions, the presence of the Moon, exotic flora and fauna, etc.

Fig. 1. The author of this presentation, pointing to the South celestial pole in this capture combining a total half-hour exposition during a Crescent Moon.

5. What can I do with astrophotography?

The author has identified at least five different ways to use astrophotography in different educational activities, such as:

- Teaching about the celestial sphere and the Earth’s movements: There are different pictures showing one of the celestial poles, planetary alignments, and many time-lapses of sunrises, sunsets, moonrises and moonsets. Use them to explain how the Earth revolves and how our latitude determines the position of the celestial pole in the sky (and *which one* of the poles you can see).
- Take advantage of new technologies to provide immersive experiences and explore new places: Today we have the ability to take a virtual walk inside a museum in another country, or simulate the thrills of a roller coaster through Virtual Reality (VR) headsets. Use them to also show a beautiful starry night from a very dark place (in case you live in a polluted city) to immerse your audience in a new environment, and choose an astronomy app to complement those experiences (this includes virtual planispheres, such as Stellarium). The author of this document had previous experience in projects involving VR technology and similar techniques, as an additional reference[1].
- Development of new skills by teaching software tools: Create a lesson to teach stacking software (e.g. Startrails, StarStax, Time Lapse Assembler, Photoshop CS, etc.). Post-processing is not necessary difficult and provides new challenges to your audience, since you can do much more that only *beautify* your pictures: it is also possible to create time-lapses or stacking pictures when is necessary (e.g. pictures under Full Moon) or add special effects by including the sky and people.
- Explain and debunk a few pseudosciences: Some people still believing that the Apollo missions never went to the Moon and all was staged in a Hollywood studio. However, among all the proofs that *we really went* to the Moon, you can use some basic photography concepts to explain certain “strange" pictures, such as some of them showing the sky without stars. The best part is that you can even *replicate* those pictures, when using the proper equipment.

6. Conclusions

This presentation was about taking advantage of the possibilities of astrophotography, with some examples from the North of Chile as an iconic place for this activity. Use it as a pathway to encourage your students/audience to be creative and relate this activity with any prior knowledge about astronomy. Some future scientists in your class/audience will reinforce their inner artist, or vice-versa! And finally… astrophotography is great to share a fresh perspective of your hometown. The possibilities are endless and your audience will always appreciate visual resources when learning a new topic.

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Diary of a Martian Beekeeper: a True Collaboration between Art and Space

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G. CLANCY*5, A. O'HARA*5, A. WHITE*5

Abstract A theatre show 'Diary of a Martian Beekeeper' was created, to promote the importance of Astronomy & Space exploration, to ignite curiosity and discover new and engaging platforms for science in the Arts & in STEM Education. In Shaw's capacity as artist-in-residence at CIT Blackrock Castle Observatory, she collaborated with European Space Agency's Astronaut Centre in Cologne. A number of site visits were conducted to interview scientists, engineers, and former astronauts over an 18 month period. A devised theatre show emerged from this development phase, based on Shaw's personal documented journey and the dissemination of her research. Anonymous audience evaluations were conducted pre- and post- show. From the data gathered it has been shown that positioning science within story and placing the human at the centre of the narrative is a highly effective public engagement tool in igniting curiosity across many audience types. The nurturing and investment of artists working within these new cross-disciplinary relationships and the establishment of similar initiatives in other research centres warrants further investigation.

1. Introduction

In Ireland, the government warns that interest in Science among school leavers in Ireland is waning, but that science and technology is key to future economic growth and development[1]. Research centres in Ireland are obliged to invest in public engagement initiatives, to disseminate their work[2]. Current forms of public engagement are limited to panel discussions and other non-participatory forms of communication. There is scope to consider new and engaging platforms for communicating the sciences to a diverse audience demographic. Dr. Niamh Shaw, scientist/engineer and performer is passionate about igniting people's curiosity and is interested in making new forms of public engagement, laying in the middle ground between Arts and science.

2. About 'Diary of Martian Beekeeper'

'Diary of a Martian Beekeeper' is a live multimedia theatre performance aimed at the general public & young adult. Initially presented as a key event at Space week 2017 in Ireland and a larger production in Dublin, Ireland as part of Engineers week 2018 it tours across the UK as part of Culture Ireland's GB18[3] 2018 showcase programme.

The show was created through a collaboration between CIT Blackrock Castle Observatory, ESERO Ireland office of Science Foundation Ireland, European Space Agency Astronaut Centre (ESA EAC) and Research and Technology Centre (ESA ESTEC), Shaw and a number of theatre, and other multimedia artists, and to fulfil the following criteria:

(a) to ignite curiosity
(b) discover new and engaging platforms for science in the Arts & in STEM Education.
(c) to evaluate new methods of bringing space-themed content to the general public.

This work was funded for 12 months by Science Foundation Ireland as part of the Discover Programme 2017 and ESERO Ireland.

In Shaw's capacity as artist-in-residence at CIT Blackrock Castle Observatory, she collaborated with European Space Agency's Astronaut Centre in Cologne. A number of site visits were conducted to interview scientists, engineers, and former astronauts over an 18 month period. In addition, Niamh spent time with her father learning beekeeping. A theatre show emerged from this development phase, based on Shaw's personal documented journey at Mars Society's Mars Desert Research Station as part of Crew 173 and the dissemination of her research. This research was then crafted by the artistic team to create an informal, cross-curricular performance on STEM, Space Exploration & its human implications, using multi-media, movement, personal memoirs and con-

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tent from ESERO, & researchers, astronauts at the Astronaut Centre in Cologne. The research also explored the wider social & cultural implications of Space exploration and & the realistic possibility of human colonisation of Mars as a possible solution to the dwindling energy & food reserves on our planet to sustain human life long-term[3].

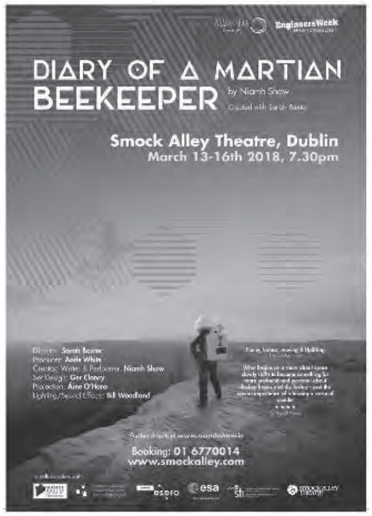

Fig 1 Poster image for 'Diary of a Martian Beekeeper' (Image credit H. Simoes, 2017)

A key strategy of Shaw's presentation style of mixing art with science was to engage the audience in new ways, crafting a narrative on which to hook scientific content. This strategy was highly effective in delivering the core science behind Space exploration as indicated by 80% audience capacity at each performance, made up of 50% regular theatre and non-theatre goers, favourable theatre reviews[4],

Fig 2 Still image from 'Diary of a Martian Beekeeper' (Image credit R. Kavanagh 2018).

social media and post-show evaluations feedback from audiences (see Fig 3).

Fig 3 Word cloud created from post-show audience evaluations to describe the show 'Diary of a Martian Beekeeper'

The data gathered from audience evaluations indicated that 'Diary of a Martian Beekeeper' stimulated audience curiosity about Space and also helped them understand a little better the importance of Space exploration and the power of the collective. Evaluations also indicated that the show impacted both science literate and theatre literate audiences, across all genders and ages (16-78 yrs) in Ireland.

6. Summary

Telling science within a story and placing the human at the centre of the narrative is highly effective, but it is recommended that this type of work, and artists collaborating in this cross-disciplinary form require further nurturing and support.

Bringing space-themed content within new forms of public engagement is an effective tool in igniting curiosity across many audience types.

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Love Letter to a Space Rock: On the Use of Art as Dissemination of Science

Cintia DURAN*1

Abstract. In 2016 I discovered the collection of rocks and minerals from the Museum of Paleontology of Guadalajara, in Jalisco, México. Within there is a single copy of a piece of the Allende meteorite rock. Since I knew of its existence, I dedicated myself to photograph and study it, first out of curiosity, then I made the decision to do some research on it. Love Letter to a space rock is an artistic approach to a scientific dialogue on research about meteoritic in Mexico. From a series of art pieces, audiovisuals, photographs and text, a declaration of love to the Allende meteorite stone, found in 1969 in the Chihuahuan municipality of the same name, will be made by me. Conceived as a multimedia art installation, this project aims to use tools of contemporary art to present important information about the meteoritic science and the importance of Mexican meteorites for world science.

1. Introduction

Love Letter to a space rock is an artistic approach to a scientific dialogue on research about meteoritic in Mexico. From a series of pieces, audiovisuals, sculpture and text, a declaration of love to the Allende meteorite stone, found in 1969 in the Chihuahuan municipality of the same name. Conceived as a multimedia art installation, this project aims to use tools of contemporary art to present important information about the meteoritic science and the importance of Mexican meteorites to world science.

About the space travel experience

Is important to remember, this project does not intend to educate, but to bring the viewer to experience, through universal ideas (like love), scientific concepts represented with contemporary artistic strategies in different platforms.

By using various artistic and media tools, we build lenguajes easy to digest, transforming scientific information on topics accessible to anyone.

This is the design of a series of unconventional dynamics for disclosure of meteoritic science of our country and publicize citizen initiatives in spreading science to non specialized audiences, but also to resume research on Mexican meteorites, emphasizing those found in the state of Chihuahua, Mexico.

2. Methodology

Research begins in 2016 when I approach the Museum of Paleontology of the city of Guadalajara, to carry out a series of photographs recording the collection of minerals and rocks owned by the museum. Within this collection there are 3 meteorites rocks, one of which is an original piece of Allende meteorite, possibly the most important meteorite on earth.

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Before starting, I would like to put into context the bureaucratic and institutional situation that we have in Mexico. The vast majority of museums and research centers are located in Mexico City, most of these institutions belong to federal government or to any public university. This, instead of promote their development, only hinders the scope that a museum, either artistic or scientific, can achieve.

The case of the Museum of Paleontology in Guadalajara is no different, is currently the only museum with scientific profile in Guadalajara, in the second largest city in Mexico. The little budget and care they receive, is reflected in the lack of interaction with the public and the lack of specialists in various subjects.

Returning to Allende, I went to the Museum of Paleontology when I found out they would hold an exhibition on meteorites. I thought it was necessary to ensure that such exposure would not be just another example of information displayed on walls, information that nobody would read. I developed a curatorial project, conducted a little research and proposed a specific curating script. Of course, it was impossible to carry out my proposal, given time and no budget for exposure. Suddenly I got stuck with a feeling of having something amazing and could not afford to show, so I started to write about it.

The Seduction of science

I had taken some workshops on the use of writing for art and accidentally found myself writing about Allende and all its wonders.

Someone told me, -you talk to the stone as if you were in love with it.

I thought about it, and I realized they were right. I had developed an almost irrational emotional attachment to the meteorite. It had seduced me, just as science could seduce all of us.

Allende meteorite fell in Chihuahua in 1969, in a small town north of Mexico. Since then, it has become the most researched meteorite rock in history.

It is supposed to be 4,567 billion years old, and thanks to it, there has been tremendous progress in to current science advances in the world. However, in Mexico and outside the scientific environment, no one knows its importance or even its existence. At that moment, I understood the importance of that particular space rock and decided to do something even more important: To declare my love to it.

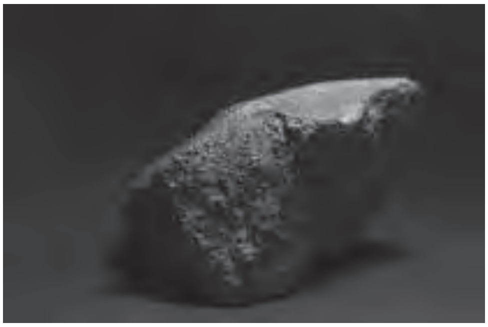

Fig. 1 Allende oriented meteorite Museo de Paleontología de Guadalajara ©Cintia Durán 2017

The first part of the exhibition focuses on the presentation of the piece exhibited in Guadalajara, which explains with photographs video and text, what an oriented meteorite is, and what is its importance. Also, as part of the parallel exposure activities there are being carried out small workshops about meteorites and how to differentiate the elements from earth rocks.

For these workshops I count on the support of Eduardo Gómez, expert in meteorites and minerals, the most knowledgeable person on the subject in Mexico.

Fig. 2 Meteorite Workshop in Guadalajara ®Cintia Durán 2017

A Love Letter

Finally the most important part of the exhibition is literally writing a love letter. Where I can tell Allende everything I feel for it. The most complicated exercise, creatively, because sharing and writing your emotions might seem easy, but it has become the most complicated part for my creative process.

Among the parallel activities, this exercise goes along with a series of small workshops and meteoritic poetry for children. Together, for a few weekends, kids will learn about poetic writing and the importance of meteorites in our daily lives.

3. Conclusions

Love letter to a space rock is still an unfinished project, 80% of the parts have been produced but has already yielded important insights into the strategies carried out. In Mexico there are many museums dedicated to art and science. However, the practices within them remain the same for 40 years. This project aims to bring the public to specific information that can understand and easily assimilate. The relationship is achieved by showing scientists talking about emotions, it gives the public an empathy with the knowledge given.

An Attempt to Look for New Possibilities of Astronomy Communication through "Chado (the Way of Tea)"

Naoko ASAMI[*1] and Naohiro TAKANASHI[*2]

Abstract. We have held several events with the intent of looking for new possibilities of collaboration between "Astronomy" and "Chado" (the way of tea). Here we report these events (occurred in in August 2014, February 2015, November 2015 and December 2016) and provide a short comment on how participants' ideas of "Astronomy" and “Chado" have changed through these events and how they were able to feel a deep connection between culture and nature.

1. Introduction

Recently, various collaborations are tried in the field of science communication. Some of them are collaborations of different perspectives, for example, "Child-rearing and Astronomy", "Art and Astronomy", etc[1]. These collaborations of different perspectives could promote mutual understanding and create a new relationship of them. In this paper, we will report our attempt to look for a new possibility of astronomy communication. We chose "Astronomy" and "Chado" (the way of tea, Cyanoyu) as different perspectives, and planned cosmic tea ceremonies. This attempt is not the first one. However, previous attempts have tried an approach from Astronomy to Chado. On the other hand, our tea ceremony is an approach from Chado to Astronomy. The planner N. Asami who is one the author of this paper is not only an astronomer but also a tea master.

2. What is “Chado” (the way of tea, Cyanoyu) ?

“Chado” is one of the Japanese traditional cultures, and concentration of many genres within the realm of Japanese culture.

In a tea ceremony in Japan, various utensils are used depending on the season or the theme, because of a concept to cherish the sense of the season with natural posture.

The essential spirit of “Chado” is expressed in the concepts of Wa, Kei, Sei, Jaku. These concepts are called the ‘four principles’, and may be interpreted as Table 1[2].

This point of view is important when you communicating Astronomy with the public. We think ”Chado” is one of the best practices that change your feeling to nature and the universe.

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Table 1. The Four Principles

	meaning
和**[Wa]**	Harmony: To get along with each other
敬**[Kei]**	Respect: To respect each other
清**[Sei]**	Purity: To be pure
寂**[Jaku]**	Tranquility: The mind that is always serene

3. How we can collaborate with “Chado”?

We have held four events in August 2014, February 2015, November 2015, and December 2016, intended to look for a new possibility of collaboration with "Astronomy" and "Chado". We report these events and give a short comment on how participants' images of "Astronomy" and “Chado" changed through the events, and how they were able to feel a deep relationship between culture and nature.

By the way, some characteristics of a tea ceremony fit to philosophy of science communication. "Nijiriguchi" is one of the examples, which is an entrance to chashitsu (tea ceremony room). All guests of the tea ceremony enter to chashitsu through the nijiriguchi. This design forces all guests who come in a chashitsu to bow, even though the guest is exalted [3]. It means that anyone in the chashitsu is equal, and it is also important philosophy for science communication too.

3.1.宇宙 "Uchu" ×茶会"Chakai"

Since we would like to have more deep dialogue each other, our events are in smaller groups. We held four tea ceremonies in the past, each of them has 5 round and about 20-25 participants took part in. Chashitsu (Fig. 1.) is decorated in the traditional style.

Fig. 1. Inside of tea room

3.2. Sweets and utensils

Themes of these events are “time”, ”cosmic cycle” and ” extrasolar planet”. We expressed them in sweets and utensils.

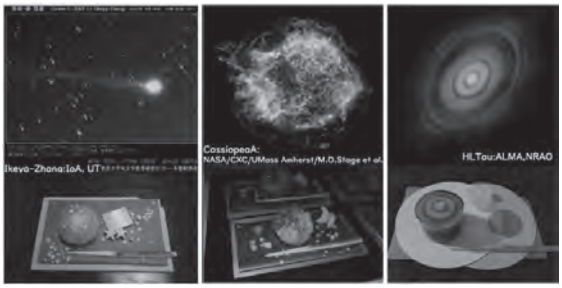

Fig. 2. Sweets are inspired from Comet (left), Supernova (middle), protoplanetary disc(right)

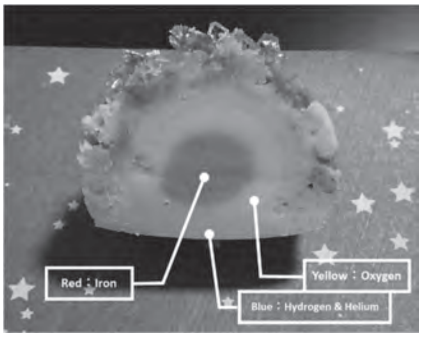

Fig. 3. Inside the cake we have a display of the structure of the star just before the explosion

We pick up one of utensils, ‘Mizusashi (water container)’ is inspired from ‘the Milky way galaxy’ made by glass (Fig. 4.). It seems to be a galaxy, but it seems to be a black hole from the other side!

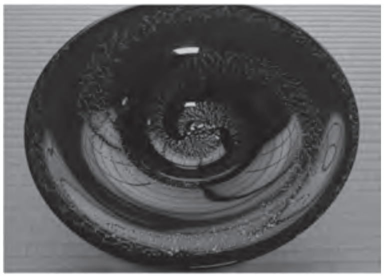

Fig. 4. Water container seems to be the Milky way galaxy

4. Fruit of the collaboration

We explained about utensils simply, in order to cherish guest’s own images. And we talk without using any images and photos, because we want that guest concentrate to feeling universe. As a result, guest got various imaginations. For example, flower decorated in the chashitsu conjured images of explosion, globular cluster, galaxy cluster, the large-scale structure of the universe, and so on.

5. Summary

We report these events and give a short comment on how participants' images of "Astronomy" and “Chado" changed through the events, and how they were able to feel a deep relationship between culture and nature. (Questionnaire results)

Acknowledgement

We give special thanks to our guests, S. Saito, R. Motomura, Y. Umezawa, W. Hayashi, S. Yonemoto, M. Kakemoto, K. Takeda, Y. Oshige, C. Tsuchiya, S. Natsugari, K. Takanashi, H. Yamaoka, A. Mimura, A. Harigaya, Tangible Earth Museum[4], Uchida Design Inc.[5], TENPLA[6], Zentaro Shoten[7] and S. & K. Asami.

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Communicating Astronomy Through Comics

Marja K. SEIDEL*1

Abstract. Which are effective communication methods in astronomy today? How much does the general public learn from an image taken by the Hubble Space Telescope? And can they distinguish from a real image and an artist's depiction? In a time, where multimedia tools and omnipresent videoclips and animations have almost become overwhelming, it is important to reflect on what we aim to communicate to our audiences. Comics can explain complex research questions in a simple, accessible, witty and interactive way without creating costly animations. By developing learning goals in a comic format, one will find oneself stripping down the ideas to their roots, to the essential. Even entire lectures can be presented in a series of comics, which turn out to be interactive and a very effective learning method. In this CAP workshop, we provided the environment to interactively explore communication through comics applied in the astrophysical context. This text summarizes the basic rules or fundamentals to create successful comics, experiences from the CAP workshop, success stories in science communication using comics and final conclusions.

1. Introduction

Communicating astronomy to the public in simple and effective ways is the aim of many people and institutions. Researchers in all disciplines are encouraged to engage the public with science [1] and new communication channels such as twitter, facebook or instagram animate authors to shorten their explanations or post images [2]. Therefore, it is critical to reconsider the learning outcome produced by these visual products. Often, space telescope images are used without further explanation and artist's depictions are not labeled as such, potentially confusing public viewers. This is where comics can come in.

Comics can catch the essence of an idea — a learning goal — in one simple sketch. Through creating a metaphor, telling a story or employing humor, it can also be much more memorable than a forthright description. In addition, most comics can be understood equally well by a variety of audiences.

2. Best practices for comics

The most important rule to remember when considering creating your own comic is that you do ***not*** have to be an outstanding artist. The "art" consists much more of identifying the core idea. The next step is translating that idea into a simple sketch that conveys the concept as concisely as possible. The final step, the actual drawing, is, in fact, only the "icing of the cake". The "xkcd" web comic is a wonderful example for the drawing's simplicity [3].

Three practical rules are: i) make it simple, ii) choose one learning goal, and iii) check your facts: while it is clearly not required to represent a scientific discovery in all its complexity, it is important that the core idea is correct; especially because the possibility exists that successful comics might go viral on social media.

Other helpful techniques are to use characters (just give it a name!), tell a story, build on your own experiences, don't punch down and of course draft, practice, draft, practice [4]. And finally, please have fun! Then you will be able to also create a fun comic.

3. The CAP comic(s)

During the CAP workshop we put the guidelines for comics into practice. Different and difficult concepts in astronomy where chosen from a prepared list between the groups. Again, the key was to not only choose the concept, e.g., neutron star or black hole, but to pick one important defining aspect. Below, an example is given in Fig. 1.

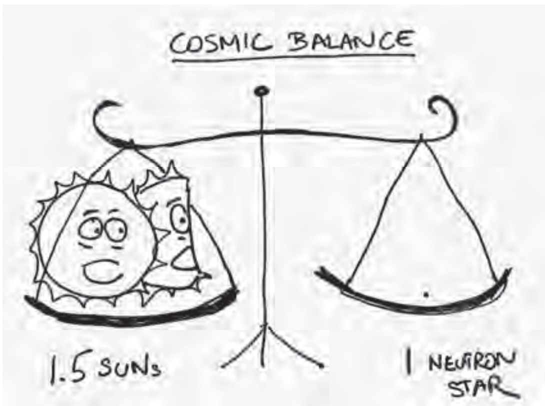

Fig.1. Comic illustrating the massive density of a neutron star compared to the sun, credit author.

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The final task was to jointly create a comic that represented the CAP conference 2018. This turned out to be much more challenging due to the multiple aspects of this conference. The idea to depict the CAP universe under construction in the form of a puzzle with different pieces could encompass this multitude of ideas.

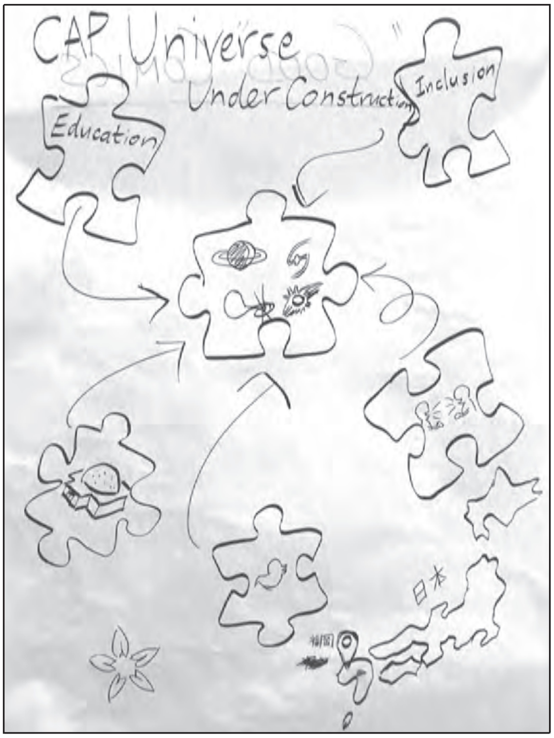

Fig. 2. CAP comic created during the workshop: education, inclusion, communication, social media, and planetarium experiences all came together "in the name of astronomy" in Japan (where we were lucky enough to experience the Sakura).

4. Interactive comic talks

Apart from stand-alone comics to communicate a certain idea or concept, comics can be used throughout an entire presentation. The basis of this idea are online videos, such as those developed by Henry Reich [5]. Instead of creating a movie in fast forward following the creation of the comic and story, the individual comics are prepared prior to the talk and the story is told in real time.

A simple setup, where a webcam is fixed to an extendible arm of a mini-tripod (or similar), can be used to film a livestream of what is happening on the presenter's table. Here, (s)he has to only place the comics and start the story telling. Based on the author's experience, these kind of talks have proved extremely successful in the past.

5. Summary and Conclusions

This workshop proposed astronomy comics as a simple, effective and high impact tool to reach a large variety of audiences with a scientific content goal. Participants agreed that it was less difficult to draw once they had decided on and found the essential idea that they wanted to communicate.

Finally, the joyous atmosphere throughout the workshop showed that creating your own comics can be an entertaining experience for yourself as well as for your audience.

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Astronomy in the Japanese Animation Movie "Your Name" (Kimi No Na Wa)

Pisit NITIYANANT*1

Abstract. In present days, many Japanese animation movies are imported to be screened in Thai theatres, but only limited to those popular animations such as Doraemon and Case Closed (Detective Conan). Whose income is generated more than 10 million THB (~290,000 USD) and are targeted on kids & family. Meanwhile, "Your Name" is the first Japanese animation movie with the aimed target on teenagers & young adults that generates the estimated gross beyond 10 million THB in Thailand. The total gross of this movie in Thailand is 43 million THB. The popularity of "Your name" in Thailand with many astronomy-related scenes in this film inspired presenter to realize that these scenes in the film might be possible to apply for astronomy learning in high school or undergraduate level. Therefore, presenter is attempting to highlight on astronomy-related scenes in "Your Name" in the points of view of Planetary Science (orbit, comet & impact cratering) and Cultural Astronomy (mural art).

1. Introduction

There are many astronomical learning media for people in the age range from high school student to young adult in Thailand but most of them are in the form of books or documentary. From the popularity of "Your Name" in Thailand, some animation movies with astronomy-related scenes should be applied as learning media for people in this age range in school, university and online community.

2. Result

These are astronomy-related topics appear on many scenes of Japanese animation movie "Your Name":

[Planetary Science]

1) Comet's orbit: The scene of the first figure of comet's orbit may has original model from the figure of PANSTARRS comet (C/2011 L4) orbit by NAOJ
2) Kepler's 1st law violation: The scene of the second figure of comet's orbit show the solar position outside comet's elliptical orbit.
3) Gravity assist: If the comet closer than the moon, the Earth's gravity should disturb its motion, leading to long-term changing of the comet's orbit.
4) Comet appearance: The original model for the comet appears in "Your Name" may be comet McNaught (C/2006 P1) and the cometary coma should appear larger because the comet's distance is a half of lunar distance and the smallest size of coma is similar to the size of Jupiter.
5) Fragmentation of the comet: The scene of fragmentation of comet with explosion may be the result of the pressure of internal gas inside cometary nucleus.
6) Comet & water on the Earth: The scene depicts comet's impact as water droplet dropping on the impact site in Japan may reflect the hypothesis about comets are one of sources of water on the Earth.
7) Impact cratering: There are 3 fictional sites of impact craters which are simple craters. The 1st crater (387BC) may be Itomori town lake with the most eroded crater rim. The 2nd crater (813) may be The crater with Go-shintai (objects worshipped) and less eroded crater rim. The 3rd crater (2013) is the lake formed by impact at Itomori town and shows the concept of younger crater overlap the older crater (The law of superposition)
8) Comparison of the 3rd fictional crater with theoretical cratering model: Used information about fictional impact to compare the size of fictional crater with 2 online theoretical cratering models. The result is the fictional 1-km simple crater quite close to the result of 0.91-km complex crater from the model of Keith A. Holsapple, University of Washington (2015)

[Cultural Astronomy]

1) The old mural painting of comet: The scene shows the mural painting depicts the comet on the ceiling of Go-shintai cave. In reality, Japan doesn't has any mural painting about comet in historic site.

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|Poster|

Project Sugo-Haya2

Misato KOSUGE[*1], Kota ISHIZEKI[*2] and Kosuke SHIRANITA[*2]

Abrstract. Sugo-Haya2 is a Japanese traditional board game Sugo-Roku adopted to simulate Hayabusa2's round-trip exploration of the asteroid Ryugu. The game shows Hayabusa2's long exploration process chronologically, and by adjusting the Sugo-Roku game's elements and the difficulty, it can precisely reflect the technical accuracy and the advanced technical level of the exploration so that the players can experience those aspects of the mission through the game. From the young to the old, this hands-on activity promotes the understanding of space exploration and make it feel close to home while having fun.

1. Introduction

Sugo-Haya2 aims to make space exploration familiar to the public. Sugo-Roku has routes drawn from the start to the goal with squares of exciting event in between. In Sugo-Haya2, the round-trip to the asteroid Ryugu is reflected on the routes, and each mission is arranged as an event. The idea of applying space exploration to Sugo-Roku came from student members (Tsubasa Horaguchi, Ichiya Yamanaka et al.) of Project Sugo-Haya2. With advices from other expert members (Mika Boots, Hiroaki Umezawa, Yuichi Sasaki, Ryota Suzuki, Yuhei Kikuya, Taku Yamaji), the Sugo-Haya2 is formed as scientifically and technically accurate as much as possible with friendly graphics.

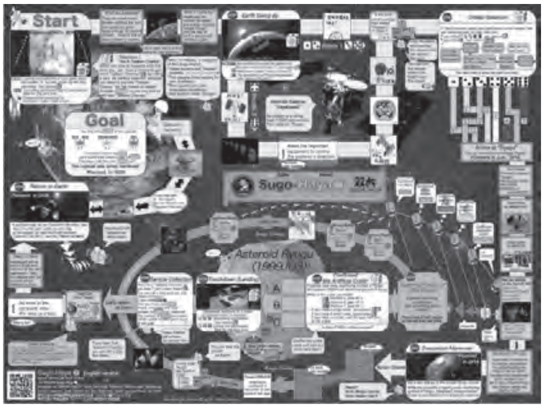

Fig.1 Sugo-Haya2 game board
Downloadable from Sugo-Haya2's website:
http://www1.hst.titech.ac.jp/club/sci_club/sugohaya2-e.html
Illustrations of Hayabusa2 : Mr. Akihiro Ikeshita

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2. Result

The Sugo-Haya2 game board is shown in Fig.1. It can be played by two or more players regardless of age. The game board and all game parts can be made with paper and it is very low-cost to prepare. Sugo-Haya2 is downloadable from our website (the URL of the caption in Fig.1).

The features of Sugo-Haya2 are as follows.

* Chronological bird's eye view of Hayabusa2 project is shown on Sugo-Roku board.
* By choosing Sugo-Roku elements and techniques, game players simulate the mission contents.
* Difference in the difficulty of the mission level within the game, the players can understand how high the technical level of Hayabusa2's mission is and feel its scientific values.

3. Summary

In summary, we were able to produce an attractive outreach tool for the public suitable for scientific and technological themes involving time series processes.

4. Acknowlegement

We would like to thank Mr. Akihiro Ikeshita, whose illustrations contributed to accurately express as well as easy-to understand the Hayabusa2's mission. The images provided by JAXA which helped to keep the Sugo-Haya2's scientific and technical accuracy.

The following people and organizations who made it possible to let Sugo-Haya2 known to the public all over the world.

Ms. Patricia McGahan
FabLab KandaNishikicho
JUMP TO SPACE

And This work was supported by Tokyo Institute of Technology Fund for Science Education Support.

We are looking forward to the wonderful scientific and technical results that Hayabusa2 will bring back.

How to Make Handmade Astronomical Explanation Panel that Can Compare "the Distance from the Earth to the Stars" by Pulling Strings

Naoko OHE[*1]

Abstract: Here I report the case of Activities for Astronomy Popularization using handmade explanation panel. This panel gives priority to intuitive understandability. This method considers universal design (UD).

1. Introduction

The constellation is not the plane that is attached to the celestial sphere. Actually, the distances from the Earth to each star are different. Therefore, I devised the explanation panel that can intuitively and tactilely confirm the 3-dimensional depth of the constellation.

I tried and errored so that everyone, including the visually impaired, can share the vastness and pleasure of the universe. And I did the workshop using that panel at the Symposium on UD for Astronomy Education[*2]. After that, I improved the panel with the cooperation, advice, and requests of visually impaired people. I will share how to make it.

2. Methods

Material: 7 mm thick panel. Different thickness and color string (about 4 kinds). Others.

(1)Prepare the design of the constellation and paste it on the panel. [1] Make the holes in the place of the main stars. Examine the distances of the main stars from the Earth by books and so on. [2] [3]

(2) Depending on the star's magnitude, choose the thickness and color of the strings. 1st magnitude star: thick, 2nd: Medium, 3rd: thin, 4th: very thin.

＜Consideration example of color UD＞

e.g. 1st: Yellow, 2nd: Pink, 3rd: Green, 4th: White (For colorblind people, "red and green" or "pink and sky blue" are difficult to distinguish.) [4]

(3) Make a knot at one end of the string. Convert 1 light year to 1 mm and measure from the knot of the string and mark with a pen. Cut the string with a margin of about 10 cm at the end of the mark.

(4) Pass the strings through the holes in the panel. Make the knots at the marked part of the strings.

3. Conclusions

This explanation panel can be made inexpensively with familiar materials, can be carried, and is also UD. I hope that can be of some help in the world.

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I think that this panel will provide the pleasant way to facilitate communication of astronomy.

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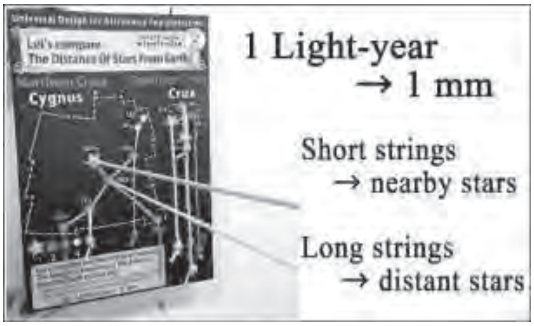

Fig. 1. "Touch and understand" UD panel

By touching the strings with different thickness, you can distinguish the star's magnitude. There are distant bright stars and nearby bright stars, and conversely, there are distant dark stars and nearby dark stars.

Fig. 2. Let's compare the distance to the stars! Please pull the string. The length of the string is the distance from the Earth to that star.

|Poster|

Astronomy is Our Culture: "Starry-scape Photo Collections" for Astronomy Outreach

Kouji OHNISHI*1,2

Abstract. From 2014 to 2015, the International Astronomical Union (IAU) conducted an exoplanets naming campaign "NameExoWorlds" that decides the names of planets orbiting other star by proposals and votes from the public. As one of the publicity activities in Japan for this campaign, we made a "Starry-scape (=Starry sky and landscape) Photo Collections" showing where the candidate exoplanets are located. We made this “Photo Collections” freely available for public outreach. Especially since the Starry-scape Photo can appeal directly to the emotions of people, it is a very effective tool as a means of the communicating astronomy with the public.

1. Introduction

Currently, nearly 4000 exoplanets are found in all skies. If you were to name these exoplanetary systems (main stars and planets), how would you name it? From 2014 to 2015, the International Astronomical Union Association (IAU) conducted the Exoplanets Naming Campaign "NameExoWorlds" that decided by proposals and votes from the public [1].

247 names were proposed from various astronomical organizations in 45 countries, and the name of the 19 series exoplanetary system was named from the name with the highest number of votes. Of these, four exoplanetary systems were named under the name proposed by Japanese astronomical organizations. These are exoplanets discovered by the Doppler method in Okayama (OAO), National Astronomical Observatory of Japan.

In promoting this campaign in Japan, we thought about a method to do the following; (1) to be aware of the existence of exoplanetary system, (2) to know the exploration method of exoplanetary system, (3) to know the situation of exoplanets exploration in Japan.

As this entrance, we decided to create a "Starry-scape Photo Collections" showing where the candidate exoplanetary system are located. One is a picture set showing the position of candidate objects in the constellation. Constellation is made in the long history of people, so it is an effective method to convey the position, the season and so on. The other is a picture set showing the position of candidate objects in the starry sky that we looked up from the ground [2].We will call such a photograph here "Starry sky and landscape photograph (abbreviated Starry-scape Photo)". Especially "Starry-scape Photo" can appeal directly to the human emotions, so we expected to be a tool to communicate in astronomy to the public who are not interested in science.

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2. Examples of production works

Figure 1 is an example showing the positions of two exoplanetary systems. We think that many people were interested in using such a "Starry-scape Photo".

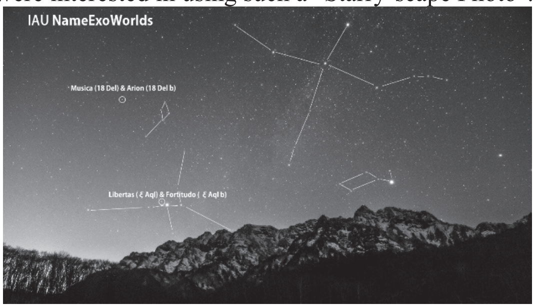

Fig. 1. Two exoplanetary systems (18 Delphini and xi Aquilae) in the sky of dusk of December

3. Summary

Looking up at the night sky, you can find stars of various names. Looking at these names, I think again that astronomy is our culture itself. In order to spread such a culture to many people, also for outreach and/or communication of astronomy and presentation of astronomy education, we would like to use the "Starry-scape Photo Collections" produced this time.

In addition to producing a sequel to the Starry-scape Photo for introduction of exoplanets, at the same time, a chart photo for Subaru Telescope HSC Viewer is also under construction. Also, every day, I post "Starry-scape Picture of the Day" on Twitter [3]. They are free to use for educational use. With this announcement as an opportunity, we would like to receive the requests of Starry-scape Photo Collections for the “communicating astronomy with the public”.

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[2] http://tenkyo.net/exoplanets/wg/gallery.html
[3] https://twitter.com/koujiohnishi

SESSION I.2:

Outreach in Visitor Centers, Public Observatories, Museums, and Planetariums

Role of Malaysia's Museums in Communicating Indigenous Astronomy and Promoting Nation Building

Nurul F. JAAFAR*[1], Ahmad H. KHAIRUDDIN*[2] and Mohd A. SHATIR[3]

Abstract. "Orang Asli" are the indigenous minority people in Peninsular Malaysia which are subjected to fallible paradigms in their traditional way of life and scientific local wisdom due to Eurocentrism. Fieldworks however prevailed that such bias perspective on ethno-astronomy were build based on erroneous and stereotype assumptions. Engagement of cultural centers as agent to disseminate "Orang Asli" knowledge and heritage for the public will fight against racial inferiority thus highlight the importance of recognizing "Orang Asli" as vital component in nation building.

1. Introduction

Orang Asli (Malay: *orang* - people, *asli* - original) are the indigenous minority people in Peninsular Malaysia and consist of 18 sub-ethnics. Each group has non-homogeneous language and culture, differ in mode of life and geographical location, either coastal, near to/in urban areas, in rural or remote forests. Some have salaried job or self-employed, while most of them practiced either permanent agriculture or swiddening, hunting, gathering and small trading for cash incomes.

According to [1], Orang Asli were subjected to slave raiding in precolonial period because they were perceived as 'savaged' and 'not humans' but being 'anthropologically exploited' as research specimens and missionary target during colonial era due to their 'primitiveness' and 'uncivilized' culture. These misconceptions again were carried out during the Malayan emergency and in post-independence epoch where they were perceived as peoples prone to the communist insurgencies infiltration, therefore need to be 'protected', 'developed' and 'modernized'.

2. Issues

The ontology of this essay is about the role of astronomy in bridging the gap of rarely discussed issues in art and science spheres – the indigenous scientific knowledge and nation-building. We highlight how the colonial discourse of Orang Asli knowledge continue to influence the present day anthropological scholarship assumptions in misunderstanding their intellectual and scientific achievements. We argue that our traditional practiced ghettoizing cultural centers into mutually two exclusive cultures – the artistic and the scientific, has keeping us in an old paradigm inertia which continue to segregate indigenous contribution in science and technology.

We also describe how such assumption of inherent racial inferiority become today's stereotype perception in museums and mass media. The Orang Asli are regarded as the Bumiputera – Son of the Soil and has been acknowledged biologically as the descendants of the earliest inhabitants in Southeast Asia but these recognitions do not portray fairness and justice in the distribution of rights, resources and opportunities among them [2]. Post-independence multi-ethnicity discourse often neglects Orang Asli from the imagined community and nationalism agendas.

3. Astronomy for a Better World

Our understanding of indigeneity is based on the vast tomes of the Orang Asli narratives written by the colonials from the Westernized lenses [3]. The ethnoscience research usually focused on the taxonomic systems for plants and animals, with very little records on celestial objects. Claims made by researchers e.g. "*No names are assigned to constellations…did not even appear to have the concept of constellation.*" (Rambo, p.84), "*…have no astronomical interest in the night sky. No stars are named nor are constellations recognized.*" (Benjamin, p.59) are contradict to the work of Malay Archipelago well-known ethnographers - Skeat & Blagden (p.723-724), Stephenson [8], even to my own ongoing series of fieldwork which recorded an immense data of

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constellations, planets, transient phenomena and calendars.

The extermination of knowledge due to the 'non-Western' intelligence is considered inferior and not included as part of the cannon of thought. de Sousa Santos in Grosfoguel [4] calls this epistemically racist paradigm as 'epistemicide' where the Westernized model of knowledge is considered superior than the 'wild', 'barbaric' and 'simple' aborigines. The corroboration to this is in the aboriginal museum practices. Museums always be portrayed as a place for 'authentic' tangible cultures, where the indigenous groups were defined based on the legacy of Western anthropology which was intertwined with colonialism and racism veins. The peoples are presumed to be less cultivated with simple technology thus influenced knowledge construction of the Orang Asli to such a degree that many scholars sedulously followed these colonial Eurocentrism boundaries in their work.

Only recently, the Orang Asli Crafts Museum and the Lembah Bujang Archaeological Museum under the auspices of the Department of Museum Malaysia took a leap in communicating science which is astronomy for the public rather than the usual subjects of anthropology, archaeology, cultural and history. With a full house attendance and great reviews, the programs were successful and partnership offers came from statutory bodies, NGOs, the mass media, production houses and Orang Asli individuals with the encouragement to rewrite stories of the Orang Asli taught in the schools' history and science textbooks. Such programs have shown that centers with specific focus on indigenous community and heritage can attract greater publicity and exposing indigenous astronomy to a wider audience from different backgrounds. We are glad that other indigenous centers have also given positive feedback and have shown interest in organizing events which appreciate the indigenous wisdom and heritage.

In order to communicate the research findings in an efficient way, the cultural centers and scholars must provide educational resources that can be integrated into the school teaching curriculum and community engagement programs. We plan to start astronomy outreach programs in indigenous schools and villages by introducing naked eye star gazing, followed by telescope viewing and planetarium shows to bring scientific awareness as well as to trigger the elders' childhood memories in mapping the constellations and seasonal calendars. We also plan to publish an introductory book on indigenous astronomy in conjunction with the IAU 100th anniversary celebrations in 2019 to decolonized the Western hegemony of knowledge especially of science and art domains.

4. Conclusion

We hope that this novel role of museums in liberating and communicating indigenous astronomical knowledge will redefine epistemic relativism and recognize epistemic diversity. This 'transmodern' pluriverse movement as what Dussel proposes in [4] epitomizes the call for plural society in multiculturalism Malaysia where the racial types' delineation is highly fluid, subjective and idiosyncratic. Together we design a better tomorrow with astronomy!

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|Parallel Session|

Maximize the Minimum Facilities: Strategy for Gaining Public Engagement at Bosscha Observatory

Fera G. PURWATI*1, Sahlan RAMADHAN*1, Emye T. HANDHITA*1 and Wildan HIDAYAT*1

Abstract. Every year Bosscha Observatory has about 50000 visitors who come to join public visits program, the regular public outreach activity there. This number of visitors has been served by limited facilities that allow for public, there are the dome of Zeiss' 60 cm telescope, multimedia room, and for addition information board near the parking area. Renovate and add the facility could not easily to be done since Bosscha Observatory is one of a heritage building and that idea will relatively need huge budget also. That should be strategies by using limited facility and resource by maximize the function of each. The ideas are improve interactive learning strategies for facilitators, fixing the multimedia in the multimedia room and static information board by using visual aids rule, and also the social media function for public outreach. We hope new method will increase the public engagement and inspire public after visiting the observatory.

1. Introduction

Bosscha Observatory built in 1923-1928, in West Java, Indonesia. Today it's already 90's year old but this observatory still doing research, education and outreach activities, in very challenging condition. There are two routine public outreach activities that held in observatory, day visit and public night.

Fig. 1 . Zeiss's dome and a group visitor who attended day visit at Bosscha Observatory.

There are several telescope lay on the observatory's area, most of them used for research. The facilities shared for public activities are the dome of Zeiss' 60 cm telescope, multimedia room for the talk, and information board near the parking.

In the other hand, limited facility issue also has affected to research and public outreach. Improvement on physical facility not only need relatively huge budget but also complex challenge by the observatory current status. Since 2008 Indonesian government recognized Bosscha Observatory as National Vital Object in Cultural and Tourism [1], the observatory should preserve the building and facility, so not easily for renovation. Quality content improvement and optimization the facility function play the role for quality improvement of public outreach activities.

2. Strategies

The very first strategy to improve the program quality is making an analysis of the current activity. Previous evaluation study gather some opinions from visitors about Bosscha Observatory and public activities. Visitors said the observatory is a good place to take iconic picture or walk around, and based on questionnaire evaluation visitors had positive impression on the facilitators, but in the other opinion are visitors come with clueless about what will they do, also for media and material impression got the lowest 311 point from average score 337 point [2].

Average visitors come to Bosscha Observatory about 50000 each year with visitor profile spread from kindergarten until university student and public. Even some of the visitors' said the purpose that go to the observatory for recreation but with the right maximize strategies we could invite them to learn also. Based on absorption-immersion and active-passive visitors participation when traveling and services provided those created the four realm model of experience [3]. Bosscha Observatory's activities potentially could cover three of it, there are esthetics, entertainment, and education aspects for public outreach.

First strategy is improvement on communicating skill for facilitators. Scientist not only given the talk but also should invite visitor to actively learning. One of success interactive learning strategies for example is think-pair-share (TPS) or peer instruction (PI) [4]. In the other hand this interactive learning strategies

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determined from the facilitator. So the next improvement is the quality of media presentation, it will be helpful for the facilitator who lack of experience. The presence of astronomer as facilitator is one of differentiator from other informal astronomical education in Indonesia, so the most appropriate media is using PPT who combined by interactivity with audience and also help the presentation. Concern of the media improvement are on the content and good visualization. For the content it should considering cognitive and topic for each group level. For visualization the PPT presented not only put the text and photo but there are several rules to make it simple, clear and great media using visual aids guidelines [5].

The other facilities for media there is static information board near parking area, it has 3 separated board. Ideas for topic put on the board are introduction about Bosscha Observatory as fixed item, and research from the observatory that related with topic per month and astronomical comic or astrophotography. The comic can explain the information about astronomy or misconception that common in public.

For social media, there are two official fans pages from Bosscha Observatory. Since social media is one of the strategic place to reach the wider community in the internet era, social media is necessary to communicate nowadays. One of the nearest engaging example from Bosscha Observatory was the press releases for Total Lunar Eclipse on January 31st , that got the 254 react (likes and love), 362 shares and 7 comments, in Facebook fans page. This response is the signal that public waiting for information from the capable scientist especially from Bosscha Observatory. So the relatable and relevant content strategies which created in various social media potentially to increase public awareness and engagement [6].

3. Conclusion

The idea of optimization the available functions and resources are make effective and efficient improvement without spend huge budget and change the system. This idea could be done by evaluation the activity, take feedback from the public, make a SWOT analysis, and consistently do this looping strategy. Still and all there are several ways to gain public outreach activity from the observatory management aspect, for example add new activities, add the role of facilitator and explore the public engagement system. Public outreach activity in the observatory has important role for public education, so we aware that science communicator should not only give the facts about science, but also encourage public to learn more after they visit. Furthermore inviting them that when we learn about astronomy, we learn about ourselves as a part of this universe.

4. Acknowledgment

We would like to thank the NAOJ and Japanese crowd funding campaign for the Japanese Travel Grant for Asia-Pacific Science Communicators and also Leids Kerkhoven-Bosscha-Fonds to provide grant for joining CAP2018 conference. We would also like to show our gratitude to Mrs. Premana W. Premadi, Mrs. Yatny, and Mr. Denny for inspiration and discussion about public outreach in Bosscha Observatory.

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|Parallel Session|

Present Situation of Public Observatories in Japan, and Activities of Japan Public Observatory Society

Kazuya AYANI*1, and the Members of the Steering Committee of Japan Public Observatory Society (JAPOS)

Abstract. There are hundreds of facilities in Japan which have equipment for astronomical observation and which are open for public observing. These "public observatories" have various types; some have telescopes as the core equipment, some have telescopes as attached equipment of museums, hotels, or outdoor education facilities. Most of them are established by local governments. Hundreds or thousands of people enjoy evening public observing in each public observatory. Japan Public Observatory Society (JAPOS) was established in 2006 to promote activities and collaboration of public observatories. Present situation of public observatories in Japan based on preliminary results of recent quick survey, and activities of JAPOS are briefly introduced.

1. Introduction

In Japan, there are hundreds of facilities where observing equipment (such as telescopes) is open for public. People enjoy stargazing through the telescopes in the facilities. Here we call those facilities as "public observatories".

First public observatory in Japan is Kurashiki Astronomical Observatory established by a private corporation in 1926 (see also Reference [1]). In 1950, Asahikawa City Astronomical Observatory was founded as a first public observatory established by a local government. In 1980s, many public observatories were founded mostly by local governments for popularization of astronomy among children in the area, and for regional revitalization. Since 1990s, about a dozen public observatories with a telescope whose diameter is one meter or larger were founded. On the other hand, many public observatories had few staffs. We established an organization to support public observatories in 2005. Situation of public observatories was surveyed and published in 2006. This year we made a quick survey by internet to investigate present situation of public observatories. Here we present preliminary results of the survey and briefly introduce our organization, Japan Public Observatory Society (JAPOS).

"Public observatories" includes various types of facilities. Some have telescopes as core equipment, some of them are museums, some belong to hotels, some are maintained by amateur astronomers.

They hold evening public observing, daytime public observing (for bright stars), on-demand star parties, lectures for public, observation by staffs for displays and scientific data.

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2. Present Situation of Public Observatories Based on the Quick Survey

We made quick survey of public observatories using query forms in the website. We categorized the public observatories into several types; "Observatories" in this and following section denote, in a narrow sense, facilities with telescopes as the core equipment. Museums, hotels, facilities for social education or outdoor activities were included if they open their telescopes for public observing. We received replies from 69 public observatories (23 observatories, 28 museums, 5 hotels, 7 facilities for social education, 6 others). The results shown here are only preliminary.

Observatories tend to be located in dark area. 39% and 13% of observatories are in mountainous regions

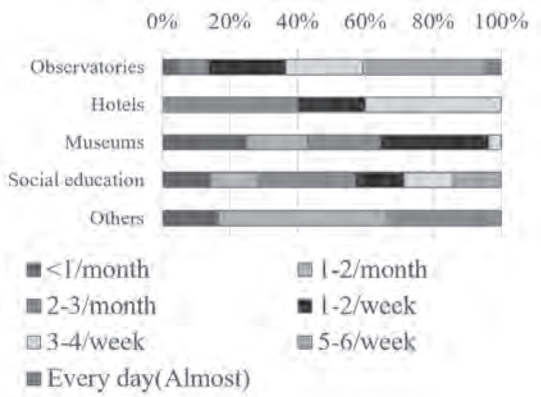

Fig. 1. Frequency of evening public observing among each type of public observatories. "Social education" stands for facilities for social education.

and in urban areas, respectively, while 54% of museums are in urban areas.

Fig. 1 shows the frequency of evening public observing among each type. Observatories tend to hold evening public observing more frequently than facilities of other types. About two-thirds of observatories hold evening public observing on three nights or more per week.

We surveyed the number of participants of evening public observing for one year from April 2016 to March 2017 for each observatory. The annual participants were several hundred to a few thousand during the year in many public observatories. Several observatories had over 10,000 annual participants. Many of the participants were families and couples.

However, the activities of public observatories are sometimes maintained by small number of staffs. Many of public observatory have 2 to 5 permanent staffs for astronomy popularization, but 17% of observatories have no permanent staffs. Many public observatories are supported by part-time staffs or volunteer staffs.

3. Activities of JAPOS

We realized that many public observatories need cooperation and exchange of information, thus we established an organization of public observatories, JAPOS, in 2005.

Annual meetings of JAPOS are held in various sites. It was held in Yame (Fukuoka) in 2017, Toyama in 2016, Anpachi (Gifu) in 2015, Fukushima in 2014, in cooperation with public observatories in each site. Each meeting has about 60 to 70 participants, who are staffs of public observatories, members of groups on popularization of astronomy, staffs of manufacturers of astronomical instruments, and supporters of public observatories. The program consists of oral and poster presentations by participants, a special exciting talk by a professional astronomer or a famous amateur astronomer, guided tours around the host facility, and a banquet. Topics of presentations include event reports, collaboration among public observatories, collaboration with regional groups, know-how of public observing. Participants learn experiences in other public observatories to improve their activities.

We hold training workshops for staffs of public observatories, for the purpose of developing skill in communication with participants of public observing.

We sometimes hold collaborative observation of short-period events, such as eclipses, interplanetary probes' swing-by around Earth. Images obtained at many public observatories are gathered and displayed in a dedicated webpage (for example, see http://www.koukaitenmondai.jp/campaign/OSIRIS-REx.html).

We have working groups to develop public observatories. One group is studying about next generation public observatories (see Reference [2]). Another group is preparing for new detailed survey of public observatories. Change of circumstances of local governments which manage public observatories may have influenced since our survey in 2006.

4. Summary

Our quick survey shows that many public observatories all over Japan provide opportunities of watching real starlight through telescopes to hundreds or thousands of visitors a year. Families, couples, groups enjoy watching wonderful sights of astronomical objects and communication with staffs of public observatories.

JAPOS promotes exchange and sharing of experiences and know-how of activities among public observatories by way of meetings, training workshops and collaborative events.

We welcome international collaboration with public observatories in other countries.

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|Parallel Session|

Communicating Astronomy in the Science Live Show UNIVERSE

Kazuhisa KAMEGAI[*1], Akihito GOTO[*2] and the Members of the Science Live Show UNIVERSE

Abstract. The science live show UNIVERSE is a weekly program at the dome theater in Science Museum, Tokyo. Two 40-minutes live shows have been performed every Saturday afternoon for 22 years. Its main concept is that scientists organize communication with the public about science. In each show, a scientist as navigator talks about scientific topics directly to the audience by using real time simulations of scientific phenomena. We also make interactive talks with audience, guest, and foreign observatory in some subjects. In this article, we summarize the contents of communicating astronomy in our live show.

1. Introduction

Many science museums make attractive science events such as science show and experiment class. There was however not much opportunity to meet scientists directly because most of the events are performed by museum staffs or educators. On the other hand, we believe that the persons who know best about the latest science are scientists. It is one of reason why we started science live show "UNIVERSE"[1] as a regular weekly program at Science Museum, Tokyo 22 years ago. We have continously performed more than 2100 live shows every Saturday afternoon up to now, March 2018. Total number of visitor reaches as much as 100,000.

In the live show UNIVERSE, a scientist or an engineer acts as "navigator" and talk about several scientific topics. Although the live show covers all field of science, a large majority is astronomy because most of navigators are researcher in astronomy. The navigator of the day constructs the day's live show by combining several contents developed for the live show. The navigator talks about the latest science by using 3-D simulations of scientific phenomena projected on the dome screen (section 4.1). We also have live observations by collaborating with foreign observatory as described in section 4.2. Furthermore, each of the live show includes ten-minute guest talk by a scientist or a science-related person as described in section 4.3. As a result, audiences can enjoy not only scientific visuals of simulations but also interactive talk among navigator, guest and audience.

In this article, we present overview of the science live show UNIVERSE featuring the theater (section 2), some contents of astronomy (section 3) and how we engage audience by communicating astronomy (section 4). How we operate the live show is also described briefly in section 5.

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2. Theater and Showing System

The live show had been performed at the theater "Universe" from its premiere in 1996 until 2008. It has 200-inch flat screen and 72 seats. The images of scientific simulations were projected with one projector, which was replaced to two projectors for stereoscopic projection in 2002. We have utilized a SGI Power Onyx workstation and GRAPE-3 computer for real time simulation of galaxy collision. The computer system was replaced to Windows PC and MDGRAPE.

The theater was totally renovated into 3D full dome theater "Synra Dome" in 2008. It has 10-m tilted dome screen and 62 seats. The full dome stereoscopic projection with 2.7 K resolution was realized with 12 projector and Infitec technology. This system was also connected to MDGRAPE-2 computer for real time simulations. Most of the showing system in the Synra Dome was replaced into 3.5 K stereoscopic system with six projectors and active shutter 3D vision. The 7.1 channel surround acoustic system is also installed.

3. Contents of Astronomy

The navigator decides contents of live show of the day. Each 40-minute live show is divided into several topics. They include, for example, travel from the earth's surface up to the end of the universe, galaxy collision simulation, gravitational lens simulation, interstellar travel simulation, interplanetary gravity simulation (Fig.1), live astronomical observation (Fig.2), guest talk. The latest scientific results and timely topics (e.g. the Nobel prize-winning study of the year) are also included in the live show. More details of the contents are described also in another article in this proceedings[2].

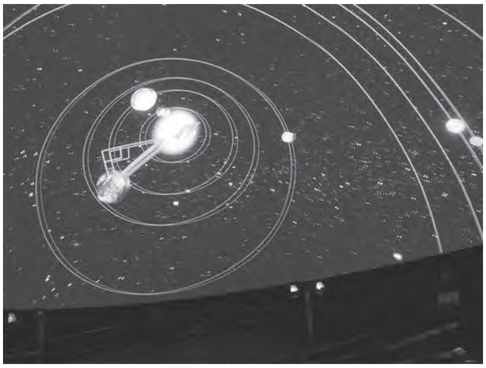
Fig. 1. One scene of interplanetary gravity simulation

4. How We Engage Audience

4.1. Interacting Simulation Live

In some of above contents, the navigator proceeds with the live show while interacting with the audience. When doing a real-time simulation experiment, the navigator selects one of audience and asks him/her to decide a few parameters. It is the first simulation under conditions that have not been done so far, and it reproduces the process that scientists are doing. For example, in a galaxy collision simulation, a spectator decides parameters of two galaxies colliding. The highlight of the simulation performed was printed out and given to the spectator. Another example in interplanetary gravity simulation (Fig.1), when simulating another star approaching the solar system, a spectator determines direction and position of the new star entering the solar system. Then we, all of navigator and audience, enjoy result of the simulation.

4.2. Live Observation

Collaborating with Yerkes observatory in the U.S.A., we have performed real-time astronomical observations in the daytime by using time difference and the Internet. Because the time difference between Japan and Wisconsin is nine or ten hours, we can observe astronomical objects from Japan in the daytime (around midnight at Yerkes observatory). The navigator and an observatory staff talk through a video call and introduce the celestial images photographed on that day (Fig.2). When it is cloudy or rainy at the observatory, we use archived images.

4.3. Guest Talk

We invite a guest scientist to the live show every week. The navigator and the guest make a 10-minutes talk about guest's research. The guest shows results of his/her scientific study or activity by using some viewgraphs. Sometimes guest appears on videophone from remote site such as foreign telescope or scientific facility. Audiences enjoy scientific talk by real scientists.


Fig. 2. Live observation with Yerkes observatory

5. Operation by Student Team Chimons

All of the live shows are operated and managed by a student team named Chimons. They prepare everything of each live show, operate simulators, pictures, lights and sounds in the live show. They advertise the live show on our web site and on SNS. Furthermore numbers of simulation software we use in the live show have been developed by Chimons. Activities of Chimons are described in another article in this proceedings[2].

6. Summary

Our activities of the science live show UNIVERSE have progressed continuously since the beginning. Here we presented the history and some examples of the performance methods in this article. With the development of science, the UNIVERSE will evolve by continuing improving and newly developing the contents and the method.

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Science Theatre Shows

Elizabeth AVERY *1

Abstract. A science theatre show can be a very powerful engagement tool if used correctly as they can tackle some of the most challenging scientific concepts in a highly effective way. In this article I will share my best and worst practice of writing, testing and presenting science theatre shows.

1. Introduction

Science theatre blends real cutting edge science and a strong narrative with intriguing and entertaining demonstrations to create an overall positive experience of science. Our approach to creating new science theatre shows at the Royal Observatory Greenwich[1] is to be bold, bright, noisy, busy, fast and fill them with lots of excitement, surprise, humour and personality. We always create very structured shows so we can be sure the learning outcomes will be met each time. We are mindful when thinking about representation on all levels including race, ethnicity, gender and age and about how sessions will impact our visitors' Science Capital[2] at every turn. I have written many shows about all sorts of different subjects but I have used the same approach for all of them. I will now share what I have learned in writing, testing, training and presenting shows.

2. Writing – What I have learned

Choose your audience

You don't have to (nor could you anyway) create something that suits everyone so don't try to. Choose who you want to target and stick to it, then involve them throughout the process.

Create your narrative early on

This will help you to pull the rest of the show together. For younger audiences this narrative is often themed around a problem you need them to help you with or an adventure you want to go on together. For older students the narrative may be more based around moving through space and time exploring whatever you find along the way. Either way, every show needs a narrative to give it purpose or your audience will have no incentive to come along with you for the adventure.

Be selective

You will create lots of content and only be realistically able to keep around 50-60% of it. It is easy to become very attached to something you have created but if it doesn't fit, cut it out and keep it for another time.

Space any demonstrations out

Demonstrations really help to punctuate a show as well as drive the pace and narrative. They don't have to be complicated but they do have to fit with the narrative. I have found that having a really great demo around 10% of the way through then another around 90% (which is a large scale demonstration) works well.

Why use that specific demonstration?

Is it because there is a lull in interest that you want to pick up? Maybe the concept you are describing is easier to understand with visuals? If you are including it because you want to use that piece of equipment then stop. Demonstrations that have been forced into shows look exactly like that – forced.

Who can see this?

Unless you are making a point that the piece of equipment you are using is so small no one can see it, everyone should be able to see what you are doing. If they can't you should either scale your demonstration up or remove it so as not to exclude large portions of your audience.

Music can really make a show

It can add drama, feeling and set the tone but can also indicate to the audience when things are about to start or come to an end. If you have 100 children, this sort of help with crowd control can be really beneficial.

Be serious about comedy

Using comedy is a great way to control an audience as well as punctuate a show. You have to be careful though, comedy is subjective and there is a fine line between involving and ridiculing your audience but if used well comedy is a great addition.

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3. Testing – what I have learned

You have your show written, you have involved your audience from start to finish - now what? Test it. No matter how painful it might be, test it. You need to know if demos work, what the timing is like and if there are there bits people consistently get confused about. When you test it, it is also a good idea to evaluate it so you can get some feedback to work on.

4. Training – what I have learned

We have found that there are a few very useful tools we provide to our staff when they are training to present a new science theatre show.

- Script - in this they will find the equipment list, suggested script, notes from the writer and key messages to deliver. They are encouraged to add their own flavour to the show but within defined parameters.
- Training videos - we provide training videos so they can see how the equipment works and how to lay it all out.
- Shadow shows - we insist on them going to see shadow shows presented by other members of staff, this helps them to begin to think how they might want to present the show.
- Time to experiment - we ask them to spend some time with the equipment in a room on their own experimenting with their own style.
- Presenter Network - we encourage staff to take part in the presenter network so they can share their experiences with others and learn from them too.

5. Presenting – what I have learned

Demonstrations don't always work

I am a big advocate of using crowd pleasing but low risk demos as I think it puts a lot of stress on your presenters if you provide them with something that doesn't often work. That is not to say a show is a fail if a demo fails; I have run shows where every single demo has failed but I would still class the show as a success, you just have to know what to do if something goes wrong.

Using volunteers

This is a great way to get the support of the audience and get them to buy in to the concept and show. You have to be careful and limit the amount of surprise you subject them to. Sometimes even when everything is explained clearly volunteers can become overwhelmed when stood in front of an audience. I always ask teachers to choose who they would like to come and help me instead of choosing myself.

If you have a demo where you are using more complicated equipment or it is more risky you can ask a teacher or adult help. This works particularly well in schools where the children will all know that one adult well.

Be committed

If you aren't committed and fully engaged in the show you can't expect your audience to be.

You are in control

It is your job as the presenter to get the show from start to finish being sure to achieve the learning aims along the way. You must be strong enough to not let your audience take the show off track by asking too many questions or being disruptive.

6. Conclusion

To conclude:

1. Science theatre is powerful tool – try it.
2. Top advice:
   - Choose your audience carefully.
   - Be economical with your content.
   - Keep your demos large scale.
3. Involve your intended audience at every stage.
4. This is a very unique format - training your staff and volunteers is key.
5. Have fun with it. As the presenter of a science theatre show the more your audience see you enjoying yourself the more likely they are to have a positive experience too.

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|Parallel Session|

A Spectroscopic Eyepiece System for Large Telescopes at Public Observatories

Osamu HASHIMOTO*1 and Hikaru TAGUCHI*2

Abstract. A number of public observatories in Japan have telescopes with an aperture size of over 1 meter for the public star gazing. The light gathering power of such large telescopes is not only helpful for human eyes to see stellar colors in the direct images, but even useful to see various physical characteristics in the spectral images. We have developed a spectroscopic eyepiece system as it can provide a direct image and a spectrum of target star simultaneously at two separate viewing points respectively. It is found that the simultaneous direct comparison of the stellar spectrum and color seen in those two viewing points is quite effective for understanding the physical meanings of them intuitively. It should be a useful tool for the education programs of astrophysics.

1. Introduction

In these a few decades a number of public observatories in Japan have built telescopes with an aperture size much larger than 1.0 meter for the public star gazing. The Gunma Astronomical Observatory (hereafter GAO) was established in 1999 equipped with a 150-cm reflector (Fig.1), which was the second largest telescope in Japan at that time. It is regarded as one of the pioneers of such large scale public observatories [1],[2].

The telescopes with a large aperture size may not always useful for providing beautiful clear images of high spatial resolution due to the seeing effect by the atmosphere. As the larger aperture gathers lights coming through the more distant air, the image quality is affected much more seriously by the seeing condition. In many cases, Saturn may not be seen more beautiful than by a smaller telescope, for example.

On the other hand, light collecting power of the telescopes always works well almost regardless of the seeing condition. We can always expect brighter images by the larger telescope.

A lot of photons gathered by the telescope with a sufficiently large aperture can provide good opportunities to see the interesting aspects of the astrophysics in the stellar light even by a human eye which is not very sensitive to the faint light. In addition to the differences of colors from star to star, it is quite impressive that various features in stellar spectra can be directly seen through the large telescopes if a suitable spectroscope is used.

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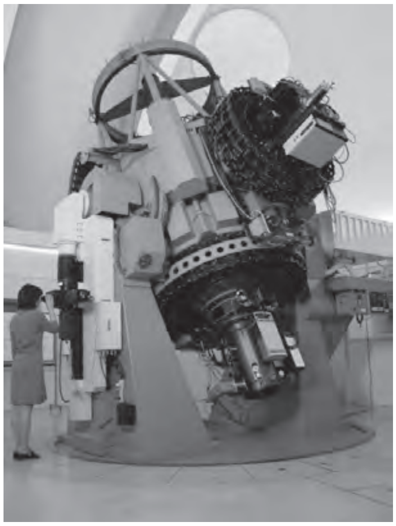

Fig.1. The 150-cm reflector of GAO. It has a star gazing optics at a Nasmyth focus in addition to some scientific measuring instruments such as a high resolution spectrograph.

2. Spectroscopic eyepiece system for the GAO 150cm telescope

A new spectroscopic eyepiece system has been developed recently for the GAO 150-cm telescope. It can provide a direct image and a spectrum of target star at two separate viewing points simultaneously. We expect that observers should be able to understand the physical meanings of the spectrum and the color much easier by direct comparison between them.

Figure 2 shows the spectroscopic eyepiece system set at the star gazing focus of the GAO 150-cm telescope. It is made as small and light as it can be easily used instead of a 50.8-mm eyepiece used for usual star gazing. It has two viewing points. One provides a direct image on the slit of the spectroscope. It makes easy to see the color of the target because a lot of photons gathered by the large aperture of the telescope are focused in the direct image. The lights come into the slit is processed to show the spectrum of the target at the other viewing point. Observers can compare the color and spectrum directly at the same time.

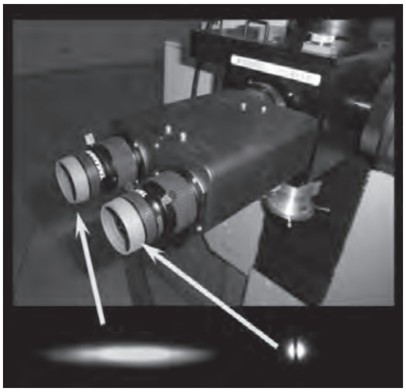

Fig.2. The spectroscopic eyepiece system set on the Nasmyth focus of the GAO 150-cm reflector instead of a 50.8-mm eyepiece for usual star gazing.

3. Application to the education of astrophysics

We have been investigating some applications of this unique instrument in education programs of astrophysics using the 150-cm telescope at GAO. It is found that the direct comparison of the stellar spectrum and color is quite effective in practice for understanding the physical meanings of them intuitively.

For example, we can easily see the difference of spectra between Mars and the red giant stars, even though their red colors in the direct images seem very similar for human eyes. Upper panel of Fig.3 shows the spectrum (left) and the direct image on the slit (right) of Mars. The spectrum of Mars is quite similar to the solar spectrum which can be observed as a rainbow. It is natural since Mars is a planet which reflects the lights coming from the Sun.

On the other hand, the spectrum of a carbon star, which is a kind of red giant star, in the lower panel of Fig.3 is completely different from that of Mars. It indicates that the carbon star is shining for itself. We can estimate its surface temperature as about 2500K from its spectrum. Some structures in the spectrum such as absorption features indicate the chemical characteristics of the stellar atmosphere as well. We can see the existence of a lot of carbon molecules in this star even though we can never touch it directly.

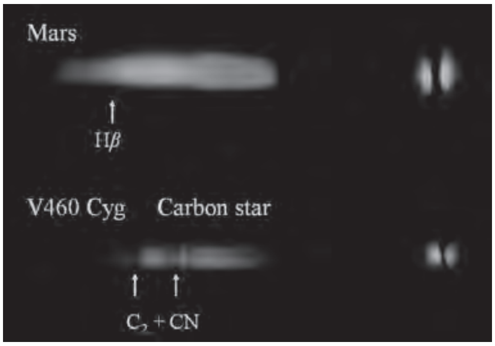

Fig.3. Comparison of spectra (left) and colors (right) between Mars (upper) and a carbon star V460 Cyg (bottom). Their spectra are completely different because of the difference of light emitting mechanism. We can see the difference of physical characteristics of the distant targets without touching them.

4. Summary

We have developed a spectroscopic eyepiece system for the large telescopes with a star gazing focus. It can provide a direct image and a spectrum of target star simultaneously at two separate viewing points respectively. It is found that the direct comparison of the stellar spectrum and color using the spectroscopic eyepiece system on a sufficiently large telescope is quite effective for the basic understanding of astrophysics. We expect that we can utilize large telescopes of public observatories more effectively with the use of this kind of unique instrument. It will expand the scientific view of observers to further understanding of astrophysics.

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Astronomy Outreach of Regional Observatory for the Public and Its Impacts Across Southern Thailand

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Abstract. Regional Observatory for the Public, Songkhla is served as the main learning center for astronomy in the South. Its core missions are to provide the astronomical academics to the communities, astronomical research to students, educational institutions and amateur astronomers in the south, and a one-stop service learning center for Islamic astronomy.

Up to the present time, Regional Observatory for the Public, Songkhla has been provided outreach services for the public for 15 months (2017.01 - 2018.03) and hosted many events activities and workshops. We have more than 26,000 people that have took part in our activities. Each our outreach activity can be connected to one another for instant, Astronomy Camp for High School Students, its objective is to build the foundation of astronomy for young students to become researchers, teachers or educators in the field of astronomy in the future, so we therefore have a workshop that provides hand-on training in astronomical research for undergraduate students as well. Beside these two activities, we also have Star Party (public night), Astronomy exhibits for National Children's Day, Science Week and other events, astronomy outreach program for schools in the region, Islamic astronomy workshops and so forth.

1. Introduction

National Astronomical Research Institute of Thailand (Public Organization) or NARIT is an institute under Ministry of Science and Technology. It has been serving astronomical academics for 9 years. NARIT aims to establish Regional Observatories in each region of Thailand. At the present there are 4 observatories that open for the public, Thai National Observatory (TNO) at Doi Inthanon National Park. It is 2,457 meters above the mean sea level with 2.4 meter diameter reflective telescope, Regional Observatory in Northeastern – Nakhon Ratchasima, Regional Observatory in Eastern – Chacoengsao and Regional Observatory in Southern – Songkhla, respectively.

In southern region, Songkhla is 1 of 14 provinces. To the south it borders to Kedah and Perish Malaysia. Within the boundaries of the city of Songkhla is Cape Samila Beach.

Regional Observatory for the Public, Songkhla is served as the main learning center for astronomy in the south. It is the third regional observatory with full-scale service in Thailand, Located at latitude 7 degree north with enable a better observation for celestial objects than any other region. Its core mission are to provide the astronomical academics to the communities, astronomical research to students and educational institutes. Since there are 70% of Islam in 5 Deep South provinces, therefore another mission is to be a one none-stop service learning center for Islamic astronomy.

2. Events/Activities/Workshops during 2017 – 2018

Even though, the unofficial opening of the observatory was in the middle of 2017 but the first event we serve to the public was in January, 2017 – Thai National Children's Day. There were 2,500 children took part in our activities and 5,000 children in 2018. The second outreach service is Astronomy Camp for high school students. This camp opened opportunity for 100 students to participate in. They will learn the basic stargazing, how to use and assembly a telescope and sun observation etc. Third, Astronomical Training for Astronomy Club in School, its mission is to outline student who is a member of astronomy club in their school how to organize activities about astronomy. However, observatory also hosted a workshop for undergraduate students who are going to do the astronomical project, to advice the software method and techniques for them.

According to Science week in every middle of August in Thailand, Regional Observatory was aware it. In 2017, we brought 3 telescopes, real meteor and astrophotography to exhibit to students who came from many schools in south region.

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Furthermore, observatory also give opportunity for local agencies such as schools universities and educational institutes to explore facilities, they will have a chance to observe the sun through a telescope, watching planetarium shows, visiting inside observatory dome and guided tour around observatory area. In addition, Star party is a one significant event. This event will be held for 4-5 times per year includes special event such as Gemenids Meteor shower, Perseid Meteor Shower, Super Full Moon and Total Lunar Eclipse.

In order to fulfil another mission which is a one none-stop service learning center for Islamic Astronomy. Last year in Pattani province, an event called Observing Moon – Sighting to Determine Ramadan Dates was held. There were a large number of Muslim took part in this event.

Fig.1. Astronomy Camp for High School Students in 2017 by Regional Observatory for the Public, Songkhla

3. Condition of students and teachers living in the conflict in Thailand’s Deep South

Since 2004, an ethnics and religions separatist insurgency in Thailand’s Deep South has begun. It has been raging for more than 14 years. This has significantly altered the livelihoods of people living in the region, especially for students. Schools have to be closed sometimes and guarded by security volunteers.

However, the record number of visiting observatory request from schools shows that school from the Deep South provinces are more than other provinces 75%. And this is can be said that even though, they are living in negative learning environment but the important point is they still want to learn.

4. Summary

Due to 15 months of providing astronomy outreach in southern region, the regional observatory has been engaging with communities in many events. The existence of the observatory can inspire people to love in learning science, especially for kids, after they took part in our activities, for the simplest, observation celestial objects through a telescope, this will give them a large impact as they can see science is real and this is valuable for communication to public.

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High School Research Activities on Astronomy in Collaboration with Public Observatories

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Abstract. At Seisho High School, there is a subject called "Super Research Science" where students are divided into groups to pursue their own research projects. In this presentation, we introduce some of the case studies this year of student groups in earth science, specifically astronomy, where the observations were conducted at public observatories.

1. Introduction

Our school, Nara Prefectural Seisho High School, offers a class called "Super Research Science". In this class, students are divided into groups according to their fields of interest. The student groups decide their specific research theme independently, plan and conduct the research and finally present the results.

We mainly conduct astronomy research through observation. Unfortunately, our school does not have an observatory, so we observe at public observatories such as the Bisei Astronomical Observatory and the Nishi-Harima Astronomical Observatory. Collaboration with public observatories has the merits that we can, not only use authentic observation equipment, but also learn professional skills. On the observatory's side, the merit is that the number of users of the observatory's facilities increases and as such its facilities are activated.

2. Case of Research Activities

In the first research project, we investigated the mass of dark matter in different types of galaxies and examined whether its proportion is related to the type of galaxy. At first, we conducted spectroscopic observations at Bisei Astronomical Observatory. According to the results of the observation, we determined the rotational speed of the galaxies and calculated these dynamical masses using Kepler's Third Law. We found the optical masses in the literature. Next, we divided the dynamical masses by the optical masses. In this way, we were able to determine the proportion of dark matter. This time, we observed NGC6503, a spiral and dwarf galaxy, and NGC7331, a spiral galaxy. As a result, we found that the proportion of the dark matter in NGC6503 is 1.1 and that in NGC7331, it is 4.7. We found that the proportion of dark matter of this dwarf galaxy was smaller than that of others.

The second research project investigated the width of the black hole binary SS433 and its intensity. First, we carried out spectroscopic observations and made a spectrum graph of the data. Next, we considered a part of the jet as a cylinder, which was divided into countless doughnut shapes. We summed up the amount of emitted light of each part of the cylinder depending on the different directions. We showed these results in the graph and compared the data of the observation and the modeled ones. As a result, the emitted light is inversely proportional to the distance from the center of the power of 2.01.

The purpose of the third research project is to observe the exoplanets WASP-50b by transit observation and to research the difference of radius between WASP-50b and its literature values. We did continuous shooting while fitting WASP-50 and the comparison star in one view. We made a light curve and researched the extinction rate. As a result, we found that the extinction rate on November 3 was 1.4%, and the extinction rate on December 20 was 2.2%. When calculating the radius of WASP-50b from this value, they became 1.04 times and 1.31 times of Jupiter's radius respectively. This is different from the value of the data found in "Extrasolar Planets Encyclo-pedia", 1.14. From these results, it is possible to conclude that either the planet is a spheroid or its size is changing.

3. Conclusions

Looking back on the past six years, observation research at the observatory, was found to have enhanced interests and curiosities of students in scientific research ventures. However, because the acceptable observatory is far from our school, it is difficult to make continuous observations.

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Stargazing Families Activity, the Most Interesting for All the Family

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Abstract. Stargazing Families is a yearly activity for families who love to stargaze and observing the night sky. The purpose of these activities is learning creation, thinking improvement and imagination skills. Participants in these activities had been asked to do the astronomical activities. Such as, How does telescope work? , How big is the solar system?, Balloon rocket competition activity and others astronomy games. They had to compete with others families. The children were the leader of the family in the astronomy missions. At 4 pm. all families explore the interesting constellation in the planetarium and a prize-giving for the family who is a winner on astronomy mission. At night all families are explored sky-objects with the largest telescope 0.7M. They observed a Jupiter, a Saturn, a Ring Nebulae (M57) and find more sky-objects with the sky-chart.

1. Introduction

We started the star-gazing for the public in 2014. That year, we have both children and adult participated in the event. And we were having trouble organizing content for participants with different age ranges. In the next year, we divided the participants into two groups : (1) family groups with children aged 5-12 years, and (2) adults with no age limit. Both groups held separate activities each day. We hope this activity helps to create learning. Thinking skills development and imagination as well as increase a good relationship with all families.

2. Methods

There are only 15 families (teams) can be attended this astronomical activity. Each family consists of at least one child between 5 - 12 years old and one adult, but not more than seven. The activities were divided into four parts, there are;

Course Training: Each team is guided to learning about the basics of astronomy such as, how to point out the north direction, How to find the right constellation by using a Star Chart.

Astronomical Activities: Each team is learned the basics of astronomy together through playing astronomy games. For example, (i) How big is our solar system? They are learning about distances between planets in the solar system. Parents advise children to calculate the distance of the planet and put a model on the scale of the tissue paper, 3 sheets of tissue representing the distance from earth to the sun. (ii) How dose telescope work? Each team is assembly a telescope by themselves, do the assignment and take photographs of family members through a telescope. (iii) Other games are included, creating the balloon rocket, astronomy jigsaw puzzle, constellations mute game and more, children will be the main player.

Planetarium & Prize-Giving: At 4pm. all families explore the interesting constellation in the planetarium and we have a prize-giving for the family who is a winner on astronomy mission.

Observing the Night Sky: Every team is explored sky-objects with the largest telescope 0.7M. They are observed the moon, Jupiter, Saturn, Ring Nebulae (M57) and find more sky-objects with the sky-chart.

3. Results & Summary

In the first year of "Stargazing Families", there were only 20 families are applicants to the event, and grow up to double in the second year. The last year (2017), we had to announce the closure of the applicant in two days after publishing. Due to the overwhelming number of applicants. All families were happy with our activity especially the night-sky observing and planetarium. On the astronomy mission, each family has received at least 73% of the full score including the picture of their family taken through their own assemble telescope. Even though this is the third time we have done the activities but there are more and more interested people would like to attend these activities.

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SESSION I.3:

Citizen Science

|Plenary Talk|

Citizen Scientists Capture Totality with the Eclipse Megamovie

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I. RUDERMAN*[4], H. HUDSON*[4], B. KRUSE*[1], B. MENDEZ*[4], M. BENDER*[5], B. COLLIER*[6]

Abstract. The Eclipse Megamovie seized the opportunity of a total eclipse crossing the US in August 2017 to capture totality for more than 90 minutes. Hundreds of trained volunteers took sets of images that were incorporated into a movie less than 5 hours after the eclipse ended. Thousands of enthusiasts submitted photographs after the eclipse, which were later incorporated into the movie and a massive dataset of total eclipse images. Thanks to their extraordinary effort and the collaboration of a team of dedicated researchers, technology leaders, and outreach specialists, the largest database of eclipse photography is now freely available. Current and future efforts are analyzing the data collected to learn about transient events in the sun's inner corona.

1. Introduction

They said it couldn't be done. How do you make a movie of a total eclipse over an entire continent? First, you train hundreds of volunteers to photograph a challenging phenomenon they've mostly never seen before, while recruiting more volunteers via a massive public relations campaign. Then harness the power of technology to set up a web interface that collects images, tags them with GPS coordinates, then rotates, resizes, and arranges them sequentially. Less than 5 hours after the eclipse ended, the first Eclipse Megamovie [1] was released, showing the sun's changing corona over 90 minutes. But that was just the beginning. Find out how citizen scientists captured more than 50K images from the path of totality and how they are being used by scientists thanks to our team and many volunteers.

2. The Plan

Scientists from UC Berkeley, led by Dr. Laura Peticolas, proposed to study the dynamics of the inner corona over a total eclipse spanning nearly 5,000km of accessible path. This area of the corona is obscured by the occultation disc on satellite observations and well-timed eclipse images are currently the best way to study this phenomenon.

Google's Making & Science team, picked up on the idea, and lent a small crew of dedicated technical staff to seize this opportunity.
This team adapted an image stitching and alignment algorithm and built a user-friendly online upload system on Google Cloud Platform. This was the first time that such a large number of eclipse images of totality would be stitched together. The goal was to create a movie of totality compressing over 90 minutes into a few minutes of successive images and to deliver this on the evening news the day of the eclipse, just 5 hours after it ended. There was no time for working on that volume of data by hand. It had to be automatic.

3. The Set-up

The partnership between research, technology, and outreach was key, as each institution worked to their strengths. The scientists at UC Berkeley envisioned the possibilities of this unique opportunity to impact science. The Astronomical Society of the Pacific engaged and trained hundreds of volunteers to take science-worthy images. And Google engineered a web presence to make the upload and stitching algorithm possible.

In order to capture the large number of photographs needed, with the precision and exposure necessary, it was vital to recruit thousands of photographers with equipment capable of taking such images. The whole team reached out to networks in-country and around the world, connecting with popular science publications, social media outlets, telescope and camera manufacturers, and the extensive eclipse community.

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[4] University of California Berkeley, Space Science Lab
[5] Eclipse over America
[6] Ideum, Inc.

More than 1,400 volunteers participated in the project by using the training materials, following the Google Group discussions, and attending training webinars and socials. All training materials are archived in the Legacy Documents [2] and are useful to anyone taking future solar eclipse photos. Materials were designed by experienced eclipse photographers, tested many times, and confirmed by the large number of excellent photos of totality.

Volunteers needed DSLR cameras, steady tripods, an ability to get the correct time to within a second, and to geo-locate either with their camera or with an image taken by their phone and uploaded with the eclipse images. Images needed to be either parallel to the horizon or polar-aligned, as the algorithm did not rotate them except with the rotation of the earth over the 90 minutes it took for the shadow to cross the U.S.

4. Results

The Eclipse Megamovie project gathered the largest number of geo-located photographs of totality and made them freely available, Fig. 1. The dataset [3] contains more than 50,000 images from hundreds of locations, Fig. 2. The weather was unusually favorable that day and only a small percentage of the path was cloudy, giving a near-complete data set.

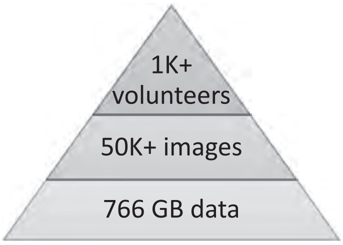

Fig 1. Participants, images, and dataset numbers

The extensive data is currently being analyzed by a team of solar physicists at UC Berkeley and Sonoma State University in California. In addition, a Zooniverse citizen science project, Megamovie Maestros [4] has started to sort and orient all images to get a more cohesive dataset of scientifically valuable images, fully registered via the bright star Regulus, coincidentally close to the Sun (and Moon).

For those wishing to repeat a citizen science project of this sort, the source code is also freely available [5]. Some lessons were learned that are important to consider. Community engagement was key and having a forum where the volunteers could assist each other with questions was vital. This also improved the quality of the training as the testing sessions were replicated many times. Recognition of volunteers made a large difference, even providing just a pin and hat gave them a feeling of ownership of the project and participating in a project larger than themselves. More than 80% of the volunteers reported that the reason they participated was to make a meaningful contribution to science. A full report of the findings from a volunteer survey can be found in the Legacy Documents [2].

Fig 2. Location of Megamovie contributors on August 21, 2017 during totality

5. Conclusion

Due to the lack of this type of dataset until after the event, the initial Megamovie released the day of the eclipse could not be astrometrically registered on the timescale of a few hours. As images have been aligned, the presence of a solar Coronal Mass ejection (CME) was found in multiple images over time, a scientific first. The dataset collected by these citizen scientists is thus of real value for professional scientists. The citizen science continues with a sorting project to do from your computer. The community and trainings that developed around an event of this scale was a first, and will be accessed for future eclipses. All data and analysis software are freely available to the public for this first-ever public eclipse archive.

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[5] Source Code:
https://github.com/google/eclipse2017

|Parallel Session|

Astronomical Phenomena Observation Campaigns for the General Public Conducted by NAOJ

Masaharu ISHIZAKI[*1], Hidehiko AGATA[*2] and the NAOJ Campaign Team[*3]

Abstract. We have carried out public observation campaigns from year 2004 for astronomical remarkable phenomena like meteor showers, total lunar eclipses, bright comets and etc. as one of the outreach programs conducted by National Astronomical Observatory of Japan (NAOJ). We plan about 1 to 3 campaigns a year. The main purpose of these campaigns is to generate interest in astronomical phenomena for the general public. But, we have also noticed that we might be able to extract some scientific results from these reports because of the huge samples. The paper which we wrote about the possibility was published in "Planetary and Space Science". The campaigns have some issues. We also show some of them.

1. What are campaigns of NAOJ

We, the campaign team of NAOJ, has conducted several online campaigns (between one to four a year) to generate public interest in astronomical phenomena. The participants of the campaigns send us their observational results and we analyze and integrate them into a report.

The campaigns are widely announced to the general public via e-mail and on NAOJ website in advance, accompanied by the method of observations of the target phenomenon. The participants of the campaigns can send their observational results to the NAOJ through "Google Forms." For example, participants report observation/duration time and number of meteors per hour in meteor shower. The analyzed results of the reports along with some statistics are presented in the website after the event.

We have conducted 41 campaigns since 2004. Here we present the examples of the campaigns conducted form 2010-2017:

- Perseids meteor shower (2010)
- Comet Hartley (2010)
- Geminids meteor shower (2010)
- Total lunar eclipse (2010)
- Perseids meteor shower (2011)
- Total lunar eclipse (2011)
- Perseids meteor shower (2012)
- Geminids meteor shower (2012)
- Comet PanSTARRS (2013)
- Perseids meteor shower (2013)
- Comet ISON (2013)
- Perseids meteor shower (2014)
- Total lunar eclipse (2014)
- Total lunar eclipse (2015)
- Perseids meteor shower (2015)
- Geminids meteor shower (2015)
- Perseids meteor shower (2016)
- Perseids meteor shower (2017)
- Geminids meteor shower (2017)

We categorized campaign’s phenomena (Table 1). Unexpected phenomena like comets, or phenomena the occurs in a limited period like meteor shower and eclipse are more popular than other phenomena.

Categories	Numbers	Average numbers of reports
Meteor shower	22	2,934
Comet	7	1,757
Lunar eclipse	6	1,458
Moon and Planets	4	306
Others	2	221

Table 1. Campaigns in categories.

2. How do we conduct the campaigns?

We announce a campaign on e-mails with ordinary mail magazine service. of NAOJ (There are 6,540 registrants in campaign mail magazine.) Participants send us observational results via “Google Forms”. After a campaign period, we analyze and integrate those results to make

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a report with Microsoft Excel spreadsheet.

We use no special tools and no special systems for realizing our campaigns.

We make not only web pages for the campaign [3] but also pages explaining in detail about the phenomenon. Our pages had 1,108,478 of page views a day, for example on a day of the Lunar Eclipse in 2018.

Fig. 2. How to conduct campaigns.

3. Bridge to Citizen Science

With meteor shower campaigns' data, we can calculate ZHR (Zenith Hourly Rate: number of meteors in ideal condition). As we calculate ZHRs, we can compare our data with other observations.

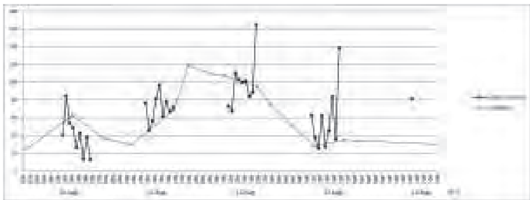

Fig. 3. Comparison of campaign's data and data from skilled observers.

We analyzed the meteor campaigns' data and published a paper on the journal "Planetary and Space Science" last year [1] [2]. In the paper, we concluded that huge number of results from the general public sometimes shows similar time variation to skilled observers. So, such campaigns have a potential to extract scientific result.

4. Issues and improvement of our campaigns

We know our campaigns have some issues. I'll share you some of them.

(1) Some types of phenomena are difficult to be a target for a campaign. For example, we won't have campaign about Mars close approach this year because it's difficult to pick up a theme to report easily and interestingly about Mars. If you have enough human resources, you can conduct other types of campaigns like gathering photos.

(2) Existing services have limitations. We can use "Google Forms" easily. But, "Google Forms" has some limitations. One of them is that we can't calculate live ZHR. Because "Google Forms" can't execute complicated live calculations. Although many participants have been desiring us to show the live ZHR in order to know the real time activity of a meteor shower.

(3) It's difficult to balance popularization and scientific data. If we intend to get more detailed data by having more accurate scientific results, input items get more complicated. It prevents participants to take part in the campaigns with ease. But on the contrary, participants want us to apply their data to scientific results.

(4) One issue could be that we conduct almost the same campaigns every year. The same persons might participate in every campaign, but that isn't verified. First-time participants in 2010, 2015, 2016 and 2017 of the Perseids meteor shower campaigns occupy about a half of all participants.

For assessing our work, we gather participants' opinions (in the second page of a campaign form). And by examining them we are gradually improving our campaigns.

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(thumbnail page, sorry in Japanese language only)

|Parallel Session|

Exploring the Universe with the Real Observational Data of the Subaru Telescope

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Abstract. A new citizen science project using the Subaru Telescope data started in 2017 at National Astronomical Observatory of Japan (NAOJ). We will use the first dataset from the Hyper Suprime-Cam Subaru Strategic Plan (HSC-SSP) to engage the general public in the identification of the shapes of interacting galaxies. As the first step, we developed the user-friendly viewer to display the HSC-SSP data, and everybody can easily access to the website of the viewer.

1. Introduction

Citizen science is a scientific work undertaken by members of the general public, often in collaboration with or under the direction of professional scientists and scientific institutions [1]. Today, extensive datasets are taken with cutting-edge telescopes such as NAOJ's Subaru Telescope, and some of them are released to the public. Not only educators and astronomy enthusiasts but also general public members are interested in using the authentic science data, and an accessible tool and program to the data are desired. For scientists, enormous amount of time and work are needed to analyze throughout an extensive survey data, so the help of general public is desired. A citizen science program matches the desires of the general public and scientists. Citizen science is also thought to be a hybrid activity between public engagement and scientific research to make the general public members familiar with an authentic observational data and let them participate in data analysis. For this reason, our NAOJ citizen science team members consist of astronomy communicators and researchers.

2. Subaru's HSC-SSP Dataset

The Subaru Telescope is a Japanese optical-infrared telescope constructed near the summit of Maunakea, 4,205 meters above sea level on the Big Island of Hawai'i. It has a primary mirror diameter of 8.2 meters, making it one of the largest monolithic mirrors in the world. The Subaru Telescope has a giant digital camera mounted on its prime focus at the top of the telescope structure, with an extremely wide field of view compared to other 8-meter class telescopes.

Hyper Suprime-Cam (HSC), the second-generation prime focus camera, is a world-leading digital camera which started to serve as a facility instrument for open use from 2014 observations in 2013. The specially developed 116 CCD's have 870 million pixels, enough to successfully capture almost the entire Andromeda Galaxy (M31) in one field of view (Fig. 1).

The Hyper Suprime-Cam Subaru Strategic Plan (HSC-SSP) is an extensive survey program which started in 2014 to observe for 300 nights with HSC. Its first dataset was released to the public in February 2017 [2]. The release includes data from the first 21 months, corresponding to 61.5 nights of observations.

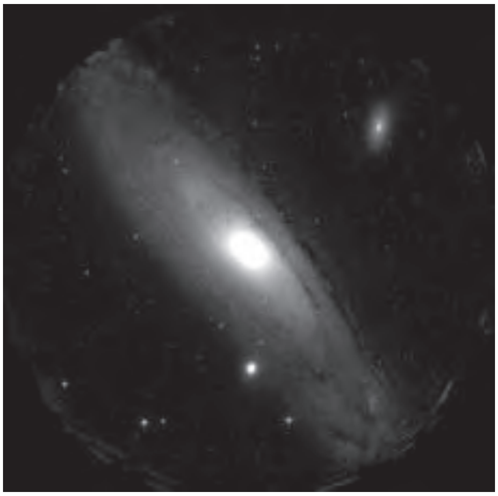

Fig. 1. The Andromeda Galaxy (M31) captured by HSC. HSC has a large field of view: 1.5 degrees in diameter which covers the area as large as 9 full moons. (Credit: NAOJ/HSC Project)

3. User-friendly Viewer of the Dataset

As the first step to making the general public familiar with the HSC-SSP dataset, we developed a user-friendly, Google-Map-like viewer

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(***http://hscmap.mtk.nao.ac.jp/hscMap2_en/***), officially released on March 8, 2018 [3]. This viewer was developed based on "hscMap," the data-handling application for researchers. When you start zooming into one of the green squares displayed on the initial screen of the viewer, an HSC image appears. If you keep zooming deeper into the Universe with your mouse or touchpad, thousands of tiny points of light start to gush out, even from dark, starless areas. Each dot corresponds to one galaxy with hundreds of billions of stars. You can see various galaxies with different sizes, shapes, and colors at different distances: from nearby galaxies which appear large with clearly distinguishable shapes to distant galaxies seen only as faint red dots.

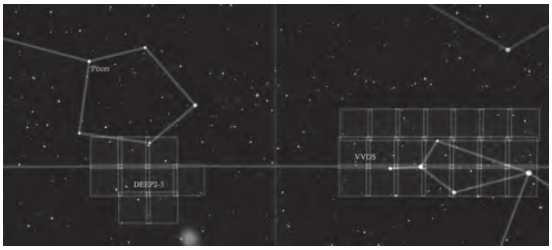

Fig. 2. A portion of the initial screen of the viewer. HSC data is hiding inside of the squares. (Credit: NAOJ/HSC Project)

The menu bar provides a list of objects recommended by the developers, including famous objects in the Milky Way Galaxy, nearby galaxies, strong gravitational lenses, interacting galaxies, and so on. Detailed information about the Subaru Telescope and HSC, the viewer, and recommended objects can be seen at the explanatory site (***http://prc.nao.ac.jp/citizen-science/hscv/index_e.html***).

4. Citizen Science Program: Interacting Galaxies

In the wide area observed by the Subaru Telescope, many interacting galaxies are found, affecting each other's shapes through mutual gravitation. We are now developing a program to let the public identify the morphology of interacting galaxies from the HSC data. Interacting galaxies show various features such as tidal stream(s), a shell or fan structure, a distorted halo, and multiple cores. These features reflect the history of interaction and merging of the galaxies. For the quantitative analysis of the history of galaxy interaction, identification of their morphology plays an important role. However, it greatly varies according to human eyes, even by experts' eyes. For this reason, we will ask citizens' contribution for the identification.

We made the prototype of our citizen science website based on the viewer of the HSC dataset, and had a workshop among 30 astronomy educators and enthusiasts at the beginning of January 2018. The participants, possible future citizen scientists for our program, enjoyed identifying the morphology of galaxies. However, many of them said, "The provided questions are difficult!" Based on their feedback, we are revising the questions about galaxies displayed on the website.

We are also planning to provide fun activities to the general public using the viewer of the HSC dataset such as "find a galaxy" contest. With the activities, we expect the general public members to feel much closer to the HSC dataset and feel comfortable to join our citizen science program.

Fig. 3. Using their laptops or tablets, the participants of the workshop access to our citizen science prototype website and try to identify the morphology of galaxies.

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|Parallel Session|

Moon and Planets Exploration Outreach in IT Era: 20 years' Challenge in The Moon Station

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Abstract. We operate the website called "The Moon Station" (*Tsuki Tansa Joho Station* in Japanaese) for 20 years since foundation in November 1998. As a pioneer of web-based outreach activity in Lunar and Planetary Exploration region, we had several lessons learned for web-based, or Intenet-based, outreach. Here we summarize our lesson learned through reflecting our 20 years' operation and address future ideal situation of Intenet-based outreach and Internet-based communication in Astronomy and Lunar and Planetary Exploration.

1. Introduction

Through more than 30 years' history of the Internet, the web is mainly used for the medium of outreach. The usage of the Internet or the web in outreach is divided into three periods:

1. Static web pages … early 1990s to 2000s.
   It was one-way communication through the web pages which can only be noted by experts who know HTML grammar.
2. Dynamically generated web pages (blog) … early 2000s to present.
   The invention of blog system changed the rule of the information transmission of the Internet. Everybody (who do not know HTML grammar) now can submit their thought easily on the web. Communication between writers and readers made easier than ever. This revolutionary change is called as "Web 2.0".
3. Social networking and mobile shift … early 2010s to present.
   Social Networking System (SNS) now connect people tightly through the friends ties. Communication between users are now daily occurrence and it forms base of SNS. Also, development of mobile devices such as smartphones and IoT (Internet of Things) gadgets helped users transmit more information from everywhere in the world.

The Moon Station passed all three periods and evolved in line with the times. The evolution taking in advancement of technology is important in the world of the Internet and Internet-based outreach.

2. The Moon Station

The Moon Station [1], [2] founded on November 1998 initially aimed for the promotion of Japanese Lunar Exploration Project called as SELENE (later Kaguya, launched in 2007) by four organizations; NASDA, NAOJ, ISAS and The University of Tsukuba. From the start to the present, we augmented the contents to users' needs for Planetary Exploration region and their worldwide trend. The 20 years' epoch-making affairs are summarized at Table 1.

Currently, we have approximately 3000 pages (both static and dynamically generated) in the website, 1000 to 28000 unique users daily.

According to user profile by Google Analytics, main users are male (male:female = approx. 2:1), 30s to 40s, followed by 20s.

We also operates official SNS account on Twitter and Facebook. There are more than 3800 followers on Twitter and more than 640 likes on Facebook as of Apr 1 2018.

The distinct feature of our website is summarized in three points.

1. Precise … written by a planetary scientists and exploration expert, the content is pretty precise compared to other web resources.
2. Quick … fully utilizing advantage of our WordPress web managing system, articles are published mostly very quickly after some events related to lunar and planetary

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exploration occurs.

3. Comprehensive … one of our renowned point is very comprehensive expression for non-professional users. The technique is cultivated by the author's 25 years experience in public outreach including three years service in JAXA's Public Affairs Department.

Table 1. Brief History of The Moon Station

Date	Event
Nov 1998	Founded as a limited-time site promoting Japanese Lunar Exploration
Nov 2000	Became a permanent site.
Feb 2002	Created a debunking corner for the "Apollo Hoax" in reaction to spreading rumors in Japan.
Jul 2003	Launched a corner on Mars and Mars Exploration.
Jan 2004	Reaches over 1 million access due to Mars Exploration Rover landing.
May 2011	Changed domain name to current "moonstation.jp".
Feb 2013	Started Ad insertion.
Mar 2016	Made full renewal (both in design and server).
Nov 2016	Launched a LLC for management of website.

3. Lesson Learned from the Operation

The main principle what we have learned through 20 years' activity is that the essence of the information exchange in the internet is truly the same as ones done in conventional ways. That is:

- Provide information what users want.
- Keep your expression as simple as you can so that non-professional users can understand the content.
- Take very much care in articles' detail, such as expression, content length and words.

Also, we can maximize benefits of the Internet (quicker updating, low publication cost, multimedia-ready, interactiveness, mobile-friendly) depending on your content.

One example we experienced is the Q&A (questions and answers) on mid-autumn moon viewing. We did not put a page on this general event as we thought we are writing pages on the exploration, not a public custom. However, many users requested pages related to the viewing, therefore we added one very simple Q&A page which only writes the date of the viewing. This page [3], written in 2000 around, marked remarkable pageviews, more than 200,000 around, in the mid-autumn viewing day in 2014. This example positively demonstrates the importance of hearing users' voice.

The specific difficulty in Lunar and Planetary Exploration Outreach is the handling of technical terms. These appears frequently on the press releases issuing from Space Development Organizations. Here, we have the following three policies:

- Lower the threshold. Write your article as much as you can (Junior High level recommended). Also, good analogy will help users understand difficult things.
- Attract your article by appealing content (such as photos, videos or your skillful writing).
- Swim with the tide: use good words related to recently prevalent things (buzz term may help you if you carefully choose it).

Also, we need to have some cares in emerging media (SNS). Recently, almost of all web media has SNS account (such as Twitter, Facebook and Instragram). When we make use of SNS, first we should think the purpose of SNS usage. We should then use proper SNS platform fitting to the demands.

The second point of SNS usage is keeping good distance between SNS users and us. We see too intimate relationship between users and distributors may sometimes result in users' annoying reactions. Users often tend to think you (site account) are kind, and do not think the account is operated by real person.

6. Summary

We are happy to have 20 years' anniversary of our website despite many financial and technological challenges. We also think that this anniversary is just a beginning of new era in Lunar and Planetary Exploration Outreach. We need to strengthen our activity such as re-launching English contents and establishing solid base of the managing LLC.

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|Parallel Session|

Hunting for Black Holes: a Citizen Science Exploration of the X-ray Transient Sky

Stefano SANDRELLI[*1], Andrea BELFIORE[*2], Daniele D'AGOSTINO[*3], Andrea DE LUCA[*4], T. DICKENS[*5], H. HAMMERLE[*6], S. KREYKENBOHM[*7], R. SALVATERRA[*8] and A. TIENGO[*9]

Abstract. In the framework of the EU funded scientific project EXTraS, we develop an education activity which was run in several workshops for high school students in Italy, Germany and UK, lasting from 30 to 80 hours each. The work foresees: a) the extraction of transient candidates through the algorithm implemented by EXTraS team; b) the validation procedure of the candidates; c) the counterpart research; d) a final discussion about the results. We adopt an Inquiry-based learning strategy, together with a peer-to-peer education approach. This global strategy both fosters the critical thinking and engages the students, who act as though they were researchers. The workshops were run in a very informal environment. The students can be divided into different groups of 3-4 people or act as individuals. The leading questions of our inquiry are the following, each of them representing a step for further investigations of the data: 1) Is the transient candidate a real transient X-ray source? 2) Is it a new X-ray source? 3) Has it a possible counterpart at other wavelengths (e.g. optical)? 4) What kind of astrophysical object or phenomenon might it be? 5) Might it be an important scientific discovery?

1. Introduction

In the framework of the EU funded scientific project EXTraS (Exploring the X-ray Transient and variable Sky [1]), we had the great chance to offer high school students a very innovative and unusual experience: to look for the weirdest astronomical sources in the data archive collected by XMM-Newton (European Space Agency), a very most successful high energy satellite launched in 1999 and still working [2].

2. EXTraS, an European Union funded project

The European funded EXTraS project was run from 2014 to 2016 by several scientific institutions lead by INAF, the Italian National Institute for Astrophysics: CNR-IMATI and IUSS Pavia (Italy) MPE and Friedrich-Alexander Universitat Erlangen-Nuremberg (Germany), and University of Leicester (UK).

Its main goal was the realization of a vast catalog of serendipitous astronomical data, relying on the observations made by XMM-Newton. The underlying scientific goal was to this data archive to discover transient and variable sources, which can be very interesting – and powerful – physical objects, as neutron stars or black holes, buried in the serendipitous data.

In order to do that, a research algorithm to extract transient and variable candidates was designed and implemented; and, finally, a suitable software to handle the extracted data was developed. Archive and software, after 3 years, are now available through an open access database [3] and science gataway [4].

The key point is that our algorithm can extract a number of astronomical candidates to be scrutinized by astrophysicists, but only a few real sky-monsters are expected to be discovered. We took advantage by this by offering high school students the chance to go through the whole validation process: they look into the data and try to discover new sources or observe already known sources. Apart the good basic science they can learn and use (statistics, physics, image handling), the added value is that they could be the very first people in the world to discover and

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characterize those transient and variable sources, which managed to get their faces on the XMM-Newton cameras for a handful of seconds, just like *extras* in movies.

3. EXTraS, the education activity

In what follows, we wish to provide the reader with an "at-a-glance" identikit of our activity. To do that, we select an astroEDU-like format as a convenient standard, since it also gives some practical indications about the costs [5].

Age: 16-19 year-old kids
Time: 40-50 hours
Group: teams of 3 members, supervised by trained teachers or scientists
Cost: software and astronomical data are freely downloadable from the EXTraS site. They can be used on line, as well
Location: inside. At school or whenever you wish
Core skills: planning and carrying out investigations; constructing explanations; engaging in argument from evidence
Type of learning activity: enquiry based learning

4. Hunting for black holes: the workshop

Hunt for Black Holes is a workshop where high school students play as researchers. They learn how to work on preliminary results from EXTraS; they are introduced to the scientific method and to space technology industry and applications.

The formal goal of the students is to validate astronomical source candidate, by exploring data extracted from the database and pre-selected by researchers. The workshop is a live role playing-like activity with a strong hands-on strategy and some formal education: the students are divided into co-operating groups; they attend laboratories and lessons given by researchers and aerospace industry representatives. The groups gather information about high energy astrophysics, space technologies, data mining and analysis. Their ability to interact with experts is fundamental to reach their goals.

A typical workshop lasts about 5-7 working days (40-50 hours), according to the specific situations. This educational strategy allows the attending students to use real scientific data and:

- to see real life applications for their studies in the field of research;
- to see real life applications for their studies in the field of space industries;
- to acquire a deeper knowledge of the Universe and the space technologies ;
- to focus on the main aspects of a complex problem;
- to develop skills in interaction, knowledge-sharing and team-building, discussion and problem solving

4. An inquiry-based learning education resource

While the students are analyzing the data, they are guided by five major questions:

1) Is the transient candidate a real transient X-ray source?

2) Is it a new X-ray source?

3) Has it a possible counterpart at other wavelengths (e.g. optical)?

4) What kind of astrophysical object or phenomenon might it be?

5) Might it be an important scientific discovery.

From 2016 to 2018 we run several workshops and other education activities laying on the workshop experience in Italy, Germany and United Kingdom, engaging more than 200 high school students.

6. Summary

The success of our workshops shows that a citizen science approach can be very useful at school, even if the proposed activity is far out of their curricula, provided that we offer them a stimulating challenge and framework. Besides, we showed that students can be engaged in a high level challenge.

Our next step is to launch the activity as a totally citizen science one: we believe every interested citizen could be able to go through the work-flow and to answer to the 5 questions.

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[3] https://www88.lamp.le.ac.uk/extras/archive
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|Poster|

Asteroid Searching Projects with the Public in Japan

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Abstract. In order to promote astronomy education and science through real experiences and observations with the public, we have been carrying out new object searching projects at Ishigakijima Astronomical Observatory, the Bisei Spaceguard Center, and Nayoro Observatory based on each concept, targeting asteroids (or minor planets) as common key objects.

1. Introduction

In the internet era, research information and data are easier to access than ever before and this has been closing the distance between citizens and scientists. Anyone can participate in science if only he or she has curiosity and interest. However, there is a threshold especially for kids and students to perform actual observations because, in most cases, it is needed to have their own instruments and have high observation technique. In order to remove such barriers and to promote education and science on observational astronomy with the public, we have been carrying out new object searching projects at Ishigakijima Astronomical Observatory, the Bisei Spaceguard Center, and Nayoro Observatory based on each concept, targeting asteroids as common key objects.

2. Why Asteroids?

This is because even amateur astronomers can make (and actually made) a large contribution to discoveries of new objects especially such as novae, supernovae, and asteroids in Japan. The following points are also considered for asteroids.

- Key objects for the solar system science: asteroids are key objects for the research of the origin and evolution of the solar system because they are thought to be remnants from the early phase.

- Unique object whose name can be proposed by discoverers: the discoverer of an asteroid can propose a formal name for the newly discovered asteroid, which attracts the interest of participants.

- Well known as targets of Hayabusa/Hayabusa2: thanks to Hayabusa/Hayabusa2, which are very popular spacecrafts appearing in movies and mass media frequently in Japan, asteroids are well known as their targets.

- Major component of Near-Earth Objects (NEOs): as many asteroids passing close to the Earth have been discovered, the importance of proper understanding of NEOs and the Earth impact risk (spaceguard/planetary defense) is increasing.

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3. Asteroid Searching Projects

Our asteroid searching projects; "*Chura-boshi Kenkyu Taikentai*" at Ishigakijima Astronomical Observatory (observational research experience for local high school students), "Spaceguard *Tanteidan*" by the Japan Spaceguard Association (spaceguard experience through asteroid search for students from elementary school to high school), and "Asteroid Search Program" at Nayoro Observatory (asteroid search experience for the 5th and 6th grade students living in Nayoro) are summarized in Table 1.

Table 1. Summary of Our Projects

	Ishigaki	Bisei	Nayoro
Start year	2005	2003	2011
No. of events held	6	~30	7
Total no. of discovery	13	12	0
(having prov. designation)	(7)	(9)	(0)
(numbered/named asteroid)	(1)	(3)	(0)

4. Summary

Combining our asteroid search activities with the public in Japan, many students from elementary school to high school join us and have experiences in observational astronomy and spaceguard, resulting in the discoveries of many asteroids. We will strengthen our cooperation in both astronomy education and research, and contribute further to the extended international collaboration in the future.

Attracting the Public with Landscape Astrophotography

Akiko IKEDA*[1]

Abstract. A group of astro-landscape photographers put together a photo exhibition project, to exhibit astro-landscape photographs nationwide. Many people were attracted to the beauty of the skies. Such photo exhibition is an effective way to introduce the public to astronomy.

1. Introduction

In 2015, the author gathered a group of 9 noted astro-landscape photographers to organize a photo exhibition tour around the country. Our exhibition of 36 photos toured around the country, and attracted tens of thousands of people, many of which have so far not related to astronomy, perhaps thinking it was too difficult for them. During two years, the group exhibited photos that combine landscapes with starry skies in 23 locations nationwide, inspiring many people, and lead them into further interest to astronomy.

2. Caption Plates

People do love great landscape pictures with beautiful stars, but the group made sure that people went home with more than the "beauty of the stars." They made a "caption plate" for each picture explaining the constellations as well as what is in the pictures. This was very well accepted, and many said they now understand that the skies are more than just romantic backgrounds. Some would even join astronomy clubs and observe the skies themselves.

3. Exhibition Sites

Many science museums invited the exhibition. In some prefectures, the group's exhibition was the first opportunity for the people to see astro-landscape photography exhibition. There certainly seems to be great differences between localities in awareness to astronomy.

4. Theme

The exhibition's theme is 'light,' in tribute to the 2015 Year of Light. Creation in the Bible started with light. The ISS crew will know where the cities are by light. But we are star gazers. We love dark skies. Light is something we have to fight against!

No, not so. We can't deny light. Light is civilization itself, and without civilization, we will have no time for star gazing, no telescopes nor cameras. Light is something we embrace. We will enjoy dark skies, but will also embrace city lights, and still fight against unnecessary light. We will even show that stars are there in the middle of a great metropolis like Tokyo. Know that our dear Earth is still beautiful, and we shall make sure that it remains that way when we hand them over to our children.

Fig. 1 Glow of Heavens, Gleam of Earth Exhibition Poster

5. Summary

During the 2 years and 23 locations, the group reached many people and introduced astronomy nationwide through beautiful pictures of the earth and skies; One way to reach the public.

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|Poster|

Annular Solar Eclipse Limit Line Project in Japan in 2012

Takeshi INOUE[*1], Kouji OHNISHI[*2], Kazuhisa MIYASHITA[*3], Chiharu ISHIZAKA[*4], Naohito FUKUHARA[*5], Mitsuru SÔMA[*6], Solar Eclipse Limit Line Project Team

Abstract. On May 21, 2012, we had the opportunity to observe the annular solar eclipse in a wide area of Japan. We planned and ran "Solar Eclipse Limit Line Project" to determine where the limit line of the annular solar eclipse was. As a result, even with a simple observation with the naked eye through solar eclipse glasses, it was shown that precise observation data can be obtained.

1. Introduction

Solar Eclipse are wonderful phenomena and very good astronomical educational occasions for people. On May 21, 2012, we had the opportunity to observe the annular solar eclipse in a wide area of Japan. We planned and ran "Solar Eclipse Limit Line Project" to determine where the limit line of the annular solar eclipse was. There were about 4km differences in the limit line predictions depending on the calculation methods (see Reference [1]). We were interested in which line the most appropriate prediction was.

2. Observation

The project was done by observing whether the ring of the sun was connected or not with the naked eye through the solar eclipse glasses, along the predicted limit line. We invited not only schools and astronomical clubs but also the public to participate in the project widely. We made it possible to report the observation results on the web.

Fig. 1. Website for the Annular Solar Eclipse Limit Line Project. http://www.eclipse2012.jp/

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*4 Osaka Science Museum
*5 Astronomical headline news for backyard astronomers
*6 National Astronomical Observatory of Japan

3. Results

We got web reports from about 15,000 people. We examined the ratio of the ring observer in the direction perpendicular to the predicted limit line. 23 local groups independently conducted observation and examined where limit line was.

By analyzing the results of web data and each group, we concluded about the limit line. On our observation results, under clear sky conditions the limit line by eclipse glasses was within ±500 m of the line calculated by M.Sôma based on the topographic data of the Moon obtained by the Japanese lunar explorer KAGUYA.

4. Summary

Even with a simple observation with the naked eye, it was shown that precise observation data can be obtained. The limit line observation of the annular solar eclipse is a project that citizens can easily participate. We hope this project will be held in many countries where annular solar eclipses will be observed in the future.

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Measurement of Night Sky Brightness with a Mobile Phone App

Kazuhisa KAMEGAI*1 and Hiroki INOUE*2

Abstract. We have conducted a crowdsourcing project to measure brightness of night sky. A simple questionnaire on a mobile phone app ask people to report how many stars they can see in Orion constellation. Thousands of responses were obtained within just one night. The results of several nights show the snapshot maps of sky brightness across Japan.

1. Introduction

Keeping dark night is important not only for astronomy, but also for human health. In Japan, the government[1] and an amateur group[2] have measured brightness of night sky for a few decades. Recently some global efforts have been also conducted[3]. However the number of measured position is limited because the precise measurements tend to require some apparatus and take long time. Here we present a result of our crowdsourcing measurement in Japan using a mobile phone app.

2. Method

A simple questionnaire is put on an interactive function “Sora-Mission” in the mobile phone app “Weathernews Touch” which is provided by a weather service company, Weathernews Inc.[4]. The question is “how many stars can you find in the southern part of the Orion constellation?” Participants look at Orion by naked eyes and select their answer from following four choices: (1) cannot find tristar, (2) can find only tristar, (3) tristar and mini-tristar, and (4) more than above. The sky brightness of the position can be easily estimated from the response. When participants send their responses, the app also gets the location information, latitude and longitude, of their position. The measurements have been carried out during the nighttime of February 5, 23, 24 and 26 in 2014, December 19, 2015, March 2 and 10 in 2018.

3. Results

We have successfully collected thousands of data points across Japan within only one night because the app has been installed on millions people’s phone.

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Total number of the participants in measured seven nights was as large as 25,000. For example, the resultant map of March 10, 2018 is indicated in Fig. 1. The distribution of thousands data points covers all over Japan. Even with such a simple method, we can find a tendency that the more distant from center of large cities, the more stars can be seen.

Fig 1 – Resultant map of March 10, 2018.

4. Summary

We have made snapshot maps of sky brightness across Japan on several nights by crowdsourcing method using a mobile phone app. We would like to make similar measurements for other seasons and for larger area in the future.

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http://www.env.go.jp/kids/star.html
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[3] GLOBE at NIGHT, http://idatokyo.org/gan/
[4] Weathernews Inc., http://weathernews.jp/

|Poster|

The "Hoshimiishi" of the Yaeyama Islands in the Late 17th Century

Jiro KONISHI*1

Abstract. In the late 17th century, in the Yaeyama Islands people used "Hoshimiishi", a star watching stone, to observe the Pleiades and Orion, and then decided when to sow rice or wheat. Several "Hoshimiishi" exist, but we do not know well how to use them. In this work, I present my field work and computer simulation and my studies on how "Hoshimiishi" was used. As a result, it was found that the date of the seedling was decided with high accuracy. Also, the time when "Hoshimiishi" was used is the Maunder minimum, there is a possibility that the crop was poorly due to a decrease in solar activity.

1. What is "Hoshimiishi"?

"Hoshimiishi" is a stone to observe the stars made in the late 17th century in the Yaeyama Islands of Okinawa Prefecture, in Japan. Since there were no calendars in the Yaeyama Islands at the time, the people of the Yaeyama Islands used "Hoshimiishi" to know the timing of the seeding of rice and wheat. A small number of "Hoshimiishi" still remain nowadays.

2. Current "Hoshimiishi"

Ishigaki-mura and Tonoshiro-mura's "Hoshimiishi" have 135-150 cm in total length and are made of Ryukyu Limestone. Weathering progresses rapidly in limestone, so most likely the size has decreased by a few centimeters since these were built. There is also the possibility that there was another small stone near these stones. People of those days were thought to observe the stars in the eastern direction, looking up at these stones from that low stone.

Fig.1. Taketomojima-island's Hoshimiishi

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Taketomijima-island's Hoshimiishi (Fig.1) is also made of Ryukyu Limestone. And in this stone there is a hole near the center. This hole is aligned in the east-west direction, it can be speculated that the object was observed from this hole.

3. Observation of stars by "Hoshimiishi"

Ishigaki-mura and Tonoshiro-mura's "Hoshimiishi" were used to know the time to seed rice. According to the description of the ancient documents, the people at that time observed the Pleiades rising to the east sky 50 days after the Autumnal Equinox day, and learned the day of the seedling. It is considered to be very accurate.

Taketomijima-island is made of raised limestone, and because drainage is good, paddy fields could not be made. Therefore, it is considered that Taketomijima-island's "Hoshimiishi" was used to know the season of wheat seeding. It is thought that the stars observed by people of those days were either Pleiades or the three stars in the belt of Orion's constellation.

4. Why did people need to use "Hoshimiishi"?

When "Hoshimiishi" were made, the period corresponds to the Maunder minimum when solar activity declined. In the Maunder minimum, there were few sunspots and the average temperature of the Earth was low. So the yield of crops was reduced, and at that time people needed to know the exact timing of the seeds to increase the yield. Because if the sowing is done on the exact date, the yield will increase.

Science Pub within Local Culture:An Interactive Communication Event in Japan

Shinjirou KOUZUMA[*1], Hitoshi YAMAOKA[*2], Shigeyuki KARINO[*3] and Kaori OTSUKI[*4]

Abstract. Science pub is an interactive communication event, which incorporate a local culture in Fukuoka. Past science pubs have been held at taverns, cafes, and restaurants, where participants enjoy talking about astronomy with tasty food and drink. We have held the science pub over 40 times including held in different cities since 2007. Over 1,000 citizens took part in the event thus far and enjoyed communicating with each other through various astronomical topics. We hope that this event increases the opportunity to casually talk about astronomy among citizens in daily life.

1. Introduction

A Yatai, which is a traditional local culture in Fukuoka, is a mobile food and drink stall, where people enjoy talking about various topics such as daily irritations, sports, economics, and politics, regardless of age and gender. This atmosphere, which may resemble English pub, is uncommon in general Japanese-style taverns. Inspired by the local culture, we conceived the concept of the science pub.

2. Concept and methods

The purpose of our science pub is to encourage citizens to communicate about astronomy with each other more interactive than ever. To encourage participants to communicate with each other as interactive as possible, there are no lectures and the participants enjoy talking about astronomy with tasty food and drink during the whole. The role of hosts, who are specialists on astronomy, is to connect participants and to provide astronomical topics. We have especially tried to attract people who had been uninterested in astronomy.

3. Past science pubs

Past science pubs have been held about three to four times a year at a different tavern every time. The number of participants is ordinarily about 30—40 people. The reason that we change tavern every time is to provide an opportunity of attending the science pub for citizens with various backgrounds. In almost every time, about one third of the participants attended for the first time in each event. In addition, regular participants sometimes played the role of hosts, that is, they tried to communicate interactively with other participants.

4. Surveys

We carried out surveys 12 times between 15th and 30th. The surveys show that the majority of the participants were satisfied with our science pubs. Participants who were dissatisfied with the event were 15% at the most. While there were positive participant's voices, some negative voices were sometimes heard: it is hard to communicate with other participants, food is light, it is too short time to talk with various people and so on.

5. Summary and final goals of science pub

We have held the science pub over 10 years and over 1,000 citizens have attended. Surveys show that most of the participants were satisfied with the event. Consequently, an event within a local culture can be helpful for outreach activities.

A final goal is that participants communicate with each other without the help of hosts. In addition, we hope that the science pub leads to increase the opportunity that citizens casually talk about astronomical topics in daily life.

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|Poster|

Technology Engagement for Public Astronomy towards Citizen Science

Muhammad H. MURTZA*[1]

Abstract. The Ministry of Education (MOE) Malaysia is providing Internet connectivity and learning platforms for schools throughout the nation to equip teachers with resources and enable better engagement with students. We voluntarily utilize this system to pilot our Astronomy project with schools. The project begun in March 2016 during partial solar eclipse that occurred in Malaysia.

1. Introduction

Astronomy should be a gateway into STEM education. Malaysia sky is polluted with light and our weather is not promising. Malaysian kids learn astronomy in one of the topics in Science class. The mission of Universe Awareness Malaysia is to pilot the usage of Internet and the learning platform known as FrogVLE provided by MOE, as a medium for teaching and learning astronomy for students and the public. The main objectives is to inspire young Malaysian to learn about our wonderful cosmos and to spark interest in Astronomy and STEM among students. To start we selected the partial solar eclipse phenomena in March 2016 to start.

2. Methodology

1. We start the project empathizing and understanding school technology ecosystem, then we explored online learning platform provided by MOE named FrogVLE.
2. Selected a natural phenomena to start with: we choose Malaysian partial solar eclipse on March 2016.
3. Craft phenomena content in an interactive way, engaging in the platform. The teacher can use it in the classroom and information about the partial solar eclipse is provided.
4. Plan Marketing strategy to promote the content for school using Facebook, Whatsapp and Twitter.
5. Monitor the engagement and participation.

3. Project

Pre-Eclipse

Used flipped classroom style and school plan science activity for the eclipse. ***Engagement***: Student shared excitement for the public online site.

During the Eclipse

School organized solar eclipse observation and STEM activity. ***Engagement***: Post pictures and activity during solar eclipse in the online site shared to public

Post-Eclipse

Student shared with the classroom feedback and insights about the solar eclipse.

Engagement : Classroom Sharing

Measurement of curiosity and excitement is based on the active engagement on the platform.
Link to site: *http://bit.ly/GerhanaMatahari*

4. Findings

Referrers : *method of approaches*

Email,SMS,Direct	652
Facebook	377
1bestarinet	78
+5 more	930

Location : *online participant location*

Malaysia	1171
United State	11
Germany	8
+4 More	847

4. Conclusion

In conclusion, using technology in astronomy education is important. It helps spark interest among students and the public and allow the young generation to explore and express their ideas and feedback. After successfully engagement with this method we organized few projects based on the same framework. We hope that this method will support our mission to inspire our generation with the wonderful cosmos.

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Aiming the Moon in a Jules Verne´s Way: Astrodynamics in a Spreadsheet

Joao A. M. PEREIRA*[1]

Abstract. Traveling to the Moon is an old idea that has fascinated humans since medieval times. This contribution intends to give the public a glance on space travel history and show how modern numerical tools can be used with ease to achieve meaningful astrodynamical results. By combining literature and cinema with scientific elements, we explore the relation of Jules Verne´s novel "De la Terre a la Lune" with astronomical knowledge of the Earth-Moon system. Very basic concepts on Newtonian mechanics accessible to the general public are used to reproduce the trip plans presented in "*De la Terre a la Lune*"; a book that inspired George Méliès to produce "*Le voyage dans la Lune*", the first space movie in history. A modern version of the ballistic space travel to the Moon is also discussed in this work by taking into account the various dynamical variables of the problem, by using a simple spreadsheet calculation. The spreadsheet outputs the time of flight the space vessel takes during the journey from which, other launching parameters can be evaluated.

1. Introduction

In the year 1865, a ballistic journey to the Moon was imagined by Jules Verne in the two volume story "*De la Terre à la Lune"* and its 1870 continuation "*Autour de la Lune*". In this adventure, a giant canon served as a mean to lift a bullet like space ship at a precise velocity and time to reach the Moon. The scientific background for the astrodynamical calculation of the journey parameters presented in the novel is likely to be provided by two consultants: Verne´s cousin, Henri Garcet, who was a Mathematics teacher, and Joseph Bertrand, the Mathematician who is responsible for the well-known Bertrand´s theorem showing Newtonian gravity supports closed orbits. Verne´s novel was captured in film by Georges Méliès, who in 1902, three years before Verne´s death, released "*Le voyage dans la Lune*", probably the first space movie in history. It is from this film a famous image of a bullet like spaceship hitting a personalized Moon´s face in the eye. It is worth mentioning that, by the year 1865, the value of the gravitational constant was yet to be measured with precision and had no role in the novels. An accurate determination of G, mistakenly credited to Henry Cavendish´s 1798 paper, was available in a scientific communication by M. A. Cornu and J. B. Baille, seven years after Verne´s novel release. The problem of the gravitational force as we know today appears in a John Henry Poynting´s 1892 work.

2. Discussion and Results

Gathering data from the novels one finds the initial conditions for the launching, such as the initial velocity, v_0, the Earth-Moon distance, d, and the optimal date for the departure, in chapter 4 of "*De la Terre à la Lune"*. Also, in chapter 4 of "*Autour de la Lune*", the following formula

$$\frac{1}{2}\ v^2 - v_0^2) = gr\ \frac{r}{x} - 1 + \frac{m'}{m}\ \frac{r}{d-x} - \frac{r}{d-r} \qquad (1)$$

where r is the Earth ratio, g is the Earth´s surface gravity acceleration and m'/m is the ratio between the masses of the Moon and of the Earth appeared. This equation furnishes the velocity of the space vessel, v, as a function of its position, x, with respect to the center of the Earth (Fig.1). It is important to mention that equation (1) takes the Earth´s gravity as reference and no mention of the gravitational constant, G, appears.

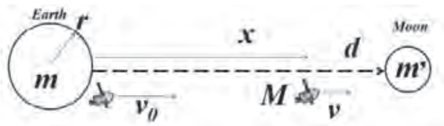

Fig.1 - Schematic view of the space trip.

It is possible to interpret equation (1) in modern terms if conservation of mechanical energy is employed taking Moon´s gravity into account as in equation (2) below:

$$\frac{1}{2}Mv_0^2 - \frac{GmM}{r} + \frac{Gm'M}{d-r} = \frac{1}{2}Mv^2 - \frac{GmM}{x} + \frac{Gm'M}{d-x} \qquad (2)$$

Equation (1) is obtained from (2) if $g = Gm/r^2$ is admitted. To input the calculation in the spreadsheet, the Earth-Moon distance is subdivided in small intervals, Δx_i, and the time spent in each interval is calculated from the velocity in equation (2) as $\Delta t_i = \Delta x_i / v(x)$. The time of flight is the sum of the Δt_i spent in each interval (97 h and 30 m). The present calculation can be easily achieved giving the original result within 1%.

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SESSION I.4:

Tourism

|Parallel Session|

Implementing Astronomy in Tourism in Northern Borneo, Malaysia

Emma Z. ZULKIFLI [*1]

Abstract Rural area and out of range for advance development facilities may be excuse for lagging in education in any subjects including astronomy but may have another advantage in terms of dark skies. Astro-tourism may be known in other countries but it is still a new term in to be used in Malaysia. This paper describes how local communities in Northern Borneo helped themselves to help outsiders on awareness of the importance of preserving the dark sky, introducing the basic knowledge of astronomy of charting the sky and help spreading awareness on astronomy and light pollution more widely. Included in this paper are also the challenges and obstacles the communities have to go through in order to make astro-tourism happened. Tackling tourism is also tackling education as educating the public and in which providing facilities can be done by the local communities although from rural area.

1. Introduction

Sabah, a state in Malaysia located at the island of Borneo is separated from its Capital City, Kuala Lumpur by South China Sea. A two hours flight or two days on a ship is making Sabah a bit outdated on development on any field. Though it sounds like Sabah is underdeveloped, this beautiful state is flourished with flora and fauna, diversity of ethnics and this state has contributed largest part in economy of Malaysia from its tourism income.

All in all, there's no Astro-tourism until the year of 2016, the Ministry of Tourism and Culture of Sabah officially announced astro-tourism and astro-photography is popular in Sabah during media interview in Perseids Meteor Shower. [1] Without any further studies beforehand or plans with travel agencies, Sabah Stargazers bears the consequence of silence in astro-tourism in Sabah but rise with the support of chalet owners.

Sabah Stargazers is a non-government organization started in the year 2013 but officially registered in the year of 2015 mainly are astrophotographers from Sabah. This organization has been a platform of astronomy in Sabah and has been recognized by the National Space Agency of Malaysia, National Planetarium, Ministry of Tourism and Culture and Education Department of Sabah in conducting astronomical events or outreach in Sabah.

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2. Advantages of Sabah

2.1 Tourist attraction

This multi-cultural state attracts more than 3 million tourists local and international every year. [2]

Graph 1 Statistic of tourists visit per year

It is most likely the number of tourist is increasing in the coming year. Because of the readily attraction in Sabah, it is easier to execute astrotourism in after daily activities which will be taken care of by tour guides.

2.2 Location

Sabah has more or less 75% with ideal sky for stargazing with the condition of no light pollution unlike for peninsular Malaysia. [3]

Fig. 1 Light pollution map for Malaysia. Image credit to www.lightpollutionmap.info

It will take only 30 minutes' drive to get to a suitable place for stargazing from the international airport in Sabah, located at the Provincial Capital, Kota Kinabalu.

The best part stargazing at the West part of Sabah is the view of Mount Kinabalu, which is the main attraction in Sabah and one of the highest Mountain in the Southeast Asia, at night under the stars. Most of the tourist nor photographers appreciate more when there is a local value included in stargazing.

Fig. 2 Center of Milky Way rising above Mount Kinabalu and Mount Nungkok. Image credit to Yunus Jinul

3. Challenges

After the announcement of astrotourism in Sabah, the authority could not help with packaging the astronomy tour to be embedded with other tour packages. It is still considered as not relevant.

Fortunately, there are few chalet owners whom are passionate to implement astronomy in their packages. They are aware of light pollution and willing to change and help to prepare facilities to execute any stargazing session or astronomy classes. On the other hand, there are also few passionate owners unable to contribute because lack of support from the local authority to help them upgrade few important facilities such as road to the amazing-view-chalets or homestays.

4. Summary

To start implementing Astronomy in tourism in a country that is still has not aware of its mesmerizing dark sky is quite a challenge but so much worth it. The number of local tourist could increase from time to time because they don't have to go out from Malaysia and spend more money to experience dark sky and may contribute to Malaysia's economy.

It takes the cooperation between the locals, the authorities and astronomy communicators to run astrotourism.

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The potential of "Astro-Tourism" in Mainland Southeast Asia

Pisit NITIYANANT*1

Abstract. Tourism is one of the important factors which drives the economy in Mainland Southeast Asian Countries, indicated by international tourist arrivals (For example in 2017, 35.4 millions in Thailand, 25.9 millions in Malaysia, and 12.9 millions in Vietnam) or International tourism income (49.9 billions USD in 2016 for Thailand). "Astro-Tourism" is a type of tourism that focuses on visiting exhibitions or joining activities about Astronomy and Space technology at Science museums, Planetariums, Astronomical observatories and Space centers. Astro-Tourism also includes participating in Celestial phenomena and could be the branch to support tourism in many countries. In this presentation, presenter will talk about the possible potentials of Astro-Tourism in Mainland Southeast Asian countries based on experiences gained during the presenter's journeys across these countries in 2014-2017.

1. Introduction

Many countries throughout the world increasing promotions on "Astro-Tourism" (e.g.,Japan, New Zealand & Chile) in recent decades.

There are 4 categories of attractions for Astro-Tourism as follows:

1) Dark-sky preserves and sites for frequent-celestial phenomena observation (e.g., Aurora over the Nordic countries)
2) Astronomical museums, planetariums and observatories
3) Cultural astronomy-related historic sites
4) Space technology museums and Space centres

Mainland Southeast Asia has many attractions in 3 categories (except Dark-sky preserves and sites for frequent-celestial phenomena observation). Each country has different number of attraction and each attraction has different ease of accessibility.

2. Vietnam

The strong point of Vietnam on Astro-Tourism is attractions from the period of Imperial Vietnam and French colonialism to Modern Vietnam. The list of attractions in Vietnam as follows:

- Vietnam National Space Centre (VNSC), Hanoi: Museum, planetarium & observatory
- Quan Tượng Đài, Huế: The former royal observatory in early-19th century
- International Centre for Interdisciplinary Science & Education (ICISE), Quy Nhơn: Planetarium & observatory
- Alexandre Yersin Museum, Nha Trang: Collection of 1910-1920s astronomy books, observation records & telescope

3. Laos & Cambodia

Although the weak point of Laos & Cambodia on Astro-Tourism is the lack of museum, planetarium & observatory, but the strong point of these countries is attractions' architecture reflect about "Mount Meru" the sacred mountain in Hindu & Buddhist cosmology. The list of attractions in Laos & Cambodia as follows:

- The old town of Luang Prabang, Laos: The component for temple roof decoration with triangular shape (symbol of Mount Meru)
- Angkor Wat, Siem Reap, Cambodia: The 12th century Hindu temple complex

4. Myanmar

The strong point of Myanmar on Astro-Tourism is the most detailed traditional star chart in this region. The list of attractions in Myanmar as follows:

- Kyauktawgyi Pagoda, Amarapura: The 19th century mural painting on the ceiling inside the pagoda, depicts hemisphere & equatorial star chart with more than 150 Burmese constellations

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- Naypyitaw Planetarium, Naypyitaw: The largest and newest planetarium in Myanmar

5. Thailand

The strong point of Thailand on Astro-Tourism is the attractions about traditional astronomy, influx of western astronomy & the network of NARIT observatories. Types of attractions as follows:
- Historic sites: Buddhist temples with the traditional star charts or mural painting about astronomical events
- Historic sites: Buildings about the 1st influx of western astronomy in Siam (Thailand) in late-17th century (e.g., Wat San Paolo, the first astronomical observatory by French Jesuit priest-astronomers)
- Historic sites: Buildings about the 2nd influx of western astronomy in Siam in 19th century (e.g., the model of clock tower for Bangkok mean time establishment, historic site of king Mongkut expedition for 1868 total solar eclipse observation)
- The network of NARIT observatories: The headquarter of NARIT with exhibition hall, planetarium & observatory in Chiang Mai, Northern Thailand, 40-m radio telescope (will built in Chiang Mai over next 5 years) and 3 regional observatories for the public (Nakhon Ratchasima, Chachoengsao & Songkhla)
- Other learning place on astronomy & space technology (e.g., Bangkok planetarium, Space Inspirium (Chonburi province))

6. Malaysia & Singapore

The strong point of Malaysia on Astro-Tourism is the only Southeast Asian nation that has astronaut program in recent decade. Meanwhile, the neighbor city-state of Singapore has the weak point as the most light-polluted country in Southeast Asia.

The list of attractions in Malaysia & Singapore as follows:
- Planetarium Negara, Kuala Lumpur: The national planetarium with the exhibition about Malaysian astronaut program on ISS in 2007.
- PETROSAINS, Kuala Lumpur: The science discovery center inside Petronas towers, the landmark of Malaysia with astronomy exhibition
- Science Centre Singapore: The planetarium with 8K digital fulldome system and observatory

7. Summary

Mainland Southeast Asia has the potential of "Astro-Tourism" by its variation of attractions from planetariums, astronomical museums & observatories, museum on space technology & space centre to cultural astronomy-related site

These attractions mentioned in these proceeding aren't all of "Astro-Tourism" attractions in this region due to an author has never been to some areas (e.g., Lower Burma, Phnom Penh, Northwest coast of Peninsular Malaysia). Thus, the way to updates the information about Astro-Tourism potential is visit these countries again in the future. (especially in "unexplored" area)

Table 1. Number of "Astro-Tourism" attractions visited by an author in 2014-2017 in each category in introduction section.

	Cat.2	Cat.3	Cat.4
Vietnam	1	2	1
Cambodia	0	1	0
Laos	0	1	0
Myanmar	1	1	0
Thailand	8	11	1
Malaysia	2	0	0
Singapore	1	0	0

Fig. 1, the map of Mainland Southeast Asia and "Astro-Tourism" attractions in this region with the name of cities and countries in the official language of each country, draw by Pisit Nitiyanant (an author)

|Parallel Session|

Astronomy as a Possible Tool of Community Building and Tourist Resources in the Sub-Tropical Isolated Isles - Case Study in Okinawa, Japan

Takeshi MATSUMOTO[*1], Reo SHINAGAWA[*2] and Maiko SHIMABUKURO[*3]

Abstract. Astronomy communication is of great use for community building in depopulated isolated island regions and for resources for tourism in sub-tropical districts without light pollutions. This article reports two case studies of these issues in Okinawa, southwest of Japan Islands.

1. Introduction

Okinawa Prefecture is located in the southern-most part in Japanese Archipelago and consists of 160 islands, 39 of which are inhabited isolated islands.

In this article, the authors will introduce recently implemented case studies that communicating astronomy can be of great use for the community building in the depopulated isolated islands and resources for the tourists visiting Okinawa.

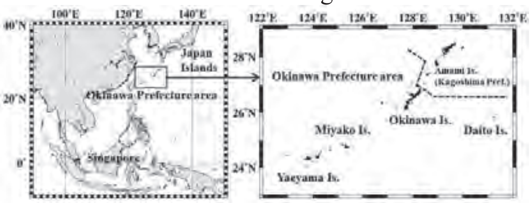

Fig. 1. Index map of Okinawa and eastern Asia.

2. Case Study 1: Astronomy class in the community building project

The population is gradually increases in the whole Okinawa Prefecture (+2.9%, 2010-2015) although that of the whole Japan decreases, according to the Japanese Government's population statistics survey in 2015 [1]. However, the population decreases drastically in the northern area of Okinawa Island and the isolated islands. Some islands are affected by more than 10% decrease of population during the past 5 years (between 2010 and 2015) [1].

In these islands 9th graders should go out of their islands for further education to enter the high school. The problem is that these young islanders never come back home after graduation. This is because there are no attractive jobs that young people want to occupy in these small isolated islands.

After young people leave their island, population of elders consequently increases. Then the industry characteristic of these islands (agriculture, fisheries, production of food processed from vegetables, excellent resources for visiting tourists, etc.) may decline. These islands may be affected by such a downward spiral unless young people come back to these islands through an attractive community building.

However, since Okinawa is located in the southernmost part of Japan, most stars can be observed through one year in Japan. Especially, the residents can observe the spectacular southern starry sky with no light pollution at night in these depopulated areas. If the residents notice that their community has such a valuable "treasure" through a public astronomy class, they will recognise the attractiveness in their own town, which may prompt the future community building by themselves.

On the other hand, the isolated islands in Okinawa are recently keen to promote staying at a private house under the control of the local tourist bureau supported by the local government (towns, villages). Many high school students visit these islands and stay at officially certified private houses during their school excursion. The islands are full of young people and look vigorous throughout a year.

"The Stardust", students' astronomical association in University of the Ryukyus, made a project plan including astronomy class and stargazing workshop by inviting schoolkids, their parents, host families and high school students during their school excursion, and the residents at Ié Island and Kumé Island, both of which are highly depopulated isolated islands, and applied to the university's in-house project which was implemented under the universities' COC (Centre Of Community) programme funded by Japanese government. Their proposal was successfully accepted and they could hold "Okinawa Space Class" in these islands in 2017.

This class consisted of two parts: Part 1 classroom lecture on the stars and the universe, folk tales about the stars, how to use a planisphere, how

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to use an astronomical telescope, etc., and Part 2 outdoor observation workshop.

The class on 7th October in Ié Island was mainly for the public, high school students from outside Okinawa and their host families. The class on 8th was mainly for elementary schoolkids with their parents. The class on 4th November in Kumé Island was for all islanders including schoolkids, their parents, host families and adults. The result of evaluation for the class by the attendees in Kumé Island was good and the authors regarded the project as successful.

3. Case Study 2: The possibility of using the starry sky in Okinawa for the tourism

University of the Ryukyus sends maximum 6 students every year to one of the ASEAN countries for short-term job training. The purpose of the programme is that the university inspires the students to get the mind of cosmopolitanism and makes them consider to look for their jobs in foreign countries through the experiences of a short-term job training and personal exchange with the business persons and the same generation (students studying Japanese languages etc.). In 2016, 5 students visited Singapore through this programme. During their stay, they visited the Okinawa Prefecture Office in Singapore (liaison between Okinawa and Singapore), Vivid Creations Pte Ltd. (Promotion event coordination, Marketing, for job training of proposing a new idea of Okinawan tour), Nanyang Technological University (for cultural and linguistic exchange among the students), etc.

Before departure to Singapore, they were given from Vivid Ltd. the task "Propose an idea of new Okinawan tour plan for Singaporeans". The number of the tourists visiting Okinawa increases drastically and counts about 9.4 million (2.5 million from foreign countries) in 2017 [2]. The students at first discussed through SWOT analysis the factors which affect tourism in Okinawa. After the field works during their stay, they found that Singapore is full of brightness at night, cloudy in many days (located under the Intertropical Convergence Zone), always foggy due to haze. Then they realised that Singaporeans have very little chance to watch the starry sky and that the starry sky in the suburbs of Okinawa could be resources for tourists from Singapore. They spent 1 hour at a hawker (food court) in downtown during lunch time on 08 September 2016 to interview to 100 Singaporean business persons, asking whether or not they wanted to visit Okinawa to watch the beautiful starry sky, by showing a smartphone with a photo of the Milky Way in Okinawa. As a result, 71 persons (71%) answered in the affirmative. Finally they made sure that the starry sky must be excellent resources for tourists, especially for Singaporeans, since star watching is almost hopeless in Singapore.

In the late afternoon on this day the students presented this issue together with the background and the result of the SWOT analysis about the tourism in Okinawa to the expert of the promotion event coordination of Vivid Ltd. Then finally they proposed several new concepts of Okinawan tour plan for Singaporeans. These include pre-existing resources such as coral reef, white sandy beach, deep ocean water spa, Okinawan healthy food, shopping etc. They insisted that the Okinawan tourism would be more attractive if these pre-existing resources were combined with new resources, starry night sky watching which is very familiar in the suburbs of Okinawa and unfamiliar to the Singaporeans. They added that outdoor wedding photos under the starry sky would also be attractive and that promotion event for Okinawan tour by use of the planetarium programme would also be effective.

4. Conclusion

The "Star Guide" license system is now completed in Japan [3]. The license holders can work as science communicators, volunteers for stargazing meetings in the local schools and during the night-time tour programmes. Their talk on the universe, stars, planets, constellations can be added values to the meeting. The authors would like to expand this action to the whole area on Okinawa Prefecture. Residents living and working in the light-polluted areas [4] in the eastern and southeastern Asian countries may wish to travel to watch the starry sky. The number of the tourists visiting Okinawa may increase from this time forward. Education programmes for English-speaking and Chinese-speaking star guide training may be required very soon.

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Introduction of Astro-Tourism in Japan "Sora Tourism" as a Strategy to Promote Science Culture

Hidehiko AGATA[*1], Hiroaki AKIYAMA[*2], Naoko YAMAZAKI[*3] and Makoto ARAI[*4]

Abstract. The Council for Promotion of “Sora” Tourism was established in 2017 to promote Japan-oriented Astro Tourism with the aim of expanding the market. Sora is the generic name of the three zones of sky, space and universe. This paper describes some of the unique cultural activities related to Sora Tourism, such as collaboration with anime, gourmet, fashion, music, sports and entertainment activities.

1. Introduction

Sora covers three zones. The first zone is the universe, galaxy and Milky Way. The second is near-Earth space, where people can travel by rocket. We call both of these “宇宙” (uchuu) in Japanese. And the third zone is the sky, aurora, the sea of clouds, and beautiful sunrises and sunsets. We chose the generic name “宙（Sora）” to cover all three zones. “宙 (Sora)” is the latter character of “宇宙”.

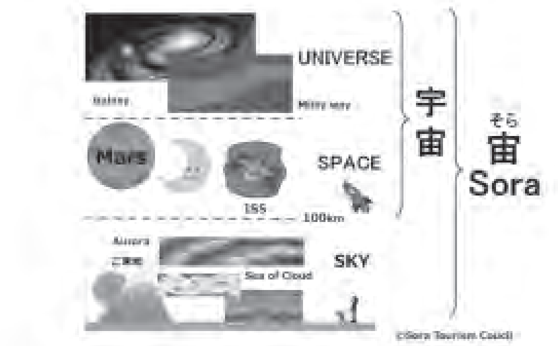

Fig.1. “宙(Sora)” zone

"Sora Tourism" is a combination of two ideas. The starry sky is involved in various different cultural activities, such as history, myths and other narratives, and human life and destiny overseen by different constellations.

The other idea is the scientific challenge of the universe, such as planetary physics and space development using rockets and satellites.

The founders of the council were Prof. Agata as leader, Prof. Akiyama, an expert in rocket system development, Naoko Yamazaki, a former JAXA astronaut, and Makoto Arai at Dentsu Space Lab, who gathered different groups together and initiated various activities.

2. Objectives of Sora Tourism Council

The first objective of the Council is to provide information and know-how connecting 12 geographical regions of Japan and various specialized organizations related to "Sora". Important information and know-how can be learned by studying the problem of starry-sky sightseeing.

So, as a first task, we are researching what kind of people appreciate the different values and appeal of the starry sky. We assume there are three layers. The first layer is experts called "sky maniacs" like CAP participants. The second layer is "star fans" who participate in such activities as taking a solar or lunar eclipse tour or going to a planetarium. The third layer is the widest, comprising people who like star-related imagery but are not interested in details.

Next, for starry sky observation a critical issue is weather. So an important second task is to find out what we can do as back-up plans in case of bad weather. Our third task is to utilize "Storytellers" in observing the starry sky. In Japan, the accreditation system called Starry Sky Guide（星空案内人）was started over 10 years ago, and nearly 5,000 Starry Sky Guides are now certified. However, they don’t have sufficient opportunities to guide. On the other hand, there are many areas where local people cannot communicate the charm of "Sora" to tourists well. We try to connect storytellers with the facilities and areas

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that need such experts.

The second objective of the Council is to improve the functions of sending and receiving tourist information. Many areas and facilities are working separately, and providing information to tourists is also done individually and separately. We need to construct a portal site that aggregates all different types of information related to "Sora".

The Council's third objective is expansion of the market. We will attempt to send and receive information not only on the web but also at actual events.

3. Specificity of “Sora” Tourism in Japan

There are many unique points of "Sora Tourism". First is unique branding. Nagano Prefecture declared itself a "Space Prefecture" in 2016. Tottori Pref. followed and named itself "星取県" or “Star-capture Prefecture”. Nagano and Tottori are good rivals.

Next is "Experience Tourism" which involves experiencing something new. In Kyoto the "Sora Fes" is a popular outdoor event involving people enjoying themselves under starry skies, including elements of fashion, culture and entertainment. Visitors are not asking for expertise but just for fun.

Gourmet food is an indispensable part of traveling. There are already many kinds of confectionery using a Moon motif. Tsukimi soba ("Viewing-the-Moon soba") including a raw egg-yolk is a famous example of this. "Tsukimi burger" has also become popular.

How many people have been healed, or have even felt saved, by the famous piece of music "Look Up at the Stars in the Night"?（見上げてごらん夜の星を） Many people love tons of songs on the theme of the Moon, stars and the universe.

A tour combining starry sky observation and sports has also appeared. A night-time tour with trekking, and a tour combining "Stars Yoga" and "Moon Yoga" with starry sky observation have started.

A space-related anime "Your Name." was a big hit two years ago and screened in 85 countries. There was a scene where the Tiamat planet fell to the town of Hida, and so a lot of people visited the location in Hida. This place is now known as a "sacred place of animation" (アニメの聖地).

Also, many characters using stars and universe motifs have appeared so far. Sailor Moon, Space Battleship Yamato, Galaxy Railway 999, and so on. Collaboration with such "Anime Tourism" is also being considered. The Animation Tourism Association certifies the 88 Sacred Places of Anime.

"Japan's 100 famous mountains" (日本百名山) is also popular. As Sora tourism, we try to accredit sites as a "hundred starlight sky spot" .

We are also looking forward to receiving certification from the Ishigaki / Yaeyama Islands by the International Dark Sky Association. The Ministry of the Environment is promoting activities to maintain the beautiful starry sky by eliminating light pollution as far as possible. Our Council is of course also cooperating with this initiative.

4. Conclusions

The Sun, Moon, stars and the universe give us healing and courage, as well as dreams and hope. "We are all going to space - having tasted it here on Earth first".

Fig.2. “宙(Sora) Tourism” logo is based on the spirit of the stars and the famous "universal illustration showing the position of the solar system" carried as a gold-plated disc by the Voyager satellite.

|Parallel Session|

Communicating Astronomy with Public through Travelogue and Supermoon Event

Mohd S. A. M. NAWAWI*1, Raihana WAHAB*2, Mohammaddin A. NIRI*3 and Nurul H. A. ZAKI*4

Abstract. Book market trends in developed countries in the world show that books written in local language have large potential and constantly growing. Travelogue written in storytelling style (containing facts, experience-based writing, personal opinion accompanied by interesting pictures) in the Malay language received a good response from the public. In fact, some of the books have achieved best seller book in Malaysia. In March 2016, a total solar eclipse had occurred in Indonesia. One year before, we had encouraged our students to plan or arrange an expedition to participate in this total eclipse. Upon our return to the homeland, we wrote a travelogue, published it into a book and sold it to the public. This book gets a good response from the readers. Likewise, in 2016, Supermoon events have taken place in Malaysia. Our students had made widely publicized through social media to encourage the public to be involved in this event. As a result, the public and some prints and electronic media had participated. Thus, this paper explains how through travelogue and supermoon event can be as a medium to communicate astronomy with the public.

1. Introduction

In 2016, there were two big events took place in astronomical events calendar which is Total Eclipse and Supermoon. So, this article explores how to publish Total Eclipse travelogue as a medium in communicating astronomy to the public. Although in this millennium era with increasing online media, people prefer to study or engage astronomy by the virtual method. The supermoon event can be regarded as a face-to-face method that can give experience to public enthusiasm which brings a real human being to science, ask questions, and build connections with each other.

2. Communicating Astronomy with Public through Travelogue

Since 2015, the writing of travelogue in the Malay language has received a good response from readers. Travelogue writers write about their journey or adventure in certain places. For example 25 years old undergraduate student, Meor Farid Aysradi wrote a travelogue about his experience traveled to Europe countries by trains. He had traveled 10,000 kilometers through 15 countries using only one ticket. Although his travelogue considered as self-published, it had successfully sold out more than 20,000 copies within two years with 8 times printed. This book shows that travelogue genre a large audience in Malaysia because of its light reading material, simple but informative, exhaustive and enjoyable. Until now, more than 50 travelogues titles in the Malay language are in the market [1].

The eclipse on March 9, 2016, crossed Palembang, Bangka, Belitung, Sampit, Palangka Raya, Balikpapan, Palu, Poso, Luwuk, Ternate, and Maba, Halmahera [2]. One year before, we had planned to choose Palembang as our place to observe the total eclipse because Palembang is the nearest cities from Malaysia. Just after coming back from Palembang with lectures, 19 students, two kids, and two crews of al-Hijrah Television, we manage our students and lecturers to write about their tasks, research and their experiences they got from the journey. Each of them must write five pages or more related to their experiences, experiment, story, their notes, and their own tasks. At the same time, we encouraged our peers who had gone to Ternate and Bangka Belitung to also share their stories, experiences or experiments from their expedition.

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Finally, within two weeks we were able to collect all essay from 22 authors from various perspectives.

From all the essays, we have categorized them to short subtopics. First and foremost the science of total eclipse was explained in certain subtopics. This subtopic discusses what is solar eclipses? How do solar eclipses occur? Why does total solar eclipse occur?. Then, some of the experiments carried out during the total eclipses will discuss in simple way method. Hence, the aim of the travelogue is to convey the message of total eclipse phenomena and what experiments or activities can be done.

Every society has their own rituals or beliefs related to eclipses. For example, solar eclipses were widely viewed by some cultural as a bad omen [3]. Thus, we also presented in the travelogue the myths or beliefs from different culture or society such as Indian and Japanese beliefs for the solar eclipse. For Muslim, there are certain rituals can be done during the eclipse to impress The Greatness of the Creator. For example, in this book we discussed how the Muslims perform eclipse prayer. As well as the contents of the sermon or *khutba*h were discussed briefly in the certain topic. After that, we discussed the significant eclipse phenomena to the lunar calendar [4].

What is more, this travelogue written in novel style with simple language described all the emotions through storytelling and monologue during the expedition such as bad experience, tribulation, sadness, cheerfull, happiness etc. Beside that, this travelogue also highlighted the journey to an attractive place in Palembang named Pulau Kemaro. Within one month and a half after coming back from total eclipse expedition, travelogue namely as (*Hilangnya Sinar Mentari antara Peluang dan Harapan, Sebuah Travelog Gerhana Penuh*)- When The Sun Disappears: Between Hope and Change, Total Eclipse Travelogue, was successfully published in April 2016 [5].

3. Communicating Astronomy with Public through Supermoon Event

We have organized a public observation of the "Super Moon" event at our university on 14 November 2016. Our university is located at Kuala Lumpur; a city skyline with high light pollution. Moon is the easiest celestial object to be detected or to be observed. So we managed to organize an event to look at the moon through telescopes or the naked eye. The program has attracted not only the campus but also the local media to come, which was good as such phenomenon had last occurred in 1948. It is a good thing to educate people to look at the Moon. The supermoon dominated the night sky because the Moon appeared to be about 14% larger than usual months. However, the subtle changes cannot be too much noticed [6] From this event, it is capable of providing a platform to engage with the public about the moon characteristics and moon's orbit. Education is important because some people have spread the news through websites or smartphones with wrong information about supermoon.

4. Conclusions

Through eclipse travelogue writing, it is not only a story about a person or group expedition but a tool to explain astronomical phenomena to the public about the solar eclipses, especially corona, Baily's beads, umbra, penumbra, ascending nodes, descending nodes, the motion of the sun and the moon etc. In addition, it also can explain about the experiments performed during the eclipse. Furthermore, significant of the eclipses to the lunar calendar and astrophotography techniques during the eclipses can be described in the book. Finally, supermoon event can be conducted as a medium to bring astronomy to the public. This is because the moon is an easy object to look even in those places with light pollution. Such event helps the public to understand the orbit of the moon.

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|Poster|

"Nagano Prefecture is the Astro-Prefecture"

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Abstract. Nagano Prefecture is located in the almost center of Japan. Because of the highest average altitude in Japan, the prefecture is known to have a cool highland climate and beautiful starry sky. In addition, there are many astronomical observatories, public observatories and amateur astronomy associations. All these characteristics give us the impression that Nagano Prefecture is "closest place to the universe" in Japan. Therefore, we initiated a regional cooperation in this area with a slogan "Nagano Prefecture is the Astro-Prefecture". The objectives of the cooperation are sharing and popularizing these wonderful features for education, tourism and protection of the dark sky in Nagano Prefecture. We report some progress and activities of "Nagano Prefecture is the Astro-Prefecture" Liaison Council.

1. Introduction

Nagano Prefecture is literally the closest place to the universe in Japan. The area is known to possess the highest average altitude, a cool highland climate and beautiful starry sky. There are many astronomical and public observatories as well as amateur astronomy associations.

We organized a regional cooperation with a slogan "Nagano Prefecture is the Astro-Prefecture". The objectives of the cooperation are sharing and popularizing those wonderful features for education and tourism and protection of the observational environment (dark sky for both optical and radio) in Nagano Prefecture.

2. Meetings and Stamp-Rally Event

We held the first meeting in November 2016 in Matsumoto. We called for people who are involved in astronomy in Nagano area. As a result, about 100 participants including professional and amateur astronomers, journalists and local government officials, got together in the meeting for mutual communication and cooperation. This meeting adopted a joint declaration, the Matsumoto Declaration (see Section 3).

Second Meeting was held in February 2018 with about 80 participants in Nagano. Some reports on measurements of night sky darkness are presented and also a sub-workshop on making a map of starry-sky spots in Nagano Prefecture. Finally, the future vision of "the Astro-Prefecture" was discussed.

Moreover, we made the first event for public, "Summer Stamp Rally - Nagano Prefecture is the Astro-Prefecture" aiming at the popularization of the astronomy-friendly features of the area and the construction of the network among the members. With the cooperation of about 50 facilities and event managers, roughly 16,500 people participated the stamp-rally events.

3. Matsumoto Declaration

The objectives of the cooperation are contributions to regional development, education, tourism, and environment preservation for astronomical observations in Nagano Prefecture by widely sharing and popularizing the wonderful astronomical-oriented features of Nagano Prefecture, which is consolidated into a single phrase of "closest to the universe". All the participants should respect each other to cooperate on the objectives.

4. Summary

We initiated "Nagano Prefecture is the Astro-Prefecture" Liaison Council, which is a regional cooperation based on Matsumoto Declaration. Please check the web page (in Japanese), http://www.nro.nao.ac.jp/~uchuuken/html/index.html.

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A Science and Tourism Project in the Bosque Fray Jorge National Park, Chile

Juan SEGUEL[*1], Claudia HERNÁNDEZ[*2], Leonor OPAZO[*1]

Abstract. Cerro Tololo Inter-American Observatory (CTIO) and the education units of the Center for Advanced Studies of Arid Zones (Centro de Estudios Avanzados en Zonas Áridas, CEAZA) created a project to support the sustainable management of the Bosque Fray Jorge Biosphere Reserve and Starlight Reserve in Chile as well as help the surrounding farming communities. The project, "Application of an innovation model based on scientific knowledge, information technologies and education, for the development of a sustainable tourism industry of the Fray Jorge Biosphere Reserve," drew on funds provided by the regional government through the Innovation for Competitiveness Fund (FIC). The purpose of the project was to link scientific knowledge and information technologies with the tourism industry, communities, and tourists to add value to current tourism products, enhance the development of special interest tourism, and strengthen economic, environmental, and sociocultural development of the area surrounding the park.

1. Introduction

Bosque Fray Jorge National Park (Parque Nacional Bosque Fray Jorge) is administered by CONAF, the Chilean forest authority. Unesco incorporated the national park as a biosphere reserve in 1977, and the Starlight Foundation certified the park as the first starlight reserve in the Americas in 2013.

Cerro Tololo Inter-American Observatory (CTIO) and the education units of the Center for Advanced Studies of Arid Zones (Centro de Estudios Avanzados en Zonas Áridas, CEAZA) created a project to support the sustainable management of the Bosque Fray Jorge Biosphere Reserve and Starlight Reserve in Chile as well as help the surrounding farming communities.

2.Project

The project "Application of an innovation model based on scientific knowledge, information technologies and education, for the development of a sustainable tourism industry of the Fray Jorge Biosphere Reserve," drew on funds provided by the regional government through the Innovation for Competitiveness Fund (FIC) and with the support of the local office of SERNATUR (National Service of Tourism) and the regional office of CONAF. The purpose of the project was to link scientific knowledge and information technologies with the tourism industry, communities, and tourists to add value to current tourism products, enhance the development of special interest tourism, and strengthen economic, environmental, and sociocultural development of the area surrounding the park. A series of trainings was carried out for the Fray Jorge park rangers members of neighboring communities and tourist operators in aspects related to flora, fauna, stars, constellations, and dark sky protection.

The Project also involved the installation of solar panels in the visitor station area and IT tools such as: high-resolution webcams, Sky Quality Meters (SQM) to monitor the night sky brightness, Internet connections, and QR codes were implemented in the park, and written materials on flora, fauna, and astronomy were developed.

3. Conclusions

Collaboration among CEAZA, CTIO, CONAF, SERNATUR and the community surrounding the park was essential for the project. Allowed us to highlight the uniqueness and richness of this ecosystem and to inspire a cultural change in the regional and local community through dissemination and transfer of knowledge.

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|Poster|

Practice Report of Astronomy Education Aboard a Domestic Ferry

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Abstract. There are not many star watching parties on-board regular ships that last for many years. In this presentation, we will report about our star watching program aboard the Ferry Sunflower, in service between Osaka and Shibushi (Kagoshima Prefecture) and operated by Ferry Sunflower Limited.

1. The significance of a star watching party

We offer the program to passengers regularly on weekends, by request of the company operating the ferris. The program consists of an explanation of the starry sky by our staff. This long distance ferry sails overnight on the Pacific route everyday and on deck, we can enjoy a nice starry sky with the Milky Way or a beautiful Moon. During the star watching parties at sea, we have favorable conditions to watch the starry sky. The influence of the city lights is extremely limited and we can provide participants an ideal place for star watching with wide field-of-view. During the voyage at the star watching party, it is possible to establish a relation between traveling at sea and observational astronomy. It is possible to inform the audience that astronomy is greatly involved in human life. Due to strong wind or waves, sometimes the event is canceled because we can not use the observation equipment, such as a telescopes, on board.

2. Historical background

The event started back in September 11, 2009. At that time, the active captain himself served as a lecturer. The thoughts of the Honorable Captain (Captain Noguchi Kuniaki) are as follows:

-For young children, who can hardly see the beautiful starry sky, I will let them have the opportunity to observe the real stars, which is one of the best memories of the first summer vacation this year.

-The starry sky seen from the ocean is absolutely different from the one in the city and it is not affected by artificial light, so it will surely be a wonderful experience. The Milky Way is clearly visible in case of no clouds.

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At the time of retirement of Captain Noguchi, Osaka Science Museum received a request from Ferry Sunflower Ltd. to give lectures at the sky watching parties and carried out at Shibushi route. Even after retirement, Mr. Noguchi was presenting approximately 20 times a year, mainly in Setouchi route from April 2011. Due to a change in public interest and joining with the Osaka Science Museum, they could not send lecturers outside the Osaka Prefecture from April 2012. This project was taken over by “Nature Education Office SORA (representative Yukiko Tajima)" that continues with these activities until today.

3. Outline of the current star watching party

The sky watching parties occur from March to October on weekends, with a duration of around 30 minutes, starting from 20:30. If the weather is good, the observation is located at the deck, and in case of bad weather a lecture will be held indoors. The content of the lecture varies with each instructor, contents can be: star, the Moon, the Solar System, the Universe, meteor-showers, the life of a Star, rockets, etc. in addition to explaining that day's starry sky. The activity is held around 90 days per year and the attendance number on average is 20 to 50 people. The participation fee is free.

4. Voices of the participants

"I had a great experience with the star watching party, it was my first time. Please continue from now on" (July 20, 2013, 60's)."The weather was nice and the children were deeply moved by the explanation of the "Milky Way" and about the "Constellations". It became one of my child's' summer vacation memories." (August 6, 2013, 40's, male). "The star watching party was fun" (August 18, 2013, 9 years old, girls).

Acknowledgments
The authors would like to thank Mr. Takuya MORISAKI for valuable information provided.

SESSION I.5:

Outreach in Research Facilities and Large Scale Programs

|Plenary Talk|

What the AAS Solar Eclipse Task Force Learned from the "Great American Eclipse"

Richard Tresch FIENBERG[*1]

Abstract. The American Astronomical Society formed the AAS Solar Eclipse Task Force to function as a think tank, coordinating body, and communication gateway to the vast resources available about the 21 August 2017 "Great American Eclipse." Our safety messaging won the endorsement of several medical societies, but in the weeks immediately preceding the eclipse, the marketplace was flooded by counterfeit eclipse glasses and solar viewers, forcing a last-minute change in our communication strategy.

1. Introduction

On 21 August 2017 a total eclipse of the Sun crossed the United States of America but touched no other country. Millions of people got a rare chance to see the solar corona. Outside the path of totality, all of North America experienced a partial eclipse. As the first total solar eclipse to touch the U.S. mainland since 1979 and the first to span the continent since 1918, the "Great American Eclipse" presented a great opportunity to excite people about science and connect them to the cosmos. Yet it also presented a great challenge: more than 300 million people needed to learn how to view the eclipse safely.

2. AAS Solar Eclipse Task Force

To address this opportunity and challenge, the American Astronomical Society established the AAS Solar Eclipse Task Force to function as a think tank, coordinating body, and communication gateway to the vast resources available about the 2017 eclipse and solar eclipses more generally.

One of our first activities was to send two eclipse astronomers by car along the entire path of totality over several weeks to alert cities and towns about what was coming. They talked with government officials, public-safety officials, tourist bureaus, and local businesses. Most communities had not yet heard of the 2017 eclipse and were grateful to be given advance warning to prepare for the event.

3. "Get Thee to Totality!"

Among our main goals was to encourage people to get into the path of totality. Some 12 million Americans live within the path, and two-thirds of the U.S. population lives within 500 miles (800 km) from it [1]. The difference between a total eclipse and a partial eclipse is literally the difference between night and day. Yet a study done for NASA by the University of Michigan [2] suggests that whereas about half the U.S. population viewed the eclipse directly, only 6% (1 in 16) traveled to see it, and many of these people traveled not into the path of totality but to a place where the partial eclipse was simply deeper than at home. Somehow a key part of our message wasn't heard clearly.

A clue to the nature of the problem appears in the Michigan study, which says, "Approximately 20 million adults traveled from their home area to another area to be able to watch the solar eclipse, usually seeking a higher degree of totality." Something got lost in translation, because "a higher degree of totality" is as meaningless as "a higher degree of virginity."

Another clue comes from looking back at the maps that were distributed widely before the eclipse. Some represent the partial eclipse outside the path of totality with crescent Suns but either have no graphics along the path [3] or show totality as little more than a black disk [4]. Nowhere do they indicate that only along the path can you see one of the most awesome sights in all of nature: the solar corona.

4. Eclipse Eye Safety

Aside from promoting awareness of the eclipse, the AAS Solar Eclipse Task Force focused on developing and disseminating eclipse safety information and working to ensure the widespread distribution of safe solar-viewing glasses and filters. We wanted to avoid a problem we'd seen in other countries at other eclipses, where astronomers encourage people to observe the event but doctors and other experts warn people to stay inside to avoid eye injury.

The AAS and NASA jointly developed safety messaging that won the endorsement of the

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American Academy of Ophthalmology, the American Academy of Optometry, and the American Optometric Association. We based our message on the ISO 12312-2 international safety standard for solar viewers [5], which was adopted in 2015. Our basic message was simple: Except during totality, look at the Sun only through viewers that are certified to meet the ISO 12312-2 standard.

In retrospect, we didn't work hard enough to find all the professional societies of eye doctors, e.g., we overlooked the Macula Society and the American Society of Retina Specialists. And we should have tried harder to reach primary-care physicians, since more people visit their regular doctor each year than visit an eye specialist.

5. The Amazon Problem

In the weeks immediately preceding the eclipse, it became clear that the marketplace was being flooded by fake or counterfeit eclipse glasses and solar viewers, most of them apparently imported from China and sold on Amazon.com. They claimed to meet the ISO 12312-2 standard, but there was no evidence backing that up. By the time we convinced Amazon to vet their sellers and promote only genuinely safe eclipse viewers, the damage was done: the public was confused about whether any solar filters were truly safe.

This development led to us make a last-minute change in our communication strategy. We compiled an online list of manufacturers and authorized dealers selling genuinely ISO-compliant viewers. Then we informed the public via our website and a widely picked-up press release [6] that they should buy their eclipse viewers only from one of the vendors on our list.

How prevalent were eclipse-related eye injuries? The American Society of Retina Specialists asked its 2,000 members for reports and received news of only 25 injuries. Among the Macula Society's 400 members, only 10 reported treating eclipse-related eye injuries. The American Optometric Association received only 13 reports of injuries from its 4,500 members. Still, there's bad news in this good news: After hearing about the problems with eclipse glasses/viewers sold on Amazon.com, many people presumably opted not to watch the eclipse at all.

6. Conclusions

It should be much easier to prepare the U.S. for the annular and total solar eclipses that will occur just six months apart in late 2023 and early 2024, respectively. Reasons include these: (1) The last total solar eclipse in the U.S. will be a recent memory, not a distant one; (2) Huge numbers of Americans who didn't travel to totality know someone who did and now regret their choice; (3) Amazon has pledged to do a better job of vetting sellers of eclipse viewers to ensure compliance with ISO 12312-2; (4) The fact that eye injuries were so rare in 2017 will reassure people that eclipse viewing is safe; (5) The communities along the path in 2017 had a positive experience and will share their stories with communities along the path in 2023 and, especially, 2024; and (6) A significant fraction of the millions of Americans who experienced totality in 2017 will want to do so again in 2024 and to make sure their family and friends do too.

The "Great American Eclipse" of 2017 was a great success and a great learning experience for eclipse-related event organizers. Building on that experience, we hope to make the total solar eclipse in the U.S. on 8 April 2024 even greater!

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|Plenary Talk|

One Telescope for One Family: "You are Galileo!" NAOJ Project Episode II

Hidehiko AGATA [*1], Hiroyuki TAKATA[*1], Yasuhisa TSUZUKi [*2], and Shinji KASHIMA[*2]

Abstract. The National Astronomical observatory of Japan (NAOJ) would like to develop a small inexpensive assembly-type astronomical telescope and distribute it at a low price around the world -- our goal is "one telescope for one family". Pioneer sales channels will allow it to be distributable from 2019 onwards (this project is one of the candidate projects of the IAU 100 years celebrations).

1. Episode I

Since 2008, NAOJ has been providing the "You are Galileo!" project. This project is derived from the Galileoscope project which was a cornerstone project during the IYA2009. In 2007, NAOJ Director General of NAOJ, Norio Kaifu asked the NAOJ Public Relations Center to make a 10$ astronomical telescope kit from. Unfortunately, at that time, we could not fulfill this request due to NAOJ not having a contrivance to produce and sell. Therefore, the project team of "You are Galileo!" which was organized in the Public Relations Center, studied the commercially assembled telescope kit of about 4 cm in diameter and certified the following two kits as "You are Galileo!" telescopes:

(1) 10 $ telescope (15 times)
Star Book Ltd. 1,718 yen + tax
(2) 20 $ telescope (35 times)
Orbys Ltd. 2,800 yen + tax

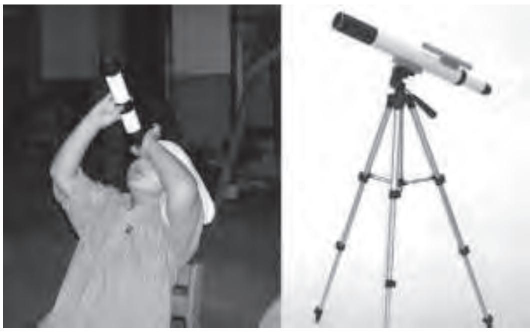

Fig. 1 "You are Galileo!" telescopes. (1) on the left and (2) on the right.

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"You are Galileo!" Project has provided opportunities for observation of celestial bodies using these small telescopes for children. We have done many workshops and observation in Japan and internationally. For example, we organized workshops in Mongolia (7 times), Indonesia (5 times), Thailand (5 times), Cambodia, Myanmar, Egypt, Uzbekistan, Brazil, Peru, and Saudi Arabia etc. In Mongolia 7 workshops for children and school teachers were held at Ulaanbaatar (twice), Khovd, Miyangado, Mandalgobi, Dalanzadgad and Bayan Ulgit, total of 440 telescopes were distributed.

Also, although it is mainly in Japan, these two assembly kits have been sold by the tens of thousands each year for the past ten years since 2009. The goal of the "You are Galileo!" activity is not only to assemble the astronomical telescope, but also to rediscover Galileo by using the country language version worksheets prepared on the project's website (http://kimigali.jp/index-e.html).
Although it is a derivation activity of "The Galileoscope", we can say that "You and Galileo!" have achieved good results over the last ten years. However, there are two main problems in "You and Galileo!" project. (1) It is difficult to reliably observe Saturn's ring and Venus's phase for 4 cm diameter. In Japan, it is listed in the guidance guidelines of the junior high school (Ministry of Education, Culture, Sports, Science and Technology). (2) There are limits to the number of productions and distribution channels (especially in overseas distribution) for these two Japanese companies.

At present, there are several astronomical telescope kits that can be purchased at a relatively low price. However, when children and students individually purchase and use it, it is not enough for performance and price. Our new goal is "one telescope for one family". We would like to develop an inexpensive assembly small telescope and distribute it at a low price to all over the world.

2. Episode II

(2-1) Selection of joint development company

In March 2016, the Japanese Ministry of Education, Culture, Sports, Science and Technology has changed some rulings. Including national universities, the sale of goods (although there are still some restrictions) in national institutions are now possible. So, in May 2016, "You are Galileo!" team start seeking a partner to co-produce a new telescope -- a telescope for one family. We have been consulting with each company of Star Book, Orbys and Bandai since 2008, but we have not reached to an agreement. We have inquired various astronomical telescope companies etc., and in the end, Vixen Telescope Company will partner with us for this project.

(2-2) Confirmation of basic specification

We checked performance with all the small telescopes we got, and as a result we went through the specifications of the development telescope. The main specifications are as follows. The most important point: the surface of the Moon, the ring of Saturn, and the vengeance of Venus can be observed easily.

- Diameter 50.8mm Achromatic glass lens
- F8 , 2 Eyepiece lens
  (magnification: 16 times, 60 times)
- Kepler formula
- Barrel plastic tube division type
- Simple viewfinder
- Price target of 3,000–6,000 yen ($25-50)

Cooperating with Vixen, we have made three trials. We repeatedly tested with potential users (Fig 2) and we succeeded in developing the compact astronomical telescope assembly kit with the expected specs.

Here are some of key findings based on user's comments:

- It seems that even a small child can see it because the field of view is wide. (A)
- It is hard to make. It might be good as an entry primer. (C)
- Because the tube is long, it is not suitable for children. (D)
- It looks best among the 5 types. (E: majority opinion)
- Very high contrast. (E)

A	B	C	D	E
Star Book X15	Star Book X30	Orbis X31	The Galileoscope(USA)	NAOJ Telescope

Fig. 2 Performance check of prototype.

(2-3) Finished product & future plan

The new "You are Galileo!" telescope is assembled from 13 parts including two glass eyepieces.

Fig. 3. Structure of new "You are Galileo!" telescope

At NAOJ, the method of selling this telescope kit has not yet been finalized. However, our team plans to distribute as a project part of the IAU 100 celebrations in 2019. Not only NAOJ, but also the Japan Telescope Industry Association is planning to sell it to overseas through each company's telescope shop.

|Plenary Talk|

Organising ESO press conferences: what have we learnt

Oana SANDU[*1], Lars L. CHRISTENSEN[*2] and Richard HOOK[*3]

Abstract. A Public Information Officer will, at least once in a lifetime (but ideally many more times) have to communicate a major scientific discovery through a press conference. It was once a very popular method of communicating important results, but getting journalists in one place for a press event is becoming more and more challenging. In this talk, I will reflect on the current challenges we face in organizing press conferences and their possible causes, touching upon topics such as: instant journalism, free online news and the decline in advertising revenue for media outlets, as well as embargoes and how they work in the current media landscape. I will then look at the key learnings we, at the European Southern Observatory, can extract from two major press conferences that we recently organized, both online and on site, with journalists from across the world.

1. Introduction

In 2016, the education and Public Outreach Department (ePOD) of the European Southern Observatory (ESO) organised a press conference at its Headquarters to announce the discovery of Proxima b, the closest exoplanet to our Solar System. In 2017, another major press conference was organised to announce the first light from a gravitational wave source.

On these two occasions ePOD had the opportunity to test and compare various formats of organising press events. This allowed us to reflect on some of the challenges public information officers (PIO) face today, as well as conclude what methods work best for a major intergovernmental organisation such as ESO.

2. Challenges

The first challenge we faced was the even faster rate at which news is currently published. Digital media has promoted “instant journalism” — getting the news out there is often times more important that creating original and correct content. This tendency makes travelling to press events, especially over long distances, seem obsolete. Even Question and Answer sessions or face to face interviews that press conferences facilitate do not seem to attract journalists when they have to publish fast.

We have noticed that there is an effort in the media community to stop this race against the clock by introducing pay-walls to digital content. However, digital content consumers seem to be very unlikely to pay money for their news [1]. The only type of content that consumers are likely to pay for is premium and exclusive content [2], which is good news for PIOs.

A second challenge we have identified is the money scarcity, a consequence of declining print subscriptions and of advertising budgets migrating towards online channels [3]. Additionally, the newspaper workforce has shrunk by 20,000 positions (39 percent) in the past 20 years [4]. This lack of funds directly impacts the number of journalists available to cover science news and the likelihood of them traveling to a press event.

A third challenge we face are handling embargoes in this fast paced environment. To give a specific example, NATURE’s Wednesday embargoes usually lift at 19:00 CET, leaving us with three options:

Option 1) we run a press conference under embargo. This puts pressure on PIOs to get only trusted journalists to sign in and avoid leaks. The general public is now used to being a witness to such major announcements, therefore this scenario would leave them dissatisfied.

Option 2) we run the press conference under embargo and make a recorded press conference available online after the embargo lifts. In this case, we noticed that the general public was confused about the timing of the press conference and frustrated about the lack of interaction.

Option 3) we run the press conference after the embargo lifts and stream it online. In this case, we saw a decline in media attendance as journalists were busy releasing their stories. The general public was happier, but there was not much time for interaction left.

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Item	Proxima b	Gravitational Wave
No of journalists on site	20	18
No of journalists registered online	157	270
Total media participants	177	288
Interview requests	58	~20
Public watching online	—	About 1 Million
EurekAlert	3766	2486
Meltwater	2264	677
Website visits to press release	267 687	131 706

Fig. 1. Statistics for the two press conferences organised by ePOD in 2016 and 2017. Image credit: ESO

Under these circumstances, we were left with the question of whether it is still worthwhile to organise press conferences. Looking at the increase of fake news and click baits, the emergence of alternative facts, the decreasing occurrence of fact-checking and corroboration and the overall decline in trusting science, we concluded that efforts are to be made to communicate scientific results via press events. We therefore had to extract key learnings from our experiences and decide what worked best for our case.

3. Key learnings

We have identified eight key steps that helped us in organising better press conferences:

1) We have defined clear guidelines for when we do a press conference. The decision is often times based on the scale of the result and its capacity to have a high return on investment.
2) We maintain an advanced notice system that offers our journalists access to all our texts and visuals 48 hours in advance of public release. This helps relieve the pressure of fast publishing.
3) We provide extensive material (text, illustrations, images, videos, including ready for TV) in several languages so that journalists can create premium content.
4) We fix interviews "under embargo", understanding that many journalists cannot attend in person. We therefore make a greater effort in responding to their individual requests.
5) We provide extensive training for speakers, offering feedback and support for presentations, doing a dry-run with simulated question & answer sessions. We work with the scientists to ensure messages are consistent, as well as avoiding jargon and creating "catchy" phrases or visuals.
6) We organise on-site press conferences after the embargo lifts, to cater for the need of footage from TV outlets for their evening news.
7) We broadcast the press conference to the wider public.
8) We organize a Reddit session after the press conference to answer more questions from the public and offer more interaction with the scientists.

4. Conclusions

We understand and accept that, despite all these steps, we will still not cater to everyone's needs. We are also constantly looking at emerging challenges.

The "invisible Internet" will make it harder for science communicators to reach their target audiences. A Reuters survey found that the use of WhatsApp for news is starting to rival Facebook in a number of markets including Malaysia (51%), Brazil (46%), and Spain (32%) [5].

There is also an overall decline in news consumption. In the same Reuters survey, almost a third of respondents in 36 countries said they often or sometimes avoid the news. Reasons vary from the negative effect on mood news has or it cannot be considered reliable [6].

The diversity of trends and the differences at global versus local scale also impose challenges. What might work for readers in Austria, could be completely wrong for readers in Latin America.

Finally, we are witnessing an acceptance of the declining role of human editors. More than half of respondents (54%) in the Reuters report prefer paths that use algorithms to select stories rather than editors or journalists (44%). This effect is even more apparent for those who mainly use smartphones (58%) and for younger users (64%) [7].

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|Plenary Talk|

Updates from the IAU Office for Astronomy Outreach

Sze-leung CHEUNG*1, Hidehiko AGATA *2, Lina CANAS *3 and Yukiko SHIBATA*4

Abstract. This paper provides an update of the activities on the IAU Office for Astronomy Outreach (OAO), highlighting the activities of the office and its IAU National Outreach Contacts. This paper also provides an introduction to the actions in the draft document of the IAU Strategic Plan 2020-2030 on astronomy outreach.

1. Introduction

In 2009, the International Year of Astronomy 2009 (IYA2009) has reached more than 815 million people in 148 countries [1]. The IAU realized the importance of central coordination of outreach activities. In 2012, the National Astronomical Observatory of Japan (NAOJ) signed the agreement with IAU to create the IAU Office for Astronomy Outreach (OAO). In 2017, the IAU and NAOJ further extend the agreement of the OAO office to 2021.

2. Connecting the world

The OAO has setup the IAU National Outreach Contacts (NOC) network since 2013. This network borrowed the concept of the Single point of contact (SPoC) network established during the IYA2009. The NOC network is an important resource for global reach. At present, there are 81 NOCs in place.

In the last year, the NOC has played an important role to propose the raw ideas and activities for the IAU 100th anniversary, which formed the skeleton of the current IAU100 program structure.

The OAO is currently working on NOC network restructuring. The aim of this restructuring is to improve its overall effectiveness. The OAO was also working on strengthening the communications of NOC network.

At the same time, the NOCs are also improving their national structure and internal communications, and we encourage the astronomy communicators worldwide to work closely with their NOC. We also encourage people to contact the OAO and propose a NOC if the NOC did not exist in the country.

Fig 1. The current map of IAU NOCs. Credit: IAU Office for Astronomy Outreach.

3. IAU OAO activities

The OAO has conducted different activities in the past year, ranging from the NOC meetings, communication training held at the Asia Pacific Regional IAU Meeting (APRIM), You are Galileo! Training program organized in Myanmar together with NAOJ and the National Astronomical Research Institute of Thailand (NARIT). A few more highlighted are explained below.

3.1 Communications, access to information and resources

A more detail description of the communications work can be found in this proceeding from reference [2].

The IAU OAO also bridge between the public and different IAU scientific bodies, address public enquiries with different units of the IAU, produce IAU related content as theme pages on IAU website. And the OAO also helps to increase the visibility of the IAU to the public.

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3.2 CAP Journal

The Communicating Astronomy with the Public Journal (CAP Journal) is the only peer-reviewed journal on astronomy communication started in 2007. It is a platform for sharing best practices among the communities. The production of CAP Journal was done in the European Southern Observatory (ESO) before and it is recently moved to OAO/NAOJ. Issue 23 was published by OAO in February 2018.

After the issue was successfully produced in OAO, the next goals are to encourage submissions on research and application papers and to reform and build a strong editorial board for CAP Journal.

We have recently started a call for reader's feedback and call for papers in the upcoming special issue on solar eclipses.

3.3 Astronomy Translation Network

Astronomy Translation Network is a project to connect volunteer network, to translate astronomy materials and share valuable resources, with the aim to bring more astronomy into different languages. A more detail description of the project can be found in this proceeding from reference [3].

4. IAU Strategic Plan 2020-2030

The IAU is preparing its next decade strategic plan 2020-2030 [4]. The following are listed as the strategic goals 2020-2030.

- Goal 1: The IAU leads the worldwide coordination of astronomy and the fostering of communication and dissemination of astronomical knowledge among professional astronomers
- Goal 2: The IAU promotes the inclusive advancement of the field of astronomy in every country
- Goal 3: The IAU promotes the use of astronomy as a tool for development in every country
- <u>Goal 4: The IAU engages the public in astronomy through access to astronomical information and communication of the science of astronomy</u>
- Goal 5: The IAU stimulates the use of astronomy for teaching and education at school level

Unlike the previous strategic plan 2010-2020, this strategic plan not only focus on astronomy for development but in general cover all aspects of the IAU. Where the goal 4 is related to the OAO office and had listed the following action items.

- Increase the NOCs; restructure and ensure their effectiveness
- Facilitate international communication through exchanges and translations
- Provide open databases and public-friendly access to astronomical information
- Encourage communication of science and critical thinking through IAU member public engagement, professional-amateur, and citizen science activities
- Promote dark skies and the pale blue dot message

The strategic plan will be voted in the upcoming IAU General Assembly, in Vienna Austria, take place in August 2018. The OAO will develop plans and would like to hear stakeholder feedback on the mentioned actions.

To address the issues regarding astronomy education (goal 5), the IAU was planning to set up a new office – Office for Astronomy Education (OAE). The OAO will work closely with OAE.

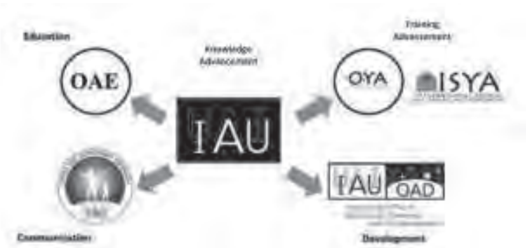

Fig 2. The relation between the various IAU components and offices in the proposed IAU Strategic Plan 2020-2030

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|Parallel Session|

PR and Communication Activities in Nobeyama Radio Observatory, NAOJ

Kenzo KINUGASA[*1], Mitsuru HAYASHI[*1], Hidemi IDE[*1], Hiroshi MIKOSHIBA[*1], Kazuhiko MIYAZAWA[*1], Noriyuki SHINOHARA[*1], and Ken'ichi TATEMATSU[*1]

Abstract. The open to the public started at the inauguration of Nobeyama Radio Observatory (NRO) almost without precedent of Japanese research institutes in 1982. Since the opening to the public, the cumulative total of visitors reached 3 million on October 2013. Now, the campus has about 50 thousands visitors a year. In addition, we put effort into the cooperative activities for the local. These years, we have an agreement with local tourist association for astronomy popularization and starry sky tourism. The cool highland climate and beautiful starry sky may attract the visitors, but our unique outreach activities as an advanced research institute such as Open House Day, Thanks Day for the locals, and so on, are also the main factor which brings such a lot of visitors to Nobeyama. For many visitors, we opened the exhibition room of the National Institutes of Natural Sciences (NINS) in 2017, by refurbishing the control building of Nobeyama Millimeter Array (NMA). The main objective of this room is introduction of NINS and natural sciences as well as NAOJ and astronomy.

1. Introduction

The Nobeyama campus of the National Astronomical Observatory of Japan (NAOJ) is located in the Nobeyama highland in Nagano Prefecture, which is at an altitude of 1,350 m near Yatsugatake Mountains. It is one of the coldest places in the main land of Japan. Nobeyama is an ideal site for radio observations because of the cool climate and relative high altitude.

The campus started at the inauguration of Nobeyama Solar Radio Observatory in 1969. The Nobeyama Radio Observatory (NRO) was founded with the 45-m radio telescope and Nobeyama Millimeter Array (NMA) in 1982. These powerful telescopes and facilities pushed up the Japanese radio astronomy to world-class levels. Especially, the 45-m radio telescope as the world's largest single-dish telescope for millimeter wavelength observations, continues to be active at the forefront of research more than 30 years.

2. Open to the Public

Nobeyama has made the campus accessible to the public at all times since the inauguration of NRO in 1982 almost without precedent of Japanese research institutes. NRO may be a pioneer of PR activity in the institutes of Japan. Since the opening, the cumulative total of visitors reached 3 million on October 17th, 2013 [1].

Fig.1 shows the road to the record, the annual and cumulative totals of visitors. These years, we have about 50,000 visitors a year.

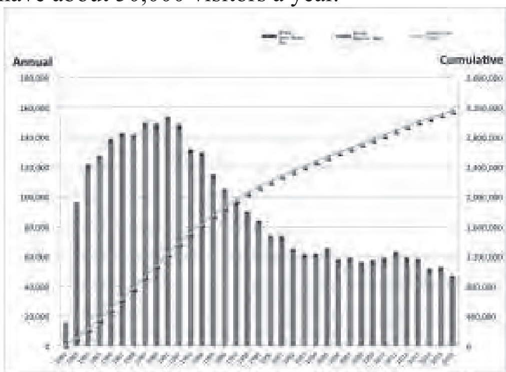

Fig.1. The annual and cumulative totals of the visitors in the Nobeyama campus (fiscal year 1982-2016).

Besides the regular open (every day except for New Years Days), we have unique outreach activities such as Open House Day, Thanks Day for the locals, Special Guide Tour Week, and so on.

Open House Day of the Nobeyama Campus was held once a year since 1983. On this day, we have many events such as some lectures, touch of a reflector of 45-m radio telescope, handicrafts of the antenna and detectors and so on. On the average, we have about 2,500 visitors on the day (Fig.2). The day is also a cooperative opportunity with the local governments and communities.

3. Regional Cooperation

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These years, we put effort into the cooperative activities primary for the local. The local governments review community resources for regional activation. They notice a starry sky and astronomical observatory as tourist resources. NRO and they share a mutual interest of astronomy and starry sky. Then, we have an agreement for astronomy popularization and starry sky tourism with the local tourist association.

Fig.2. A scene of Nobeyama Open House Day. Many participants and 45-m radio telescope.

For example, one of the activities in 2017 was "Nobeyama Time-Lapse Project", which was held by the local government and tourist association and cooperated with NRO and Tenmon Guide, an astronomical magazine in Japan. The local PR video was made from starry sky time-lapse movies taken by the participants. Please see the movie at YouTube site, https://www.youtube.com/tenmonguide.

In addition, we initiated a regional cooperation in Nagano Prefecture with a slogan "Nagano Prefecture is the Astro-Prefecture" along with professional and amateur astronomers, communicators of museums and public observatories, journalists and the local government officers. The objectives are contributions to regional development, education, tourism, and environment preservation for astronomical observations in Nagano Prefecture by widely sharing and popularizing of the wonderful astronomy-oriented features of Nagano Prefecture [2].

4. NINS Nobeyama Exhibition Room

National Institutes of Natural Sciences (NINS) is the upper organization of NAOJ. NINS consists of 5 national institutions for natural sciences such as Fusion Science (NIFS), Basic Biology (NIBB), Physiological Science (NIPS), Molecular Science (IMS) and Astronomy (NAOJ).

As the first PR site of NINS, the NINS Nobeyama Exhibition Room is started in April 2017. It was refurbishment of the control building of NMA at the almost center of the Nobeyama Campus. The contents are not only the exhibition of NAOJ and NRO such as displays of historical radio antenna and receivers, but also the introduction of NINS and other institutions. So, it is so challenging because of covering wide field of natural sciences.

In addition, the room has a 4D2U theater [3]. It is developed in NAOJ for the general public to present the latest research results, but also fun and easy to understand. The theater is mainly opened in holidays and the summer season.

Fig.3. Photos at NINS Nobeyama exhibition room. Molecule models (left) and 4D2U theater (right).

5. Summary

The NAOJ Nobyama campus is open for the general public since the inauguration of the NRO in 1982. Now, the campus has about 50 thousands visitors for a year. Our unique outreach activities such as Open House Day, Thanks Day for the locals, are also the large factor to bring such a lot of visitors to Nobeyama. We also put effort into regional cooperation. Now, we have many opportunities of the cooperation with the local governments and astronomical communities in Nagano Prefecture. In addition, NINS Nobeyama exhibition room is opened. It exhibits the introduction of NINS and institutions as well as NAOJ and NRO.

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|Parallel Session|

Astronomical Communication between the Public and a Remote Observatory: Challenges of Subaru Telescope

Hideaki FUJIWARA*1

Abstract. Many astronomical observatories are located in remote and isolated areas for their research purposes. Such situations sometimes become a barrier in communication with their supporters and stakeholders. Subaru Telescope is an 8.2-m optical-infrared telescope atop Maunakea, Hawaii, operated by the National Astronomical Observatory of Japan. It is important to continue to create awareness in Japan and the worldwide community through programs that share the information and the inspiration from the observatory in the remote place, while having in mind that the long-standing support of the public is an essential key for the stable operation of our organization. We present our public information activities at Subaru Telescope to convey our new findings, exciting activities, and enthusiasm of workers in effective ways of communicating with the public to overcome our remote location. Those activities include a launch of spherical (360-degree) photo gallery of the observatory that realizes a virtual tour in planetarium domes and a live event on Twitter from Subaru Telescope's operation room atop Maunakea during a special observation program, both of which could attract the public attention in terms of sharing our excitement, time, and atmosphere of real astronomical research facilities and staffs working there.

1. Subaru Telescope

Subaru Telescope is an 8.2-m optical-infrared telescope at the summit of Maunakea, Hawaii, operated by the National Astronomical Observatory of Japan. More than 1200 research papers have been published based on observations using Subaru Telescope since its scientific first light in 2000.

Public Information and Outreach Office at Subaru Telescope is in charge of public relation activities, and continues to create awareness in the worldwide community through programs that share the information and the inspiration. A few tens of web releases per year are issued from Subaru Telescope to share new findings based on the observations and observatory's activities to support such achievements with the public [1]. Guided summit facility tours are also offered to the general public because the program enables us to communicate astronomical research by showing the real research facilities. In addition, we conduct a number of public outreach activities particularly focusing on the local people in Hawaii [2] since keeping awareness of Subaru Telescope in the local community is important for its operation in Hawaii.

Since Subaru Telescope is almost fully funded by the Japanese government, meaning that the operation of Subaru Telescope is covered by taxes in Japan. Therefore, it is quite obvious that the long-standing support of the public in Japan is an essential key for the stable operation of the telescope.

One of the biggest challenges in the public information and outreach activities at Subaru Telescope focusing taxpayers and future taxpayers in Japan is its actual location. The observatory is located in Hawaii, where is about 6000 km far from Japan. Even in Hawaii, the telescope is located atop Maunakea, whose elevation is more than 4000 m. Such a potential hurdle from a remote and isolated location is not only the case for Subaru Telescope, but for other major astronomical facilities.

2. Virtual Tour of Subaru Telescope Facilities using Spherical Photo Gallery

Subaru Telescope is the first observatory that started guided tour program of the summit facility for the general public among the Maunakea observatories. Every year hundreds people enjoy the program. However, to join the program, participants must prepare their own transportation to the summit of Maunakea. Moreover, all the participants should be 16 years old or older to avoid a medical problem caused by low atmospheric pressure at the summit.

To clear those hurdles in participation to the summit facility tour program for the public, we launched a gallery of spherical (360-degree) photo of the observatory's facilities (Fig. 1). The gallery is posted on the observatory's website [3], and one can change the direction of view and zoom in/out on web browser as one likes, which achieves a "self-guided virtual tour" of Subaru Telescope.

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Fig. 1. Selected images from the gallery of spherical (360-degree) photo of Subaru Telescope's facilities. A variety of images included the exterior of the enclosure, telescope, secondary mirrors, observing instruments, and maintenance facilities.

The spherical images can be projected onto a planetarium dome. In 2018 we held a "guided virtual tour" of Subaru Telescope by using those images and giving a talk associated to the projected image in the planetarium dome of Science Museum in Tokyo (Fig. 2). More than 100 people joined the tour, and particularly children who cannot come to Maunakea due to the age restriction had special experience.

Fig. 2. A scene of the "guided virtual tour" of Subaru Telescope held in the Science Museum. MC and "tour guide" (author) stand in front of the audience, and giving brief explanations of the observatory's facility projected onto the planetarium dome.

3. Live Report from Observation Room via Twitter

To share our experiences and excitements at the observatory with the public, we made a trial live report from Subaru Telescope's observation room during observation on May 29, 2017 by using Twitter [4]. By posting 32 tweets in the single night, we made (semi-)real-time introduction on what was happening during the observation activity at the astronomical observatory. The tweets were ranging from the procedure of observation run, to how astronomers and operators survive at the summit of Maunakea by showing photos of their diner and snacks (Fig. 3). The live report campaign engaged interest from the public, and got 3194 "RTs," 7233 "Likes," and 34 comments. One of the comments says "(he/she) enjoyed the live report and felt as if I were a member of the observation team," with which we conclude that the campaign succeeded in sharing our experiences, excitements, and even time at the observatory with the public.

Fig. 3. Examples of tweets reporting the observations at Subaru Telescope in the night of May 29, 2017.

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|Parallel Session|

IAU and the Public: IAU Office for Astronomy Outreach Communications

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Abstract. The IAU Office for Astronomy Outreach (IAU OAO) communications comprehend a set of ongoing tasks that contribute to the IAU direct interaction with the public. Its primary goal is to support the current outreach activities around the world by disseminating, promoting and encouraging outreach-related activities from and to the IAU. Examples of these tasks are managing the IAU Public Enquiries and FAQs, the IAU Social Media, the IAU Astronomy Outreach Newsletter, and the IAU Themes.

The IAU OAO utilizes a set of digital platforms and their data analysis tools to manage the content and community response. How data is gathered from the different tools available, the importance of indicators and their subsequent analysis, are steps considered for each of these channels in order to maximize our audience reach, influencing the overall communications strategy of an organization such as the IAU.

1. Introduction

The IAU Office for Astronomy Outreach (IAU OAO) currently manages the following channels:

- IAU Frequently Asked Questions (FAQs);
- IAU Themes;
- IAU Social Media;
- IAU Astronomy Outreach Newsletter;
- IAU Office for Astronomy Outreach Social Media.

The IAU OAO is in charge of answering public enquiries for IAU-related affairs, via email and IAU Social Media channels (Facebook and Twitter), thus allowing the IAU to build a dedicated dialogue with the public by using direct channels such as emailing, messaging, commenting, tweeting or retweeting.

The IAU Social Media intends to promote public awareness of the IAU activities by sharing upcoming IAU conferences and symposia, information about the IAU Scientific Bodies activities, and updates from the IAU Office of Astronomy for Development (OAD) and the IAU OAO.

The IAU Astronomy Outreach Newsletter is a community generated digital publication curated by the IAU OAO team to improve community building and disseminate commendable efforts, such as astronomy outreach and education activities and resources around the world.

The IAU Themes featured on the IAU website, encompass the most popular topics related to astronomy and the IAU, triggered by the most frequently asked questions (FAQs) that the IAU has received over the years.

2. IAU Themes & FAQs

The IAU Themes featured on the IAU website comprise the most visited iau.org pages with nearly 100 000 views per month and highlight the role of IAU and its scientific bodies. The monitoring is done mostly by using Google Analytics in iau.org domain. With this free monitoring tool we intend to identify the pages that attract the majority of our viewers and the relations between social media campaigns and traffic increase on our website.

3. IAU Social Media

The IAU is active on Facebook and Twitter engaging and average of 15 000 combined followers around the world and intends to promote awareness of the IAU activities and its visibility near our target audience: the general public.

As monitoring tools we use mostly Twitter Analytics and Facebook Insights, our focus being mostly on geographical distribution, and followers' interactions with the content provided. These free tools prove valuable for us to tailor future content and shape

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the campaigns, providing our community with maximum content of interest.

4. IAU Astronomy Outreach Newsletter

The IAU Astronomy Outreach Newsletter is curated by the IAU OAO team and our content focuses on groups and organizations:

- Organizing large-scale events at a regional or international level;
- Offering astronomy education or communication job positions;
- Creating innovative projects or inspiring stories;
- Looking for professional–amateur collaborations in astronomy;
- Creating any educational resources or activities.

The newsletter is issued twice a month and translated into five languages – English, Japanese, Spanish, Galician and Serbian, with popular contributors highlighting both national and international quality outreach and education activities to the global community.

It has a reach of 5000 outreach and educational subscribers around 50 different countries. To disseminate and monitor our reach within our community of subscribers we use MailChimp, with the focus being on optimization of release date and level of engagement with the content (e.g. click rate, popular links, etc.).

Fig. 1 MailChimp statistics reports are used to monitor our world reach. In this report, our key countries are USA, Japan, UK (#2 June 2018).

5. IAU Office for Astronomy Outreach Social Media

The IAU Office for Astronomy Outreach Twitter and Facebook page started in June 2017 and from September 2017, our team implemented a new social media campaign, in which the team dedicates a full week to each country and its National Outreach Coordinator (NOC). Following our IAU Guidelines for communication, our goal is to (1) promote existing worthy national activities, (2) raise international awareness for the continuous outreach efforts done at a local/national level and (3) to increase the visibility of the NOCs activities and the NOC network.

During this week the NOCs can:

- Highlight their work and their institution's activities;
- Highlight worthy national events or activities in astronomy outreach and education;
- Promote astronomy clubs or organizations active in the country.

Fig. 2 Facebook Insights, number of Likes2017-2018. Top: IAU OAO Facebook, Bottom: IAU Facebook.

One year after the launch, our fan base on Facebook is now of 2000 people and we use mostly Facebook Insights to monitor our reach during a particular week – increase number of followers in a particular region, depending on the country featured, etc. Here the networks from our NOCs play a huge role and help us to understand the national / regional visibility and reach of our activities.

|Parallel Session|

Public Relations, Education and Outreach on the TMT Project in Japan

Miki ISHII [*1] and Wako AOKI [*2]

Abstract. TMT is an international project to construct a next generation large telescope. For astronomers in Japan, it is a project developed further from the Subaru Telescope, one of the largest optical/infrared telescopes at present in the world. The TMT-J Project Office has been making efforts to release information on the project and also to contribute to science education and outreach. Whereas there is an advantage that the project is developed from and also enhanced by Japan's well-known Subaru Telescope in the field of optical/infrared astronomy, special efforts are required to promote the understanding of this type of project where other international partners take part. We report the strategy and experiences of the TMT-J Project Office in the area of public relations, education and outreach.

1. Introduction

The Thirty Meter Telescope (TMT) is a next generation optical/infrared telescope with an aperture of 30m, planned to construct atop Maunakea on the Island of Hawaii. In comparison to the 8.2m Subaru Telescope, one of the telescopes currently at the forefront of astronomical observation, TMT will have 13 times the light-gathering power and 3.6 times the resolving power, enabling it to perform at an unprecedented level of sensitivity. Utilizing this power to its fullest extent, TMT will aim to search for signature of life on extrasolar planets and to reveal the nature of astronomical objects in the very early universe.

The TMT project is driven by international collaboration consisting of five partner countries that are Japan, USA, Canada, China, and India. As part of its contribution, Japan is taking charge of the design and manufacture of the telescope structure, and the production of all of the mirror blanks for the primary mirror. It is also responsible for a portion of the surface polishing of the primary mirror and science instruments. The National Astronomical Observatory of Japan (NAOJ) is responsible for Japan's role in the project.

2. TMT-J EPO activities

Because TMT is a telescope which will be completed in almost 10 years from now, we need to think about how to sustain a long-term interest in our EPO activities in Japan. We are working to improve TMT's visibility through our webpage, newsletters, NAOJ's Open House Day, exhibitions and other occasions.

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Fig. 1. Donor recognition plaque installed at the Subaru Telescope office in Hilo, Hawaii. The plaque is one of our visualization efforts to sustain the long-term support for the TMT project. TMT supporters can put their names on the plaque by donating 1000 yen and over to NAOJ. Not a few donors are looking forward to the completion of TMT and are willing to visit and see the plaque when the telescope is completed.

2.1 Educational activities

We have an educational program to offer lectures for all age groups throughout Japan on request from many kinds of bodies, including science museums and local organizations. These lectures are generally about what we have learned from the results of the Subaru Telescope, what questions are raised from these results, and how we aim to solve these questions with TMT. We also visit primary schools and junior high schools to develop and foster children's interest in TMT.

For graduate students and postdocs, international workshops, initiated in 2016, are organized by the TMT international working team of the Workforce pipeline, Education, Public Outreach and Communications (WEPOC). Participants can gain international teamwork and leadership experience which will be necessary to work for the TMT project. These workshops provide a valuable opportunity for young Japanese researchers and students to see an international project like the TMT project (including project management) first hand in their early career.

Fig. 2. TMT lectures in FY2013-FY2017. About 270 lectures have been held in 30 prefectures (out of 47 prefectures in Japan) and also in the Hawaii Island.

2.2 Activities for the general public

We are working to increase the recognition of TMT through various events such as NAOJ's Open House Day. For example, we have a TMT booth at the JpGU meeting (the largest meeting on geoscience in Japan), CP+ (the largest annual consumer camera and photo imaging show in Japan), and the Space & Astronomy EXPO (to exchange technical information including manufacturers).

Most items on exhibition are also available for external exhibitors such as science museums. For example, the 3D CG movie on TMT can be downloaded from our website (http://tmt.nao.ac.jp/gallery/index.html). TMT panel data are also found on the same web page for download, print and display of TMT posters for exhibition purposes. In addition, TMT scale models can be rented.

We have been cooperating with Club TMT, a cheering group in which many museum people participate. Many lectures and exhibitions on TMT have been held in cooperation with Club TMT.

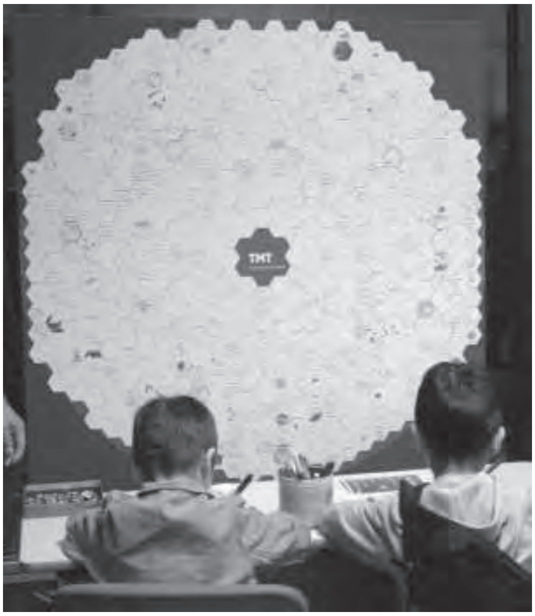

Fig. 3. TMT section at NAOJ's Open House Day. NAOJ annually hosts this event at the Mitaka headquarters and receives about four thousand visitors every year.

3. Summary

Because the TMT project is such a long-run project of about 10 years to complete the telescope, we should consider how to sustain the long-term interest in TMT and how to educate young generation through our EPO activities below.
- We are working to enhance the recognition of the international project in which Japan participates. As part of this effort, we highlight Japan's strategy to lead the world astronomy through collaboration between TMT and the Subaru Telescope that is Japan's flagship telescope widely recognized by the public.
- We collaborate with science museums to attract people who are interested in science.
- We collaborate with the international WEPOC team of TMT. We should disseminate and make known our international activities such as future leaders workshop so that more Japanese become familiar with TMT and other international projects, and hopefully will be involved in them.

|Parallel Session|

Together, Let's Touch the Sun with Hinode!

Kentaro YAJI[*1]

Abstract. "Let's Look at the Sun with *Hinode*!" is a joint solar observation campaign for high and junior high school students. It started in 2010 and still continues today. It has been highly praised as a unique EPO activity using *Hinode* data. The students compare their own observational data with *Hinode* data and analyze it to be able to deeply understand the Sun. Several schools have a presentation of their observation results for local science contests and junior sessions at the annual astronomical meeting. This work reflects the actions of this unique activity over the past eight years.

1. Introduction

Hinode is a Japanese solar observation satellite and was launched in 2006. Since then, *Hinode* has observed the Sun in orbit over one solar cycle (eleven years) and produced wonderful scientific results[1]. The project highly encouraged the use of *Hinode* data for, not only research, but also for astronomy educators working at public observatories, planetariums and science museums. Therefore, *Hinode* team and astronomy educators have collaborated with each other and promoted various EPO activities with *Hinode* data since its launch[2]. In addition, we would like to give the students in particular a chance "to touch" the Sun with *Hinode* data. As one of these challenges, we proposed "Let's Look at the Sun with *Hinode*!"

2. Let's Look at the Sun with Hinode!

"Let's Look at the Sun with *Hinode* !" is a joint solar observation campaign for high and junior high school students. It is shortly called "With *Hinode*!". Among schools in Japan, many extracurricular science clubs have solar observations using traditional sketching and state of the art of photography in Hα line, CaK line, and even radio. To provide a chance of more actively "touch" *Hinode* data, we proposed a joint solar observation campaign as an *Hinode* Operation Plan (HOP) to the *Hinode* team.

Hinode team has frequently accepted observation proposals from researchers around the world and HOP attributes a certain number of observations to each approved proposal. We submitted a proposal entitled "EPO Campaign Observation for High School Students," which was approved as HOP173. The students who have solar observations are interested in *Hinode.* As they compare their own data with Hinode data, the students can deeply understand the Sun but also promote the mission. These are the goals of "With *Hinode*!"

Every summer vacation, "With *Hinode*!" is carried out for one or two weeks. When observed in July, we must submit the observation proposal until mid-June. The proposal is usually approved late June and carried out late July. Then we determine observing targets and request *Hinode* team, at the students' request. *Hinode* observation results are open online and the students can access *Hinode* data. Prior to the activity we have we provide lectures and give observation advice to the participant schools.

What do both students and teachers, want to study with "With *Hinode*" project? We implemented a questionnaire survey and the and the answers follow below:

"Change/Development velocity of sunspots and prominences", "Moving velocity and rotation cycle of sunspots", "Features differences with observation wavelengths", "How can we draw a sketch of sunspots using ground-based observations?", "Temperature variation by solar radio observation".

3. Observation Summary

"With *Hinode!*" started in 2010, and although initially only a few schools participated, up to date, twenty seven schools, facilities and groups participated from east to west, across Japan. The participants include public observatories and the education departments and astronomical clubs of universities. At first, many schools compared their own solar optical images with x-ray images taken with *Hinode.* In 2013-2014, which is the solar maximum, more than ten schools participated in this joint observation and some new participant schools appeared. In 2014, they could capture a dynamic change of the prominence within a few days. Although the solar activity is getting lower, eight schools participated and reported their observation results. In 2016, one school succeeded in observing solar flares.

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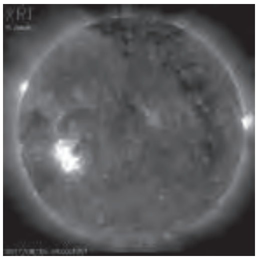
A number of schools studied the simultaneous observation data and compared these with their own data. They held presentations at their schools' festivals, prefectures' science contests, and junior sessions in the astronom-ical society's annual meeting. The examples of re-cent presentations are "Following the Relations be-tween Prominences and X-ray" by Tsuno High School in Miyazaki Prefecture and "Sunspots Ap-pearance and Disappearance with Multiwave Obser-vations" by Urawa-Nishi High School in Saitama Prefecture (Fig.3).



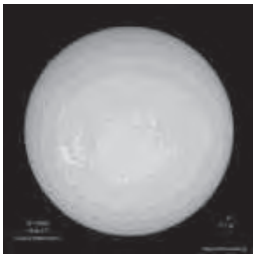


Fig.1.(left) X-ray solar image taken by *HINODE*(NAOJ/JAXA)
Fig.2.(right) H-alpha line image (Urawa-Nishi High School)

4. The Reasons for Success

One solar researcher asked me "Why are these joint observations successful?" Below we present some reasons and considerations:

Japanese high and junior schools' extracurricular activities clubs (Astronomy, Natural Sciences, etc.) are very active. From results of the questionnaire surveys after the joint observations, the students enhanced their understanding of the Sun through *Hinode*. They were motivated to learn due to the joint observations.

Since *Hinode* observational data is more acces-sible to the students compared with other satellite data, "With *Hinode*!" has spread to other schools and facilities and has sparkled interest in the public.

"With *Hinode*!" is the first observation proposal for education, with foreign solar researchers highly valuable in the joint observations. At *Hinode* science meetings, the participants praised the proposal and inquired on the observation results of the high school students. The reason of success is that the researchers highly encourage the joint observations and the students. This also contributes to the extension of *Hinode* mission. For the past few, "With *Hinode*" has been highlighted in the IAU Outreach Newsletter and this international exposure generated interest from other oversea countries such as Sri Lanka, Thai, Romania, Spain and Columbia.

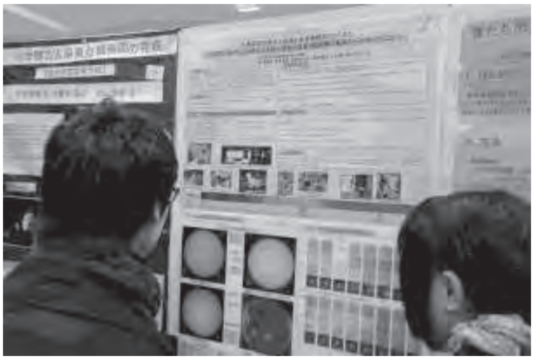


Fig.3. An example of a poster presentation in junior session of an annual meeting of Astronomical Socie-ty of Japan in 2015 (Courtesy of Mr. Sakae, Urawa Nishi High School) (Reprinted from Yaji et al. (2016) (Fig.2) by permission of ASJ) [3]

5. Summary

"Let's Look at the Sun with *Hinode!*" is a joint solar observation with *Hinode* and high and junior high school students. It is carried since 2010, and is highly regarded by domestic and foreign solar researchers. The students study the Sun with *Hinode* data and their own data and hold a presentation at various science contests.

Through "With *Hinode*!", they can touch the sun and deeply understand it.

In future, with missions such as "Parker Solar Probe", "Solar Orbiter" and "Solar-C/EUVST", the next solar missions, I hope that similar activities can encourage students in a positive way, such as "With *Hinode!*"is doing.

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|Parallel Session|

Public Communication and Public Outreach of Hayabua2 Mission

Makoto YOSHIKAWA*1, Yuichi TSUDA*1, Satoru NAKAZAWA*1, Sei-ichiro WATANABE*2
and the Hayabusa2 Project Team

Abstract. Hayabusa2 is an asteroid sample return mission of Japan. It was launched in December 2014 and it will arrive at its destination, Asteroid Ryugu, in June or July 2018. Up to now, we have done many public outreach activities. In this paper we show our activities. These activities are quite effective to share science and technologies with public people.

1. Introduction

Hayabusa2 (Fig.1) is the second asteroid sample return mission following Hayabusa. Its purposes are to study the origin and evolution of the solar system and to develop the technologies that enable a round-trip mission to an asteroid. In addition to these "official" purposes, we have done many activities to enhance public interests to the universe by using this mission. In this paper, we show what we have done for the outreach activities and the public relations in the Hayabusa2 mission.

2. Hayabusa2 Mission

Hayabusa2 was launched in2014, as a follow-on mission of Hayabusa (2003-2010). The target asteroid is (162173) Ryugu (the provisional designation is 1999 JU3), which is a C-type near Earth asteroid. Hayabusa2 will arrive at Ryugu in June or July of 2018, stay there for about one and half years, and return to the Earth at the end of 2020.

We will study the organic matter and water on the asteroid to find some clues related the origin of the life. Also we will study various physical natures of the asteroids to understand the formation and evolution of the solar system bodies.

The engineering issues such as reliability and new technology are also important purposes of Hayabusa2 mission. Hayabusa2 has many new mission payloads such as an impactor, a small lander and three rovers, Ka-band communication systems, and a deployable camera. Scientific payloads on board are Optical Navigation Camera (ONC), Laser Altimeter (LIDAR), Near Infrared Spectrometer (NIRS3) and Thermal Infrared Imager (TIR). The impactor will create a small crater on the surface of Ryugu, and we will try to get sub-surface material in or near this crater (Fig.1).

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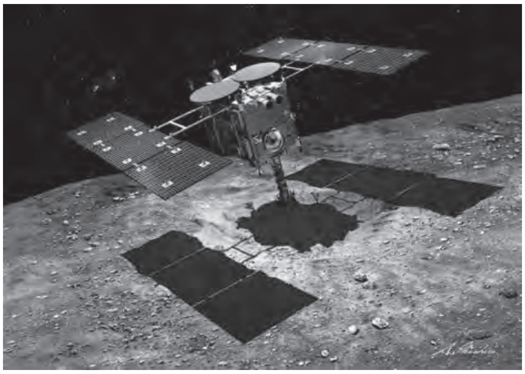

Fig. 1. Hayabusa2 spacecraft
This illustration shows that Hayabusa2 is touching down to the small crater created by the impactor of Hayabusa2. (Illustration by Akihiro Ikeshita)

3. Public Outreach Activities of Hayabusa2

The outreach activities of Hayabusa2 were started before the launch, and up to now we have carried out campaigns such as "Let's meet with Le Petit Prince! Million Campaign 2", Asteroid naming campaign, Swingby observation campaign, Ryugu observation campaign, and "Image Ryugu" Space Art Contest.

The "Million Campaign 2" (Fig.2) is a similar campaign that we did for Hayabusa mission. In this campaign we asked people to send their names, messages, illustrations, and photos to us. Then we put them in the target makers and the reentry capsule of Hayabusa2. So we can deliver them to the asteroid or they can make a round trip to the asteroid. The total number of entries was about 410,000.

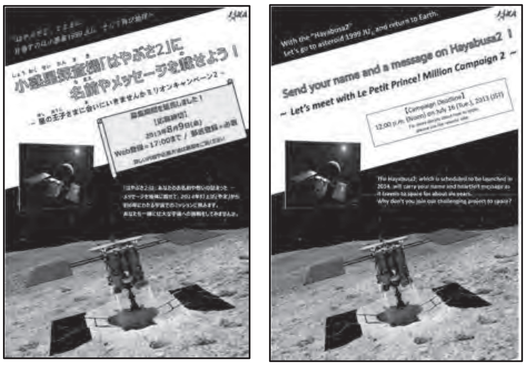

Fig. 2. "Million Campaign 2" for Hayabusa2

Fig. 3. Reactions from public people for Hayabusa2

Asteroid naming campaign is the campaign to name the target asteroid. When Hayabusa2 was launched, the target asteroid did not have its name, and it was called by the provisional designation as 1999 JU3. So we asked public people to propose the name. About 7,300 people sent their proposals to us, and the name Ryugu was selected. This name comes form a story called "Urashima Taro", which is a very famous fairy tail in Japan.

As a little high-level campaign, we carried out observation campaigns of both Hayabusa2 at the Earth swingby and Asteroid Ryugu. Swing-by observation campaign was done on December 3, 2015, when Hayabusa2 approached to the Earth at the distance of about 3090 km to perform the Earth swing-by. Hayabusa2 was observed in about 40 sites in Japan. So many people were able to see Hayabusa2 off to Ryugu. Ryugu observation campaign was done form July1 to August 15 in 2016. Although Ryugu was very faint and its magnitude was about 18.5, about 14 observatories and amateur observers were able to take the image of Ryugu.

In the beginning of 2018, just before the asteroid arrival, we have started "Image Ryugu" Space Art Contest. When we saw asteroid Itokawa by Hayabusa, we were very surprised because the appearance of Itokawa was totally unexpected. Since we do not know how Ryugu looks like, so we asked public people to image it. We asked to science museums or gropes related astronomy to be the node of this contest. The role of node is to collect artworks from public people. The number of node is 18 in Japan and 6 in abroad. We are looking forward to the artworks form public people.

In addition to these campaigns, we have been doing more basic activities such as public lectures, classroom lectures, and town meetings. As a new thing for public lectures, we have started what we call "Hayabusa2 Talk Live" since February 2016. This is a lecture series once in two months. Hayabusa2 project members talk about their field of research related to Hayabusa2 mission. We broadcast the talk by Internet. We also made the web site, pamphlets, fact sheets, goods, videos, etc. We made a mascot character of Hayabusa2, which is "Hayatsu-kun = Haya2-kun". This is also helpful especially for small children.

4. Summary

Space missions are very important for developing advanced technologies and for revealing the nature of universe. But we must not forget that most important thing in missions is people. Of course, the key of success of each mission is people. And missions must be such things that make people happy. From this point of view, the outreach or education activities related to space missions should not be treated lightly. The fact that we had a lot of reactions from public people to Hayabusa2 (Fig. 3) indicates that our activities are effective.

Up to now the Hayabusa2 mission is in the beginning stage, and the real mission will begin when Hayabusa2 approaches Ryugu in June 2018. We will carry out public communication and public outreach much more intensively after Hayabusa2 arrives at Ryugu.

Acknowledgments

The authors would like to thank all the people who supported Hayabusa2. The authors also thank to The Planetary Society of USA (TPS), The Planetary Society of Japan (TPSJ), Japan Public Observatory Society (JAPOS), Japan Spaceguard Association (JSGA), and individual people who helped the outreach activities.

|Parallel Session|

Public Acceptance of ALMA in Japan

Masaaki HIRAMATSU[*1]

Abstract. ALMA provides new insights of the cool universe to astronomers. Not only that, ALMA offers great opportunities, and challenges, to communicate radio astronomy with the public. In this paper I describe the challenges in communicating ALMA in Japan, several best practices on Twitter and collaboration with artists, and summarize the ALMA's impact on the society.

1. Introduction

The Atacama Large Millimeter/submillimeter Array (ALMA) is an international astronomy facility which is operated in a partnership of the European Southern Observatory, the U.S. National Science Foundation, and the National Institutes of Natural Sciences of Japan in cooperation with the Republic of Chile. With its unprecedented sensitivity and resolution, ALMA is producing fascinating results which transforms astronomy. As an Executive of ALMA, the National Astronomical Observatory of Japan (NAOJ) is responsible for the education and public outreach (EPO) activity of ALMA in Japan.

2. Difficulties in Communicating ALMA in Japan

Although ALMA produces wonderful images and astonishing results, there are several adversities in communicating ALMA in Japan. First, ALMA is located in Chile, the other side of the planet seen from Japan. The harsh condition at the 5000-m altitude site prevents people from visiting the actual site. In addition, most of the people are not familiar with radio astronomy itself and it is very hard for them to imagine the rich astronomical fruits by seeing the array of antennas in the desert.

ALMA has a lower profile in Japan compared with other astronomical facilities such as the Subaru Telescope, the Hubble Space Telescope, and the Super KAMIOKANDE, the neutrino observatory in Japan. Raising the profile of ALMA is one of the goals of ALMA EPO activity in Japan.

Sometimes, however, adversity is the best school. Unfamiliar scenery of the Atacama Desert and movies of synchronized dance of antennas could be used as eye-catching items. Showing the stories of people seeing the invisible universe to search our cosmic origins can stimulate interest of the public.

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3. Presenting photos and stories with Twitter

We operate a twitter account @ALMA_Japan in Japanese. We launched it in 2011 and the current number of followers is about 38,000. @ALMA_Japan posts ALMA news and latest research results, as well as ALMA-related photos and information of celestial events such as eclipses. @ALMA_Japan's tweets gain a million impressions in a month.

In operating the twitter account for 6 years, we found that tweets with nice photos gain more impressions. One of popular tweets is the post with a photo of the three types of ALMA antennas, which illustrates the importance and the beauty of international collaboration. It marked 330 RTs and 124,000 impressions. Another popular tweet is the ALMA image of a dying star U Antliae, which shows a beautiful bubble around the star. It gained 570 RTs and 262,000 impressions (Fig. 1).

Fig 1. Most popular tweets of @ALMA_Japan. The photo of three ALMA antennas (left), ALMA image of U Antliae (center), and the largest moon in 2016.
Credit: NAOJ, ALMA (ESO/NAOJ/NRAO)/F. Kerschbaum

The most popular tweets by @ALMA_Japan is, unfortunately, not about ALMA but about the largest moon in the year (Fig.1). It marked 3800 RTs, 2000 favs, and 541,000 impressions. Why was it so popular? We suppose this is because the tweet can invoke people's action to watch the moon by themselves, and that creates values to share it with the readers' friends. ALMA images are beautiful, but it is difficult to prompt people to do something and to enjoy the value in their daily lives.

4. Connect ALMA with people's daily lives

Aiming to connect ALMA with people, we have tried several approaches.

One approach is using Twitter. Not just posting ALMA news but carefully watching what people care about is important. An example is using a trending hashtag. On #PiDay, March 14th, we posted an photo of the antenna dish. The shape is apparently related with pi, and we introduced that pi is essential in Fourier transform, the key concept in interferometer. The other example is a lunar eclipse. After tweeting the information of eclipse, we posted an eclipse image taken with a radio telescope which shows the temperature change of the moon during the eclipse. It showed that the radio telescope can observe what we humans cannot see in a simple and direct way. It could be an eye-opening item for radio astronomy.

Fig 2. The ALMA MUSIC BOX.
Credit: NAOJ

The other and more innovative approach is the ALMA MUSIC BOX. This music instrument is based on the ALMA observation image of a dying star R Sculptoris. A music disk corresponds to a stellar image in a certain radio frequency. We made holes on the disk where the radio emission is strong in the ALMA image. In other words, the radio images are directly transformed into sounds. We exhibited it in two art museums in Japan and more than 200,000 people enjoyed the exhibition. In addition, 11 artists inspired by the ALMA MUSIC BOX created a compilation album with a support from a crowd-funding project. And moreover, the album resulted in an orchestra concert featuring ALMA in Kyoto. In the concert we exhibited ALMA's and other astronomical images in the hall to get awareness of the origin of the music. It was an impressive example of collaboration between astronomy and art.

5. Public acceptance: people inspired by ALMA

As a consequence of ALMA EPO activities, we can find several examples which shows that ALMA is accepted and digested in the public.

One good example is the Japanese rock band ACIDMAN. They got to know ALMA through a science program on TV and visited ALMA. They released a single titled "ALMA" in 2010, even before the start of science operation, with a music video taken at the ALMA site. The song "ALMA" is one of their representative works and their fans are familiar with the telescope. Furthermore, one of their fans named her/his own café after the telescope. The café owner learnt ALMA through ACIDMAN and were got inspired with ALMA's challenge to the universe.

The other example is an engagement ring inspired by ALMA's image of a protoplanetary disk around a young star HD 142527. The designer happened to see a news article based on the press release from ALMA. He was impressed by the name of the telescope, *soul* in English, and ALMA's venture in search of our cosmic origins. Then, he created a ring named after the telescope as a symbol of love.

6. Summary

In spite of difficulties in communicating ALMA, the telescope inspired some people and we have shared the value of ALMA. Important points are; to clearly show our visions, key messages, and our stories; to watch what people care about; and to weave our stories into the society and people's daily lives. As ACIDMAN and the ring designer knew ALMA from a TV program and a news article, even the normal communication activities such as press releases and media relations could result in unexpected developments. The ALMA MUSIC BOX showed that the collaboration with art could enhance the value of scientific activity and provid new opportunities for enjoying science.

|Parallel Session|

Challenges to Communicate the Basics of Scientific Results from the Solar Observing Satellite Hinode

Naoko INOUE*1

Abstract. Three challenges to communicate the basics of Hinode's scientific results are presented; demonstrations, a lecture and videos, to convey our researches investigating the solar magnetic activity through the observation of the solar observing satellite, Hinode. Their effects analyzed via questionnaires are also presented. Demonstrations were found to be very effective to communicate the importance of the solar magnetic fields. The questionnaire collected at the lecture showed that public outreach staffs should be involved more deeply to make the contents easily understandable. By creating videos in a dialogue style, we managed to communicate the basic results to a limited number of people. It is still difficult to communicate the basics of our scientific results in spite of our efforts, and our challenges continue.

1. Introduction

The main objective of our public outreach (PO) activity is to let people recognize our basic researches in solar physics and support us. In order to achieve this, we communicate on our webpage that the solar activity such as solar flares originates from the magnetic field and that we try to measure it on the Sun.

However, the number of accesses to our website tells that the people's interests in the solar observing satellite Hinode tend to be limited to the events such as solar eclipses and transits of planets seen in beautiful images and movies of the Sun. Since Hinode's launch, we made the scientific results or events open on our Hinode website. The top 3 most accessed articles are for the beautiful movies and images taken by the Hinode Solar Optical Telescope, such as those taken at the occasion of the Venus transit.

On the other hand, the access numbers for those articles that are related to solar magnetic fields are much smaller. They include the discovery of new type of magnetic fields, those associated with sunspot formation, and a trial of measuring magnetic fields in the upper atmosphere by a sounding rocket experiment, CLASP, with very important results in solar physics.

It is very difficult to communicate the basics of our scientific results concerning the magnetic field on the Sun. In this paper, we would like to present our three challenges to narrow such communication gaps.

2. Demonstrations

The demonstration could be a "hook" on which people's interests are caught, and that the people may understand the science from experience. We have developed two kinds of demonstrations. In the first demonstration, we try to visualize magnetic field lines. In the X-ray image of the solar corona (Fig. 1. left), there are many bright regions, and solar flares tend to occur in these regions. They are called "active" regions, where the magnetic field is strong. In these active regions, we can see many loops, which trace magnetic field lines. We try to reproduce these magnetic field lines using two magnets put under a transparent oil container with iron powder in it (Fig. 1. right). By comparing 3-D iron-powder magnetic field lines with those in X-ray coronal images, people are stimulated to learn that there are many magnetic field lines on the Sun. Then, we add a comment that at the foot points of coronal loops, sunspots are located, which correspond to the magnets used in the experiment. We also explain that sunspots drive solar activity such as solar flares through magnetic fields.

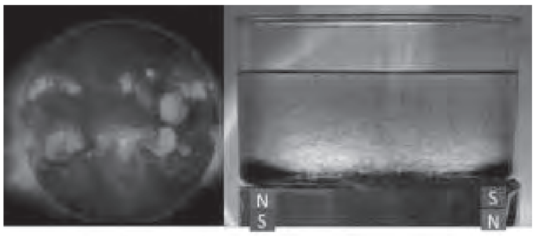

Fig. 1. Magnetic field lines seen in X-ray image of the solar corona (left, ©NAOJ/JAXA) and those reproduced by demonstration (right, ©NAOJ).

The effect of the demonstration in a science museum was surveyed by asking two questions: "What impressed you most?" and "Freely comment on the demonstration." The total of 63 people answered and 29% of them wrote about magnetic fields. For example, they understood that sunspots play a role of magnets, that the prominence is

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supported by magnetic fields, and they wrote that the experiment was extremely wonderful, and so on.

The survey revealed that the visualization of the 3D magnetic field lines in the corona is effective to communicate the significance of solar magnetic activity.

In the second demonstration, we try to visualize the principle of the solar magnetic field measurements. Magnetic field lines are thought to extend radially from a sunspot, and spectral lines sensitive to the magnetic field become polarized: This situation is simulated by putting pieces of polarizer on the image of a sunspot. If we look at the model sunspot through a polarizer and rotate the polarizer, just as polarimeters on Hinode and other solar observatories do, we can see the changes of brightness in the sunspot image. This demonstration attracts people's interests, and we could communicate not only how to measure solar magnetic fields, but also that Hinode has detected the flare triggering magnetic fields by precisely measuring the photospheric magnetic field.

3. Lecture

The lecture that we held at the occasion of the 10th anniversary of Hinode's launch had four talks from forefront researchers, and presented Hinode's new scientific results obtained during these ten years, and our future research plans in solar physics, as well. We focused on the researches of coronal heating, flare trigger, and chromospheric magnetic fields.

We also surveyed through questionnaire. The two questions were asked: "Freely comment on Hinode and the future researches of the Sun," and "Freely comment on the lecture." Responses from 157 out of 228 participants in total were collected. We found the audience's enormous expectations on solar flare researches and the next space mission, SOLAR-C.

On the other hand only a few comments were addressed on the coronal heating problem, and some of them felt that the contents of the talks were rather difficult and that the speaker should use easier wordings. This shows that the public outreach staff should be more deeply involved in the lecture preparation process by iterating and improving the contents and the wordings of lectures. Intensive interaction among researchers and PO staffs are thought to be needed.

4. Videos

We created a series of videos summarizing the lecture in a dialogue style, and put up on our website.

We collected the responses of audience who watched the videos by placing an enquiry at the end of the webpage: "What do you expect for the future solar observation after the Hinode era?" We received 40 responses, and only 8 made comments on the three research areas that we intended to convey; a) coronal heating problem, b) flare prediction with high accuracy, and c) the measuring of chromospheric magnetic fields. Remaining 32 responses wrote about their vague expectations without specific comments, or nonsense ideas of their own, ignoring the contents of the videos, although a couple of them are important topics in solar physics. Three comments among the 8 appropriate ones noted above described specifically what they learned through the videos. It is still a success that we could convey what we really wanted to communicate to a limited percentage of people.

Fig. 2. Video in a dialogue style on our website (©NAOJ).

5. Summary

Our challenges are introduced to overcome the difficulty of ordinary people in understanding of solar magnetic activity. Demonstrations were found to be very effective to understand the importance of solar magnetic fields. While lectures will be able to draw their attention much on the scientific results, and to get their expectations up, public outreach staffs should be more deeply involved in the preparation process. Finally, on-line videos alone are able to communicate the basic scientific results to a limited number of people.

In conclusion, difficulty still widely exists in our communication of the basic scientific results to the public, and our challenges continue.

|Poster|

Himastron ITB's Current Activities in Popularizing Astronomy

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Abstract. Himastron ITB is an astronomy student organization that communicates astronomy to the public through various activities; mainly using three approaches: social media, events, and collaboration with other astronomy-related communities. They are meant to achieve our objective: disseminate astronomy to the public.

1. Introduction

Astronomy Student Association of Bandung Institute of Technology (Himastron ITB) is an organization with restricted membership, accepting only ITB's undergraduate astronomy students. Established in October 19th, 1965 at Bosscha Observatory, it now has 111 active members and hundreds of alumni. Himastron ITB has three main objectives: provide academic and students' basic, well-being supports; accommodate its members to improve their self-development skills and astronomical expertise; and disseminate astronomy to the public. The first and second objectives are this organization's uniqueness compared to other astronomy-related groups, because it also serves its members interests and aspirations as part of academic society of ITB. The third objective will be our focus in this article.

2. Media

The internet era has made Himastron ITB keep in touch through social media, providing people with accurate information on astronomy. Himastron ITB has connected through Twitter (@Himastron_ITB), Instagram (@himastronitb), official blog (https://himastron.as.itb.ac.id/), and the recently popular apps in Indonesia, LINE (@himastronitb). Himastron ITB often explores fresh issues in astronomy through Twitter threads and articles in the blog. The publications are in Bahasa Indonesia. We also use social media to publicize our events.

3. Activities

Teleskop Keliling (in English, Mobile Telescope) is a series of solar observation events hold in urban parks, public or community events, even schools throughout Bandung. In 2015 and 2017 alone, there were respectively 1,566 and 1,199 visitors attended.

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Himastron ITB also held scientific discussions with student bodies from other fields. The discussion topics are related to astronomy like nautical navigation, astrobiology, and radio astronomy. We also have annual events: Asteroid Day and Astara Ganesha, held to commemorate the Tunguska event in 1908 and World Space Week, respectively. They include talks, workshops and competitions for students.

4. Relations

Astronomy-related communities are, at first, quite uncommon. As time goes by, our activities started to pique people's interest in astronomy. For example, Astara Ganesha has successfully encouraged astronomy enthusiasts from high schools in Bandung to form their own astronomy club under the name "Astrophile". Besides reaching the target audience, our activities also inspire the members to continue spreading astronomy through their own way; regional amateur's club, media, and even astro-entrepreneur.

5. Conclusion

Our efforts have impacts and potentials for the future of disseminating astronomy to the public. Qualitatively, science literacy level of young people, especially in Bandung, has successfully increased due to our continuous efforts in popularizing astronomy. Also, if the development of astronomy-related clubs keeps taking places throughout the country, with each inspired by the preceding ones, this could contribute towards the betterment of astronomy in Indonesia, since they have one goal in common: to disseminate astronomy as widely as possible.

Acknowledgments

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Long and Steady Voluntary Works by the Toyonaka Astronomical Association

Keiko CHAKI [*1]

Abstract. The Toyonaka Astronomical Association (TAA) had its 30th anniversary last October. It has carried out fifty stargazing parties per year on average for 30 years. I would like to introduce the missions, features, activities, the effort and the achievement of TAA

1. Introduction

The return of Comet Halley in 1986 raised interest in astronomy. There were many children and teachers who wanted to see the comet and celestial objects through telescopes. Some star parties were held and interest and activities continued after that. In order to respond to the requests, the representatives of the clubs around gathered and TAA was established in Oct. 1987, consisting of volunteers from astronomy clubs in the region. So TAA is not a club but an organization to carry out stargazing events at schools and public places. Over 144,200 people have observed the universe through our telescopes and binoculars over the past thirty years. If you held a star party with 100 participants every day, it would take almost 4 years to reach that number.

2. Missions and Values of TAA

1. Convey the pleasure and the interest in astronomy
2. Draw attention to the brilliance and the wonder of the universe and the nature of the earth
3. Popularize astronomy
4. Provide hands-on learning of stargazing
5. Support extracurricular activities for students
6. Promote scientific and environmental education
7. Encourage healthy development of young people

3. Main Activities

- Hold stargazing parties and astronomical events for school students and the general public
- Educate about light pollution
- Conduct trainings of stargazing guide for beginners
- Organize Toyonaka Star Festival for citizens and families, which includes:
  - Telescope making workshops
  - Nature observing
  - Overnight stargazing with accommodations
  - Star-light concert
  - Astronomy-related games

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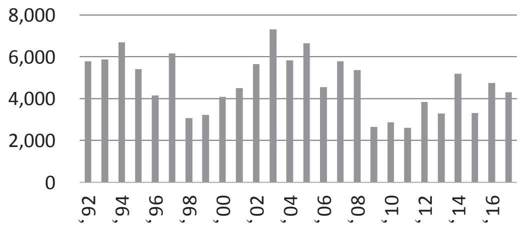
4. Features

Regarding the school stargazing parties, TAA organizes them on request from teachers. Attendance is limited to students of certain academic grades, depending on school curricula. And our stargazing is counted as an extra-curricular science class. The cooperation with teachers is inevitable.

5. Transition of Stargazing Participants

According to our data (Table 1), the year of 2003 had the most participants (7,325 people). It is considered that the Mars' closest approach attracted many people. The second (6,698 people) was 1994, the year of the collision of Comet Shoemaker-Levy 9 with Jupiter. Participants have decreased recently because the number of children has been decreasing.

Table 1 Transition of Stargazing Participants



6. Conclusions

TAA has been active for thirty years because we have received requests from schools. Although the population of children is decreasing, we would like to continue our activities as long as there are children who want to see and know celestial objects.

|Poster|

Education and Public Outreach Activity in ASIAA IAA Quarterly and Searching for Extraterrestrial Life Website

Mei-Yin CHOU*1 and Lung-Yih CHIANG*2

Abstract. The Education and Public Outreach (EPO) team of ASIAA in Taiwan works on public relations, websites, publication, educational and promotional activity and collaboration. The publication includes the ASIAA Quarterly (IAAQ) that aims to promote ASIAA‘s research and activities. We also collaborate with PanSci, a popular online science media/website/community among Traditional Chinese users, to launch the Searching for Extraterrestrial Life website in 2017.

1. ASIAA Quarterly (IAAQ)

The IAAQ (天聞季報) aims to make ASIAA‘s activities known, i.e., ASIAA-led projects and current research topics, introducing our research staff, and to raise awareness of the many contributions from astronomy. The target readers are senior high school students, and each issue of IAAQ is now sent to more than 100 schools in Taiwan. IAAQ has been made available online for public access worldwide. The IAAQ online version can be seen at: https://sites.google.com/a/asiaa.sinica.edu.tw/iaaq-on-web/

2. Searching for Extraterrestrial Life

ASIAA has collaborated with PanSci to make a Searching for Extraterrestrial Life website (http://outreach.asiaa.sinica.edu.tw/etlife). Through art-directed web design, parallax scrolling and web video, we introduce the most current and intriguing subjects such as sending messages to space, liquid water in our solar system, habitable exoplanets, interstellar organic molecules, and Taiwan’s effort on those fronts. We also promote this website on http://www.pansci.tw

This project is supported from the Ministry of Science and Technology grants MoST 104-2515-S-001-004-MY2.

Fig. 1. (*Left*) The cover page of 2017 IAAQ summer issue for the *Searching for Extraterrestrial Life* project. (*Right*) The QR code for the IAAQ online version. Image Credit: ASIAA.

Fig. 2. The main page of the *Searching for Extraterrestrial Life* website (*left*) and its QR code (*right*). Image Credit: ASIAA.

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NAOJ Mitaka Regular Stargazing Party

Satoshi KIKUTA[*1,2], Naomi ISHIKAWA[*1,3] and Hidehiko AGATA[*1,4]

Abstract. National Astronomical Observatory of Japan (NAOJ) officially hosts a stargazing party twice a month at NAOJ Mitaka campus. Parties are mainly organized by grad/undergrad students in astronomy. Participants enjoy a lecture on various topics before stargazing with a 50cm diameter reflecting telescope. In this proceeding, we present a summary of our party focusing on its benefits to research institutes, students, and the public.

1. Introduction

The first time of National Astronomical Observatory of Japan (NAOJ)'s official star party took place in 1996 when Comet Hyakutake approached the Earth. Since then, the number of visitors has been increasing and about 70,000 people have visited in total. It continues to attract both old and young people, from Mitaka as well as various regions near Tokyo, and stir their curiosity and imagination.

On clear nights more than 250 people visit us. Even when it is cloudy, we do not cancel party and just show and explain our 50cm telescope in a dome. On rainy days we cannot open the dome (to protect the telescope) but still 50-100 people visit us to enjoy exhibits and a lecture. To prevent overcrowding, we regretfully decided not to take walk-ins in 2012. Participants have to make reservations beforehand from the official website (https://prc.nao.ac.jp/stargazing/en/). Since it is quite popular especially in summer times, we are forced to hold a draw from Apr to Sep from 2014.

2. Characteristics

Three major characteristics of our party are: (1) it is a star party in Tokyo, (2) it is a star party in research institute, and (3) it is a star party organized by students.

(1) NAOJ Mitaka campus is located in the western portion of Tokyo Metropolis, Japan. Despite its proximity to large cities, most participants are surprised at the starscape from Mitaka; they are so unconnected with the night sky in their daily lives, and we still can see many impressive views through our 50cm telescopes even in a large city. The universe stretches out above us anytime – this is one the most significant awareness we wish to tell. Typical targets include Planets, the Moon, double stars, M42, etc.

(2) As a leading national research institute in astronomy in Japan, NAOJ provides the public with opportunities to know its recent accomplish-ments for free in various ways (outreach activities). The star parties are one of them which began in 1996.

(3) Our star parties are mainly organized by grad/undergrad students in astronomy, and NAOJ pays them for their work. A lecture given by them is one of the main contents of the parties. Its topics range from target objects of the nights to the most recent scientific outcomes. Not only organizing parties, they also have the initiative in recruiting and training new students.

3. Conclusions

In parallel with the growing number of visitors, our party is significantly improved too, as a result of great efforts of past student staffs and warm support of NAOJ staffs. The established scheme for parties is so sophisticated that student staffs can routinely and smoothly conduct parties. All handouts and slides used in past lectures are archived on a wiki page and made available for all staffs. Thanks to these legacies, students can concentrate on polishing their communication skills or challenging to kick-off new activities. Many alumni developed their abilities here and are now flourishing in various fields (e.g., as researchers, planetarians, and even politicians), which we believe in turn contributes to astronomical society and the public.

By hosting star parties, institutes can grow students' career skills and benefit public welfare simultaneously. We are happy to share our insights and help other institutes to have lovely star parties.

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|Poster|

NARIT's Strategies on Astronomy Communication for the Public

Jullada KAOSAARD *1, Piriyaporn SABHASRI *2 and Titaree PUTTAWAN *3

Abstract. National Astronomical Research Institute of Thailand (Public Organization) (NARIT), under the Ministry of Science and Technology. NARIT is a national research organization for astronomy in Thailand. Besides the main missions of doing research and developing in astronomy, the institute also creates academy astronomy networks to exchange knowledge and technology with government agencies and private sector both domestic and international. The Institute provides astronomical communication for public, creating awareness and knowledge for Thai society.

1. Introduction

The Public Relations Division of NARIT has played a key role in public relations and corporate communication by publish astronomical information to the public. The main goal is to inspire people to become more interested in science and technology to create a learning society for sustainable development by provide access to people of all ages especially the youth. NARIT is focusing on simple information that is easily to understand through various communication channels and continuously organizing astronomical activities for people both central and regional. At the same time, it provides opportunities to learn from real experiences, stimulates attention, inspires learning about astronomy.

2. Methods

To emphazise, NARIT constantly provides press releases on astronomy news to public through various channels such as newspapers, television, radio and online media. Social media sites such as Facebook, Twitter, Instagram and YouTube are excellent ways to reach and communicate with people. There is also corporate website (www.narit.or.th), it is a source for searching knowledge and astronomical activities.

Astronomical activities that NARIT regularly organizes are stargazing, observing the major astronomical phenomena such as meteor shower, Mars Opposition, Jupiter Opposition, Saturn Opposition of the year. There were tens of thousands of participants. There is also a recent Astronomy Talk about the progress of the astronomy and recent surveys In terms of depth that interested by numerous of people especially family groups.

3. Summary

For the past eight years since the institute has established, Thai society has awaken and been following astronomy news more and more. The media will contact NARIT when they need more astronomical information for news. People are more interested and participate in astronomical activities every year. The news published by NARIT was rated 6 out of top 10 science hot news for Thais in 2015, NARIT's facebook page is also poppular among knowledge pages and there are more than hundred thousands of followers in 3 years. There were over a million views in some topics. Social media explicitly has magnificent impact nowadays in communication, it clearly shows how much attention astronomy news get from the public.

Ultimately, NARIT expects that astronomy will be a tool to develop Thai people to have a rational and effective thinking process as the foundation for creating a learning society in the future.

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Creating SKA Visitor Centre Experiences

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Abstract. The Square Kilometre Array (SKA) will be the world's biggest radio telescope. Visitor centres in the SKA's host and member countries will link local facilities and research with the SKA and its exploration of the universe. How will visitors find their connection to one of this century's most exciting science endeavours?

1. Introduction

The Square Kilometre Array (SKA) will be built in remote, radio-quiet locations in Australia and Southern Africa. Visitor centres in the SKA's host and member countries link local facilities and research with the SKA.

2. Principles and best practices

Visitor centres need to cater for a wide variety of visitors, among them individuals and groups; adults and children; taxpayers, decision-makers, and other stakeholders; scientists; people with an existing relationship to the host institution, fans of science, critics and sceptics.

To connect diverse visitors to telescopes at remote sites, we identify a number of different ways of creating links: science interest (astronomy, cosmology, gravity, pulsars); "wow factor" (size, scale, net traffic, computing power); local telescopes (size, purpose, design, history); local technology (instrumentation made locally for SKA, spinoffs) host country connections (family, indigenous culture, nature, arts); live contact (time, webcams, weather, people to identify with); exhibits for all senses (models, samples, sounds, film, large images, virtual reality); global ideas and goals (peace, international collaboration, sustainability).

Experience and research in related fields points to some best practices for visitor centres of this type: Know your audience [1]. Use interactive, preferably collaborative and mechanical exhibits where possible; make activities as intuitive as possible [2,3,4]. Build around your best experiments/activities. Train your guides and use their enthusiasm. Design with awareness of visitor diversity [5,6] and make content accessible online. Facilitate public access to real scientists and science data, and access to public for scientists.

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3. Conclusion and acknowledgements

We plan to test these principles in a new visitor centre project for Onsala Space Observatory, Chalmers University of Technology, Sweden, one of 10 member countries in the SKA Organisation. Placed close to existing radio telescopes, the aim of the project is to share the excitement of radio telescopes and technology for exploring space using radio waves, and connect visitors to both the SKA and other global projects in astronomy and geodesy (ALMA, EVN, LOFAR and VGOS).

Thanks to Mathieu Isidro, to Markus Pössl and to Jodrell Bank Discovery Centre staff for discussions.

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|Poster|

Management and Public Relations in the Multi-organization Cooperation Research Projects in Particle, Nuclear Physics and Astrophysics Fields

Tomoya NAGAI*1

Abstract. The Joint Institute for Computational Fundamental Science (JICFuS) was organized based on results of a large-scale calculation in particle physics, atomic nucleus, astrophysics, and computer development. The calculation resources of JICFuS (CCS, KEK, NAOJ, etc.) and RIKEN 'K computer' is effectively used, and it aims at nationwide research system construction of the computational fundamental science. Here, I introduce activity of the management and public relations (P.R.) of this project.

1. Introduction

JICFuS aims to create a better relationship with society based on two P.R. concepts in order to promote the development of institute and computational science.

- Improve understanding of the importance of computational basic science and reliability to JICFuS
- Increase the recognition of basic computational science and JICFuS

Our P.R. activity policies are

- Support JICFuS researchers to conduct P.R. and hearing activities
- Create contents including websites to provide information to stakeholders
- Create a mechanism to return to JICFuS researchers by proactively collecting information
- Create a risk management system
- Study and implement methods to measure degree of recognition, understanding and reliability

JICFuS manages the project with the head of the institute and the steering committee. In addition, in order to concentrate on research activities by researchers, JICFuS employs a full-time project manager to provide the following support to facilitate research and development in virtual organizations by multiple organizations.

- Communication and coordination with the MEXT, RIKEN AICS to operate 'K computer', RIST which is the HPCI operation secretariat, research institution secretariat promoting the 9 priority issues, etc.
- Carry out the project smoothly by management of budget and personnel, construction of research and development issues and research organization, compilation of documents including report, etc.

2. Contents and Activities

JICFuS publish various information via website [1]. In here, you can find a lot of contents; movies, brochures interviews, and so on. Monthly JICFuS is a Web magazine serially published in our webpage. We interview young researchers and make articles for the citizen who is interested in computational science. Some of the interviews are shown as short movie in YouTube.

We organize various events to get close to not only computational science, but also particle physics and astronomy. "Quark Card Dealer" is the trading card game for understanding promotion "Quantum Chromo Dynamics". Players collect quark cards while obeying the rules of the color charge and construct hands which correspond to baryons and mesons. It is very popular with little children!

Results of research and activities in the JICFuS are announced in the media and public through press release and a press conference.

3. Summary

Issues and characteristics of management and P.R. in multi field and institution collaborative projects are that culture and common sense, such as research method and way of reporting results, are different when fields are various. Also, while management and management policies of various institutions are varied, it is also necessary to have a P.R. strategy for joint projects and to manage the project promotion. For that reason, it is important to share concepts among researchers with different fields and participating organizations, and it is necessary to consider the unified part separately from the individual parts.

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|Poster|

Journey through the Universe – 14 Years of Communicating Astronomy to the Public

Janice HARVEY*[1]

Abstract. Celebrating its 14th year (2018), Gemini's annual Journey Through the Universe (Journey) program is a continuation (and adaptation of) a program initiated by Jeff Goldstein at the Challenger Center, which ran from 1999-2012. Gemini Observatory joined the Journey network in 2004. Due to the significant outreach and educational resources available at Gemini as well as the community of observatories on Maunakea at large, Hawai'i provided a model community for the effective integration of this program. In its current incarnation in Hawai'i, the multi-faceted Journey program has evolved from a week-long event to a year-round program consisting of hundreds of classroom presentations to over 8,000 students. Eighty STEM professionals, including staff from the Maunakea observatories, NASA, and several universities visited over 300 classrooms island-wide in March 2018.

1. Introduction

Journey through the Universe is Gemini Observatory's flagship outreach program that focuses on STEM education for K-12 students on Hawai'i Island. Gemini, along with the Mauna Kea observatory community, celebrated its 14th year of Journey in 2018. The continuation and growth of Journey in Hawai'i is due to the scientific outreach and educational resources available at the observatories on Maunakea, the unique partnership with the State of Hawai'i Department of Education, and the support of the local community business partners and ambassadors who work alongside our astronomy educators.

2. Journey Evolution

Hawai'i became a national Journey community in 2004 and has grown from engaging 1,000 students in our first year to over 8,000 students in 2018. The objective of the program is to inspire students to want to be scientifically literate and be aware of the career opportunities the observatories offer. Journey supports STEM education by assisting with the integration of NGSS (Next Generation Science Standards) in Hawaii's public schools.

3. Career Panels

During Journey week observatory staff hold "Career Panels" at both the Journey middle and high schools. These panels focus on career and staff diversity, personal stories, and the breadth of opportunities an observatory career can offer.

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4. Assessment

In 2017 Gemini's PIO department embarked on a pilot project to formally assess the key elements of the STEM/Astronomy Career Awareness program for local students and teachers in Hawai'i. The objectives were to establish a baseline (and repeatable) evaluation process that would provide actionable data/metrics on changes in awareness, attitudes and perceptions in a controlled program environment.

4. Future Goals

Gemini will use the data received from the assessment to further evolve the Journey program. We will review the impact on career awareness and programming, see if there are any changes in attitude toward STEM careers and what are the most effective avenues to do so. We will continue to assess the Journey program with the goal of incorporating longitudinal studies for both students and teachers.

6. Conclusion

Sustainability of a flagship program such as Journey through the Universe is paramount. With the continued support of the Hawai'i Department of Education and local astronomy community, we look forward to years of continued growth and measureable success. For additional information on Journey through the Universe, please visit Gemini Observatory's website, www.gemini.edu/journey.

SESSION I.6:

National and Regional Programs

|Parallel Session|

The Naked Scientists in Croatia: Successes and Challenges of Running an International-level Science Communication Event in a Smaller Country

Jacinta DELHAIZE[*1], Elizabeth PETROVIC[*2], Dijana GRAHOVAC[*3]

Abstract. We report on a large science engagement event held in Zagreb, Croatia with international guest-of-honour Dr Chris Smith from 'The Naked Scientists' show. Seven events were held over two days, each targeting different audiences including the public, media, members of government, students and academics. Key events included Croatia's inaugural Science-Meets-Government session and a Naked Scientists Live Show for the public. We describe the importance of cross-institutional collaboration and engaging with embassies of larger foreign nations to support such science communication initiatives in developing countries.

1. Introduction

Croatia is a small country in central Europe with a population of ~4 million people. It is a developing country and is experiencing a significant 'brain drain'. Youth unemployment levels are high and many young people leave to seek employment in other countries. Although excellent science is being conducted in Croatia, fewer international engagement and science popularisation opportunities exist compared to larger nations.

To combat this brain drain and increase public engagement in science, a large science popularisation event was run in the Croatian capital of Zagreb on 24-25th October 2017. The project was named 'The Naked Scientists in Croatia – A Science Affair'. The main organisers were Dr Jacinta Delhaize, an Australian astronomy postdoctoral researcher working at the University of Zagreb, and the Australian Embassy in Croatia. The organisers invited an international guest, Dr Chris Smith, to Zagreb and created a series of science communication events centred on Dr Smith's visit. Here we describe the events and discuss the successes and challenges involved.

2. International guest

Basing a science communication event around the visit of an international guest star was beneficial as it brought novelty, prestige, expertise, an international perspective and justification for collaborating with foreign embassies.

The guest star was Dr Chris Smith, a scientist and expert science communicator based in Cambridge, UK. He is the creator and co-host of the internationally popular BBC radio show, podcast and website 'The Naked Scientists.' Dr Smith is also an Australian alumnus, having previously lived and worked in Australia, where he started his career in radio. During his visit to Croatia, Chris was the guest-of-honour at numerous events aimed at engaging a wide range of audiences.

3. Description and evaluation of events

'A Science Affair' consisted of seven individual events, each aimed at different audiences. These are described below.

Science-Meets-Government. This was modelled off Australia's 'Science-Meets-Parliament' and was the first time such an event was held in Croatia. It was hosted by the Australian Ambassador to Croatia, Her Excellency Elizabeth Petrovic. Participating in the event were seven scientists from different seniorities and STEM fields. Also attending were five government representatives from Croatian Parliament, Ministries and Agencies. Dr Smith acted as the international facilitator of the event. The session consisted of a 1.5-hour free-form discussion of topics such as the need for introducing quality assessment and outcomes-based rewards into the national science system. The question of how to facilitate international collaboration and encourage 'brain circulation' instead of 'brain drain' was also discussed.

The success of the session was evaluated through feedback forms completed by all attendees. Ninety per cent of participants said they enjoyed the event and would like it to happen again. 70 per cent of government representatives stated that they now understood more about life in science, however only 45 per cent of scientists felt they understood more about life in government. We attribute this to the

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fact that the short session was dominated by discussing issues in science. We endeavour to make Science-Meets-Government a larger, annual event, with future sessions focusing on life in both science and government/policy-making.

Science communication master class. Twelve undergraduate/Masters/PhD science students received science communication training during a 2-hour workshop with Dr Smith. Each gave 5-minute science-based presentations and received immediate feedback from Dr Smith. All students indicated that they found the event useful and felt more confident in presenting their work to a range of audiences. The workshop also triggered an ongoing collaboration, with several students writing feature articles for The Naked Scientists website.

High school visit. Dr Smith and Dr Delhaize visited a local high school where they discussed astronomy and general science topics with ~500 students aged 14-17 years old. This triggered an ongoing 'student research experience' collaboration between the high school and the University of Zagreb's Faculty of Science.

Interviews with scientists. Dr Smith interviewed several Croatian scientists about their research. This gave the scientists interview experience with a professional science communicator and a possible platform for international exposure for their work if the material is used on The Naked Scientists show.

Academic reception. An evening reception was hosted by the British Embassy in Croatia. It was attended by ~60 members of the academic, diplomatic and leadership communities in Zagreb. This was an excellent opportunity to create new networks and foster future collaborations. Dr Smith addressed the guests on the importance of science communication. Ambassador Petrovic and British Deputy Ambassador Peter Clements spoke about the importance of international scientific collaboration and science diplomacy.

Media meet-and-greet. The Croatian press were briefed about 'A Science Affair' during a panel discussion with representatives from each of the partner institutes (see Section 4), Dr Smith and Dr Delhaize. Journalists then conducted exclusive interviews with Dr Smith. This resulted in at least 9 articles online and in 2 major Croatian newspapers, and many radio and TV interviews including prime-time shows. These reached a broad and substantial general audience around the country.

Live show. The final event was The Naked Scientists Live Show. This was held in a university lecture hall and was attended by ~200 members of the public. Dr Delhaize gave a short astronomy lecture and Dr Smith performed a series of impressive science experiments. The show was televised on three Croatian TV stations and has had over 600 views on Youtube.

4. Cross-institutional collaboration

A key element to running this low-budget event was generous cross-institutional collaboration. The main event partners were the Australian Embassy in Croatia, the University of Zagreb's Faculty of Science, the Ruđer Bošković Institute (a major research institute) and the British Embassy in Croatia. Each institute provided venues, equipment and supplies for events, thus minimising costs.

The main costs incurred were the airfares, ground travel, accommodation and promotional fees for Dr Smith. These costs were covered by the Australian Embassy through their Public Diplomacy budget and the Australian Government's Global Alumni Network.

Cross-institutional collaboration also provided organisational support and access to media and government contacts. The involvement of foreign embassies also brought an element of prestige, particularly when official invitations were sent on behalf of ambassadors. However, it should be noted that events involving foreign embassies must be politically and diplomatically neutral and must have clear benefits/relevance to the embassy. In this case, it matched the mission of the Australian Embassy to engage with Australian alumni (Dr Smith and Dr Delhaize) and to promote Australia's stance on scientific diplomacy and international cooperation.

5. Conclusions

We have demonstrated how a low-budget, international-level science communication event can be held in a small, developing country with few pre-existing networks. High levels of public engagement were achieved with a broad range of audiences. All feedback was extremely positive and ongoing collaborations were established as a result of the event. Cross-institutional collaboration, engagement with foreign embassies and an international guest-of-honour were the keys to the success of 'The Naked Scientists in Croatia – A Science Affair'.

National Campaigns in India: What Do They Teach Us?

Niruj M. RAMANUJAM[*1], Samir DHURDE[*2], T. V. VENKATESWARAN[*3] , Rathnasree NANDIVADA[*4], Aniket SULE[*5], Priya HASAN[*6]

Abstract. The Public Outreach and Education Committee of the Astronomical Society of India has initiated many national level astronomy campaigns since its formation in 2014. These were in collaboration with a diversity of local stakeholder groups across India, building on previous work by other groups. Here, we describe these campaigns, discuss the necessity for national coordination, and list some of the lessons learnt.

1. Introduction

India has had a rich tradition of large scale astronomy campaigns for many decades now. These campaigns have been varied in terms of geographical reach, the target audience, and their number. Many of the campaigns of the past were organised around celestial events by mass organisations.

The Astronomical Society of India (ASI) constituted its Public Outreach and Education Committee (POEC) in 2014. Since then, the POEC has been taking the lead in organising many such astronomy campaigns on a national scale, in collaboration with local groups. In the following sections, these campaigns of the POEC (of whom all the authors are members) along with earlier ones are described and the lessons learnt from them are discussed as well.

2. The POEC of the ASI

The ASI is the primary body of professional astronomers in India and it formed the POEC in 2014 to promote interest and awareness of astronomy in India. The POEC creates quality open source resource material, maintains an active social media presence, publicises research news from India and elsewhere, supports students and amateur astronomers, publishes a newsletter, among others. The POEC works with different networks of stakeholders who have been active for many decades in their localities (e.g., planetaria, amateur astronomy groups, Peoples Science Movements, research institutes etc).

3. Past national campaigns

India is unique in having a number of mass-based science popularisation organisations, called Peoples Science Movements, or PSMs (see [1]), each operating in an Indian state. These PSMs, in collaboration with other astronomy organisations, have been organising mass campaigns around celestial events for many years. The first was the total solar eclipse in 1995, when Navnirmiti Foundation created and distributed 0.5 million eclipse glasses (Monteiro & Mahashabde, private communication) for more than 100 public camps in the country. The total solar eclipses of 1999 and 2009 also saw similar efforts, as also the transit of Venus in 2004 and 2012. One of the first truly national campaigns, with centralised creation of resource material and a national coordination committee was the 'Eyes on ISON' campaign in 2013, which led to more than 175 training workshops. Many of these campaigns saw participation from local student science clubs, amateur astronomy groups, and teacher networks. IYA 2009 also had a large number of individual events organised across the country.

4. Need for national coordination

The 'Eyes on ISON' campaign taught us that a national level coordination is essential for the success of any campaign in a country like India. The sustained and effective work done by many groups is restricted to

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their local area. Resource material that is created is often not publicly available, partly due to problems of language and translation. There is a large diversity of quality of program content and of funding across these groups. A crucial factor that necessitates reinvention of strategies and regrouping networks for every event is the lack of documentation, evaluation and reports.
However, these national campaigns are an effective way of disseminating astronomy in the public domain. Providing a layer of coordination ensures the creation of quality resource material that can be shared and translated. It also facilitates the bringing together of many disparate networks (e.g. teacher groups, planetaria, science centres, student clubs, governmental science organisations, PSMs etc). The presence of this diversity is seen to enrich the programmatic contents of these campaigns.

5. National Campaigns by the POEC

Since its formation, the POEC has initiated many national campaigns, of which the three largest are:

(1) Transit or Mercury (2016): The POEC crowd-sourced telescope owners across India through online tools to organise public viewing of the transit, reaching around 75000 people [see 2].

(2) Zero Shadow Day (ZSD): ZSD occurs for locations between the two tropics when the declination of the Sun equals the location's latitude. In 2017, the POEC started a campaign (see [3]) in the relevant states in collaboration with PSMs, leading to around 200 events in schools. This year, we aim to reach ten times this number, partly helped by an android app that we have commissioned.

(3) Total Lunar Eclipse (31 Jan 2018): The POEC crowd-sourced an interactive map of more than 600 locations hosting eclipse parties, set up a website with resource material, contacted schools and colleges across India to see the eclipse, and organised an anti-superstition social media campaign (see http://bit.ly/eclipse31jan).

In addition, the POEC organises regional campaigns during astronomy conferences in collaboration with local stakeholders, in the host city or state. These last for a couple of weeks, and consist of many programs aimed at school students, college students, and science teachers. These campaigns include Kashmir Valley (2016, [4]), Rajasthan (2017) and Hyderabad (2018, [4]) during the annual meeting of the ASI, and Jaipur (2018) during IAU Symposium 340. The POEC has also initiated a Festival of Measurement at the four cities hosting Jantar Mantars, the large non-telescopic 18th century masonry observatories, to enable school students to use these instruments to make astronomical measurements.

6. Lessons learnt and caveats

Based on the experience of the POEC since its formation, we infer the following lessons and caveats in the context of organising national campaigns.

(1) Special attention is needed to seek out and identify active stakeholders in each region. Working only with easy accessible (e.g. online) groups may perpetuate existing regional and social biases.

(2) In a common platform for organisations that differ widely in funding power, access to government etc, it is important to build a system of inclusive participation and decision making.

(3) Since the local dynamics and power structures are not known to us, it is crucial to identify multiple independent partners in each region and not rely on a single point of contact.

(4) A variety of tools and options need to be made available for a given purpose (e.g. for accessing material, sending in feedback etc), to accommodate differing bandwidths and ease of using online tools.

(5) Create centralised repositories of resources (e.g. our website astron-soc.in/outreach) and online tools.

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|Parallel Session|

Communicating Astronomy with the Public: Communicating a Deviance in Vietnam

Vu T. NGUYEN*

Abstract. Vietnam is proud of its thousands of years of history and tradition but this country is still a freshman in the school of astronomy. This paper is an attempt to address the challenges in the institutional building process of astronomy in Vietnam, from a deviance case to a late acceptance. The paper also illustrates how the amateur sector, by focusing on public outreach and education, can contribute to astronomy development and astronomy for development in Vietnam. The findings show that science communication, together with education, can help promoting democracy in developing countries.

1. Introduction

What we talk about when we talk about astronomy in Vietnam: It is a new yet long story.

Did you know? The first Asian cosmonaut is from Vietnam, thanks to the Soviet Union. Consequently, when the world said goodbye to the USSR, Vietnam also said goodbye to its dream of space. It took time for Vietnam to once again open its doors to the world and it even took a longer time for astronomy and space science to go back to the country.

This paper tries to answer 3 questions in the context of Vietnam: (i) what is the current status of astronomy, (ii) what have amateur astronomers done, and (iii) what are the lessons learnt from astronomy communication.

2. An Insight into Astronomy in Vietnam

In Vietnam, disciplines such as astronomy and space science are generally absent from the policy-making process as they require long-term investment and commitment.

In 2006, twenty years after Đổi mới (Renovation Policy), Vietnam delivered its National Strategy for Space Technology Research and Application until 2020. [1] What were the results? Only space technology and space application. There has been not a single word for astronomy and space science as if they never existed or Vietnamese policy makers never hear any of these before. The only focus on space technology is really troublesome.
Moreover, political contestation has created two national agencies in charge of space programme [2], and no body in charge of astronomy research.

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Besides, this so-called comprehensive plan does not have the say and participation of amateur astronomers, astronomy enthusiasts in Vietnam, and people who are interested in astronomy, in general.

Furthermore, it is a fatal mistake that Vietnam Space Committee [3] has no representative from the Ministry of Education and Training. It explains why astronomy education has gradually declined, from 2 credits to 2 teaching periods at undergraduate level.

In addition, it is unfortunate to see Vietnam shows no interest in the IAU Strategic Plan 2010–2020 ‘Astronomy for the Developing World’ despite it is a beneficiary, not mentioning the fact that Vietnam has gained a good reputation for being a successful story of the United Nations Development Goals.

3. VietAstro: A Decade-Long Journey

Fig. 1. The official logo of VietAstro and HAAC

Established in 2007 by Ho Chi Minh City Amateur Astronomy Club (HAAC), VietAstro has become the nationwide community for amateur astronomers in Vietnam, and the national consortium of Vietnamese amateur astronomy clubs.

Even though it is not the first of its kind, it is a must to mention VietAstro to get to know the success and challenges of Vietnamese amateur astronomy.

Born at the dawn of the internet era in Vietnam, thanks to the vision of its co-founders, VietAstro has its own brand as well as social media accounts. During the last 10 years, there are a variety of its outreach activities, from sky parties to introductory courses to astronomy, from astrophotography to DIY optical and radio telescopes, and from local stargazing camps to eclipse hunting trips worldwide, etc.

As HAAC is the flagship amateur astronomy club in Vietnam, its personnel coordinate and lead the way forward for VietAstro. Difficulties VietAstro is facing are challenges for not only HAAC but every amateur astronomy society in Vietnam.

Notably, it is interesting to see the amateur sector bearing the national flag of Vietnam in international engagement. After celebrating International Year of Astronomy (IYA), HAAC has been affiliated with Astronomers Without Borders (AWB) and World Space Week Association (WSWA). It has also brought to Vietnam other international astronomy projects such as StarPeace, Universe Awareness (UNAWE), Lunar Mission One (LM1), etc.

Thanks to the valuable support of the International Astronomical Union (IAU) Office of Astronomy for Development (IAU-OAD) as well as the IAU Office for Astronomy Outreach (IAU-OAO), efforts of the not-yet-recognised VietAstro have been recognised beyond the national borders.

4. Communicating Astronomy as a Deviance

Why is astronomy considered deviant in Vietnam? First, the public sector seems not to care and the state-controlled official associations have been only nominal and frequently inactive while the incomplete legal framework challenges any effort for civil society association. It then legally obstructs any effort of civil society organisations to involve in science and technology communication.

From the ground, young Vietnamese with dreams of space have always been struggling in transforming their passion into profession. In fact, families usually do not understand, hence, do not support what they call illusory and impractical dreams. It is believed that astronomy careers cannot earn much money.

Next, there is a lack of somewhat a kind of proper "amateur-professional" / public-private partnership in astronomy communication and education.

The above answers make the question shifted to how to communicate astronomy in this country?

VietAstro plays the critical and irreplaceable mediating role between amateur astronomy with the people, the media, and the state in Vietnam. This enterprise also replaces the role of educators in career orientation and education consultation.

It takes so much time for astronomy in Vietnam, from a deviance case, to become a late acceptance. Nevertheless, the key factors are not from the public sector but the amateur astronomy (private sector) and international pressure.

In short-term, a top-down approach to change the current circumstance of astronomy in Vietnam is likely impossible. No one would ever think of foreign influence as a change agent but the impact is remarkable. However, VietAstro cannot rely on international aid as it needs to find its path forward to more successful astronomy communication as well as better socio-political mediation effort.

To sum up, communicating astronomy in Vietnam might be different but it should not be deviant.

5. Conclusions

The national motto of Vietnam is "Independence – Freedom – Happiness". Yes, the state has gained back its independence for more than seven decades but the nation is still fighting for freedom and happiness.

Vietnamese amateur astronomers are determined to mobilise all their physical and mental strength to safeguard their rights: freedom of association, in order to officially establish an association for Vietnamese amateur astronomers; freedom of speech, in order to articulatorily participate in Vietnam public policies for astronomy and space science; academic freedom, in order to revive astronomy in Vietnam national education curriculum; so on and so forth.

Only with liberty, from the little joy of observing the beauty of the night sky, the pursuit of happiness would become possible in Vietnam. Therefore, it is VietAstro's mission to communicate astronomy, from a deviance to an excellence in Vietnam.

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|Parallel Session|

Communicating Astronomy in Bangladesh: Achievements and Challenges

Farseem M. MOHAMMEDY[*1], Niranjan C. ROY [*1]

Abstract. Since independence in 1971, Bangladesh has not seen any formal education in astronomy. It was the advent of Halley's Comet in 1986 that germinated at least two organizations that contains 'astronomy' in their names and motto. Since then, there has been a somewhat continuous flow of activities: forming a mini planetarium, night sky observations, collecting telescopes, arranging workshops and seminars, poster presentations, video sessions etc have been arranged by a core group of 'amateur astronomers'. The chief workload has been laid on the shoulders of three main organizations that carry telescopic observations and amateur astronomy activities. International Year of Astronomy (IYA) 2009 created a large impact in astronomy outreach programs. The impact was also magnified by the occurrence of a total solar eclipse visible from Bangladesh on 22nd July 2009. Unfortunately, however, the impact slowly got diffused in the following years. Though, by 2010, outreach programs are confined to either occasional telescopic observations, or workshops on astronomy or telescope making (very few), passing seminars by visiting scholars, or astronomy olympiads. Astronomy awareness in Bangladesh could not evolve any further than outreach programs. This paper outlines the evolution of the organizations involved in astronomy outreach activities in Bangladesh.

1. Introduction

Bangladesh is located in the South Asia, bordering on the east side of India and on the west of Myanmar. Bangladesh won her freedom on 1971 and since then she has her own astronomical activities. Organizational activities, however, took footing in Bangladesh not before the 1980's.

There are three organizations who can be credited with amateur astronomy program in Bangladesh – Anushandhitshu Chakra (est. 1975), Bangladesh Astronomical Society (est. 1985) and Bangladesh Astronomical Association (est. 1988).

2. The Three Organizations

That was 1984, and amateur astronomy was gearing up because Halley's comet is expected to shine in the night sky in 1986. These activities were the seeds for future amateur activities. Professor Abdul Jabbar, a late professor of mathematics, who routinely wrote about monthly night skies in Bengali newspapers, was the true pioneer in gearing up sky observations and astronomy thinking in previous East-Pakistan, and now Bangladesh. During the mid-1960's when his books were getting published, Apollo Mission to the Moon (1969) had generated public curiosity regarding members of the solar system as well as into space missions. The Apollo astronauts visited Dhaka on 25-26 October 1969 and the crowd to watch the men who conquered Moon was overwhelming. But it took a decade and more to solidify the ideas and gather the men and few women who will form societies and clubs to organize amateur activities in Bangladesh on a routine basis.

The Anishandhitshu Chakra (AC) is a respectable science club. Lately, and especially in the post IYA-2009 period, they concentrated their efforts toward amateur astronomy. AC's General Secretary Mr. Shahjahan Mridha played a crucial role in erecting a mini planetarium based on an imported 16-inch refracting telescope in the roof of the then science museum which later developed into full-fledged National Museum of Science and Technology (NMST).

Bangladesh Astronomical Society (BAS) was born in 1985. The core members were faculties of DU, BUET and a few businessmen who were die-hard amateurs. Since its inception, BAS has arranged many seminars, meetings on different topics and occasions of astronomy including sky observation camps to attract people towards the night sky: the Halley's Comet observation program during its apparition in 1985-86, astronomy education program in 1987, total solar eclipse observation program in October 1995, Leonid Shower observation in November 1999 were a few examples. One of the achievements of the Society was gearing up momentum and opinion about, lobbying to the Government of Bangladesh (GOB) and helping the establishment of the Bangabandhu Sheikh Mujibur Rahman Novo Theatre, in Dhaka. The latest international events organized by BAS was Space Education Seminar, 17-19 January, 2011 at Dhaka, co-organized by Asia-Pacific Regional Space Agency Forum (APRSAF) and Japan Aerospace Exploration Agency (JAXA), capacity building Teachers Training Workshop at Enayetpur, Sirajganj, arranged by UNESCO and UNOOSA on 3-5 October 2011. Other than these and other additional activities, BAS conducts a regular

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astronomy workshop - the Abdul Jabbar Astronomy Workshop since 2009. This workshop has been quite popular among students and enthusiasts and in 2017 it completed its 10th episode.

The third important organization to mention is Bangladesh Astronomical Association (BAA) which started its journey on 1988. BAA has arranged: total solar eclipse observation camp (1996), primary astronomy training workshop (1992 & continuing), Astronomy Olympiad (2007-2016), Sunfest (since 2001) etc. The BAA runs a periodicalsince June 1988, the only of its kind in the country, the Mohakash Barta .

3. IYA-2009

One of the most important milestones on astronomy outreach in Bangladesh in recent times was International Year of Astronomy in 2009. It was a year-long activity and every club or organization of repute that possess minimum interest in astronomy took part in their own way.

IYA-2009 activities were launched in Bangladesh on 1st of January, 2009 from Enayetpur, Sirajganj about 140 km north-west of Dhaka. There was activity on astronomy outreach for almost every month that year. For example, observation of partial solar eclipse (26 January, National Museum of Science and Technology (NMST), Dhaka), commemoration of Galileo's 445th birthday (15 February, NMST, Dhaka), 100 hours of astronomy (2-5 April, around Enayetpur, Sirajganj and Kashinathpur, Pabna and lastly in Dhaka), a two-week long primary astronomy appreciation workshop (26 May to 13 April), facilitated by many professors. The second workshop was conducted in the same year, 3-4 July, in Dhaka.

The most important activity of 2009 was the total solar eclipse that was visible in the northern districts of Bangladesh. It was observed on the morning on 22nd July from the northern-most district, Panchagarh, where the totality occurred for full 3 minutes and 58 seconds. More than 30,000 spectators from all over the country came to observe the eclipse.

4. Challenges

Absence of academic tradition and lack of enough routine outreach programs is creating hindrance in the practice of astronomy in Bangladesh. Though the activities of the three organizations is keeping the light alive, deficiency in proper and adequate infrastructure greatly obstacles it. Though the Government of Bangladesh has written commitment toward astronomy/astrophysics education through its science and technology Action Plan (2012), e.g. research institute for space research, national observatory etc., but there has been little progress toward that end. If these resolutions are met and the international community also come forward to suggest some effective directions, youngsters of Bangladesh will surely engage themselves in the greatest adventure of mankind.

5. Conclusion

Essentially, three organizations run parallel astronomy outreach programs in Bangladesh since the 1980's. These organizations maintain different scopes and hence have different terms of reference. The International Year of Astronomy 2009 program, initiated by International Astronomical Union (IAU), united many popularizers of science which created a massive impact in astronomy outreach programs in the country. In the following years, however, the participants dwindled as the IYA momentum was diffusing and interests waning. Astronomy Olympiad is one thing that has kept its appeal to students. And workshops still get organized, which is a positive thing. One of the reasons for lack of interest may be the absence of any university program on astronomy/astrophysics. Surprisingly, even after 40-plus years after independence; the country's universities have not introduced this globally appealing subject into their curricula. Nevertheless, in last five years, 4 engineering students have pursued their own astronomical aspirations in post-graduate education in astronomy – two already received their Doctoral degrees in astronomy. This is a remarkable story of personal strength and motivation despite the lack of any local infrastructure.

However, some international collaboration has pushed outreach activities into new potential vistas. It should be mentioned that JAXA workshop and the UNESCO capacity building workshops, arranged by BAS in 2011, and OAD grant to AC (2015) generated some useful interest and awareness in this regard.

Infrastructural development, university curricula development, inclusion in the school curricula, generous donations from wealthy citizens and through consistent corporate social responsibility programs rather than individual interests can sustain astronomy awareness programs in countries like Bangladesh.

|Parallel Session|

Amateur Activities and Public Outreach by Japan Amateur Astronomers Association

Keiko CHAKI [*1]

Abstract. Since its establishment, Japan Amateur Astronomers Association (JAAA) has been making efforts to popularize astronomy. The presentation outlined the amateur activities in Japan and the public outreach carried out by JAAA, such as the LIME Campaign and 'Subaru Challenge'.

1. Introduction

JAAA was established in 2010, as a result of the success of the International Year of Astronomy (IYA). It is an informal network connecting, mainly, amateur astronomers, astronomical fans and the general public in Japan. All the staff are volunteers and the activities of JAAA are supported by the devotion and the passion of the staff. JAAA puts special emphasis on the communicating astronomy with the public.

2. Amateur Activities

There are many prominent amateur astronomers in Japan, who are famous for their high standard research. Some are making great contribution to the progress of academic studies in the astronomical field, or even to new discoveries.

In addition to these high-level amateurs, there are lots of astronomical fans in Japan. They enjoy watching, observing, gazing, or photographing planets, comets, nebulae, clusters, eclipses, meteor showers, starry skies, holding star parties, making telescopes and so on. Each may have a different style of enjoying astronomy. But it is certain that many people are interested in astronomy in Japan.

JAAA organizes the Amateur Astronomers Meeting every year. It is a good opportunity for amateurs and fans to give presentations, exchange information and deepen friendship. The Kaifu Norio Award is conferred on presentations by youths under the age of 18 because Dr. Kaifu is the advisor of the JAAA. It encourages and motivates young people.

3. LIME Project + Moon Observing Campaign

LIME (Lunar Impact Monitoring Event) was NASA's project in 2013, to monitor the moon from the earth and catch impact flashes on the dark side of the moon, while their spacecraft, Lunar Atmosphere and Dust Environment Explorer (LADEE) was exploring the lunar environment.

NASA called for public cooperation. So we decided to support the project and made it our campaign by adding the moon observing at the same time. First, we approached amateurs for cooperation. Then, a pair of amateur astronomers kindly offered to make a life-sized humanoid LADEE (*Fig. 1).

We took the humanoid to Tobi Fudou-son Temple to pray to the God of Flight for the success of the spacecraft LADEE. Also we took the humanoid to major star parties, handed out flyers we made, called for supporting the campaign and encouraged the people to observe, photograph, illustrate, or just enjoy the moon. We also distributed information of the condition and achievement of the probe. Not only we supported the project like cheer leaders, but we offered opportunities like workshops related to LIME project, to learn how to monitor, record and detect the flash of the moon.

Impact flashes bright enough to be seen or recorded do not happen so often but the campaign itself was worth doing.

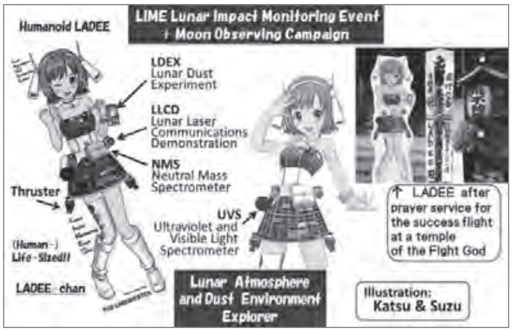

Fig. 1. Humanoid LADEE

Thanks to the illustrators, 'Katsu & Suzu', the manga-style LADEE attracted enough attention to involve many people in the campaign.

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4. Subaru Challenge

This was JAAA's campaign for the International Year of Light (IYL), to see stars at the same time or period all over the country and to challenge the light-gathering power of Subaru Telescope in Hawaii.

What if we collect all the starlight coming from the universe into our pupils and telescopes and binoculars? Perhaps our light-gathering power might exceed that of Subaru Telescope!

We made various kinds of flyers and printed over 30,000 copies. (Fig. 2)

Fig. 2. Mascots and flyers of 'Subaru Challenge'
The mascots and handouts on the left were made with the kind cooperation of the professional illustrator, Mr. Agi Jiro. The flyers of animation, *anime* characters on the right were made with the special and exceptional cooperation from the production, BANDAI NAMCO Entertainment Inc.

We appealed not only to astronomy fans, but also the general public, especially, *anime* fans. Of course! Why not! The girl, Anya, on the flyer is a character of 'Cinderella Girls', very popular among *anime* fans.

We used social media and tweeted about the campaign. Then, there were many retweets and some tweeted 'I had never seen stars before.' Others said, "Wow! the moon was beautiful. I would like to know more." Or, "Let's look at stars together, again!" And surprisingly, this movement is still going on now. They organize their own star parties.

We carried out the Challenges six times. We failed and failed. And we set the period as long as fifteen days at the last challenge. The result of the final challenge was………

Yes, we did it! We received 265 reports and there were 4707 participants. The light gathering power of the Subaru Telescope is 1,372,245. Our challenge reached 1,439,264.

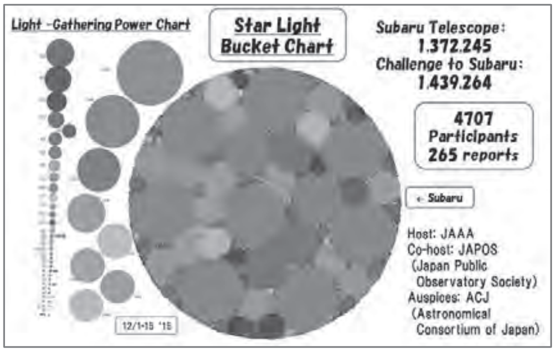

Fig. 3. Star-Light Gathering Power Chart
The biggest circle on the base is the Subaru Telescope. It is completely filled with circles which are all our equipment including human pupils, reported in the challenge.

5. Conclusions

By setting targets like this challenge, it becomes easier to see the achievement and the current status. We get motivated to reach the goal by seeing the progress. Also it is fun like a game. Stargazing becomes more enjoyable. And it makes astronomy more familiar and more popular.

Through these kinds of campaigns, we hope that people can feel in a number of ways as follows:
Feel connected: So many people are observing at the same time and all are connected.
Feel the peace and the wonders: Feel how happy we are to be able to see stars in peace. Feel the splendor and wonders of the universe. And we can share these feelings of the splendor, wonders and happiness.
Feel we are a part of the universe: Imagine we are sharing the same sky. Imagine someone else is stargazing like you. Somebody living far away is looking at the same stars, the same moon, the same planets, the same galaxies and the same universe.

The sky is equally above us.

The universe is one, around us.

Acknowledgement

I would like to express my deepest appreciation to the late Mr. Hideaki Kimura. He was a secretary of JAAA and passed away last year. I am sure that those campaigns could not have been carried out and achieved without him. I pray his soul may rest in peace in the celestial heaven, the universe.

|Poster|

Communicating Astronomy with the Public: The Regent University Community in Ghana

Emmanuella RANDALL-ABAKAH*1

Abstract. After we attended the 2017 West African International Summer School for young Astronomers, which was held on the 30th July to 5th August 2017, here in Accra, Ghana, two other participants and I from Regent University college of Science and Technology, decided to start a society of Amateur Astronomers at the University here in Accra Ghana. The aim for starting the society on campus was to help demystify the study of Astronomy and to assist members to learn how to navigate the night sky with the help of modern technology and software. With these, members have become familiar with the basic Astronomy and are able to navigate the night sky without difficulty. And non-members have taken keen interest in issues relating to astronomy and space science in general.

1. Introduction

Astronomy is a broad subject that cuts across human historical and religious background. It explains the beauty of existence in terms of the celestial bodies, galaxies and their mathematical representations. Astronomy utilizes mathematics, physics and chemistry.

In the part of the world I come from, we have a lot of Mathematicians, Physicists and Chemists who know little or nothing about astronomy as a subject or as a field of study, due to the apparent lack of enthusiasm, and the paucity of knowledge about astronomy; as well as misconceptions regarding astrology and astronomy.

Communicating astronomy must be done at all levels of communication e.g. societal, institutional, group, interpersonal and intrapersonal.

- Social media could also be used as a platform to disseminate information and stay abreast on the latest news in astronomy. Astronomy chat groups could also be created. Intra-school and interschool astronomy quiz competitions could be organized. Periodic visits to the broadcasting houses could be arranged for mass communication of astronomy with the public. These activities must be carried out actively and consistently. These actions will help clear such misconceptions and bring to light what Astronomy is truly all about, as a field of Science.

If we can work on this peculiarity built within each man by promoting astronomy as a principle, this will adequately bring into light a clear and a detailed means of making them understand what these celestial objects

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2. Objective

To Communicate Astronomy with the Regent University of Science and Technology community.

2. Indigenous challenges in astronomy communication

The lack of public awareness about astronomy as a field of study (relative to the subjects mentioned previously) in my part of the world, is the bed rock for the misconception between astronomy and astrology. Thus, astronomy is neither promoted nor often taught formally in our part of the world.

- It is not included in our school curriculum both at the primary and at the secondary levels. Only a few tertiary institutions offer astronomy as an option with physics.
- Moreover, the culture and traditions of the people make it even harder for the average African girl or woman to gain exposure to the field of astronomy.
- Lack of well-trained tutors, communicators and peer educators in astronomy.

3. Conclusion

Our traditions and culture has allowed paucity of knowledge in astronomy to thrive. This is worse among the females, sadly for the same reasons. However, creating public aware-ness especially among women is likely to have that knowledge trickle down to their offspring and more uniformly distributed among both genders.

- Like the astronauts and cosmonauts on the International Space Station (ISS), maybe astronomy might just be the solution to breaking through human boundaries thus, helping us embrace each other and appreciating the harmony in our diversity.

Introduction of the Japanese Society for Education and Popularization of Astronomy

Hidehiko AGATA*1, Naohiro TAKANASHI*2 and Kyohei ANDO*3

Abstract. Japanese Society for Education and Popularization of Astronomy (JSEPA) is the largest community of people who engage in a variety of activities related to communicating Astronomy with the public. JSEPA's main purpose is to promote education and the popularization of Astronomy, which include not only school and social education, but also lifelong education. JSEPA started in 1987, and now it has over 650 members, that conduct a large variety of activities. Reports of those activities can be found in journals and conferences.

1. Introduction

The first conference for education and popularization of astronomy in Japan was held in 1987 -- this event marks the foundation of JSEPA. Two years later, JSEPA was established officially and started publishing a journal named "Tenmon Kyoiku" (Astronomy Education). Since 2007, JSEPA has been one of the academic partners of the Science Council of Japan. In 2018, JSEPA is reformed as a General Incorporated Association. [1]

JSEPA consists of 666 members, including 603 general members, 37 student members, 23 corporate members, and 3 patron members. For example, JSEPA is composed by: teachers of elementary, junior high, high school, researchers of science education, staffs of science museum and planetarium, observatory, amateur and professional astronomers, education and public outreach officers, science communicators, science writers, publishers, Astronomy enthusiasts, students etc. There are three permanent working groups (school education, social education, public engagement) an seven local branches (Hokkaido, Tohoku, Kanto, Chubu, Kinki, Chugoku & Shikoku, Kyushu & Okinawa).

Fig. 1. Member activities. Credit: JSEPA.

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2. Activities

Members of JSEPA engage in a variety of activities, such as stargazing parties, workshops, seminars, lectures, development of educational materials, writing books, and so on. The individual goals of the members, their location, etc, for doing these activities may vary, however, the mindsets, tools and passions are similar to each other. On the other hand, JSEPA convenes an annual conference (three days) in summer every year. Regional conferences are also organized in each branch, two or three times per year. The conferences are opened to everyone interested.

Publication is an important activity for JSEPA. “Tenmon Kyoiku” is a journal where you can read various articles including refereed papers, opinions, report of practices, columns and so on. It is published six times per year. JSEPA also publish proceedings of the annual conferences. In addition, publishes textbooks for beginners who intend to hold stargazing parties. These books are published as needed.

When occasion arises, JSEPA is a recognized authority to make public comments on issues related to the field of education. Ad hoc committees or working groups are established in order to treat those issues.

3. Summary

JSEPA is a developing community. We welcome collaboration with diverse partners. Please contact us if you have any ideas at jimu@tenkyo.net

References

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|Poster|

Astronomy Outreach in Zambia and Malawi

Prospery C. SIMPEMBA[*1], Sohan JHEETA[*2] and Patrick MZAZA[*3]

Abstract. We consider spreading astronomy to schools as a means of engaging with young people and motivating them to take up science and engineering careers. During our school visits, we donate small telescopes, astronomy software and start astronomy clubs. On the other hand, we make use of natural events such as solar and lunar eclipses to mount public engagement activities to explain astro science to the public. For each country, an optical telescope has been acquired through donation for use in public outreach. Seminars and workshops are held for teachers of science, taking advantage of already planned activities such as the Work Space Week (4-10 October), Global Astronomy Month (April), Africa Code Week and national science week. These activities have resulted in increased astronomy awareness in both the young people and the elderly and have led the foundation for introducing aspects of astronomy in school curricula. Other inspiring programmes have been lined up such as the Physics Road show, a means to offer science in institutions that lack expertise and equipment by a group of people selected to be role models for the young. Through these activities, it has been possible to foster collaboration with UK, Zambia and Malawi.

1. Introduction

The population in Zambia and Malawi is largely made of young people, presenting an opportunity for growth of human capital. We thus find it useful to constantly engage the young people by taking outreach activities to schools. Zambia finds strenght in partnering with Malawi and Sohan Jheeta [1] of Britain to roll out intensive outreach activities. Training workshops and short intensive courses in science and astronomy have wider acceptance in both countries. This outreach work is achieved through a dedicated team of men and women that do outreach who constitute the National Outreach Committee (NOC).

2. Objectives

We aim to reach out to the majority Zambian and Malawian population and enlighten them about astronomy and the spin-off benefits of astronomy while generating interest in young people for them to choose science and technology careers that can then filter into astronomy and space science specialisations.

3. Approach

We visits schools and form astronomy clubs. The social media platform is used to reach out to the public and we stage public activities in planned major events such as World Space Week, Africa Code Week, social media week, national science week, Yuri's Night, global astronomy month etc.


(a)


(b)

Fig. 1 Photo taken after addressing grade 11 pupils of Olympia Secondary School (a) and grade 12 pupils of Nkana Secondary School (b) (Image credit: Sohan and Prospery)

4. Summary

Our outreach activities have increased astronomy awareness in both Zambia and Malawi.

References

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New Challenges for Public Outreach by Astrobiology Center of Japan

Nobuhiko KUSAKABE*1

Abstract. Astrobiology Center (ABC) of Japan is established in 2015. For public, "Life in the Universe" is one of the most attractive topic. Many famous science fiction and alien movies are made in some countries. In many case, such movie creators and/or writers would interviewed to real researchers and (at least partly) reflect on their works. However, most public people do not know actual astrobiology research. Therefor, ABC needs to tell scientific astrobiology research.

1. Introduction

As a result of developments in extrasolar planet observations, astrobiology research to explore "Life in the Universe" and uncover its mysteries has become a pressing subject. Astrobiology Center (ABC), established in 2015, advances this field by combining disciplines, promotes research into extrasolar planets and life both outside and within the Solar System, and develops observational instruments for these purposes.

For public, "Life in the Universe" is one of the most attractive topic. Many famous science fiction and alien movies are made in some countries. In many case, such movie creators and/or writer would interviewed to real researchers and (at least partly) reflect on their works. However, most public people do not know actual astrobiology research. Therefore, ABC needs to tell it.

2. ABC Activities

ABC main activities are grants-in-aid for astrobiology research, cooperation with foreign astrobiology institutes, inter-university cooperation for instrument development, international workshops, invitation of foreign researchers and development of young researchers. We have three offices of Exo-Planet Search Project Office, Exo-Life Search Project Office and Astrobiology Instrument Project Office.

3. Outreach activities

At first, we have opened the astrobiology center official website since 2015 (http://abc-nins.jp). In the website, twelve topics related astrobiology and exoplanet researches have been released until now. And we organized and participated various outreach programs such as visiting lectures, public talk, symposiums and open campus based on the research topics of Astrobiology. For example, recent topic is photosynthesis on a habitable exoplanets. Plants on exoplanets are quite attractive topic. We talked about both photosynthesis and habitable planet on some symposium.

In an open campus, we held exoplanet and alien drawing events for children. In this event, we explain some exoplanet parameters such as size, temperature, stellar type and gravity. Then children drew freely their own planets and aliens based on scientific exoplanet environment. On the other workshops, we try to Active learning type workshop. Particularly, "NAZO-TOKI (solve a riddle)" type workshop is a new type science outreach method. Children solve astrobiology related riddle (not only a "Quiz") with some hints. It feels treasure hunting (fig.1).

Fig. 1. A photo of NAZO-TOKI event.

3. Summary

Drawing events are good tool for children. However, it needs to improve. NAZO-TOKI events are new approach for science outreach. This riddles feature is not only scientific information but also experience and thinking. So making riddles are quite hard. But this event can be expected to good tool for Active learning.

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|Poster|

Cosmology at Buddhist Temples: a Public Dialogue in Science and Religion Through Astronomy

Haruka MAKIZAWA*1, Hiroaki ISOBE*2

Abstract. A series of public event "Otera-de Uchu-Gaku (OUG) (Cosmology at Buddhist Temples)" have been held in Kyoto to promote communication between science, religion and the public, as well as to attract participants that are not so interested in science. From the questionnaire to the participants we found that OUG could attract a higher fraction of low-interested-in-science participants when compared with other science events for the public. Moreover, from the interviews to the guest scientists we found OUG is also inspiring to the scientists as well. We interpret that the presence of Buddhist monks as experts of a different but equally important field mitigates the asymmetry between experts (scientists) and non-experts (public). Finally, from the experience of OUG we believe that astronomy can be an excellent gate to a better dialogue about science and religion among the pubic.

1. Introduction

Most participants in science events are already interested in science[1]. How to reach and involve those who have little interest in science is one of the major challenges in science communication. Interestingly, similar thoughts are shared with Buddhists in Japan. "Otera de Uchu-Gaku (meaning Cosmology at Buddhist Temples, hereafter refereed as OUG) started in 2010, altogether with a group of young monks called "Free-style monks" that aim rebuilding the role of Buddhism in the contemporary society.

OUG is regularly held every 2~3 months at various Buddhist temples in Kyoto City and nearby areas. Every time there are lectures by guest scientists, by a monk (usually the priest of the temple), and a sit-in-a-circle discussion with all the participants. Snacks and drinks are served. The themes of the scientist's lecture are mostly in astronomy and related science, but not restricted to them (there were also lectures on biology , informatics and social sciences).

2. Survey method

In order to compare participants with other science cafés, we classified participants from the viewpoint of their interest and involvement in science and technology using a method developed by the Victoria State Government of Australia [1][3].

We also conducted a post-questionnaire to the scientist, the speaker who gave the lecture.

3. Results of questionnaires to participants

Previous study found the rate of low-interest participants in science events to be 0~10 %[1]. But in "Otera de Uchu-gaku" we found a higher rate of low-interest participants (10~23 %) . Some participants said that it is exciting to witness and join the lively interaction of scientists and monks and combination of temple and astronomy appears that the event is more open to outside.

4. Results of questionnaires to scientists

Comments from the scientists are mostly positive and can be categorized as follows. (1) There are commonalities and differences between science and religion. (2) Presence of monks help them have a flat relationship in which every participant can learn from each other. (3) OUG can be an effective way for science communication.

5. Summary

'Cosmology at Buddhist Temples' could attract more participants whose interest or involvement in science is low. Collaboration with Buddhist monks relativized the position of scientists and produced a flatter relationships. This allows more active learning not only for the general participants but also for the scientists.

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Developing Astronomy Awareness in Sabah, Northern Borneo of Malaysia Through Astrophotography

Muhammad L. H. MUHARAM*1

Abstract. To effectively spread astronomy awareness not all methods suit communities that don't have an early exposure to astronomy. This paper discuses the best practices developing astronomy awareness in Sabah, northern Borneo using its own dark skies territory through the photography of night skies also often called wide-field angle astrophotography. There are two main objectives used for spreading awareness: using dark sky places and using the beauty of the celestial objects captured through the art of astrophotography. Several programmes were held mainly for photography enthusiasts from the local community but also from outside of northern Borneo and also introducing astrophotography to the public, school teachers and students. The findings were based on the participation and the success of the public outreach programmes held in the year of 2017 with public, school and university. In conclusion, the astrophotography can act as earlier basic awareness that combined with art attracting the audience with pictures and more effectively than words.

1. Introduction

Sabah is a state in Malaysia in which 75% of its area is still in nearly excellent conditions for stargazing.[1] The early astrophotography group in Sabah was based in Ranau in 2001 by a group of PUSKAL.[2] In 2013 a group of Sabah Stargazers was founded consisting of local photographers and by 2015 they had become a reference in Sabah for astronomical information.

2. Methodology

We used a method combining three stages: theoretical, practical and final product. Participants will be joining a workshop on astrophotography editing. Later on, the participants are introduced to a practical program during a trip to dark sky places to shoot an astrophotography image. Then, from the theoretical and practical class, participants will be using their own image to posting the final products in social media with detail and explanation.

3. Findings

Based on several series of workshops and outreach programs held in dark sky places across Sabah, the number of participants slightly increase every year. The statistics recorded to show the number of participants from 2015 until 2017.

Table 1. Number of Participants

	2015	2016	2017
Workshop (student)	5	12	22
Workshop (public)	3	6	14
Meteor observations (student)	25	75	84
Meteor observations (public)	15	250	350

4. Conclusions

Astrophotography can act as medium to educate public to protect and preserve the night sky from excessive light pollution. Research shows that (among other reasons) interest and positive experiences in science earlier in life can help stimulate individuals to engaged inthe future with science.[3]

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|Poster|

Learning Astronomy through the Photograph of Solar Analemma

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Abstract. The picture of solar analemma, a figure 8 shaped of the solar path in the sky throughout a year, contains a lot of information such as the movement and position of celestial bodies especially the sun and earth. The pattern will be different depend on the location of the observer. Therefore, we have built the first analemma photograph in Indonesia consisting partial solar eclipse observed from Bandung city. The result can be used for education purpose to explain about astronomy. The picture of our analemma has been distributed and hopefully can attract more people who want to understand the meaning behind that beautiful figure 8 shaped photograph.

1. Introduction

People, especially children, usually have more curiosity to unique images which can lead them asking the meaning behind. They need help knowing how to make sense of what they see [1]. The example is the unique image shape of analemma which looks like 8 figure. Analemma can be described as the Sun position in the sky at particular time throughout the year [2]. Our team has successfully created an analemma photograph consisting solar eclipse [3]. It can be used to provide additional, outreach material to attract people learning astronomy.

2. Observation and Method

We took images of the sun once a week over one year from Bandung, with the latitude of -6^0 South. Each single images were collected every Wednesday at around 07:21 LT with DSLR camera and ND filter at certain procedure and shooting position. After combining weekly images, finally we obtained analemma plot which has been presented and shared for education as well as outreach purpose.

3. Result

Our analemma photograph clearly shows characteristic of sun's path from near equator. It contains bunch of information that people can learn. The analemma's shape results from the tilt of Earth's axis (23.5˚) of rotation relative to the plane of its orbit around the Sun and from the elliptical shape of that orbit [4]. Accordingly, the two circles that resemble figure 8 is created. The shape varies depending on at which hemisphere we observe.

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Fig. 1. The result of our analemma photograph with eclipse event (Mumtahana, F.M., et al. 2016).

Other thing to learn is about effect of elliptical Earth orbit. As it seen in Fig.1, the spaces between suns look narrower during summer solstice, because the sun was at Aphelion which can be considered like move more slowly. Otherwise, during winter solstice, the gaps became wider because the earth moves faster due to perihelion [3].

6. Summary

Understanding the meaning behind analemma photograph can be the fun way to study the coordinate system of the earth and celestial and how they move, calculation time the sun rises and sets, and some other science facts related to Astronomy. It is very useful as original reference for education purpose as Indonesia is still lack of original references about observation. Eventually, after the picture was released, it has been used in several lectures, media, and books.

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The TENPLA Project: Communicating Astronomy in the urban life –The activity of Roppongi Tenmon Club

Seiichiro NAITO*1 *3, Naohiro TAKANASHI*2 *3, Tomohiro SENSUI *3, Chie TSUCHIYA *3, Kozue URIU *3 and RTC administration team

Abstract. The "Roppongi Tenmon Club" is a series of the astronomy popularizing/outreach open events held in Tokyo City View, Roppongi Hills. The concept of the RTC is "a club activity for adults," mainly oriented the adult persons working in the city center area of Tokyo. We suggest that this activity works to provide sensible citizens the occasion of an engagement with the expert knowledge in their daily life scene.

1. Introduction

The "Roppongi Tenmon Club" (RTC) was started in the IYA2009, under the cooperation with the city developer, the media and the Tenpla project [1].

The site Roppongi Hills is the urban business and fashion capital located in the central Tokyo. This site holds rich cultural and academic atmosphere with facilities such as a cinema complex, the art museum, the library and the seminar center. Thus the site works as a hub among the relatively younger, active intellectual persons. One more characteristic facility is the Sky Deck at 270m from sea level, the highest open air rooftop. As stated above this is a quite unique site for the astronomy communication.

2. Activities

2.1. Starwatching, Astronomy Seminar

RTC's main activities are held monthly and also in the special astronomical occasion or seasonal events.

2.2. Special Lecture, Talk session, Workshops

The special events inviting the famous researcher or cultural talents, sometimes in the collaboration of the museum/gallery exhibitions.

2.3. Hoshizora Annai-nin

RTC continues the course of the certificate system for the Astronomy Guide lead by Yamagata Univ. Our goal is to incubate the active citizen who will extend the stargazing opportunity in their own fields.

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3. Targets

Each starwatching welcomes hundreds of visitors from wide generation, social and ethnic groups. Mail magazine subscribers approach nearly 12,000. Mentioning specially, the supposed core target layer is persons in ages of 30s to 40s, especially female.

We guess that the characteristics of the site is more acceptable for this public layer rather than educational places such as science museums. So we consider to draw their interest out setting the suitable approach to the astronomy, sometimes with other cultural context.

4. Discussion

The astronomy communication at the urban trend capital has valuable high media appearance, and it may lead the potential of the advanced development in cross-genre situation.

As the new "circulation model of knowledge" framework [1] RTC provides the expert knowledge to the public to incubate their perspective on the universe. The increase of those acceptor citizen will cultivate the social values of astronomy.

5. Summary

We report our public outreach practice examples targeting urban dwellers, especially receptive and active business layers. We remark that these activities at the hub site of the urban active, intellectual population possibly leads cross-cutting influence for the public. We realize the role the new model of the intellectual cycle among the researchers and citizens to cultivate the social values of astronomy.

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|Poster|

The Activities of Science Station in Japan

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Abstract. Science Station (SS) is a specified Non-Profit Organization (NPO) corporation in Japan, continuously spreading "real science" all over the society. Current SS's activities, which mainly target high-school students, consist of three pillars—GS, Star Class, and school visit (Science Delivery). These activities handle not only astronomy but also other science fields.

1. Introduction

Science Station (SS) is a specified Non-Profit Organization (NPO) corporation in Japan get involved in science communication mainly with high school students, in hopes of spreading the "real science" all over the society. SS's member now consists of ~20 university students specialized in astronomy or other science fields, and some faculty members who help the students run SS.

2. The History of Science Station

SS was originated from an astronomy camp "Galaxy School (GS)" held at the Kiso Observatory, the University of Tokyo (Sakai et al. in prep.). GS started in 1998, and produces 10–40 graduates every year. Some of those graduates who experienced and enjoyed "real science" in the GS camp hope to take part in the management of the camp to hand down their experience to the next generation. Following the two graduates who voluntarily joined the GS camp as teaching assistants at the first time in 2001, a few graduates participated in the GS camp every year. In addition, some graduates were also interested in science communication itself. In order to support these activities steadily, SS was established by some of these graduates and some faculty members of universities as an outreach organization in 2004.

Basically SS consists of university students, and some member resign every year when they graduate from the universities. On the other hand, some graduates of the GS camp newly join SS constantly. This cycle contributes to steady operation of SS, and increases the number of influenced students, which reaches 10,000 in its long history of 14 years.

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3. Science Station's Activities—Three Pillars—

Current SS's activities consist of three pillars—GS, Star Class, and school visit (called "Science Delivery"). Not only astronomy but also a wide variety of science fields is covered by these activities, because SS consists of not only students of astronomy but also those of other science fields.

GS is an annual four-day observational-astronomy research camp for high school students all over Japan, most of whom like science or astronomy, and aims to tell them the scientific method through astronomy. Star Class is a two-day camp at the Kiso Observatory for high school students mainly from Nagano prefecture, which is held three to five times every summer. It is similar to the GS camp, but targets of Star Class are not necessarily interested in astronomy. Although both camps focus on astronomy, Science Delivery focuses not only on astronomy but also on a wide variety of science. So far SS has conducted 81 Science Deliveries in total, in which SS send members to high schools to give lectures or science experiment classes. For example, in Science Delivery to Shimane Prefectural Matsue North High School in 2016, we provided seven classes covering astronomy, mathematical physics, experimental physics, information science, computational chemistry, mathematical biology, and even computer art.

4. Conclusion

SS has been delivering the "real science" not only on astronomy but also on various science fields all over the society since 2004. Main activities of SS are GS, Star Class, and Science Delivery, which influenced more than 10,000 students after 14 years. These activities are mainly organized by GS graduates. SS annually holds the GS camp and influences participating high school students. When they become university students, they join SS and conduct the next GS.

The Assessment of "Fun and Play" Visiting Activity for Young Children

Akihiko TOMITA[*1]

Abstract. The four-column record for assessment of fun and play visiting activity for young children aged three to six has been developed referring the three-column record developed by the after school care educators in Japan and the EU Universe Awareness Programme Evaluation Guide.

1. Activity and Assessment Method

When the target is young children and the activity type is fun and play, the assessment of the activity is not easy. The domains of active learning shown in the EU Universe Awareness Programme Evaluation Guide [1] is useful for the assessment. The example of the activity is "*Uchu no O-hanashi*,"[2] which includes the slide show, storytelling, picture coloring, admiring large-format pictures spread on the floor, and question-and-answer circulation for several dozen three- to six-year-old children at the same time in a big room at nurseries, kindergartens for about 45 minutes. I visit there as a guest scientist. In order to obtain the data for the assessment, I have recorded the voice of children. The analysis method is a kind of qualitative one. Referring to the 3-column practice record method developed by the after school care educators in Japan [3], I summarized the children's voice, guest scientist's voice, and guest scientist's impression and intention. I added the fourth column of assessment, the scientific evaluation, referring to the EU Universe Awareness Programme Evaluation Guide. I picked up "motivation" and "scientific skills" words from the record when they muttered and asked each other what they felt, what they found, and what they got excited about. Children also tried to interpret their findings and exchanged their ideas with each other. Among the items in the "scientific skills" domain in the Guide, looking at carefully, asking, exchanging opinions, interpreting or trying to interpret, and trying were the frequently appeared items. I also picked up the words of children obtaining the scientific way of view and attitude through the activity. An example of the four-column record is shown in the next section; instead of four columns, I present here in an expanded way due to limited space.

2. The Four-Column Record

After seeing rocket launch video:

1. Child's voice: Listen, if we do "boo-oh" with a bird and the firework, would it go with an awesome speed?
2. Guest scientist's voice: Ah, you may be right. A bird flies, and with the fireworks, you guess that it would fly much more.
3. Guest scientist's feeling and intention: A strange question comes.
4. Scientific evaluation: Asking, Curiosity
1. Yes.
2. Well, a rocket goes much farther. A rocket goes much much higher than a bird does.
3. I will gentry tell him that help of a bird is not a good strategy. (Tomita's interest: low)
1. If we do with a bird… bird and the firework?
2. Well, ah…
4. Exchanging Opinions
1. With 10 birds and two fireworks, it would go greatly.
2. Combining things that fly may make it go well.
3. Regardless of reality, with any possible ideas, we will enjoy constructing a new strategy. I will change my attitude. (Tomita begins to enjoy)
1. With the bomb and a bird… two birds and three bombs, and with the firework, it would…
2. Great combination. It can be a good one.
1. With a bird, and the bomb bangs, and…
2. OK, then, other than a bird, firework, and bomb, what would you have that fly?
1. Airplane!
4. Interpreting, Enjoyment

Communication continued…

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|Poster|

Nationwide Lecture Activity During Tanabata Period

Hitoshi YAMAOKA*1

Abstract. The Astronomical Society of Japan (ASJ) promotes a nationwide astronomical outreach activities in summer. We introduce the way how to promote such large activities with the smallest resources.

1. Tanabata lectures

From 2009, the International Year of Astronomy, ASJ continues to promote nationwide astronomical outreach activities in summer. At their hometown, researchers, amateur astronomers, and astronomy communicators organize lectures, star gazing parties, special planetarium shows, etc., around the Tanabata night (July 7th in the Gregorian calendar), the traditional Tanabata night (July 7th in the traditional lunisolar calendar), or the one-month-later Tanabata (August 7th). Tanabata is an old regional star-related folklore which is common in the East Asian countries.

Each year, total number of activities reaches around 100 (Table 1), and several thousand participants enjoy them. Activities are held in whole area of Japan, and some activities are held in foreign countries (Chile, Peru). It strengthens the connection between the local people and the researcher who came from other area.

Table 1. Number of registered activities in each year.

year	activities	year	activities
2009	98	2013	119
2010	77	2014	93
2011	87	2015	104
2012	88	2016	89
		2017	99

2. Procedure

The procedure how to gather the activities are very simple. We prepare a registration form in our website [1]. Each organizer of the activities fill the form with the information of lectures, star gazing parties, or the special planetarium programs, and so on. After a review, the activity will be shown in table (Fig. 1). Then people can search the activity which they want to participate, and get some information.

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Fig. 1. Registered activities in 2017.

The organizer can use the "Tanabata lectures" logo in their website or the posters/handbills which introduce their activities. Unified poster (Fig. 2) was made only on the first two years, but it turned out that such promotion is expensive and ineffective, so we ceased it.

Fig. 2. The unified poster for the first year (2009).

3. Summary

The cost and man power for this promotion is very little. Each year, the web administrator open the registration form on April or May, and collect the information. On the other hand, this is a good chance for the researchers who does not always do some outreach activities. We encourage it.

References

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SESSION I.7:

Engaging with Students and Teachers Outside the Classroom

|Parallel Session|

Galaxy School (“Ginga-Gakko”) —The Longest-Established Astronomical Research Program for High School Students in Japan

Fumiya SAKAI[*1,2], Daisuke TANIGUCHI[*1,2], Shunsuke YUSA[*2,3], Takashi MIYATA[*1,2], Yuzuru YOSHII[*1,2], Yuki MORI[*1], Naoto KOBAYASHI[*1], and Science Station

Abstract. Disinterest in science among children has concerned public for more than few decades in Japan. To create a stir in this situation, Galaxy School, which is a four-day camp of astronomical research for high-school students, was launched 20 years ago by a cooperation of Japanese nonprofit organization “Science Station” and the Kiso Observatory, the University of Tokyo. Through this camp, students can experience the complete cycle of the scientific research from observation, analysis, to final presentation with frequent discussions. The school programs are designed so that the students can develop their interest in scientific method. This activity became the pioneer of this kind in Japan to stimulate the subsequent activities at other institutes.

1. Introduction

In the last decades, “disinterest in science” among students in Japan has concerned the society very much. Students lose their interest in science as they go to the higher grade [1]. Also, they cannot experience the enjoyment of “real science” in the limited amount of school hours. To help improve this situation, a yearly event that provides students with an opportunity to experience real science through observational astronomy was initiated. That is “Ginga-Gakko,” meaning Galaxy School (hereafter GS) in English. GS was introduced as an example of the astronomical education for high school students outside the classroom.

2. What is GS

GS is a four-day camp of experiencing observational-astronomy, in which high-school students use a professional telescope at an actively working observatory. It was originally started in 1998 by the Kiso Observatory, Institute of Astronomy, School of Science, the University of Tokyo, and has been held annually at the end of the academic year (around March in Japan) since then. Now GS is mainly promoted by a Japanese nonprofit organization “Science Station” with the cooperation of the Kiso Observatory.

2.1. Outline

The Kiso Observatory is located in the highland area in Japan with the 1.05 m Schmidt Telescope as the main facility. The telescope is equipped with a variety of wide-field optical digital imagers from 2K- and 8K-CCD cameras to the latest Tomo-e Gozen, which became the world’s first wide-field CMOS camera. In this camp, students use the Schmidt Telescope and one of those imagers by themselves to observe their own targets, which are selected at the beginning of the camp.

For each GS, about 30 students get together from all over Japan (Fig.1.). They are selected from the applicants (typical subscription rate is 2-3) based on essays on a given subject. The total number of high-school students who participated in GS reached to 562 after 20 years (to the end of 2018). In the GS camp, all students stay at the observatory for 4 days to concentrate on pursuing an astronomical subject. The Kiso Observatory has an accommodation facility including a cafeteria for up to 40 people. The students are divided into three groups depending on their interest, and each group tackles one subject together. Three professional young astronomers are assigned as the leaders of each group, and two or three teaching assistants from Science Station are assigned per group.

To offer students the experience of real science, the difficulty and interestingness of the subjects as well as the camp program are carefully prepared and

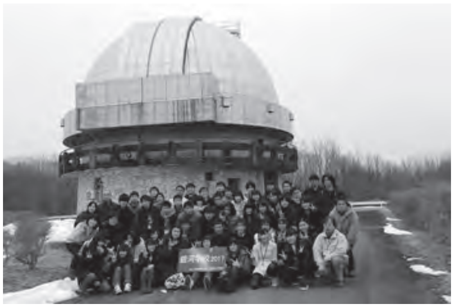

Fig.1. Group photo of the students and the staff at the 20th memorial GS.

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organized. Nevertheless, the close supervision by the group leader is critical so that they can adjust the difficulty of the subject depending on the average and scatter of the student academic skills.

2.2. Timeline

In GS, students experience all the major steps of astronomical research (from observation to presentation) in 4 days as follows:

On the 1st day, students take brief lectures on the outline of GS, the telescope and the instruments, then move toward the tour of the telescope. Following the explanation on their research themes, after dinner, each group makes observation one after another in the observing room in the telescope dome. This becomes the first major event in GS. If the weather condition is bad, back-up data obtained before the camp is available.

From the 2nd day morning, the students start reducing and analyzing the obtained data. In this session, the students can learn how to process the raw image data with computers. Most of the students did not imagine they need to process data by themselves before they join GS. Therefore, they appear to find this session very fascinating. During the data processing, they start analyzing the results, and gradually shift to discussion on the subject. Active group discussions, which are very important for the students to understand the research subject, are frequently set up. The teaching assistants also support the discussion and motivate the students to accomplish their research objectives. In this session, the students tend to realize the importance of the science lectures at school because they need the fundamental knowledge of science to come up with new ideas.

On the 3rd day, the students usually spend whole day with intense discussions to prepare for their presentation in the late afternoon. At the presentation session, every student in the group has his/her own short presentation part so that all of them can experience the feeling of giving a talk. By receiving various unexpected questions/comments from other groups and staff members, they realize the importance of this session in the cycle of the research process. This is the highlight of GS.

On the 4th day, the students experience another type of presentation, a poster session, with intense exchange of ideas among students in a friendly atmosphere. Finally, the students go back to their home after lunch.

Despite the long period of 4 days, the schedule is always found to be relatively tight. This is inevitable to provide students with sufficient time for thinking and discussion.

3. Impact

GS may give a great impact on the participants' future. The immediate impact on students can be quantitatively estimated using questionnaires collected from the students at the end of GS. According to the questionnaires in last four years, 85 % of the participants answered that they had strengthen their interest in science. Judging from the comments in the questionnaires, this may be because students come to be able to picture the real research, which has been ambiguous until they really expose themselves to the professional research environment. As a result, some students sharpen their interest in astronomical research to become real astronomers, and others choose academic careers in other fields.

After the camp, some students spontaneously continue their research for another year to present their results at the Junior Session in the annual meeting of Astronomical Society of Japan. Giving a presentation in front of many astronomers is a whole new experience for the students. This is not the part of the GS program, but encourages the students to continue research experiments by offering a chance to communicate with professional astronomers as well as students with the same interest all over Japan.

Although the above two short-term impacts may be meaningful enough as a high-school student program, we also observed much longer-term impacts after 20-years experiences of GS: many GS graduates became real researchers (including astronomers), and also work for various industrial companies. We are gradually analyzing the long-term paths of the GS graduates, and hope to present the results elsewhere.

4. Conclusion

GS is a four-day camp of experiencing observational astronomy for high school students at a professional observatory. Through this camp, students can experience the real scientific method that they can rarely learn at the nominal high-school classes. GS appears to have a large impact on the participants, and thus is continuing for 20 years with the dedicated supports from all the graduates and related staff.

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Representing the Universe: a Hands on Challenge

Stefania VARANO[*1] and Sara RICCIARDI[*2]

Abstract. Astronomical images are representations of reality mediated by observations, meaning an instrument with its characterization (resolution, sensitivity, etc.). We propose a hands-on approach that takes advantage of the fact that many children's toys use image sampling as a gaming tool, in order to reproduce images at different resolutions. The most innovative concept of this laboratory is the introduction of hard science subjects through a playful approach, and the use of toys as research instruments. This play-based learning activity takes place in a highly inclusive and participative environment, leaving much space to personal intuition and autonomous discovery. The use of familiar objects and ludic equipment, low tech, prevents literacy barriers and gender issues and encourages immediate commitment and engagement.

1. Introduction

"Learning through play" describes a pedagogical and psychological approach according to which children make sense of the world though play. The concept is mainly based upon John Dewey's contribution [1] to the theory of constructivism [2] and Seymour Papert's theory of constructionism [3]. They basically suggest that "*education is not an affair of 'telling' and being told, but an active and constructive process*" ([2] Dewey, p.85) and that "*the best learning takes placed when the learner takes charge*" ([3] Papert, p.25). Play-based learning programs (such as the Montessori Method [4] and the Reggio Emilio Approach [5]) are student-centered learning approaches, focused on the fully autonomous development of children's cognitive, social, experiential and creative potential through play. Play-based learning should be as unstructured, creative and not content-guided as possible. "*Practitioners can and should plan for children's play, however, by creating high quality learning environments*" ([6] Moyles, p.4); they can orchestrate an environment by deciding what toys, materials, and equipment to be included in that environment.

Play-based approaches not necessarily employ toys as work equipment. In this activity we take advantage of the fact that many children's toys use image sampling as a gaming tool and make use of simple, very little structured playful stuff for reproducing images at different resolutions.

The main aims of this activity are:

- to introduce basic concepts of astrophysical imaging, such as spatial and chromatic resolution and sampling through toys and playing;
- to create an inclusive and participative environment, leaving much space to personal intuition and autonomous discovery;
- to prevent literacy barriers and encourage all children's commitment thanks to familiar objects and ludic, low tech equipment.

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2. Description of the activity

The activity addresses 9-10 year-old students and includes two sessions of two hours. It is addressed to a class working in teams of 5-6 students.

2.1. First part: the pegs

In each group, 2 of the students (the "operators") are given a peg board with a colour image under it: they have to use the board as a colour sampler, inserting pegs of corresponding colours in the holes, in order to make the image recognizable to their friends (Fig.1).

Fig. 1 "Operators" at work, sampling the image through the holes of the peg

The *operators* start reproducing the image with a limited number of the biggest available pegs. The other group members will try and guess the subject being reproduced; meanwhile they also try and help the operators by winning more pegs for the representation. The additional pegs are obtained by drawing and guessing astronomical.

During this phase, facilitators provide the additional pegs and the paper sheets indicating what subject to draw, but also provide the language necessary to help children articulate what they see happening and perhaps ask questions, in order to expand and enhance play.

2.1. Second part: pixelization

In the second part of the activity, each group is given a color image and several sheets with grids of different sizes (Fig. 2).

Each student, or groups of 2, works on a grid, coloring each cell with a single color, chosen in order to be the most representative of the "overall" color of the box. The range of possible colors is limited to max 24 different ones, i.e. the ones already owned by the students.

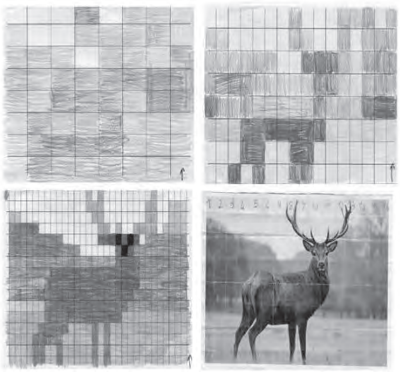

Fig. 2 The image of a deer pixelized in 64 up to 512 pixels and compared to the original one.

3. Results

The main results of the activity are as follows:

- the simplicity of the used materials, together with their friendly and daily life nature, favored an extremely positive attitude of the students;
- scientific concepts seemed to be very efficiently delivered (the "eureka moment" really occurred);
- the lab encouraged a deep personal involvement and a proficient team work.

With regards to the pegs, the "brand-issue" has been taken in to account: future developments of the lab can also include the preparation of self-made pegs-like material for the representation of images at different resolutions.

4. Conclusions

This lab clearly proved as "*the true value of play is not that it can teach children facts, but that it can help them acquire important procedural knowledge, which is beneficial in acquiring declarative knowledge*" ([7] Pinkam, p.31) We have literally seen the idea of images as data carriers rising in these children's minds, while they experimented the limits of the medium and tried to overtake them.

Next step will be to create a consistent, repeatable activity, with standard equipment, such as arranged kit or a list of material.

We have also discussed a possible third phase, which could include the digital elaboration of the images, with dedicated graphic software or educational software such scratch [8], to dig dip on the concept of quantity of information in an image. We could also turn this lab multidisciplinary creating an art gallery of deconstructed images with less and less information and relate with the work of Piet Mondrian.

We would like to thank the kids (5°C Scuola Primaria Marella IC12 Bologna) and their teacher Stefano Rini that kindly hosted our first attempt of this activity.

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Thai Astronomical Conference (Student Session): TACs

Pranita SAPPANKUM*1 and Matipon TANGMATITHAM*1

Abstract. The Thai Astronomical Conference: student session (TACs) is an annual high school-level astronomi-cal conference held by the National Astronomical Research Institute of Thailand (NARIT). TACs serve as a plat-form where young astronomer can share their projects and also Thai teachers and students can learn new experi-ences and ideas to do the astronomical projects. Participant can be separated into 3 groups. The first group is presenter who is student who presents their work. The second group are observers. They can be teacher or student who want to observe student projects. The last group consists of general public who want to join special public talk on a topic related to the special event each year. TACs have been ongoing for four consecutive years. In each subsequent year, TACs has gain more popularity in terms of participants and broader ranges and varieties of topics being presented. In many cases, observers in the previous years have returned the following years as pre-senters. It is our hope that TACs will continue to be a platform where teachers and students across Southeast Asia can exchange their works and serve as a connection from high school to college-level astronomy.

1. Introduction

NARIT 's public outreach department has important role to educate and inspire the public in the topic of astronomy though many kinds of activities and workshop such as teacher training workshop. Many high school students in Thailand are beginning to engage in many forms of science projects, especially in astronomy. This is an excellent extra-curricular activity that would and encourages student to develop learning astronomy outside of classroom. It calls project Base Learning.

During the process of project-based learning, Students choose their own research topics under some supervision by their instructors. Research topic could begin as a simple curiosity inspired by daily observations (e.g. what cause stars to twinkle), or offer a chance for student to learn how professional astronomers work (e.g. How can we use period luminosity relation to measure the distance). So student investigate, perform observation/data collection and try to find conclusion to their findings.

The Thai Astronomical Conference: student session (TACs) was created to serve as a platform, incentives, and motivations for students who engage in project-based learning activities. The conference is loosely based on our observation in the Astronomical Society of Japan (ASJ) junior session which is held annually in Japan.

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2. TACs model

The purpose of TACs is to offer a form of support for the students who are pursuing project-based learning in astronomy. Secondly, it is to serve as a platform where students who share similar interest in astronomy can share their works and findings. Finally, it is also aimed to establish a high school astronomy network.

TACs activities consist of oral presentation, poster presentation, Observatory tour/stargazing and public talk; the topic of public talk are related to astronomical issue at the moment such as Meteorite over Thailand, extraterrestrial, life on Mars. Each section has different target for example presenter and observer are the same target group. They can be teacher and student but public talk are public around 300 people.

3. Result

NARIT has been organizing TACs for 4 years. In 2014, TACs has the total number of participants around 130 people in the first years. In 2015, TACs is rapidly increase participant around twofold**.** The following year there is a small drop in the number of participants, before it picks up again in the following year.

From presentation both of oral and poster presentation are divided in several topics for instant astronomy club activities, The sun, The solar system/Exoplanet, stellar, Observation, instrument/programming, Galaxy. The most popular topic is the solar system/Exoplanet. The least number of topic are instrument/programming follow by galaxy and Astronomy club of which are relatively new topics.

4.Figures and Tables

Fig 1. Oral presentation section.

Fig 2. Poster presentation section.

Fig 3. Observatory tour/Stargazing activities

Fig 4. Special public talk topic about life on Mars.

Table 1. Number of presenter

	2014	2015	2016	2017
Oral	88	126	124	139
Poster	32	113	94	124
Total	130	239	218	263

Table 2. Number of projects presentation

	2014	2015	2016	2017
Oral	31	35	31	44
Poster	3	16	17	27
Total	34	51	48	71

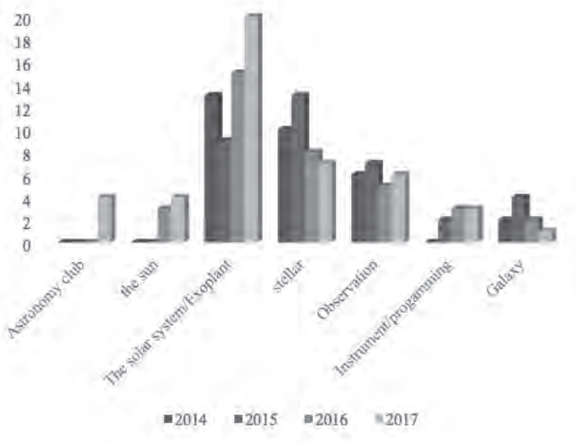

Fig 5. The chart presents the number in different topic from 2014 to 2017-

5. Summary

TACs have been established for 4 years. In each subsequent year the number of participants increased with more broader ranges and variety of topics. Many observers in previous year return later as presenters. In the future, we hope that TACs will involve more participants from broader background and reaches out to other Southeast Asian countries to become an international platform for student interactions.

Acknowledgement

[1] Astronomy societry Junior session: ASJ , Japan
[2] Institute for the promotion of Teaching Science and Technilogy: IPST, Thailand.
[3] National Astronomical Research Institute of Thailand (Public Organization), Thailand.

|Parallel Session|

Strategic Outreach and Public Engagement in a University Context

Jen A. GUPTA*1

Abstract. In 2017, the Institute of Cosmology and Gravitation at the University of Portsmouth in the UK introduced a new five-year strategy for outreach and public engagement. The strategy provides a framework for a structured programme of activities, with defined aims and intended outcomes. This article provides an overview of the strategy, explains the process we went through to develop the strategy, and gives details of our new strategic outreach and public engagement programme that was introduced in September 2017.

1. Introduction

Many university astronomy/physics departments run school outreach and public engagement programmes, delivering activities and putting on events to engage school and public audiences with astronomy. However, this work is often done on a reactive, rather than proactive basis, involving one-off interactions with limited scope to assess the impact of such engagement.

The Institute of Cosmology and Gravitation (ICG) is an astrophysics and cosmology research institute at the University of Portsmouth in the UK. ICG members have been active in outreach and public engagement for several years, mostly on an ad-hoc basis as described above.

In 2012 the author was employed as the first full-time Outreach Officer for the ICG, and began to formalise the activities and events of the department. Taking this a step further, the ICG then developed and introduced a five-year outreach and public engagement strategy in September 2017, to provide a framework for a structured programme of activities, with defined aims and intended outcomes.

This article is set out as follows. Section 2 provides further information about the process of creating the strategy. Sections 3 and 4 give details of the outreach and public engagement strands of the strategy and related programmes. Finally Section 5 contains the conclusions and some advice for others looking to set up a similar strategy in their place of work. Copies of the strategy are available on request from the author.

2. Creating the strategy

An initial meeting was held in January 2017to review the outreach and public engagement work that had been carried out at the ICG to date, and decide on the overall direction of the new strategy. This meeting was attended by the ICG Directors and staff responsible for outreach/ public engagement and impact, and was facilitated by the Director of Outreach and Public Engagement for the South East Physics Network (SEPnet).

The strategy was then written by ICG's Outreach Officer with input from the people named above, and circulated to the ICG academic staff for comments and approval, before being implemented in the 2017/18 academic year. The strategy splits activities into two strands: 'schools outreach' and 'public engagement'. Both strands have defined aims and intended outcomes and will allow for meaningful evaluation to be carried out on the new programme.

3. Schools Outreach

The aim of the schools outreach strand is to deliver activities to school pupils aged 7-18 in order to:

- Expose school pupils to the wonders of astrophysics and cosmology.
- Raise the 'science capital' of pupils and families, encouraging them to study physics to a higher level, particularly those from underrepresented populations within physics (e.g. women, ethnic minorities).

Science capital is a concept widely used in the UK to understand the participation of young people in STEM subjects (see the ASPIRES project report [1] for further information).

The motivation for the schools outreach strand is to move away from one-off interactions to a sustained programme of repeat engagements with the same pupils. Three secondary schools (age 11-16) were

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identified from the University of Portsmouth's list of target 'widening participation' schools and approached to participate in the schools outreach programme. These three schools are in areas of Portsmouth with very low participation rates in higher education. Following in-person meetings with the respective Head of Science teacher, all three schools signed up for the five-year programme. The primary schools (age 5-11) that feed into these schools were then contacted and agreed to participate as well.

The schools outreach programme can be summarised as follows. In year 5 of primary (age 9/10) and years 7-9 of secondary (age 11-14), we visit the school to run activities with the entire school year cohort. In year 10 of secondary (age 14/15) and at A-level (age 16-18) we switch to holding half-day events at the university for a smaller number of students who are interested in continuing to study physics to a higher level. All activities are based on general topics within physics and astronomy, and there is no requirement for activities to directly tie-in with the research topics of the ICG.

4. Public Engagement

The public engagement strand has two aims, which are to:

- Engage different publics with ICG research, through activities that have an impact on the publics and researcher/research programme.
- Cultivate a culture within the ICG where public engagement is embedded alongside research, teaching, and other academic activities.

The ICG strategy follows the definition of public engagement set out by the UK's National Co-ordinating Centre for Public Engagement [2], a key aspect of which is that public engagement is a two-way process, that benefits both the public and the researcher. Unlike the schools outreach strand, there is a requirement for public engagement activities to have a link to research carried out at the ICG.

There are many motivating factors for researchers to engage the public with their work, but one of the driving forces behind the public engagement strand of the strategy is the Research Excellent Framework scheme where UK universities are rated on their research, including its wider impact beyond academia. In a field such as astrophysics, where other types of impact (e.g. commercial) are not as common, demonstrating the impact of research through public engagement plays an important role in the REF submission.

The public engagement strand of the strategy is not yet as well-defined as the schools outreach strand, but work focuses on two areas. First, providing opportunities for researchers to engage the public with their work, for example at the ICG's annual public stargazing event (attended by 800 members of the public in January 2018). Small grants are made available for ICG researchers to work with the public engagement team to develop new demonstrations to explain their research to the public at these events. Second, providing support for researchers to develop their own public engagement projects tailored to specific targeted public audiences. One such project is the Tactile Universe [3], which is creating resources to open up ICG research on galaxies to audiences who have vision impairments (for more information, see the Tactile Universe contribution in these proceedings). There are plan to hold a 'Hack Day' style event for ICG members to come up with new ideas for public engagement projects.

5. Conclusions

The outreach and public engagement strategy has meant that these activities at the ICG have become more targeted and focused, providing a framework to consider requests for school visits etc. against. The strategy is designed to be a working document and will be reviewed annually and adjusted if the needs of the ICG change.

A key part of the strategy's success was having buy-in from the ICG's senior management from the start, involving the Directors in the initial meeting, and gaining the approval of all academic staff before it was implemented.

For the schools outreach strand, developing a relationship with the teachers through in-person meetings has been crucial. Now that the programme has been established in each school, the focus for the 2018/19 school year will be on developing methods for evaluating the impact of the activities.

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|Parallel Session|

Let's Celebrate "Zero Shadow Day" !

Samir DHURDE[*1], Arvind PARANJPYE[*2], Alok MANDAVGANE[*3], Sonal THORVE[*1], and Niruj M. RAMANUJAM[*4]

Abstract. On at least one day every year, in about a 100 countries in the world, shadows "disappear" at noon (i.e. are minimum because the sun's rays are perpendicular). Such a "Zero Shadow Day" (ZSD) is unique between the Tropics and makes for a great outreach opportunity for astronomy communicators at all places close to those latitudes. This event happens during the daytime, can be easily enjoyed by everyone and there is no need for specialised equipment to show it - just the Sun has to be shining overhead on the ZSD for the local latitude. We explain this occurrence, share experiences from India where this event is popularised as a national campaign, and enlist ideas and tools to plan a ZSD event. The authors would be happy to help initiate proper plans of holding this event all over the world.

1. Introduction

It so happens, that on particular days, for places between 23.5°N and 23.5°S latitudes, at local noon, shadows are minimum compared to other days of the year (or completely disappear for objects like cylinders!).

The idea of celebrating these special days as "Zero Shadow Day" originated at the Inter-University Centre for Astronomy and Astrophysics (IUCAA) in Pune, India. It's potential to provide a good chance to talk about astronomy and do some daytime astronomy outreach activities was recognized by the authors and it was turned into a public event. It is currently also the theme of a national campaign being run for the last two years by the Public Outreach and Education Committee (POEC) of the Astronomical Society of India (ASI).

2. Why and when does your shadow go missing?

Contrary to popular belief (or misconception), the Sun is almost never exactly overhead at noon, but usually transits a bit lower in altitude, a bit to the North or South of the Zenith. The Earth's rotation axis is inclined at 23.5 degrees to the plane of its revolution around the Sun. This means that the noontime highest position of the Sun in the sky will shift slowly, over the year, from 23.5 degrees south of the celestial equator to 23.5 degrees north of the celestial equator, and back again.

Particularly for people living between 23.5°N and 23.5°S latitude, the Sun's declination will be equal to their latitude twice – once each during the northern and southern motion. On these two days, the Sun will be exactly overhead at local noon. Its rays being perpendicular to the ground, all objects at that place will cast the least shadow directly underneath them. This day of "zero shadow" is of course different for different tropical places but is very enjoyable.

3. Advantages of ZSD themed outreach

- It only requires the Sun to be shining overhead and a vertical object (could be your own body) to cast a shadow, thus making it inexpensive.
- It is easy to observe and understand.
- It has popular appeal as people relate to their own shadow going missing and are willing to hear why.
- Any daytime astronomy teaching / outreach activity can be pooled with it.
- It is easy to include girl students who are many a time restricted if the outreach involves night time observations.
- It can lead school students to better understand concepts in their Geography syllabus.

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4. Indian ZSD Campaign

One famous use of the Zero Shadow effect was Eratosthenes' effort to determine the Earth's circumference after hearing of a well in Cyrene whose walls did not cast a shadow inside it on the summer solstice. Around 2005, while repeating the Eratosthenes' experiment with Indian schools students at IUCAA, it was realized that watching the zero shadow in itself can be a fun event. Since then the event has continued to gain popularity with schools and amateur astronomy / outreach groups.

Since 2017 the POEC has taken it up as a national campaign with the first round in 2017 focusing on motivating schools to celebrate Zero Shadow Day (ZSD). It has also initiated the creation of a resource base, mobile apps etc. for educators and the public to enable them to learn more details easily.

5. Activities in the national campaign

- Creation of state-wise maps and lists of towns for ZSD dates.
- Curating articles and videos in English and many Indian languages.
- Creating a webpage [1] with our resource material
- A call for a national outreach campaign and running a social media campaign to augment it.
- Organising regional training workshops to train science communicators and teachers, in collaboration with several outreach stakeholders.

Local groups used this material to organize their own training workshops, leading to more than 120 events in schools on ZSD in 2017.

6. Planning to run the event

- Be aware of the date(s) and time of ZSD for their latitude. A webpage [2] and an Android app [3] has been created specifically for this by one of the authors.
- Keep a backup plan for unfavourable climate conditions like extreme summer temperatures or sudden rains.
- Encourage people to bring their own objects and see their shadows go missing.
- ZSD is also known in many tropical places e.g. it is called *Lahaina Noon* in the Hawaii islands. See if it can easily be given a local touch.

7. International scope of ZSD outreach

Fig.1: Zero Shadow Day happens within the Tropics. Are you celebrating it in your country?

This phenomenon can be used for unifying and exciting cross-border outreach, even in remote places that may be devoid of any resources. It is not limited to India and can be experienced in over 100 countries in the tropical regions, representing 40% of the world's population. Almost all of these are developing countries [4] (see Fig.1). ZSD can provide an appealing theme that costs hardly anything to implement. The advantages mentioned in section 3 are applicable anywhere in the world.

8. Conclusion

Based on the experiences from the campaigns run in India, we are certain that there is a potential to take ZSD celebrations to a larger scale. It can be used for networking astronomy communicators across the world, under one simple event. The authors are committed to getting many more people to enjoy and learn from it. They are willing to share best practices and could initiate plans of having this event in places across the world and reporting it.

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|Parallel Session|

Engaging the Public through "Viaje al Universo"

Fernanda URRUTIA[*1], Manuel PAREDES[*1], Dalma VALENZUELA[*1], Peter MICHAUD[*2]

Abstract. *Viaje al Universo* (Journey through the Universe) is an annual Gemini Observatory local outreach program started in 2011 in Chile. The program brings astronomy into the classroom, during an entire week in local Chilean schools. The project's main objective is to build a network of schools committed to the organization of astronomical outreach activities amongst their pupils and local communities. For this we provide a wide variety of educational talks and workshops throughout our local host community schools.

During 2017, *Viaje al Universo* was carried out in five schools and the program reached over 40 teachers and 1,500 students. During the program scientists, engineers, and technicians from Gemini Observatory and other observatories of the Region of Coquimbo, such as Cerro Tololo Interamerican Observatory, the Giant Magellan Telescope and Las Campanas Observatory, visited the local schools with interactive presentations, hands-on workshops activities to share with students the wonders of the Universe, the science and the technology involved in the astronomical Observatories located in Chile.

Last year's program (2017) focused on the prominence of women in science, where, in addition to visiting the schools, we coordinated a public lecture and a "mateada astronómica (astronomy coffee)," for more than 100 women.

1. Introduction

More than 1,500 students were impacted by *Viaje al Universo*, one of Gemini South's annual core programs. *Viaje's* main purpose is to bring astronomy into local classrooms.

Since 2011 Gemini South has fostered this program among diverse Chilean schools in the Region of Coquimbo. For an entire week astronomers and engineers from Gemini as well as from other partners -such as the University of La Serena, Las Campanas Observatory, and the Giant Magellan Telescope - visited different classrooms to share with students the wonders of the Universe that night after night we investigate in the observatories.

More details you can found in http://www.gemini.edu/viaje

2. Viaje al Universo 2017

During this year, *Viaje* was carried out in five schools in two cities of Chile: La Serena and Coquimbo. The program reached over 40 teachers and more than 1,500 students, allowing Gemini to increase its network of schools committed to the organization of outreach activities amongst their students and local communities. This year's program focused on the prominence of women in science, where, in addition to visiting the schools, we organized a "mateada astronómica (astronomy coffee)", Fig. 1, and a public lecture, Fig 2, for more than 100 women.

Fig. 1. PIO Staff member Fernanda Urrutia and Gemini's Science Fellow Veronica Firpo, posing at the end of the "Mateada Astronómica", an initiative boost by Gemini South during *Viaje al Universo* to promote girls involvement

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Fig. 2. Gemini South's Science Fellow, Veronica Firpo, joined a group of enthusiastic female students at the end of the public talk about women in astronomy, held during *Viaje al Universo* activities.

3. Aims

In keeping Gemini's outreach goals, *Viaje al Universo* aims to bring science closer to young people and to develop their interest in physics and astronomy, motivating the next generation to be involve in STEM careers.

Viaje al Universo also aims to provide sustained and long-term contact with the schools, including a network of teachers, with whom Gemini shares its progress in science and technologies. At the same time, a major emphasis is on creating a sense of community and partnership within the schools near Gemini and Chilean observatories and also preserve the amazing night skies from light pollution.

4. Seven years and Counting

From 2018 Gemini's flagship multi-faceted *Viaje al Universo* program has evolved from a week-long event to a year-round program. During this year (2018), professionals from Gemini will visit over 70 classrooms to share they knowledge with the local students.

In addition to classroom visits, *Viaje al Universo* will feature a host of educational events and workshops which go far beyond the *Viaje´s* week activities, including "Career Panels" which focus on the diversity of observatory careers, career stories from the staff, and the excitement of getting to new the careers in charge to explore the Universe.

This year, the activities will be focused in the total solar eclipse of 2019, which will be observed in the same region where the Gemini South telescope is located.

5. Summary

Viaje al Universo, as with all Gemini Observatory education and outreach programs, aims to bring science into the classroom, making it closer to young people and develop an interest in physics and astronomy.

At the same time, a major emphasis is to create a sense of community and partnership within the local schools where Gemini is located, and also with the others professional observatories based in Chile and, at the same time, preserve the amazing night skies of northern Chile from light pollution.

EU Space Awareness: Lessons Learnt from an Educational and Outreach Project to Inspire the Next Generation of Space Explorers

Wouter SCHRIER [*1], Jorge RIVERO GONZÁLO[*2], George MILEY[*3], Pedro RUSSO [*4] on behalf of the EU Space Awareness Consortium

Abstract. EU Space Awareness is a European educational and outreach project that uses the excitement of space to attract young people to science and technology and stimulate European and global citizenship. Since its launch in March 2015, EU Space Awareness has reached more than 107,000 people across 68 countries directly, including 4,014 students and 5,799 education professionals. Over 160 activities were organised during the project, amongst which 34 local teacher trainings, 4 Massive Online Open Courses (MOOCs), 1 international Space Education Conference and 2 summer schools. The project has developed and published more than 300 high-quality and peer-reviewed educational resources. The project has implemented an extensive evaluation strategy, which shows strong evidence that all of the intended outcomes were achieved within the programme, and that it has been very successful in stimulating an interest in space science and showcasing the varied career opportunities that are offered by space science and engineering.

1. Introduction

EU Space Awareness[1] is a European educational and outreach project, coordinated by Leiden University (the Netherlands), that uses the excitement of space to attract young people to science and technology and stimulate European and global citizenship. Running from March 2015 until February 2018, the project targets diverse groups that are influential in the complex processes that lead to career decisions. The project was designed to show teenagers the opportunities offered by space science and engineering and inspire primary-school children when their curiosity is high, their value systems are being formed and seeds of future aspirations are being sown.

2. Approach

EU Space Awareness engages children and teenagers directly and indirectly through educators, teachers, and families. A coherent suite of EU Space Awareness activities aims to: (1) Acquaint young people with topical cutting-edge research and "role-model" engineers, (2) demonstrate to teachers the power of space as a motivational tool and the opportunities offered by space careers, and (3) provide a repository of innovative peer-reviewed educational resources, including toolkits highlighting aspects of Galileo and Copernicus.

EU Space Awareness features 10 partners and 24 national contact points across Europe and Africa. It exploits extensive international networks of schools and science museums to reach teachers, educators, and the general public and works closely with the European Space Agency.

3. Educational Resources

High-quality educational resources have been developed and distributed by the project through its extensive dissemination and partner network in 30 countries across Europe and Africa. Among these resources are Space Scoops[2], career interviews and activities, webinars, videos, citizen science projects, and an extensive repository of educational activities aimed at both Primary School and Secondary School education. All of these educational activities have been peer-reviewed through the astroEDU platform, both by an educator and a space science expert.

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In 2017 the project developed the 'Journey of Ideas', a special toolkit showcasing the history and accomplishments of Islamic science and technology and telling the story of a shared history based on tolerance and respect for other cultures.

To highlight opportunities in space exploration and the career potential it offers, the project has created a dedicated *Careers Hub*[3] section on its website, offering a wide selection of resources to learn more about careers in space. In total, more than 50 career-focused resources can be found here, ranging from interviews, to webinars, career profiles and brochures.

In total, the project has developed more than 300 high-quality space-related educational resources[4] that have been translated in multiple languages to make them widely available in classrooms worldwide.

4. Professional Training

EU Space Awareness also provided extensive educator support and professional training through workshops and Massive Online Open Courses (MOOCs), as well as high-impact events for teachers and policy-makers at the European Parliament.

Since its launch in March 2015, EU Space Awareness has reached more than 107,000 people across 68 countries directly, including 4,014 students and 5,799 education professionals. More than 160 activities were organised during the project, amongst which 34 local teacher trainings, 4 MOOCs, 1 international Space Education Conference, and 2 summer schools.

5. Evaluation

An extensive evaluation strategy[5] has been developed and embedded throughout the project, rigorously testing its effectiveness and identifying its impact on key target audiences. Results aim at a better understanding of the career aspirations of space-related workers, the vision that children have of space and space science, and the identification of best practices towards stimulating the next generations of space scientists.

It is clear that there is strong evidence that all of the intended outcomes, as identified by the Evaluation Framework, were achieved within the EU Space Awareness programme. In brief: The EU Space Awareness activities were considered interesting and useful and participants also expressed a range of other positive emotions associated with their teaching and/or learning of space science. They reported greater appreciation of the relevance and diversity of space science contributions and gained substantial factual knowledge relating to the specific topics covered. The interdisciplinary relevance of space science was highlighted by many participants as one of the aspects they liked most about the activities and resources, and found most stimulating within many of the training sessions.

6. Conclusion

Outcomes of the evaluation framework have shown that the activities and resources developed by EU Space Awareness have been very successful in stimulating an interest in space science and showcasing the varied career opportunities that are offered by space science and engineering. Overall, there is detailed evidence that the main EU Space Awareness activities have directly reached and inspired over 107,000 people throughout Europe and beyond.

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|Parallel Session|

"Mitaka TAIYOUKEI Walk" a Scaled Solar System Over the City

Toshihiro HANDA[*1], Hidehiko AGATA[*2], Setsuko OASA[*3], and Suguru YOSHIDA[*3]

Abstract. Since 2009 we make a seasonal campaign named "Mitaka Taiyoukei Walk" about 30 days every year. The scaled solar system in 1:1.3x10^9 are mapped over Mitaka city. The campaign provides more than 200 stamping spots at stores, office, and others over the city. At each spot every visitor sees a poster showing the planet size and collects the stamps. Through this activity visitors actually walk around the city and recognize the scales of planets and their distances. It is not only the scaled model but an entrance to latest finding on astronomy. In 2017, 3200 visitors joined the campaign and we will have it also in 2018. The key to success is that the campaign is organized three sectors of academism, local government, and local commerce as even partners.

1. Introduction

In these days public outreach covers wide range from academism to events in daily life; from citizens' science to sidewalk star party. In such activities we have to recognize that we should not carry out isolated knowledges but understanding with relation of many knowledges through background mechanism.

In this paper we report an activity for public citizens named "Mitaka Taiyokei walk (MTW)" which means "a self-organized walking tour in Mitaka city". It is a seasonal campaign held in Mitaka, one of the satellite cities near Tokyo. In this activity we hope to give an actual image of sizes and distances of planets and other objects in the system.

Although there are many scaled models of the solar system all over the world, one of the best scale is 1:2x10^{10}. In this scale the diameters of Earth and the Sun and are 0.6 mm and 7 cm, respectively. The separation between them, or 1 au is 7.5 m, and the nearest star, alpha Cen, is 2000 km away from the Sun. It is the only scale in which people can compare the interplanetary and interstellar scales directly. [1,2]

2. A scaled model over the city

Another best scale is 1:1.3x10^9. In this scale Earth is 1 cm in diameter and 115 m away from the Sun; people can see their sizes and can walk between their distances. Pluto is 4.5 km away from the Sun and this distance matches the whole extent of Mitaka city. Therefore, we mapped the scaled solar system over the city. This is a basic idea of MTW. [3]

We put the Sun at the Mitaka railway station, the hub of intracity traffic. Centered on there we define 11 annual zones using the scaled orbits of *planets* in the solar system. Besides 8 classical planets we add the Sun, Ceres, and Pluto, because we should avoid too big difference in area of each and people can know these objects are important members through the names of zones.

In each zone we post a sign with a circle which means the size of the planet of the zone in the 1:1.3x10^9 scale. If people go there actually, they can be impressed the sizes and distances of all planets through their own eye and foot.

3. Contrivance for actual walk

Although there are many scaled solar systems, only few people walk through it actually. To improve the situation some contrivance is required.

In MTW the city authority and chambers of commerce organize many shops, such as private stores, restaurants, offices, city hall branches and others. They are target to visit. Based on its location every shop is assigned one of the 11 *planet* zones.

MTW is open for visitors about 30 days from late September in every year. During the campaign period visitors can collect a specially designed stamp at each shop. MTW organizer gives a prize with novelty to a visitor on his/her stamp collection. The planet-size circle is shown at each stamping spot and on the MTW guide map.

We set 100 stamping spots in 2009 and 228 in 2017. We are surprised that more than 100 visitors collected all stamps every year. In Japan we have many stamp-collecting events in other cities. So, the stamp collection is a strong motivation for them. Japan has a tradition of journeys of many temples (e.g. Shikoku pilgrimage). It may be a cultural relation

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between them.

Besides regular stamping spots, we make extra spots at the short-term events such as open house day of National Astronomical Observatory of Japan (NAOJ). Because of its irregularity, we call such spots as *comet* stamps. In 2017 we set 18 comet stamps.

4. Beyond the scale model

The scaled solar system is just an entrance. Based on this framework we should provide astronomical findings and understanding. MTW we made the followings.

We made 4 prize names, Galileo, Kepler, Newton, and Chushiro Hayashi. Through these names make a hint to know their contribution of astronomy and solar system researches. In 2018 we will make a new one as Kozai, a great astronomer in celestial mechanics and the former president of IAU.

Each stamping spot we show a short message on the *planet* of the zone. It may be a hit to learn the planet more.

Several *science cafes* are held during MTW days. Because both NAOJ and Institute of Astronomy University of Tokyo are located in Mitaka, we can easily have them.

Some commerce stores provide special goods and services during MTW; e.g. sweets, green tea pack, and bowls. All these goods have a logo of MTW and brand names related to the *planet* of the zone.

To move around the whole city, bicycle is convenient. It is a vessel to access *planets*. So, the bicycle rental shop gives the name of space proves to each of their bicycle. You can visit any planet with Voyager, Hayabusa, or New Horizons! Each bicycle has a name plate with short instruction of the prove.

5. Results and future

Since 2009 we have had 9 times. The stamping spots and visitors increase every year, although 2017 was the slightly decrease due to bad weather. In 2017 over 3200 visitors collected 134 stamps on average and got some novelties. Figure 1 shows growth of visitors and stamp spots.

Statistics of questionnaire survey shows majority of visitors are 40s and under 20s. More than half visitors joined MTW more than three times. Currently about 80 % visitors live in Mitaka. We hope to increase visitors from outside Mitaka. A railway company operating Mitaka station join the executive committee for 2018 campaign and they should help us.

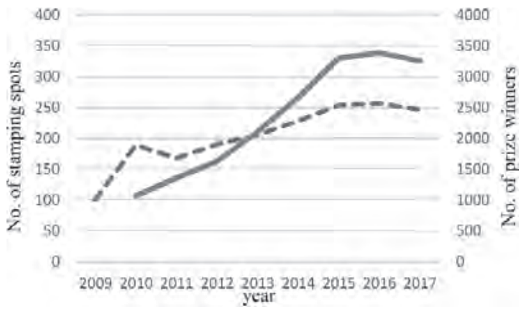

Fig. 1. The growth curves of MTW. The solid line shows the number of prize winners, which indicates the number of active visitors (right axis). The broken line shows the number of stamping spots, which indicates the size of campaign.

We will enrich the scientific contents, too. For example, shop masters of stamping spots want to have talks on astronomy and visit NAOJ facility. We have to reply such demands and make a tighter relation between academism and local society.

6. Summary

“Mitaka Taiyokei Walk” is a seasonal activity based on the scaled solar system over the whole city. We made some contrivances to walk across the whole scaled solar system actually and it becomes real. Collaboration with three sectors (academism, city authority and commerce) is a key to success. Increasing visitors and stamping spots lead a good effect on local economical and public interest on astronomy. Based on the previous achievement, we continuously innovate new activities which make the campaign to be more attractive and enhance the public interest on astronomy.

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|Parallel Session|

The Case of the Stolen Rings: an Astronomical Live Role-Playing Game for Kids

Stefano SANDRELLI[*1], Francesca CAVALLOTTI[*2], Simona ROMANIELLO[*3] and Alessandra ZAINO[*4]

Abstract. "The Lord of Rings – the mysterious case of the stolen rings" is a live astronomical role-playing game for kids aged 6-13. Its goal is to introduce participating kids to some of the main topics concerning the Solar System: a) the role of gravity; b) the distribution of mass and light; c) the effects of rotation; d) the distribution of water. It is an inquiry and fun-based learning activity: the kids behave as if they were detectives, in a storytelling framework. They are provided with a very well-defined plot to which they called to contribute actively, interacting with ordinary people and animators, exploring the gaming area, discovering facts and collecting symbolic objects. Finally, the game openly confronts the gender issue: the kids are led by a fictional character, Martina Tremenda, who is the role-master of the role-playing game. She is a 12 year-old girl who represents curiosity and hunger for knowledge.

1. Introduction

According to Wikipedia [1] *a live action role-playing game (LARP) is a form of role-playing game where the participants physically portray their characters*. *The players pursue goals within a fictional setting represented by the real world while interacting with each other in character*. (…) *Event arrangers called game-masters decide the setting and rules to be used and facilitate play*.

Since 2005, we have designed astronomical live action role-playing games for kids in Italy, which are then performed in the most important science festivals in Italy (Genova, Perugia, Bologna) and other public occasions.

We believe that LARPs can provide a fruitful context to blend together some of the most effective educational methods. Indeed, LARPs give us the opportunity to build a narration, which provides both an inquiry-based learning activity and a truly hands-on framework. Kids play as "characters", using their minds, their competences, their knowledge, their imagination and their bodies. And they have a lot of fun: we share the Italian Nobel Prize winner Dario Fo's vision: true cultural growth is only achieved through fun, passion and laughter.

While LARPs can be tailored to be inexpensive, they can be quite demanding in terms of the involvement of animators.

2. Target and characteristics

In what follows, we wish to provide the reader with an "at-a-glance" identikit of our activity. To do that, we select an astroEDU-like format as a convenient standard, since it also gives some practical indications about the costs involved:

Age: 6-13 year-old kids
Duration: 2-3 h
Target group: from 2 to 8 teams of 3-5 members, supervised by scientific animators
Cost: 5 $ or € per group (total amount: less than 50 $ or € on the basis of 8 groups of 5 members each)
Location: outdoors
Core skills: asking questions; planning and carrying out investigations; constructing explanations; engaging in argument from evidence, communicating information
Type of learning activity: enquiry and fun learning
General goals:

- obtaining a general view of distances in the Solar System;
- acquiring an overall awareness that the latter changes and evolves.

Learning objectives. Students will be able to understand that, in the Solar system:

- gravity changes from planet to planet;
- luminosity changes with the distance of the planet from the Sun;
- water is quite a common substance;
- rotation is important in preserving the rings.

3. Plot of the role-playing game – part 1

Last night, the rings of Saturn were stolen by a mysterious Centaur. G.V. Schioppanelli, the retired astro-detective of the town, is now running a very well-known Pizzeria, the Red Giant Pizzeria, and he cannot help with the investigations. Our kids will do the work instead of him. They form groups of mini-astro-detectives and they will be led by Martina Tremenda. But who is Martina? Let us discover her.

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4. Martina Tremenda

Martina Tremenda is a fictional character created in 2014 by one of us (S. Sandrelli) to build a coherent narrative framework which includes science labs, games and other informal activities organized by the Italian National Institute for Astrophysics (INAF) under the collective name of *astrokids*.

While Martina is a typical first name from Milan, her surname *Tremenda* means "naughty, mischievous, scamp, impertinent" and it rhymes with "merenda", which is the typical afternoon snack time for kids. Some of Martina's adventures are told in nursery rhymes and songs, where the meaning of the assonance *Tremenda/merenda* is widely explored. Indeed, Martina is always hungry: she wants to explore, to understand, to travel, to meet new friends – terrestrial or alien. In order to do that, she is also keen on breaking rules or expected behaviours, if this can help her to go deeper in her explorations. Martina is red-haired, she has five pigtails, she is unconventional and able to build her own pedal spaceship. In addition, Martina and the spaceship are able to travel around the universe with no limit – not even the speed of light.

Some of you may recognize in Martina some of the main characteristics of Pippi Longstocking, Astrid Lindgren's character (International Andersen Prize, 1958), while her ability to move around is inherited from Giovannino Perdigiorno (something as *Little Johnnie Timewaster)*, the character created by Gianni Rodari (Int. Andersen Prize, 1970).

We believe she can be helpful also in giving kids a positive example that defies some gender-related prejudices, which tend to become more and more marked among kids aged 10-13.

5. Plot of the role-playing game – part 2

The kids are appointed astro-detectives in-charge and asked to find the rings by browsing around the Solar System, which is scaled so as to fit the gaming area. The latter must be big enough to let kids run from one side to the other effortlessly whilst becoming aware of distances. A gaming area sized 1 km x 0.5 km is appropriate. Great care must be taken in choosing a safe car-free area, such as a pedestrianized one (historical city centers, in our case), better still if crowded with people who are not playing. Kids are required to talk to anybody who can give them information. But how can they distinguish those people who can help? By trying: just asking and talking to people. In every phase of the game, they can ask Martina for suggestions.

At the correctly scaled distances, kids can find animators who play the various planets: they are the right people who can give useful information. As soon as kids discover that Saturn's rings were destroyed in the theft, Martina suggests that the rings can be rebuilt, if they are able to gather the right ingredients (gravity, light, rotation, inclination, dust and water, represented by simple objects like apples, spinning tops and so on).

The kids can get the ingredients from the different planets: every planet has ingredients in quantities which are proportionate to the real physical properties of that celestial object.

After collecting the ingredients, they have to take them to the "The Red Giant" and give their best recipe to Mr Schioppanelli. Depending on the recipe, rings can be too thin or too luminous or too fast-rotating and so on. The winning team is the one that prepares the best recipe to cook the rings in the smallest amount of time.

6. Summary

Come to meet Martina at: astrokids.inaf.it

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|Parallel Session|

Implementation of National Level Experiential Learning Astronomy Outreach Practices in Developing Countries Like India

Vikram D. LONDHE*1

Abstract. The major challenges faced in the field of astronomy communication in India viz. the lack of awareness, networking, funding, accessibility, network of trained and committed educators combined with diverse demographics, are all addressed by the creation of a national level platform called Natskies Observatory. We have introduced Experiential Learning Technology (ELT) for creating interest in astronomy among students with diverse age groups and demographics. A structured scientific content through Experiential Learning is delivered in the form of experience which helps students and teachers to learn basic concepts of astronomy and space science. The activity delivery model has been created by considering their age group. National level accessibility is currently served with the ongoing Outreach Programs. We have also created a special set of activities that cater to underprivileged students through our mobile unit. The funding for the entire organization is set in the form of rotational reversible approach where participant's admission fees helps effectively to run the organization. So far, Natskies Observatory has successfully conducted introductory and advanced programs for thousands of students. "*The only source of knowledge is experience – Albert Einstein*

1. Introduction

The Experiential Learning technology has been integrated with the hands-on experience kits to engage students in a learning process. Training modules for the educators, the interest quotient analysis of the students are performed under various variables. Our methodology describes the implementation process for setting up a national level platform to engage students through ELT in the comfortable environment. The workshop drafting parameters are set to focus on the outcomes of all our practice. The data analysis or observation at every step allows us to refine the experience.

2. ELT at Natskies

Natskies has opted for the experiential learning technology (ELT) as our formal education strategy. ELT can be simply put as learning by doing. ELT at Natskies lets participants experience the situation, reflect the situation, then try to form an abstract concept and do it again and refine it. We put children through direct inspiring experiences. Our ELT strategy is followed by focused reflection, increase useful knowledge, develop skills that they can apply, clarify values that can make a difference, and develop deep capacity for contribution. [1] We have developed the content which truly delivers the results. The ELT at Natskies are performed under the supervision of our educators.

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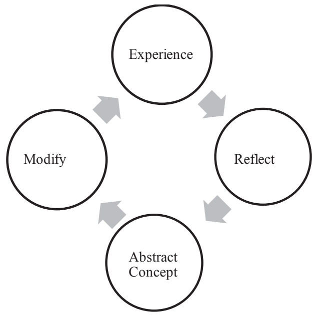

Fig.1 Cycle of ELT by David A. Kolb

3. Application to ELT

Here we present an example of the process of drafting an Astronomy or Space Science workshop and its learning process. The output datasets are calculated through the interactive workbooks.

Experience: Make the rocket and launch it, *Reflect:* Prepare a debrief on the experience, note down observations, assess impact on materials used, and identify any modifications required in process, assembly, design, dimensions, materials or launch. *Abstract Concept:* Understand parts and aspects of a Rocket**.** Draw a concept of "Air Propelled Rocket" Build / Modify: Assemble materials, understand process of assembling materials, consider all external factors impacting launch (wind / Newton's laws, etc.) and identify launch strategy Experience: Re-launch the rocket and fill out post flight reports.

4. Workshop Drafting Parameters

1. Learning from a workshop should be best conveyed as a process, not in terms of outcomes. A process which involves feedback on the effectiveness of their learning process. [2]
2. Learning has to draw ideas from the topics so they can be examined or refined.
3. There should be time given for a reflection.
4. Learning from workshop consist thinking, feeling, perceiving and behaving.

As India is a developing country, it has students from various age groups, demographics and education boards. So, the workshops is delivered or supervised according to the level of understanding of Participants.

4.1. Parameters for Workshop Placement

The parameters which directly impact the methodology implementation are resources, data sets of diverse demographics, time allowed for the reflection and the weather conditions.

4.2. Adaptation

India is a country with extremely diverse demographics, with twenty-two different languages are spoken, 50 state level educational boards and five international educational boards. The educator has to adapt for the various demographics. [3]

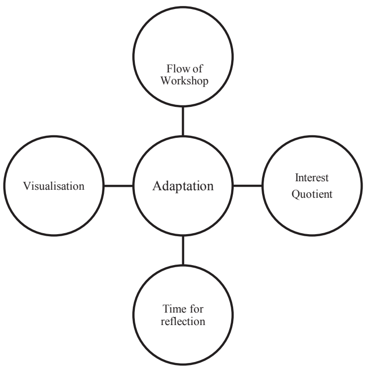

Fig. 2 Adaptation Technique to involve diverse demographics

The educator has to effectively adapt to increase the participation of the students. The educator helps to visualize concepts and keeps the steady flow of the workshop.

5. Results

The Experiential Learning Technology proves to be an effective tool to communicate Astronomy and Space Science to the diverse demographics participants. ELT has helped to raise the interest quotient amongst participants up to 85%. [4]

6. Summary

The key concept is the learning cycle, learning style, learning space, environment, interest quotient analysis have severed as very useful tools in delivering the workshops for students and training educators. The ELT technology has been successfully applied to enhance the learning experience of the participants.

The outreach activities support the organisation to reach out to more students every year. Research and development in the organisation complements the ELT learning process.

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|Parallel Session|

Let's Make our Butterfly Diagram!

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Abstract. Kwasan Observatory, Graduate School of Science, Kyoto University was established on the east of Kyoto City in 1929 and has promoted outreach activities since its establishment. One of our unique programs is the partnership program with the Board of Education, City of Kyoto. Over 3400 elementary school students have visited Kwasan Observatory since 2013 and students of Kyoto Municipal Horikawa High School have guided and supported them to look around the observatory. In order to combine students with the observatory more closely, we have developed a learning tool, "Let's Make Our Butterfly Diagram!" It enables students to experience activity like an observer or astronomer and teaches them the mysteries of the Sun and the importance of long-term observations.

1. Introduction

Kwasan Observatory, Graduate School of Science, Kyoto University, was established in 1929, and has achieved significant results in the planetary science and solar physics. We have also promoted outreach activities since its establishment. Since those activities make residents in Kyoto proud of Kwasan Observatory, it was approved by Kyoto City as "The Buildings and Gardens Which Make Kyoto Attractive" in 2014.

We are struggling to popularize not only the astronomy, but Kwasan Observatory and its solar observations to the public. As the Okayama Observatory was established in 2018, however, the budged of Kwasan Observatory is reduced by 70% from April, 2018. In addition, the number of sunspot observation reports is decreasing in Japan. According to the reports of the Oriental Astronomical Association, there used to be 49 domestic reports in 1984, but recently, only 24 were reported in 2017 (Suzuki, M, private communication).

2. Solar Observation at Kwasan Observatory

We have been observing the Sun every day from 1997 by using a 7-inch Sartorius Telescope equipped with an H-alpha filter. Originally this telescope was installed in 1910 to observe Halley's Comet before Kwasan Observatory was established.

In addition, we have drawn sunspots by another 5-inch telescope since 2004.

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3. The Partnership Program with the Board of Education, City of Kyoto

The partnership program with Kwasan Observatory and the board of education, city of Kyoto, has started in 2013. In this program, we have invited elementary school students in Kyoto to visit Kwasan Observatory. Table 1 shows the number of elementary schools and students that have visited the observatory.

It is not easy for us to welcome over 700 elementary school students during a short period. To overcome this challenge, students of Kyoto Municipal Horikawa High School kindly offered to support us. They made a workbook for the students, guided them to look around and operated the 4-D theater [1], [2]. In this program, elementary school students, high school students and scientists can teach and learn something each other. The board of education intends to have students to have "genuine" experiences and to meet to unknown. This program makes us to collaborate in public education and also leads us to genuine and unknown experiences.

This was an interesting program even in the first stage, we have been sophisticating it to the next stage. We considered followings: how students use the data observed in Kwasan Observatory, how students experience activity like an observer or astronomer, and how students learn the essence of astronomy (e.g. accumulation of observations leads to a discovery.). Addressing these subjects, we have developed this learning tool, "Let's Make our Butterfly Diagram!"

Table 1. Number of Schools and Students

	2013	2014	2015	2016	2017	Total
Schools	9	12	12	10	12	
Students	595	652	724	714	728	3403

4.1 What is Butterfly Diagram?

Butterfly Diagram is a latitude distribution of sunspots with time. Sunspots tend to emerge at lower and lower latitudes as the solar cycle progresses [3]. This diagram indicates the mysteries in solar physics: why the solar cycle is caused, and why the emergence latitude of the sunspot moves as the solar cycle goes.

4.2 Let's Make our Butterfly Diagram!

In order to draw the butterfly diagram with students, we prepared these items: "My sunspot card", a grid sheet (90cm×155cm), and round seals. "My sunspot card" shows the latitude and date of a sunspot. Those data were taken at Kwasan Observatory. On the basis of the data, students put seals on a grid sheet. The QR code, the Japanese 2-dimentional barcode, is also printed on the card, and participants can access the website and see the diagram's progress. Fig.1 shows the complete butterfly diagram that we made collaboratively with students and the public in 2017.

4.3 Activities outside the Observatory and Students' Comments

In order to nurture their curiosity, we support the students after they go back to their class rooms. After the diagram complete, we send them the copy and explanation handout. In addition to that, we visit the school and give a lecture when they request it. In Feb. 6, 2017, we visited an elementary school and gave a lecture to 128 students in the 6th grade. These are some of students' comments: "I wonder how the butterfly diagram will be in future." "I can see the Sun for granted every day, but I learn that there are still many unsolved questions about the Sun."

We also carried out this activity as a workshop in the training course for the astronomy guide [4] of Kyoto on Oct.14, 2017. On this activity, approximately 40 participants completed the butterfly diagram within 1 hour. On the basis of this activity, we gave collaborative learning program as the part of the geoscience lecture at Kyoto Kogakuin High School in Feb. 2 and 6, 2018. These are some of the comments by the high school students: "I think this learning program is the fruits of observers' enormous efforts. I really enjoyed this activity to use the precious data." "It was an impressive experience for me to handle the original data. I was very excited at the moment that a piece of data gathered into a large amount of data."

Fig. 1. Let's Make our Butterfly Diagram 2017

These comments indicate that the students experienced the gate to the astronomy and realized the importance of long-term observation.

5. Future Works

We intend to develop more outreach contents and tools. We welcome feedbacks from school teachers, students and you, readers. One of our next missions is to invite all the student in Kyoto to visit Kwasan Observatory. Moreover, Kwasan Observatory is open to everyone around the world.

6. Conclusions

"Let's make our Butterfly Diagram" activity teaches us the importance of long term observation. It combines the observatory with students and the public. Observatory staffs can collaborate with students, and appeal the mysteries of the Sun. Students also can meet the astronomical observatory, be like an observer or astronomer, and wonder how the Sun will be.

How can we keep observation and survive as an educational center with a limited budget? This is our biggest challenge.

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|Parallel Session|

'Robots Looking at the Sky': Opening Professional Telescopes to Students

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Abstract. 'PETeR - Robots looking at the sky' is an educational project of the Instituto de Astrofísica de Canarias (IAC) which aims to engage students in science and to encourage them to acquire STEM skills through their active participation in guided research in Astronomy using robotic telescopes. The project, which is web-based (www.iac.es/peter), provides students with different approaches to experience the culture of doing science, such as learning scenarios and research projects, and at the same time, allows them to discover the universe making their own observations of their favorite objects.

1. Introduction

The challenge that many educational systems are facing is how to encourage students, especially girls, to acquire STEM (Science, Technology, Engineering and Mathematics) skills, and how to increase the number of young people who want to develop their future careers as professionals in the fields of technology and research. A recent study from the Spanish Foundation for the Science and Technology [1] shows that students attribute their lack of interest in STEM studies to the way these subjects are taught in schools, its complexity and the apparent lack of sufficiently attractive professional opportunities.

To solve this problem, initiatives that engage students in interesting and motivating scientific experiences, following an inquiry-based education approach, involving teachers as key players and ensuring the participation of other stakeholders, such as technology and research centres, are needed.

Astronomy is a science that unites the ancestral human longing to know what is beyond the world that surrounds us with the 'wow' effect produced by the images of the Universe. This makes it the perfect engine to arouse curiosity and interest in scientific subjects, both in young people and in adults. In the last decade, the implementation of robotic telescopes, designed to work autonomously, coupled with the development of tools that allow their use by non-professional observers, have made it possible to open this science to the participation of the educational community and the society in general.

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2. PETeR

PETeR, which stands for the Spanish acronym of Educational Project with Robotic Telescopes, is an enquiry-based online lab (www.iac.es/peter) which aims to familiarize the Spanish educational community with the scientific method and practice, while contributing to the diffusion of Astronomy and Astrophysics. This is achieved dedicating some observing time with professional robotic telescopes to educational activities and e-science projects aimed at students. PETeR is coordinated by the Instituto de Astrofísica de Canarias (IAC) through its Communication and Scientific Culture Unit.

Thanks to agreements signed between the IAC and the owner institutions of several robotic telescopes installed at the Observatories of the Canary Islands (the Liverpool Telescope, the OpenScience Observatories, LCO, …), some observing time with these telescopes is available through PETeR to the Spanish educational community.

The project allows students to approach science in different practical and enjoyable ways. One of them is the use of learning scenarios. Each scenario introduces several concepts related to a topic on Astronomy, and provides one or more practical activities which make use of real astronomical images, and a student-friendly software for visualizing and analyzing the images. Finally, the users can complement the scientific process requesting their own observations.

Fig. 1. Students from Escola GEM (Spain) analyzing the image of a galaxy obtained with the Liverpool Telescope through PETeR. Credits: Escola GEM.

A second approach is the participation in research projects, either those that students propose or others that we design. All projects are conceived in four different steps: the first one consists of providing the users with some orientation, in the form of educational materials, to introduce the topic. Then, a second phase which involves formulating research questions and hypotheses; a third step in which users prepare and conduct the observations, and the drawing of conclusions at the end. The participation of IAC researches, especially women, giving scientific advice or acting as tutors, is also a way of bringing scientists closer to the students and to show this profession as a career opportunity.

Another key point of the project is to engage and train teachers in Astronomy. With this aim we organize international Galileo Teachers Training courses every summer with a special focus on hands-on activities, and in collaboration with other educational projects like NUCLIO, the Faulkes Telescope Project, the National Schools' Observatory, as well as the European Science Education Academy. We also maintain an active collaboration with the Ministry of Education of the Canary Islands to provide training courses for local teachers throughout the school year.

3. Results

PETeR users consist of more than 160 primary and secondary schools in Spain, over 20 non-formal schools (science clubs and camps, after-school centres, …) and nearly 20 amateur astronomer associations. More than 150 teachers have been trained in total since 2015, most of them from Spain, but also from other European countries through KA1 of the Erasmus+ programme.

Learning scenarios and pre-defined observations are the preferred option for many teachers, especially for those having contact with telescopes for the first time. However, about 20% of the school users propose new observations and their own research projects.

An example of the power and impact of this approach is the project developed by a Mathematics teacher of the El Calero Institute of Secondary Education in Gran Canaria (Canary Islands) and his 12 year-old students. The project consisted of choosing two fields in which they were going to look for variable stars, requesting observations through PETeR with LCO telescopes, and complementing them with archive data and with observations from an amateur telescope of the astronomical group of their island (AAGC). They performed differential photometry on the images and constructed the light curves of the stars in the studied fields, which they later analyzed to check for variability. Once a number of candidates were identified, the students determined what kind of variables they could be, estimated their periods, and made a mathematical characterization of the light curves. The result was the discovery of two new variable stars, both eclipsing contact binaries, with periods shorter than 24 hours. These students are the youngest in the world to make a discovery of this type during formal education, and have appeared in TV, radio and press media.

4. Conclusions

Astronomy is the perfect hook to promote scientific and technological vocations among students. However, it is important to provide teachers with training and guidance to introduce astronomical topics in the classroom in an attractive way. Our experience with PETeR also shows that another key point is giving the educational community access to powerful tools like professional robotic telescopes, and trust on their possibilities, because sometimes this can make a real difference.

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|Workshop|

Tinkering with the Universe: a Primary School Project

Sara RICCIARDI*1, Fabrizio VILLA*1 and Stefano RINI*2

Abstract. In this paper we describe the workshop "Tinkering with the Universe" held at the Communicating Astronomy with the Public (CAP 2018) in March, 2018 at the Fukuoka City Science Museum, Fukuoka. The goal of the workshop was to have our community tinkering together with simple material mixing low tech and hi-tech to build something new and unexpected. We want to engage people with this way of learning, have feedback from the community and hopefully sparkle some collaboration.

1. Introduction

Our attempt was to bring to the international astrophysical community at CAP an approach that was extremely successful in our local community.

Since 2012 we have been working together with teachers (mainly primary school) to design, promote and deliver hands-on, self-directed and playful activities to engage children with STEAM. Our most powerful approach is tinkering. Tinkering is a holistic way to engage people with STEM disciplines mixing them with Art, contaminating hi-tech material with low-tech and recycled material. Knowledge is not simply transmitted from teacher to learner, but actively constructed by the mind (and the hands) of the learner. Constructionism [1] suggested that learners are more likely to develop new insights and understandings while actively engaged in making an external artifact. This method supports the construction of knowledge within the context of building personally meaningful artifacts, and the more self-directed the work is the more meaningful the learning becomes. In this playful context, the kids just play and learn, they do not psychologically classify the activity as math or science so they are finally free to enjoy science and free from their self-prejudice. We strongly believe this approach could be important for kids and young-adult too and that it is a matter of democracy and gender equality (especially in Italy) [2] to allow people to engage with this empowering tools. This method is extremely powerful but also extremely onerous in term of time and organization. The materials used, the physical spaces involved and the strategies of facilitation require a huge amount of work; at the same time to do tinkering is not expensive in term of money so it is a suitable activity for schools.

As researchers we know that science is not just literacy and instead the real research happen when we use our creativity to imagine new ways, new path to follow. Doing that we fail without fear because we know this is how research works. We believe we have to tell also this part of the story. For someone tinkering is not "enough" disciplinary and this may be true: we are passing an attitude, a way to tackle our world, a first technological literacy not astrophysical concepts that are "accidentally" learned but in an indirect and personal way. We strongly believe that tinkering could be also successfully embedded in a project based learning experience where other more traditional methodologies are exploited too. Tinkering deeply engage people, could help to build some learning building blocks and stimulate cooperation in a playful environment.

2. The workshop

To understand tinkering you have to try it! So we let our colleagues play at CAP 2018 with one classic tinkering workshop "the scribbling machines". To provide a bit of context and to illustrate how tinkering works for us we provided a very brief introduction of about 18 minutes. The presentation with videos and the speaker notes is available [A]. In the presentation we provide some coordinates to understand tinkering and we highlight the wonderful work of the Tinkering Studio at San Francisco Exploratorium [3] [4] [5] and also how tinkering is relate with another very powerful, successful and popular way to engage children: coding [6].

We allow about one hour and half of pure play where participants organized themselves in group of 3 people and they made different type of scribbling machine e.g. a "noisy machine" (noisy Martian), an animal-like machine (pig?), a super tall one and other wondrous creatures decorated also with "courtesy set" items such as toothbrushes and shower caps. An incomplete gallery of media is here [B], hoping the participants will update with personal video, pictures and comments.

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3. Feedback from participants

We asked the participants to fill in a short questionnaire to understand if, for this audience, tinkering is a good idea in astrophysics, hoping to get people involved and hopefully collaborate for future co-creation. We are very pleased about the results. We had back 43 filled questionnaires The first question was about childhood and a personal memory of building something and people went wild. We asked in the second question if the participant liked to build the contraption and in the fourth question if tinkering can be a viable approach for astrophysics. Unanimously people liked very much to build the machine especially if we take count of all the hearts and stars sketched on the questionnaire.

Fig. 1. The tinkering workshop at CAP 2018. Participants playing with Scribbling Machines.

The participants stated also that tinkering can be a viable approach, in some cases adding comment about related possible difficulties. For some of the participants is very suitable for technology related astrophysical issues. One person was unsure. The third question was about previous knowledge of this method. We got six people that already knew tinkering as an educational tool (3 from Philippines and 3 from Netherlands), the 4 facilitators from INAF, 8 people knew from articles, tv, newspaper and colleagues but the majority of this people stated that the workshop provided a more deep knowledge and above all provided an useful context. In this group we got a lot of comments maybe the line more rewording for us was the comment of Thea – I have seen it on TV and books but it's a completely different experience doing it by myself – and this is a great reward that pay back all our organization efforts. We got 6 people that recognized something in the tinkering they already knew but they didn't categorize as tinkering and 19 people that didn't know tinkering at all. We got creative ideas about possible future contraption to build; the majority are technology based ideas: rover, landers, rockets, adaptive optics, moon exploration, pressure gun, spectroscope, resonant cavities, radio transmitter and detector, high energy particle detector, analog film camera and telescopes. Some people proposed science based ideas: planetary science, asteroids, solar system, supernovae, binary stars, spiral galaxy, orbits, dynamic, gravity, celestial mechanics, ET design, black holes, inflating universe. We would like to go deep and understand better those participants ideas. In the last yes/no question we asked if people want to be involved in a co-design and co-creation of a novel tinkering lab. We got 2 people not interested, 4 people unsure, 10 people didn't answer and 27 people interested and we hope to interact soon with them. Some of the participants got very excited and a lot of them believe that this material/approach could really works in their local community for this reason the majority of the material we brought at the workshop is now around the world to allow people to try and hopefully let us know. We will provide our full support to the local communities in this experimentation.

6. Summary

We brought tinkering in the welcoming community of CAP and IAU. We got an amazing feedback from participants and we hope this will be a start for a co-design and co-creation of new tinkering ideas around the world.

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|Poster|

Developing a Teen Culture in Astronomy

Thierry BOTTI [*1],

Abstract. This text presents a long-term and successful programme designed in close collaboration with the local education office to develop teachers and teenagers' culture in astronomy and our wish to go even further through observation time exchange on robotic telescopes with educational institutions over the world.

1. Introduction

In 2009, in the framework of the IYA, after several years of collaboration with the local education office, we decided to design together a complete programme to encourage teachers involvement in specific projects dedicated to astronomy discovery during or outside school time. Over time, the project evolved and we are now looking for international collaborations to begin a new step of our project.

2. Strength of the projects

If the project still going on with success it is because there is, since the beginning, a great involvement of the local education office combined with a great support of the astronomical research community. Thus, all teachers who want to be part of the project benefit of:

- A training course on astronomy and project management supported by the local education office (around 70 teachers had been trained per year).
- The support of researchers during the development of the project.
- Facilities to observe the universe and a training course on how to use them.

During the first step, from 2009 to 2014 we provide to the programme 8 small telescopes and 4 CCD cameras available for the schools involved.

According to the success of this programme we find the founding to acquire a 50 cm robotic remote telescope: IRiS. This new facility is in priority dedicated to junior high schools and high schools but a small part of the observation time is also allocated to univer-sities and for teachers training.

Table 1: IRiS	
Primary mirror	50 cm
CCD	2048 x 2048 pixels
Observation field	Visible spectrum (8 filters)
Field of view	24' (= full Moon)
Targets	Deep sky (exoplanets, nebulae, galaxies, supernovae…).
Monitoring	online with a PC
Location	Observatoire de Haute-Provence —100 km from Marseille; France

Table 2: the use of IRiS all types of users included

2014/2015	*2015/2016*	*2017/2018*		
Accepted projects	***Accepted projects***	***Submitted projects***	***Accepted projects***	***Nb of nights***
30	*28*	*49*	*48*	*109*

3. And now … to go further!

To engage more teachers in the programme, we would like to give them the opportunity to observe night sky during day time.

So, we are looking for educational institutions involved in such hands on activities in astronomy with robotic remote telescopes that could be interested to collaborate with us. Then, we would like to design a project of collaboration based on observation time exchange and training (online training) for teachers on how to use our respective telescopes. It could also offer some opportunities of communication between the teenagers involved over the world …

Fig. 1 – IRiS telescope in its dome at the Observatoire de Haute-Provence; France

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Asteroid Day: A Vehicle For Raising Public Awareness Of Astronomy And Space Exploration Among Primary Students In Ireland

Adriana CARDINOT*1, Andy SHEARER*2 and Jessamyn FAIRFIELD*3

Abstract. Asteroid Day is a global awareness campaign which takes place annually to learn about asteroids, their impact and to increase awareness on how we can protect the Earth from future asteroid impacts. At the event students tested their own hypothesis and carried out investigations to discover new concepts in Astronomy. The activities encouraged learning and promoted positive attitudes towards Astronomy.

1. Introduction

Space had been used as a theme to immerse people with science for many years. The Asteroid Day is a global awareness campaign which takes place annually to learn about asteroids, its impact and to increase awareness on how we can to protect from future asteroid impacts. In Ireland, the event was organised by the National University of Ireland Galway on June 27th in a primary school in Galway. Altogether, more than 100 primary students were involved in a playful learning environment designed to establish a learning approach enhanced with the use of hands-on activities.

2. Event Outline

The declining interest in science is a serious concern for all countries. Research has been showing that it is mainly affected by the way science is presented at schools with a low level of interaction and connection with real world [1,2]. In this event, we aimed at using different approaches which had more emphasis on scientific inquiry and hands-on activities that could encourage students to develop a deep understanding and appreciation for astronomy. The event consisted of three parts: (1) talk with an Astronomer from NUI Galway about asteroids and the science behind it, (2) workshops to encourage students to think in ways similar on how scientists do and (3) a public lecture at the university.

Each workshop reinforced the links between astronomy and their its contributions to our modern life. We aimed at conducting activities that would challenge the participants to investigate asteroids and other astronomical objects. School workshops included:

1. "The Size of the Sun": a game to explore the relative size of different celestial objects in the Solar System.
2. "Being an Engineer": students were challenged to create a rover made with pasta, and a rocket made with a plastic bottle that was launched at the end of the event.
3. "Modeling Asteroids": using clay and paper models students investigated the shape and formation of asteroids.

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3. Conclusions

Our hands-on activities encouraged learning and promoted positive attitudes towards Astronomy. Also, the use of household materials in the workshops made the teaching of Astronomy interesting and easily adaptable for any age group in and outside the school.

Postgraduate participation in public engagement with science events has the potential to enhance their education, developing skills and capacities that are useful in both academic and non-academic careers.

4. Future Work

We plan to investigate further the use of arts for promoting astronomy to underrepresented groups in STEM in Galway. This future work is part of the Making Space Programme which is funded by the Royal Astronomical Society under the Outreach and Engagement Fund (RAS200).

Acknowledgment

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|Poster|

Community Astronomy Education: Eclipse as Opportunity in Middle Georgia

Donovan L. DOMINGUE*1

Abstract. Project ASTRO at Georgia College successfully engaged communities in rural Georgia in learning about astronomy through the August 2017 solar eclipse. With endowment funding for protective eyewear, public school teacher workshops, public library engagement and communication with school administration, citizens of central Georgia experienced the solar eclipse. Sharing the rich eclipse history of Georgia and highlighting educational practices associated with eclipses was a successful strategy for encouraging participation and preparation for the event. Incorporating local scientific history as an interdisciplinary approach may strengthen the retention of science lessons and benefit local outreach efforts.

1. Introduction

Georgia College & State University became the newest member of the Project ASTRO cohort of educational institutions in 2015. Project ASTRO began in 1994 as an Astronomical Society of the Pacific program funded by the National Science Foundation (NSF). The recent Georgia site addition began a relationship between teachers and local astronomy professors at the same time that national preparations were being made to prepare the public for the August 21, 2017 eclipse.

To encourage learning opportunities among the schools and communities of central Georgia, a focused education effort was created to involve local schools and libraries. The central Georgia schools would only experience a partial eclipse (97%) but the path of totality did enter the state of Georgia at its northern most corner.

The Georgia Project ASTRO program had access to endowment funding for classroom supplies and eclipse glasses. This Kaolin Endowment also provided funding for a limited term Kaolin Endowed Chair position to assist a faculty member in reduced teaching load. The funding provided the resources and time needed to complete this project.

2. Outreach Activities

The administration of the nine public schools in Baldwin County, Georgia agreed to visits and eclipse lessons were provided to the teaching staff. Eclipse glasses were promised for each student to encourage participation and safety. The glasses were not delivered to the schools until the month of the eclipse to keep them secured from loss or damage. As the eclipse date came nearer, schools from nearby counties requested lessons plans and glasses donations. Purchased supplies limited our outreach but a few additional schools were able to participate.

The local public library system was contacted as a means of reaching non-school age adults. The library staff embraced the activities and introduced programing for the adults and pre-school age children in the community. The library created a day-of-eclipse event to supervise the use of eclipse glasses and other observing tools when the university astronomers were not present due to their travel to the totality path.

3. History as an Outreach Tool

The meetings with teaching staff provided time to introduce the mechanics of eclipses but also to review the local history of eclipses as mentioned in local newspapers and websites such as timeanddate.com. Archival research provided direct accounts of the activities in our community during previous eclipses. The newspaper articles also gave accounts of science expeditions to the region for the events. Milledgeville, GA was visited by totality in 1834 and 1900 and this gave teacher workshop presentations an important historical context for the upcoming eclipse.

6. Summary

The willing participation of local schools and libraries provided astronomers from our institution the ability to get over 8000 students observing the partial eclipse in our area. An additional 2000 glasses were distributed to the public with funding provided through an endowment for science education hosted at our university. It is encouraged for communities with past eclipse experience to review those events as part of outreach activities that combine the public interest in history and astronomy.

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Delivering Astronomers to a Lot of Classrooms! The "FUREAI (Friendly) Astronomy" Project, NAOJ

Tokiko FUJITA*1, Nobuo ARIMOTO*1 , Hidehiko AGATA*1

Abstract. "FUREAI (Friendly) Astronomy" is a project that takes astronomers from NAOJ to schools all over the country. This program is running for eight years - from 2010 to 2017, and was held in a total number of 481 elementary and junior high schools from Hokkaido in the north, to Okinawa prefecture in the south, Ogasawara-Island, Hachijo-Island and others around Japan. 47,149 students have interacted with astronomers and the project is very popular with all schools. We will introduce mainly the impressions of students and lecturers.

1. Introduction

"FUREAI (Friendly) Astronomy" is a project takes astronomers from NAOJ to schools all over the country. If there are opportunities for students and astronomers to meet directly, various fun "chemical reactions" would happen. With this idea, "FUREAI(Friendly) Astronomy" was born. By using "Astronomy Promotion Fund of NAOJ", students can take classes about stars and the universe for free.

Classes are created by exchanging e-mails between teachers and astronomers.

Astronomers lecture about their field of study, the latest astronomy results, or depending on the teacher, about basic the Sun and the Moon content .

2. Astronomer's impressions

★Honest questions from students regarding the latest research developments in Japan, reveal expressions of surprise - this great feedback became an unforgettable experience.

★It is a great social contribution of the NAOJ to continue to implement FUREAI (Friendly) Astronomy.

★I am revigorated when I see the students pleased or very impressed listening to the story of the universe. Even when I 'm tired of my routine every day, I can remember why I do my research by looking at the students's eyes.

★I would be happy if I could impact the students, give them dreams, and help them to have their world and cosmic views.

3. Student's impressions

*1 national Astronomical Observatory of Japan

★I didn't know that the far side of the Moon cannot be seen from the Earth.

★ I understood well that the Earth is a special planet where life can live.

★ I knew the Subaru telescope, and I was surprised that the astronomer who made it came to my class.

★ I think that it is really amazing to find a galaxy that is as much as 12.8 billion light years away from here. I am pleased that Japanese technology is active around the world.

★ I took this class, I had a new dream. That is to be an astronomer.

Fig.1 Class at a school

Fig.2 Places of FUREAI Astronomy in 2017

5. Summary

From these stories we can see that astronomers do not give unilaterally.

We would like to set up efforts like the direct interactive outreach activities of students and astronomers of "FUREAI (Friendly) Astronomy" on the National Astronomical Observatory of Japan.

Please continue to support "FUREAI (Friendly) Astronomy."

http: //prc.nao.ac.jp/delivery/fureai.html

|Poster|

Observational Experience Program for High School Students at the VERA Ishigaki-jima Station

Tomoya HIROTA*1, Mizusawa VLBI Observatory of NAOJ

Abstract. Mizusawa VLBI Observatory of NAOJ regularly organize outreach programs for high-school students in local regions around the VLBI stations. In this poster, we present details of our continuous activity of the educational program for high school students in VERA Ishigaki-jima station.

1. Introduction

Mizusawa VLBI Observatory of NAOJ has been operating a very long baseline interferometer (VLBI) VERA (VLBI Exploration of Radio Astrometry) since 2002. VERA consists of four 20 m diameter radio telescopes at Mizusawa (Iwate), Iriki (Kagosima), Ogasawara (Tokyo), and Ishigaki (Okinawa) in Japan, with the longest baseline length of 2300 km. VERA aims to construct three-dimensional map of the Milky Way through high-accuracy astrometry of strong maser sources associated with young and evolved stars [1]. The highest astrometric accuracy achieved with VERA is an order of 10 micro-arcsecond.

To maintain large scientific projects such as VERA, consent of the local public is crucial. For this purpose, various kind of outreach events are useful to educate them how and what kind of outcomes of cutting-edge astronomical researches are produced with instruments located in their local regions. From the beginning of VERA, we have been organizing open house of the observatories, star parties and public talks around the VERA sites. In addition, we continuously hold specific events targeted for local high school students to provide real astronomical observational experience with VERA radio telescopes.

2. Brief summary of the Program

At the VERA Ishigaki-jima station, we started a program called “Chura-boshi Kenkyu Taikentai” or “The Beautiful Stars Research Team Workshop” since 2005 under cooperation with local high schools, a recreation center for young generations, and a NPO star club in Ishigaki. We schedule 3-day workshop during the summer season every year. Until 2017, we have accepted 184 high school students, 10-20 participants every year. Most students are from local high schools while 27 are from outside Ishigaki.

The scientific goal is to search for new maser sources using the 20 m radio telescope, which will be future targets for VERA astrometry. The program includes lectures on astronomy by NAOJ staff, facility tour, star party at the Ishigaki-jima Astronomical Observatory, radio observations, and students’ presentation of their research results. We also conduct optical observations for part of students [2]. The observation session is designed to enable high school students to experience all research activities as astronomers are doing, such as research planning, reading scientific papers, preparation of observations, telescope operation, data analysis by using software for astronomers, database survey, and discussion on their results. NAOJ staff and graduate students serving as tutors give instruction for all these activities.

In past 13 years, students have discovered 7 new maser sources with the 20 m radio telescope. The results were press-released in local newspapers and TV news. Some of them were actually observed with VERA for scientific project. As by-products, there were a few students who entered university to study astronomy. Thus, our program works well for public outreach, education and scientific research.

Acknowledgement

We would like to thank the Japan Society for the Promotion of Science (JSPS) for their support as one of outreach programs “Hirameki-Tokimeki-Science”.

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Stargazing Party for Local Children at Kudan Secondary School and Revival of an Astronomy Club

Shio KAWAGOE[*1], Nobuhiko KUSAKABE[*2] and Shigeru NAKAMURA[*3]

Abstract. Teachers of Kudan secondary school, graduates of Kudan high school and some astronomers cooperated to design a stargazing event at Kudan secondary school for local elementary school students, and to revive an astronomy club. From 2009 to March 2018, we held 71 stargazing events. We have succeeded in establishing a cycle to educate the next generation through the stargazing events.

1. Introduction

Kudan high school had a 15 cm refractive telescope on the top of a school building, and an astronomy club at the high school had a long history lasted 80 years. The high school integrated with Kudan junior high school, and became Kudan Secondary School in 2006. At that time, there were no school geology teachers and no person who could use the telescope in the Kudan junior high school. Therefore, the astronomy club disappeared in 2009.

However, some school science teachers of this school wanted to use the telescope to organize stargazing events for public, especially local elementary school students. Graduates of Kudan high school wanted to revive the astronomy club. Therefore, the teachers, the graduates and some astronomers cooperated to design the stargazing events at Kudan secondary school for local children, and to revive the astronomy club.

2. Stargazing events

In November 2009, we have started the stargazing events for the local children. In order to call for participants, we announced this event using posters and homepages. A program of this event was not only stargazing with the telescope but also lecture on how to use the telescopes, and lecture of astronomy using simulation software. Because of this, the number of participants was limited to 10 on each event. From 2009 to March 2018, we held 71 stargazing events for the local children. The number of applicants is 5366 for capacity 710 (Fig. 1.).

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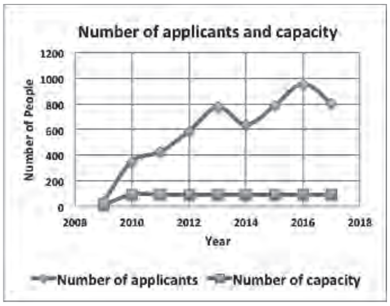

Fig. 1. The number of total applicants and capacity for every fiscal year.

3. Reviving "new" astronomy club

"New" astronomy club was established at Kudan Secondary School in April 2010. Recently, some students who participated in the stargazing events are enrolled in Kudan secondary school, and join the astronomy club. They are participated the events as a staff. Moreover, college students who are graduates of the astronomy club have supported the stargazing events and have taught the students of the astronomy club. We succeeded in establishing a cycle to educate the next generation through the stargazing events.

4. Summary

We designed the stargazing events at Kudan secondary school for local elementary school students, and to revive the astronomy club. We have succeeded in establishing a cycle to educate the next generation through these events. We shall pursue to continue this cycle.

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|Poster|

Useful Astronomical Activities at Boarding School for the Popularization of Astronomy

Tatsuhiko KITAGAWA*1

Abstract. There have been many astronomical activities at high schools around the world. They have been reported before. However, astronomical activities of boarding schools have not known well. Here we summarize the advantage of our boarding high school, and we will show some activities peculiar to the boarding school, especially extra class "Introduction to Astronomy". Through these activities, we were able to contribute to increasing astronomy fans.

1. Introduction

I had worked in a private boy's boarding high school until March 2017. We all students and teachers were able to do stargazing because we were able to be in the school all day and night. For example, the Leonid meteors in 2001 and the annular eclipse in 2012 were watched by all students and teachers. Then we could have extra classes in the evening (19:10 – 21:00) as another advantage of the boarding school.

2. Extra class "Introduction to Astronomy"

This extra class began with the demand of a student who liked stargazing and astronomy. The main activities were research and presentations on the observation (Ham Radio Observation of meteors, a hunt for asteroids, a light curve photometry of asteroids) every year. In addition, my students had a stargazing meeting for elementary school children, took lectures of "the Astronomy Guide", and took part in "the Forum of the Astro High School" every year.

The students could learn how to study science (Hypothesis, Observation, Verification, etc.), and learn the basic skills of photographic observation by a hunt for asteroids. Their activities could be enhanced from a qualitative observation to a quantitative one by light curve photometry of asteroids using DSLR cameras. In the last two years, they had worked on a search to estimate surface properties of the asteroid by a light curve and 3-D model of an asteroid.

3. Factor in growth of activities

The reason why the students' activity continued and developed is that they were able to study hard with other school students by annual ASJ junior session and they were able to get some advice from professional researchers at scientific conferences.

4. Summary

Through these activities, my students could experience the accuracy and pleasure of natural science study. Some of them entered universities on the astronomy field or earth planet science field. It is thought that this extra class "Introduction to Astronomy" was able to contribute to increasing astronomy fans.

Fig. 1. Participation in astronomical conference

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The Role, Advantages and Challenges for Astronomy Clubs at Secondary Schools in Malaysia

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Abstract. Astronomy clubs at secondary schools throughout Malaysia have indirectly become a vital platform in educating the public about astronomy by inculcating interests in students and spread it to the community. This research inquiries into the main role, advantages and challenges of the clubs, specifically in Selangor, Malaysia. Using the qualitative methods, the researcher focused on collecting data by interviewing the person in charge, students, teachers involved and analysing the current situation. The researcher has found that the current main challenge is that the club performance depends on the person interest in handling it with passion. Without deep passion and interest, even the best utility and instrumentation can not guarantee any success in communicating astronomy to public.

1. Introduction

Astronomy knowledge and awareness in Malaysia arises and spreads mainly because of Islamic influence. This is because astronomy are closely related to Islam in performing *ibadah* (obedience) and prayers. If we analyzed past history, the Islamic scholars mainly mastered astronomy and cosmology partly because it is closely related to fiqh (Islamic jurisprudence) and aqidah (Islamic creed) besides the encouragement in Islam to observe nature and their behavior. Astronomy is known as falak (in Arabic), thus majority of astronomy clubs in Malaysia are named as Kelab Falak. Currently, clubs are established under the schools' initiative or with the offer of the State Education Department as a result of the high performance in spiritual activities. For this reason, very few secondary schools have astronomy clubs as one of their extra-curricular activities. However, with the help of authorities and intensive activities, the number of astronomy clubs is increasing.

2. Methodology

This research applies qualitative methods using a semi-structured interview. Participants are the authorities, such as the coordinator, club advisor, teachers and the person in charge of making the module for the club. This was done in close cooperation are given with Ministry of Education Malaysia (KPM), Selangor State Education Department (JPNS), Selangor Mufti Department (JMNS) and some elite schools with active astronomy club in Selangor state under the supervision of JMNS (total of 29 state secondary schools).

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3. Results & Discussion

Currently, the clubs empathize skill building and enhancing the knowledge of club members and students. In addition, in an indirect manner the clubs are act as a catalyst for raising public interest and curiosity in astronomy.

The advantages of the clubs are, firstly is to have the support from authorities. JMNS has played important role in the continuity of the clubs by bringing expertise, advice, programme, instruments, facilities and also to initiate a meeting to coordinate a year-ling scheduled programme with the school calendar. Secondly, passion and interest of the person in charge. Eventhough most of the teachers, officers and staff have no formal background in astronomy education, they have the passion in learning and apply it to the club's activities.

Challenges include limited time allocation, change of club advisory teachers, insufficient financial distribution, lack of expertise, incomplete documentation and inadequate instruments.

4. Summary

In conclusion, the State of Selangor has done a great job in spreading astronomy to students and society. Generally, Malaysia is in a developing phase of reviving astronomy and its awareness to the public. This includes rewriting and reviewing modules for astronomy, constructing new observatories, programmes, workshop and public observations. Astronomy clubs have indirectly played a dominant role in spreading interest in astronomy to society. Finally, most of the identified problems are fixable in a near future with the support of the relevant authorities.

|Poster|

Latin American Olympics on Astronomy and Astronautics (OLAA)

Marcela J. MORILLO*1, Madelaine ROJAS*2, OLAA GROUP*3

Abstract. The wish to know the Universe and understand the natural processes that surround us have contributed to the evolution of the field of astronomy and astronautics. This continuous pursuit for knowledge is usually done by engaging in new fascinating challenges. Latin American countries with a very limited experience in the field have made a strong effort to promote science in children and young adults. The development of OLAA has been one of the major transformations and big challenges for the future of the region.

1. Introduction of the Program

The Latin American Astronomy and Astronautics Olympiad (OLAA) is an event that gathers middle school teams composed by both students and teachers from several Latin American countries. Every team participates in activities that test their knowledge of astronomy and promotes a cultural exchange between the participants and the local community as well. OLAA aims to encourage young people in Latin America to study astronomy, astronautics and related sciences; it is not a simple contest of knowledge. Teams must demonstrate different abilities which not only promote the exchange of activities but also promote the exchange of knowledge and the development of a peaceful spirit which allows the coexistence among the participants during the days of the competition. This skills are displayed when participants develop their activities with honor, discipline, humility and cooperation among them. They must receive support from different fan associations and / or students which engage a whole community to provide the tools such as the construction of Observatories, Science Museums, Planetariums, etc., that are necessary to develop the event in the participating countries.

OLAA is carried out by the Council of Member Countries, including Argentina, Brazil, Bolivia, Chile, Colombia, Ecuador, Mexico, Panama, Paraguay, Peru and Uruguay (OLAA GROUP). The first OLAA took place in 2009 in Brazil, during the International Year of Astronomy. Since then it has been developed annually, twice in Brazil, twice in Colombia, and once in Argentina, Bolivia, Uruguay and last time in Chile, from October, 8th to 14th 2017, where participants had the opportunity to visit one of the largest astronomical observatories in the world in Cerro Paranal. In 2018 the contest will be held in Paraguay, 2019 in Mexico and 2020 in Ecuador. In order to participate in OLAA, students must compete in the national Olympiads in each of their home countries. These countries aim to have astronomy formally taugth in Latin American schools and agreed to promote and execute programs for the development of the scientific field. In nine years, OLAA has come a long way and impacted the participating countries. Astronomy has reached a good level of popularity in various Latin American countries that has allowed the training of students and teachers, allowing the community to be in touch with scientists that train them in various astronomical topics.

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2. Conclusions

Due to the significant growth of OLAA in these past 10 years of existence, the moment of pursuing a goal which let us being recognized in the astronomical field has turned up. For this, OLAA is in a process of restructuring, consolidating, updating contents and regulating the program so that we get the support and approval of astronomical entities worldwide in order to maintain and improve our own goals.

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Stargazing Workshop by University Students in Okinawa

Reo SHINAGAWA[*1], Miku NAGAMINE[*2] , Hiroki MORIKAWA[*2]
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Abstract. Okinawa Prefecture has a beautiful southern starry sky. We visited two isolated islands in Okinawa Prefecture and held a stargazing workshop in order to give a chance to people in the region to realize the charm of a starry sky and learn about astronomy. We guided them, not only through the starry sky, but also giving insights of the local culture in connection with stars and constellations.

1. Introduction

The isolated island areas in Okinawa Prefecture, southwest Japan, have an amazing starry sky with little light pollution. This is advantageous to astronomy education in the sense that we can find various "natural" teaching materials (such as stars, planets, constellations, etc.). On the other hand, and since there are no universities in these areas, there are very little opportunities for school kids; junior and senior high school students, to communicate with university students and to learn about stars, constellations and the Universe in general.

Furthermore, in recent years, universities are required to contribute to the local community. Therefore, the authors started a community building project named “Okinawa Space School”, and in 2017, visited two isolated islands holding a stargazing workshop for the residents, mainly for school students.

2. Method

2.1. University COC program “Chura Pro”

"Chura Pro" is a project in which the students of University of the Ryukyus go to a local community and collaborate with the local people for community building by discovering problems and solving it independently.

This project was implemented under the universities’ COC (Center Of Community) program funded by the Japanese government.

2.2. Stargazing workshop “Okinawa Space School” Curriculum

1. Story of Space and Astronomy (indoors)
2. Talk about Okinawa folklore based on stars
3. In case of good weather: Workshop of Astronomical observation (outdoors).

In case of bad weather: Quizzes about "Space and Astronomy", learn to operate an astronomical telescope.

3. Result

We could provide an opportunity of exchange between university students and remote island children.
The students were able to learn more about the area through planning and implementing the classes in collaboration with the local people.
The authors got an opportunity to think deeply about local issues.
The school had a lot of echoes and was asked for continuation

4. Discussion

If we can organize this flow of the implementation of the class as one model and advance it to the flow of University → Local government → Country → World flow, we can contribute to astronomy education.

5. Future Work

1. Move form a student-based project to a community-based project.
2. Make a contrivance that students go to the local community.
3. Development of an evaluation method.

Acknowledgements
This work was supported by the University of the Ryukyus COC Program “Chura Pro”.

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|Poster|

Astronomy Communications with Students using Metropolitan Telescopes

Yohko TSUBOI*1, Ryo IIZUKA*2, Hiroki KAWAI*3

Abstract. Chuo University installed CAT (Chuo University Astronomical Telescope) and SCAT (Spectroscopic Chuo University Astronomical Telescope) at the top of a building in Korakuen campus in Tokyo. From the roof top, we can see “Tokyo Skytree” and “Tokyo Dome”. Despite the metropolitan area, undergraduate students, as well as graduate students, are operating the telescopes and observing night sky. What are we studying with the telescopes?

1. Introduction

For the education of the students who learn every kind of science, practical observation should be useful. However, if the campus is in metropolitan area, it is expected that the observable targets are limited, and then the selections of student’s themes are difficult.

Chuo University Science and Engineering Department is located at Korakuen, i.e. the metropolitan area in Tokyo. From the roof tops of the buildings, we can see “Tokyo Skytree” and “Tokyo Dome”. Despite such location, we, under-graduate students, as well as graduate students or staffs, are observing night sky using optical small telescopes installed there.

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2. Observations

Chuo University installed CAT (Chuo-university Astronomical Telescope) and SCAT (Spectroscopic Chuo-university Astronomical Telescope) at the top of a building in Korakuen campus. The diameters of CAT and SCAT are 26 cm and 36 cm, respectively. The limiting magnitudes for CAT and SCAT are 15 mag and 13 mag, respectively. The spectral resolution of SCAT is R~600.

We are catching *enormous* flares on stars, using the telescopes, just after receiving an e-mail which tells X-ray detection of such flares with Monitor of All-sky X-ray Image (MAXI) on International Space Station (ISS). Since the frequency of flares is known to decay as the flare scale becomes larger, such simultaneous multi-wavelength observation has been seldomly made before.

Fig. 1. CAT and SCAT

A Report of an Astronomical Outreach Event for High School Students "What If You Could Become an Astronomer in a Week? (MoshiTen)"

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Abstract. An astronomical outreach event for high school students,"What if you could become an astronomer in a week? (MoshiTen)", has been conducted every year since 2011. During this one-week event of MoshiTen, participants experience many kinds of the astronomical research activities with an active learning style under supports of professional astronomers and graduate/undergraduate students (Student Learning Advisors, SLAs). Each group discusses and decides their research theme, and conduct astronomical observations using the *Hitomi* 1.3-m telescope. Then, they work on data analysis of their own data and make presentations on their research result to the public on the final day of MoshiTen. The style and program of MoshiTen event are good for encouraging participants' attitude of learning actively.

1. Introduction

An astronomical outreach event for high school students, " What if you could become an astronomer in a week? (MoshiTen)" , has been conducted every year since 2011 by Tohoku University, Miyagi University of Education, and the Sendai Astronomical Observatory (SAO), supported by Japan Society for the Promotion of Science (JSPS) and Foundation for Promotion of Astronomy in Japan. Through this one-week event of MoshiTen, participants experience many kinds of research activities such as (1) research theme decision, (2) preparing s research proposal and review, (3) observations with the 1.3-m *Hitomi* telescope in SAO, (4) data analysis, (5) presentation and feedback from peers, and so on.

Table 1. Typical Schedule of MoshiTen

	Location	Event
Day 1	SAO	Opening ceremony Discussion on research theme *Hitomi* operation practice
Day 2	Tohoku Univ.	Research proposal review
	SAO	*Hitomi* observation
Day 3	Tohoku Univ.	Data analysis
	SAO	*Hitomi* observation
Day 4-6	Tohoku Univ.	Data analysis Presentation practice
Day 7	Tohoku Univ.	Achievement presentation to the public Closing ceremony

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*5 Saitama City Space Theater

2. Event Schedule

Typical event schedule is summarized in Table 1. About 16 students were selected by essay screening under competition ratio of ~3. They are divided into 4 groups of 4 students. After passing their research proposal, they conduct observations with the *Hitomi* telescope with their own operation. Their final research presentations are broadcasted via *Ustream*, and >200 people watched it in 2017.

3. Learning Support Framework

Participants experience active learning of astronomical researches supported by professional astronomer staffs and student learning advisors (SLAs), who are graduate and undergraduate students of Tohoku Univ. and Miyagi Univ. of Education. Each team has one astronomer staff and 4-6 SLAs, which is more numbers than participants. Experiences as SLA are also good for SLAs themselves to gain their generic ability through the extracurricular activity [1].

Questionnaire investigation to the participants after the event shows that participants were satisfied with the event and they gained their interests to the astronomy and active attitudes of learning by experiencing all process of research activities with the supports of the staffs and SLAs.

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|Poster|

"Observing the Sky, Understanding the Earth": An Earth Sciences Astronomy-related Educational Activity for the Italian Upper Secondary School

Andrea E. BERNAGOZZI[*1,2], Gabriele GIULI[*2], Michael CARROLL[*2], Eleonora PARIS[*2], Albino CARBOGNANI[*1], Jean M. CHRISTILLE[*1], P. CALCIDESE[*1], P. BÉCHAZ[*3], G. CARMASSI[*3], S. DE LUCA[*3], P. RICCARAND[*3] and F. VERTHUY[*3]

Abstract. We describe the design, implementation, exploitation and preliminary results of the Trial Educational Package "Observing the sky, understanding the Earth", focused on the link of Earth Sciences with Astronomy, and developed for the Italian upper secondary school.

1. Introduction

The UNICAMEarth Working Group of the University of Camerino and the Astronomical Observatory of the Autonomous Region of the Aosta Valley (OAVdA) jointly developed an Earth Sciences Astronomy-related educational activity for the Italian upper secondary school.

This framework accommodated a Ph.D. thesis in Earth Sciences and a School-Work Alternation project for five students of the 4th year of the high school Liceo Classico of Aosta. Fondazione CRT of Torino partially funded the project.

2. Meteorites: messengers from space

The Trial Educational Package (TEP) "Observing the sky, understanding the Earth" was built according to the criteria of the International astrophysical online educational initiative astroEDU [1]. The topic is: "meteorites as a proxy to understand some properties of the Earth's interior".

By using some basic background information contained in the TEP, the students should classify four pre-selected digitised scan of meteoritic sections from the Virtual Microscope Europlanet Meteorites Collection [2], stating if they belong to chondritic or achondritic meteorites. In this way, they can appreciate how meteorites, which are remnants of the ingredients that formed the Solar System, can provide unique information about the average chemical composition and the inner structure of the Earth.

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3. Experimentation

The TEP was administered in the second half of the school year 2016-2017 to 59 students of the Liceo Scientifico "Edouard Bérard", and in the second half of the school year 2017-2018 to 49 students of the Liceo Classico and 40 students of the Liceo Artistico, for a total of 148 students divided in 41 teams (3 to 5 students per team) from upper secondary schools all based in Aosta, Aosta Valley, Italy.

4. Conclusions

As shown in Fig. 1, 87.8% of the teams classified at least three meteoritic sections accurately. This result is encouraging about the effectiveness of the TEP: no participant had ever carried out such task before.

The TEP will be made freely available on the web through the channels accessible to the UNICAMEarth WG and the OAVdA. In addition, the TEP will be submitted to the astroEDU/it platform [3], the Italian leg of the International astroEDU project. [4]

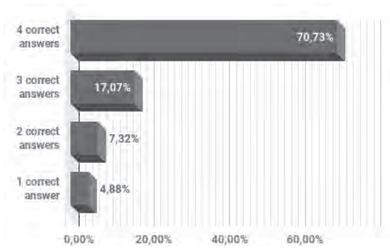

Fig. 1. Answers of the students [Credit: OAVdA].

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Maunakea Scholars Modules: Bringing Real-World Astronomy to Science Classrooms

Kelly BLUMENTHAL*1,2 and Mary Beth LAYCHACK*3

Abstract: The Maunakea Scholars Program was designed to give Hawai'i Public School students a chance to apply for time on the world-class telescopes atop Maunakea. The project is in its third year of enabling students from all education levels to engage in authentic research. Feedback from participating and interested teachers shows that many are intimidated by their own lack of subject matter expertise in astronomy. Others want to incorporate astronomical data into their other classes, but do not know where to start. Thus, we started the Maunakea Scholars Modules, which will allow teachers interested in MKS to engage their students in an expert-level science education.

In 2015, the Canada-France-Hawaii Telescope began the Maunakea Scholars Program (MKS) for public high school students in Hawaii to gain "real" research experience in astronomy. Although the MKS has fulfilled a need in the community, there are several issues that keep the program from reaching more schools. For example, there are not enough mentors for all interested schools. Further, many teachers might be interested in the MKS, but are not able to dedicate the necessary time to the full program.

The Maunakea Scholars Program, and its offshoot, the Maunakea Scholars Modules (MKS-M), are designed with the target community in mind: the Hawai'i public schools (HPS). This community faces some unfortunate challenges. About 50% of students qualify for free or reduced lunch under Title 1[1]. Teachers are often under- or unqualified to teach the subject matter for which they are responsible[2] and perhaps as a result, HPS students routinely underperform the national average of proficiency in science and mathematics[3]. Many of the unique things about this community make for a rich classroom experience. HPS includes schools on protected Hawaiian lands, some of which are primarily taught in the Hawaiian language[4]. It also hosts the largest minority population in the United States (roughly 75%)[3].

The Department of Education has developed a set of science standards in an attempt to improve science and mathematics proficiency nation-wide, called the Next Generation Science Standards (NGSS)[5]. HPS plans to implement this into curricula by the 2019-20 academic year. The NGSS has faced much push-back, and its implementation poses a real challenge for HPS science educators. Chemistry is not included in the NGSS as a stand-alone subject, so schools will have to reorganize the structure of science education to cover chemistry concepts in biology, physics, astronomy, and general physical science classes.

The Maunakea Scholars Modules is designed to meet all of these challenges and unique opportunities. While the MKS-M are still under development, we have a memorandum of understanding with the Board of Education (BoE), and are working closely with the BoE and local educators, in addition to community leaders and cultural groups. The modules will fit into, or compliment, teachers' existing lesson plans. They will also be available online for free to anyone interested in using the modules. We will provide detailed reading material to educate the educators on the subject matter covered in the module. To understand the efficacy of our work, we will also provide pre- and post- testing to teachers. In this way, we can iteratively build the modules to be more beneficial for the students, and increase the science capital of the community.

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|Poster|

Science Education Support Using Original Astronomical Teaching Tools and Teaching Research on Elementary Astronomy in a Small Public Observatory, Heartopia Anpachi Astronomical Observatory, HAAO

Hiromi FUNAKOSHI

Abstract. Astronomy teaching tools are very effective when used for elementary education. With just a few simplified principles, we can intuitively explain complex astronomical phenomena. Here I'll introduce some original astronomical teaching tools and astronomical outreach activities of the Heartopia Anpachi Astronomical Observatory, HAAO.

1. Introduction

Good teaching tools are effective for learning elementary astronomy, one example is learning about the mechanism behind the changes in the shape of the Moon.

2. Original astronomical teaching tools and utilization

These are effective tools for deepening the students understanding of astronomy in classrooms. Complexity can be explained by combining simple principles and we can understand intuitively various astronomical phenomena. What we can understand with original teaching tools are follows.
① The phases of the Moon: We can understand the reason why the shape of the Moon periodically changes, timezone and direction in which the Moon with a different phase can be seen. (from a geocentric perspective). (Fig.1)

Fig.1 3D model of the phases of the Moon

② The solar eclipse : We can understand the difference between the new Moon phase and the mechanics of a solar eclipse.

③ The shape of the Venus: We can understand that the shape of Venus changes with its relative position to the Sun. Maximum eastern (western) elongation, Superior (Inferior) conjunction. Synodic period of Earth and Venus.

Fig.2 Approach of Earth and Mars

④ Approach of Earth and Mars : The approach phenomenon of Earth and Mars occur every two years and two months. (Fig.2)

3. Activity and outreaches of a small public observatory

I am striving for a distinctive operation such as astronomy teaching, craft work, experiments.

① Delivery to school Astronomy lesson
With a set of lesson tools for elementary school students (Fig.3), I am carrying out classes that can't be done by school teachers.
② Astronomy course for university students and teachers
I have astronomy lecture using original astronomical teaching tools. I understand the usefulness of the teaching tools and convey the points to teach.
③ Activities of Junior Astronomy Club
We support astronomical research through astronomical observations. The results are presented at the Japan Astronomical Society Junior Session.
④ Featuring workshop class
I am holding workshop classes which can't be done by others related to various astronomical works and astronomical phenomena.

Fig.3 Classroom for phases of the Moon at elementary school using teaching tools.

4. Summary and Future Plans

From now on I also want to develop teaching tools to disseminate astronomy.
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GROWTHing the Education: Summaries and Highlights of Education Efforts from the GROWTH-Taiwan

Chow-Choong NGEOW*1 and the GROWTH Collaboration

Abstract. The "Global Relay of Observatories Watching Transients Happen" (GROWTH) project is an international collaborative project that emphasizes on both research and education, initiated under the "Partnership for International Research and Education" (PIRE) program. In Taiwan, our institution joined the GROWTH collaboration under the GROWTH-Taiwan project. Educational activities of the GROWTH-Taiwan are summarized in this work, which include an international summer students research program, a research-driven course using big data, and two summer camps oriented with science themes of GROWTH.

1. Introduction

The GROWTH project was established to address three fore-front astrophysical themes (an example is given in [1]), with mean of relayed observations from a network of observatories and telescopes. Further details of these GROWTH science themes and the GROWTH network can be found in *http://growth.caltech.edu*. Besides research, the GROWTH collaboration also emphasize on education. Hence, GROWTH was selected in 2015 as one of the project funded by the NSF's PIRE program. The leading institution of GROWTH is California Institute of Technology, and the entire GROWTH collaboration includes 13 institutions located in 8 countries. In parallel, the GROWTH-Taiwan project was also selected and funded under the grant MoST 104-2923-M-008-004-MY5.

2. GROWTH-Taiwan Educational Activities

In this work we summarize some of the education activities of GROWTH-Taiwan. These include: (a) International summer students research programs – the GROWTH's education committee will select eligible undergraduate students to work on various summer research projects in international partnered institutions for a duration of 6-8 weeks. Our institution has hosted few GROWTH summer students in past two years. (b) Research-driven course – several courses in GROWTH instutions will use real observational data for doing time-domain astronomy projects. In our institution it is the "Advanced Observational Astronomy" course, which use the data from the Palomar Transient Factory (PTF) for the study of variable stars (see Figure 1 for an example of the outcome of such projects). (c) Summer camps – our institution has organized two 3-5 days summer camps with themes related to the main research topics of GROWTH in 2016 ("Asteroids") and 2017 ("Gravitational Waves and Related Astrophysical Phenomena"). The summer camps were aimed for STEM undergraduate students in local universities.

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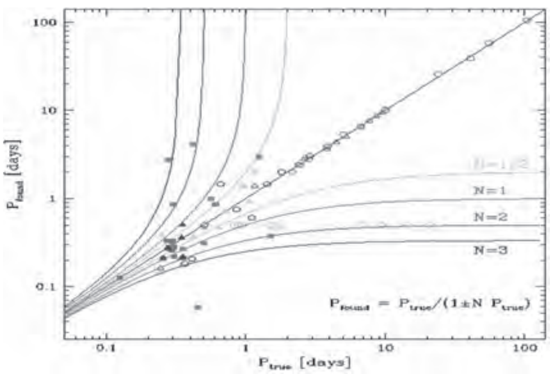

Fig. 1. Comparison of the periods for selected eclipsing binaries found by the students in 2016 class, using the PTF data with Lomb-Scargle algorithm coded in python, to the "true" periods (P_{true}) derived from the full Kepler light curves. Different symbols represent results from different students, and the curves indicate the expected aliasing periods as given in the lower right corner.

3. Conclusion

Here, we gave summaries of GROWTH project and the educational activities of GROWTH-Taiwan.

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|Poster|

The NARIT Astronomical Teacher Training and Workshop

Thanakrit SANTIKUNAPORN*1 and Sawatkamol PICHADEE*2

Abstract. NARIT organized "The Astronomical Teacher Training and Workshop" to train teachers for teaching science and astronomy in schools. The ultimate goal of this particular training is to empower teachers to use the sense of wonder generated by space and astronomy to inspire students to pursue science careers and to strengthen their critical thinking. The training is divided into three levels: Beginners, Intermediate and Advanced, each level with a different objective. The Beginners level began in 2010, with 4,500 participants. The Intermediate level began in 2011, with over 245 participants. The Advance level in 2012 with 17 teachers has initiated over 100 astronomical projects. The trainings are organized by the Public Outreach Department of NARIT, with cooperation from IPST (the Institute for the Pro-motion of Teacher Science and Technology of Thailand).

1. Introduction

NARIT started organizing "The Astronomical Teacher Training and Workshop" because astronomy, as a subject, has been included in Thai Basic Education Core Curriculum since 2008. The training is divided into three levels with different objectives. The Beginners level, inspires teachers to get basic knowledge and provides them astronomical activities to use in classroom. In the Intermediate level, teachers obtain more skills in astronomical observation and some ideas to create simple astronomical projects and research. In the Advanced level; teachers have to be a student's advisor to work on astronomical projects altogether with NARIT's staff.

2. Beginners Level

For this level, we organized a workshop five times per year throughout Thailand with 120 participants per workshop. The activities comprehend: lecture in basic astronomy, how to make stargazing sessions, using telescopes to observe the Moon phases and the night sky.


Fig.1 Lecture in Basic Astronomy & how to stargazing


Fig.2 Using telescope for night sky observation

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3. Intermediate Level

For this level, we organized a workshop 1 time per year with 30-35 participants per workshop at Doi In-thanon national park, Chiang Mai, Thailand.


Fig.3 Visit TNO


Fig. 4 Using telescopes at night

4. Advanced Level

For this level, the workshop is divided into three phases. Phase 1 is discussion and advice on how to create astronomy projects and learn activities based on scientific procedures. Phase 2 is to present their project. Phase 3 is to present at Junior Session in ASJ, in JAPAN. Some activities are shown in Figure 5 and 6.


Fig.5 Scientific procedures activities.


Fig.6 Go to present at Junior Session-ASJ, JAPAN

5. Summary

The Astronomical Teacher Training and Workshop trains teachers for teaching students in school and empowers them to create activities by themselves. The next mission of The Astronomical Teacher Training and Workshop is to organize workshops throughout all cities in Thailand and neighboring countries.

Strengthening Astronomical Knowledge for High School Students in Indonesia

Aprilia*1, Hakim L. MALASAN*2, Muhammad I. ARIFYANTO*3, Yayan SUGIANTO*4, Muhammad I. HAKIM*5, Lucky PUSPITARINI*6, and Chatief KUNJAYA*7

Abstract. Because Astronomy is not in the national curriculum of Indonesia, it is very challenging for the high school students to participate in an Astronomy Olympiad, as well for the educators to teach Astronomy. Some activities have to be done. The outcomes are to strengthen the astronomical knowledge for the high-school teachers, and also to improve the students' achievement in the international Olympiads.

1. Introduction

Participation of Indonesia in the international Olympiad in Astronomy, like IOAA (International Olympiad on Astronomy and Astrophysics; see Reference [1]) has gained attention among high schools students. This participation might increase students' enthusiasm in Astronomy. The success in Olympiads can become the evaluation of the students' ability and also teaching-learning process, especially in Astronomy. These all need some preparations. In Indonesia, we have TPOA (http://www.tpoa-indonesia.org/), as an Astronomy Olympiad Coaching Team, where professional astronomers are the members, which does activities for the participants of Indonesia in the Olympiads.

2. Activities

Some activities for preparing and supporting students for the International Olympiads in Astronomy: Science Olympiads (Districts, Provinces, National levels) arranged by the Indonesia Ministry of Education and Culture, National Astronomy Trainings for International Olympiads, Teacher Trainings, Teacher Symposium for National Science Olympiads, Training of Trainers, Public Nights.

3. Assessments

Fig 1-2 and Table 1 show data achieved relating to the participants of Indonesia in the Olympiads.

4. Future Outlooks

For the activities relating to the participants of Indonesia in the Astronomy Olympiads, it is hoped that the TPOA will play role in developing high-school students' knowledge in Astronomy. In this case, TPOA can be able to become the center of excellent of Astronomy and the main source of information in the National Science Olympiads.

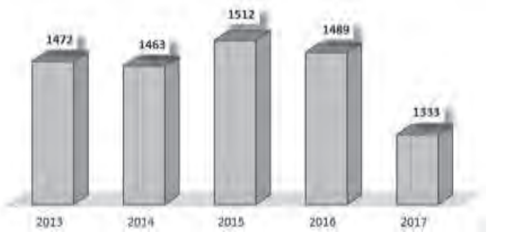

Fig. 1. Participants' number of Province Science Olympiad, Astronomy subject, in 2013 – 2017

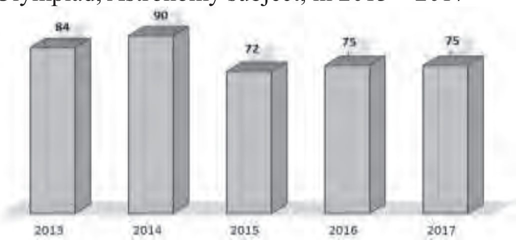

Fig. 2. Participants' number of National Science Olympiad, Astronomy subject, in 2013 – 2017

Table 1. Medal Prizes for Indonesia in IOAA

Years	Gold	Silver	Bronze	HM
2013	1	1	1	2
2014		3	3	1
2015	2	6	1	1
2016		1	4	
2017			5	

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Taipei Astronomical Museum
Science
Education
Science
Communication
Museum
Studies

SESSION I.8:

Unconventional Outreach and Other Communication Practices

|Plenary Talk|

30 Minutes Monthly Workout: Media Training

Francisco RODRÍGUEZ[*1], Mylène ANDRÉ[*2] and Laura VENTURA[*3]

Abstract. Over the past years, the education and Public Outreach Department (ePOD) of the European Southern Observatory (ESO) has received from media a steadily high number of requests to visit ESO's observatories, to interview ESO's astronomers and experts. Without any doubt, media are one of the most effective channels to reach different target groups and the general public. Therefore, media requests offer to ESO an invaluable communicational opportunity. The ePOD office in Santiago (Chile) is in charge of coordinating and attending media requests to visit ESO observatories, all located in Chile. To take the best advantage possible of these opportunities, ESO scientists should be well trained and prepared to face interviews and convey confidently their messages. For these reasons, the ePOD group in Chile developed last year a long-term media training program for astronomers. This program is structured in monthly sessions, which have been incorporated into the regular activities of the ESO Office for Science in Santiago.

1. Introduction

Over the past five years, ePOD Chile has hosted, in average, 50 media visits per year at Paranal, ALMA and La Silla observatories, triggering at least one interview each. In addition to that, an average of 52 interview requests with ESO staff come yearly from Chilean media. In total, dozens of astronomers and engineers are interviewed per year and give key support while hosting media representatives at the observatories.

On top of this, two additional factors will most probably trigger even more interest from media: on one side, the beginning of the construction of the Extremely Large Telescope (ELT), and, on the other, an increasing interest among Chilean public for astronomy.

In this context, the internal demand for a formal media training has become a priority. The objective of this project is to provide our experts with tools to face this challenge.

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2. Developing an adequate media training format

According to previous experiences and to the recommendations made by scientific organizations and letters, a media training should include: (a) a theoretical and general overview of the media environment, the concept of news and the journalist's work, (b) a visit to a newsroom and a direct interaction with journalists to understand their work and interests to build an article, (c) practical exercises, among them interviews, creation of articles, stand ups.

These three dimensions will give scientists a unique opportunity to learn effectively and become better communicators in representation of ESO and their own research.

A standard media training format generally consists of one or two intensive sessions given by external contributors. Considering astronomers' busy schedule and duties at the observatories, the more classic intensive format was replaced by a long-term program, with regular short training sessions.

We started with a pathfinder experience where we aim to have monthly sessions over a period of six months. Each session aims to cover a different topic and includes a practical exercise. To implement this, the Office for Science in Santiago offers 30 minutes space during the Scientific Coffees on Fridays.

3. Topic of the sessions

When presenting the project at CAP conference in March 2018, four sessions on the following topics had been given: (a) context of Media in Chile, (b) the interview, (c) field trip at a newsroom, (d) the press conference.

During the first session about Chilean media, the attendants learnt about the state and types of Media in the country. The different focuses of news articles and the journalists' expectations. This session ended with a practical exercise where trainees have to write the first paragraph of a news piece on the basis of the 6W (what, where, who, when, how, whom).

Then, in the second session, the focus was shifted on the journalist's work itself and how he hold an interview as main source of information. Here the scientists learnt basic and key information about how to face this type of requests, with practical recommendations. The final exercise was organized in pairs where they interview each other with the intention to create an article based on the information collected in the interview.

In the third session, the group participated to a field Trip to the newspaper La Tercera, one of the main Chilean newspaper. There, the scientists could experience how editors, journalists and designers are organized to create the daily news. Astronomers had a round table with the science editor, and a journalist of the digital area where several topics were covered and questions were addressed in a one-hour conversation.

Finally, during the fourth session, a press conference was simulated, allowing astronomers to practice all the aspects covered in the previous sessions. In group of three, they had to answer several questions previously delivered via email, facing cameras and the rest of the audience, composed of their own colleagues. A quick review was done afterwards, and a more detailed analysis was carried out thanks to the recording of the session. This session was repeated to allow more astronomers practice.

For the future and to end this first cycle, two more sessions are planned: "Digital Media" and "How ESO Newsteam works on the ESO press releases".

4. Conclusion

From the beginning, the reception among the staff has been good, with an average attendance of 12 people per session, showing high interest to participate. The proposed format was also well appreciated due to tight schedule of the astronomers working at ESO. Ultimately, we received requests to repeat sessions from the astronomers who could not attend the previous sessions.

It was observed that live exercises performed during the 30 minutes session were received and executed better than those which were done after the sessions. This will be taken into account for the future training, as practice is vital for astronomers to work on their abilities and skills.

Finally, at the end of the sessions, interesting conversations were raised by the astronomers, especially around how to address potentially delicate topics, such as light pollution, being a woman working in science and especially at an observatory, or management issues. These discussions are indicators that astronomers are concerned about their role representing the Organization when facing the media, and, eventually confirm the importance of a regular media training.

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|Plenary Talk|

How do You Provide the Sharpest View on the Universe?

Georgina L. MAFFEY*[1], Ilse VAN BEMMEL*[1], Francisco COLOMER*[1], Huib Jan VAN LANGEVELDE*[1]

Abstract. The Joint Institute for VLBI ERIC (JIVE) in the Netherlands is the central organisation in the European VLBI Network (EVN) - a network composed of radio telescopes across the globe. VLBI (Very Long Baseline Interferometry) is a radio astronomy technique whereby multiple telescopes can focus on a single source at the same time to improve the resolution of the resulting image. From a scientific perspective JIVE's aim is to provide support for users of the EVN, while developing new tools for data processing and contributing to leading research. However, as a European Research Infrastructure Consortium (ERIC) it also has a responsibility to ensure that the research and technical developments embarked upon are shared across the European Community. The following paper discusses the challenges to date of achieving this balance.

1. Introduction

The Joint Institute for VLBI ERIC (JIVE) in the Netherlands is the central organisation in the European VLBI Network (EVN) - a network composed of radio telescopes across the globe. VLBI (Very Long Baseline Interferometry) is a radio astronomy technique whereby multiple telescopes can focus on a single source at the same time to improve the resolution of the resulting image. VLBI has been used as a technique in radio astronomy for the past 50 years, however there are few resources available beyond the scientific literature to explain the technique.

In 2015 JIVE was inaugurated as a European Research Infrastructure Consortium (ERIC). This status also includes a commitment to contribute to the "*mobility of knowledge and/or researchers within the European Research Area*" and "*to the dissemination and optimisation of [research] results*" (European Commission 2018). JIVE has begun to realise these commitments through a project known as JUMPING JIVE (Joining up Users for Maximizing the Profile, the Innovation and Necessary Globalization of JIVE).

Through the JUMPING JIVE project several challenges have been recognised in the communication of knowledge and research related to VLBI: how to communicate a complex niche topic that requires a high level of understanding as a basis; how to target a range of audiences for whom VLBI is relevant - the public, peers and policymakers; how to share key research findings across a network (the EVN) consisting of multiple partners and multiple native languages. The proceeding sections explore how these challenges are being addressed at JIVE.

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2. How to communicate a complex niche topic that requires a high level of understanding as a basis

VLBI is regarded as a complex technique in radio astronomy, requiring a high level of technical expertise. This perception from within the astronomy community creates an additional barrier when embarking on broader communication practices, particularly when balancing scientific accuracy against clarity in a topic.

In acknowledgement of this, three strategies have been adopted:

- Storytelling: in articles circulated on platforms that reach beyond the JIVE community (i.e. social media and blogs), as a way to humanise what is traditionally a technical topic;
- Key messages: identifying understandable statements that outline JIVE and the EVN's roles, and then using these messages as a red thread to build subsequent stories around;
- Simplification: in recognising the key components of JIVE and the EVN's roles it is also possible to remove the technical noise that is inappropriate for a large number of audiences.

It is possible to see the realisation of these three strategies in a brochure developed to attract (predominantly) early career researchers who may be interested in submitting an observation proposal with the EVN (Fig. 1 and Fig. 2 – an online copy can be found at www.jive.eu/jive-brochure).

Fig. 1. The outer cover of the brochure developed to attract (predominantly) early career researchers who may be interested in submitting an observation proposal with the EVN. Image credit: JIVE

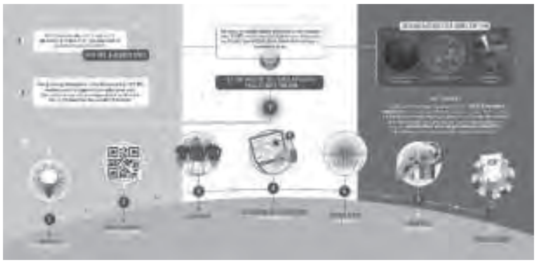

Fig. 2. The inner cover of the brochure developed to attract (predominantly) early career researchers who may be interested in submitting an observation proposal with the EVN. Image credit: JIVE

3. How to target a range of audiences for whom VLBI is relevant - the public, peers and policymakers

In adopting the strategies highlighted in section 2 it is conceivable to design materials that are adaptable depending on the audience. Illustrations and images can be used on materials that reflect the core messages identified and provide a visual support to any accompanying text. By adopting a storytelling approach consistency of these core messages can also be achieved resources produced, ensuring that while the technical level of information provided to each audience may differ, the overarching themes remain the same.

4. How to share key research findings across a network (the EVN) consisting of multiple partners and multiple native languages

As with many European institutes, JIVE suffers from language barriers in communication. While this is not an immediate problem for communication within the scientific community or policy, it does present challenges when addressing a broader European audience. At present, the aim is to provide materials that are openly accessible. Consequently, it is hoped that JIVE member countries will adapt these resources for their own use, such as translating press releases or outreach materials. Ensuring the success of this also lies in the active engagement of a network of individuals across institutes who are invested in using and distributing such resources.

4.1. Conclusion

From a scientific perspective JIVE's aim is to provide support for users of the EVN, while developing new tools for data processing and contributing to leading research. However, as a European Research Infrastructure Consortium (ERIC) it also has a responsibility to ensure that the research and technical developments embarked upon are shared across the European Community. Key strategies had to be adopted to address the challenges associated with striking a balance between these commitments, such as: focusing on core organisational themes that are relevant across audiences; ensuring that accuracy does not undermine clarity by using techniques like storytelling; and, designing materials that are recyclable for different audiences.

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|Parallel Session|

Communicating Astronomy: Knowing Your Audience

Sara ANJOS[*1], Anabela CARVALHO[*2] and Pedro RUSSO[*3]

Abstract. Science communication practitioners are always looking for better ways to engage their public. This is the case for astronomy communicators, a community of practice that is interested in engaging with those who are traditionally out of the science radar, including the less privileged ones. One of the major challenges astronomy communicators face when addressing the public is related to knowing what their interests are, whether they have and which are their misconceptions and ideas about astronomy, if any. Building strategies to know one's audience may be decisive for the success of an astronomy communication practice, both in formal and informal settings. In this article, we present some of the challenges practitioners may face when communicating astronomy to today´s audiences and suggest approaches to address them.

1. Introduction

Science and Technology (S&T) are the basis for multiple individual and collective decisions about issues such as health, climate change and food safety [1]. In this regard, the public is expected to understand S&T topics, not only as a mere recipient of knowledge but also to be in a position to engage in dialogue and decision-making processes with social impact [2]. The growing focus on dialogue and open participation calls for a better understanding of the ways the public appropriates scientific knowledge (in a dynamic and concrete situation). Therefore, communicating science to, with and for the public implies not only for communicators to develop specific skills to engage and communicate effectively in a multicultural environment, but also to know and understand their audience´s norms, values, expectations, and conventions [3] related to S&T.

We acknowledged at least three factors that result in a variety of audiences, in number and type, and pose several challenges for the practice of communicating astronomy in an ever-changing world: (a) the recognition that astronomy is an attractive science to trigger interest in STEM (Science, Technology, Engineering and Mathematics) subjects [4]; (b) the exposure that astronomy's breakthroughs benefit from in media channels; and (c) the growing focus on participation. Recent research has been showing that (at least in the western world), there is low engagement in STEM subjects, with significant differences between gender, ethnicity and cultural capital [5]. In that respect, astronomy faces its own trials, as, according to recent data from IAU (International Astronomical Union), women represent 17% of the membership of professional astronomers and people from developing countries are far from participating fully in astronomy research [6][7]. Data suggest a low level of science literacy in specific social groups, despite the high interest and the public's curiosity [8]. This calls for research to continue examining the science-public relationship.

2. Communicating astronomy: practice & research

If we want to answer the question "how does the public understand and engage with astronomy?", we argue that we need to consider three main factors: a) processes of knowledge production; b) learning processes; and c) science communication research looking at how people experience science in their lives and how scientific achievements are embedded in social relations. These aspects seem to indicate the need to develop interdisciplinary studies of science audiences.

The first factor implies recognizing that knowledge production is a process and that a scientific breakthrough depends on several decisions (for instance, choosing the topic of research, the theoretical frameworks, the funding program, etc. may interfere with the knowledge production). Sharing those decisions with the public and speaking openly about them would enhance transparency and, in some cases at least, may benefit communication processes and increase public trust [9]. With regards to learning processes, we advocate drawing on advances in science education and psychology of education [10], which have been contributing toward enriching traditional educational practices in astronomy. Finally, paying more attention to science

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communication involves recognizing the importance of communication as the interface between science and society [11].

3. Tips to engage your audience

Any communication involving the public is complex and contextual, and astronomy is no exception. As suggested above, paying more attention to science communication research may reveal important aspects about the public and its relationship with science. Existing studies on learning and communication processes of science-related topics have already led to important findings. In the following textbox, we present seven practical recommendations [12][13][14] that may be useful for astronomy communication practices. Research shows that people seek relevance in their understanding of science [12]. It also shows that, despite the fact that not everyone is interested in science and in a "clean" factual approach, most people are interested in stories about people ("the human factor") [14], as well as their discoveries and adventures, and this may be useful when communicating astronomy. One of the most difficult challenges science communicators face includes misconceptions and preconceptions regarding science-related terms [12]. This becomes a bigger issue when we face audiences that are quite diverse, with disabilities, different economic backgrounds, ethnicities and genders.

Recommendations for astronomy communicators
1. keep the language as straightforward as possible; 2. think about the possibility of alternative conceptions; 3. concentrate on finding good introductory "hooks," if possible using the "human factor"; 4. give audience a role in your practice (making them have an experience); 5. use different modes of meaning (such as visual, tactile, digital, linguistic, etc.); 6. be creative and inclusive; 7. keep it at the right level for your audience! [12][13][14]

4. Conclusions

In order to understand how the public engages with the science of astronomy, we need to develop our understanding of how people appropriate scientific knowledge. This calls for developing interdisciplinary studies of the public to understand individual processes of learning as well as to observe how science is used in personal and social settings. This may help practitioners improve their skills and strategies to engage with specific audiences. The study of science communication and its implications for society and social relations is a plus to better communicate the science of astronomy.

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|Parallel Session|

Think on Science and Innovate with Design

Silvina PÉREZ ÁLVAREZ*1, Javier MAYA*1, Alexis MANCILLA*1, M. VIDELA*1, G. DE LA VEGA*1, D.YELÓS*1, A. CANCIO*1 and Beatriz GARCÍA*2

Abstract. The Design Thinking is a proposal that began to develop theoretically at Stanford University (USA) in the 1970s and is based on the application of design techniques to meet specific needs of the product recipient (the public), without neglecting the objectives of the communicator, in this case the scientist in his role of communicator of science. In this way it is possible to design, for example, the complete graphical scenography of thematic spaces such as those proposed by the Institute of Technologies in Detection and Astroparticles for exhibitions in museums or science and technology fairs, applying the DT tools. In this presentation we describe the experience of the last six years of our group as part of "Tecnópolis", the mega exhibition of Science and Technology in Argentina and, on the other hand, it will show how to drive visitors at the new Visitor Center at Pierre Auger Observatory in Malargüe, Argentina, the biggest facility on the world devoted to the detection and the study of ultra high energy cosmic rays.

1. Introduction

In general terms, Design Thinking (DT) is a methodology inspired by the design process that was born at Stanford University in the 70s of the 20th century, as a method of creative action[1][2]. Essentially aims to solve the needs of people, using technologically possible tools, without losing sight of innovation. For this, 5 basic steps can be defined, applicable to almost all human activities in which innovation is centered on the person: empathize, define, devise, prototype and evaluate. There is no single way to address them, as there is not a single public for science.

It is possible to design the complete graphic of thematic spaces in Museums or Fairs of Science and Technology, applying the DT tool.

Questions such as:
Who are the users?
What are their tasks and goals?
What previous experiences in similar proposals they have?
How do we expected the exhibition works?

permit us to define specific goals:
. Analyze the user.
. Clearly define the topic to be addressed.
. Clearly define the topic to be addressed.
. Study nuances and possibilities.
. Find viable solutions.
. Transform the idea into meaningful.
. Increase the degree of originality.

It is possible to achieve those goals from the definition of concepts such as: focus, color, layout, size, shape, materials, typography, images, photos, illustrations, addressing, semantics. And, over all, be an observant and curious creator.

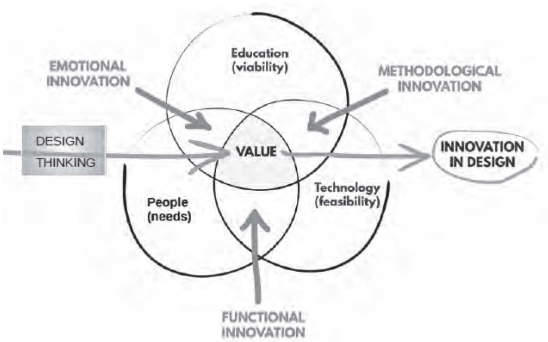

Figure 1. The DT as input for innovation

As part of the innovation in the design we appeal to different inputs which coming from the user needs, the educational background and from the available technology. All converge to produce a value through emotional, methodological and functional innovation. A simple scheme of the idea that follows the present contribution, is presented in Figure 1.

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2. Applications

The starting ideas come true through prototyping, some examples of this are the manual sketches, 3D models, digital ambiance. For each phase, different techniques help to advance in the process: brainstorming, mood board or SCAMPER, between others (see Figure 2).

The different design projects with emphasis on an optimal relationship between user (general public) and the message, gave interesting results.

Figure 2. Techniques in DT

In the past seven years, we apply the DT methodology to the exhibition in two kind of spaces the Argentinean Science and Technology exhibition, Tecnópolis, and to re design the Pierre Auger Observatory (www.auger.org) Visitor Center.

2.1 Tecnópolis

Tecnópolis is a mega exhibition of Science and Technology in Argentina. Each year, since 2011 between July and November, all the institutions which work in the country on these subjects, present different spaces to show what is doing in Argentina. The DT permitted to improve the exhibition along the years using the audience experience with a great impact on the public. So far, more than a million visitors joined us in this proposal, in which the the greatest impact was achieved with the space for the disabled (http://noticias.unsam.edu.ar/2016/09/27/el-iteda-exhibe-instalaciones-para-personas-con-discapacidad-en-tecnopolis-2016/)

2.2 Pierre Auger Observatory

In the case of Pierre Auger Observatory, part of the proposal arose after the statistic study of visits along 10 years and after noted that the number of visitor, after a pick in 2009 (the International Year of Astronomy) continuously decreased (see Fig 3). The decision, in this especial case, was transform a traditional visitor center, in which conferences and public talks were performed for the audience an all the material of education and outreach was graphic, into an interactive space, which can be visited with a help of an audio guide and in which the visitor takes his/her own decision about the visit.

The results can be seen also in Figure 3, where a good response from the public is evident. Now, the challenge is to maintain that level of interest.

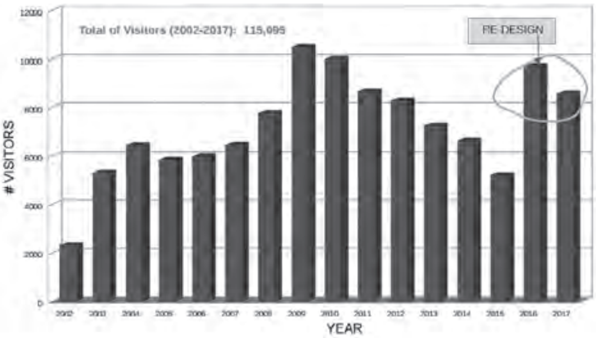

Figure 3. Statistic of Visitors in Pierre Auger Observatory 2002-2017.

3. Conclusions

The most valuable information about the "usability" of a design is obtained by observing the user. Certain behavioral guidelines help to detect successes and aspects to be corrected. A progressive change in the realization of the exhibitions allowed to achieve better results with greater impact and acceptance.

A design problem always arises from a need, and creativity does not mean improvisation without method.

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|Parallel Session|

The International Astronomical Youth Camp: Lessons Learned in 50 Years

Hannah S. DALGLEISH[*1], Joshua L. VEITCH-MICHAELIS[*1]

Abstract. Since 1969, the International Astronomical Youth Camp (IAYC) has given young adults the chance to broaden their horizons, whilst embarking on scientific inquiry into astronomy. Having run more than 50 successful camps, we have overcome a great range of challenges (e.g. logistical, pedagogical, and financial) as well as facing new challenges which continuously arise. To have a greater understanding of the IAYC's impact in the longer-term, we recently carried out a survey completed by 251 people across 54 nationalities, covering every year that the camp has run. The results strongly support that the camp's method is beneficial overall (97%) and has a positive influence upon people's lives (96%) – and 77% have remained in regular contact. We also found that the majority are studying/working in STEM (55%), with 26% in astronomy/astrophysics.

1. Introduction

The first International Astronomical Youth Camp (IAYC) took place in West Germany in 1969 [1]. There have been 53 camps held in 15 different countries across Europe and Africa, with a total of 3327 participants so far (this does not account for the participants who have attended more than once) from 77 different nationalities. For an overview of the IAYC and what it involves, see [2].

2. Challenges

The camp is run by a German non-profit, the International Workshop for Astronomy e.V. All costs are kept low, to ensure that the IAYC is sustainable and accessible to all. We do ample fundraising to support our grant program, and the organisers are all volunteers. As a result, we face time and financial limitations, which we can break down into three main categories: logistics, applications, and pedagogy.

Logistics. Organising the camp in a different country each year requires a lot of work. Although we are always on the lookout for new houses, we return to previous ones every few years. The camp house must be large and remote enough, and willing to provide food at unusual times of day. We also have to consider the transportation costs of both equipment (which is stored in Vienna) and organisers (located across the world).

Applications. Until 2012, we rarely received more applications than we had capacity for. Since then, applications have been rapidly increasing. Grant applications increased as well – although at a much slower rate (Table 1; note that due to drop-outs, those participating is always less than the total number we accept. The left-hand columns also include the number of grant applications and participants). This has posed new difficulties in participant selection and put greater pressure on our already limited grant funding. In response to the latter, we have trialed online interviews and video applications, and since 2016 we have successfully approached previous participants to help by contributing to our grant fund.

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Table 1. Number of (Grant) Applications and Participants, some information missing.

	Apps	Participants	Grant Apps	Grant Participants
2011	62	51	15	
2012	87	61	23	6
2013	96	58	21	5
2014	107	62	25	7
2015	117	61	26	9
2016	145	66	31	10
2017	129	66	30	9
2018	170	72	27	6

We aim to make the IAYC as diverse as possible: bringing together different cultures is at the camp's core. The female-to-male ratio is roughly constant (189:185 for the past 6 years), mostly white (84.5%), with 6.5% mixed, 4% Asian, 3% other, and 2% Arab – results taken from the IAYC survey (§ 3). Although the number of nationalities is steadily increasing (Figure 1), we are currently determining the best way to diverse our demographic further.

Pedagogy. Every year we recruit previous participants to become new organisers. This ensures that we cover a wide range of exciting projects, often at the forefront of research, which keeps participants returning year after year. We take consideration that some participants have no prior experience in astronomy/astrophysics, whereas others may be at PhD level. In case of poor weather, back-up projects need to be available. Finally, there is no internet at the camp: we must have enough resources for a 3-week project. A serious concern is the increasing pressure to do summer internships (or similar), limiting the number of returning participants and organisers, which is key to the functionality of the IAYC.

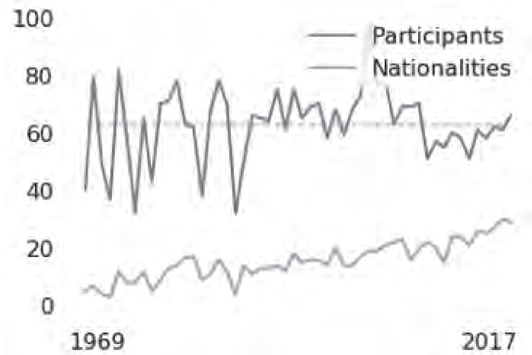

Figure 1. Numbers of participants (blue) – with mean (grey) – and nationalities (orange) at each IAYC.

3. Survey

From 2017-18 we held a survey to understand the IAYC's influence over several decades. 251 people across 54 different nationalities responded, covering attendance for every camp. Figures 2 and 3 show age and camps attended, respectively. 11% had never been abroad before the IAYC, and 61% now live in a different country than their origin. 40% are currently students, 10% hold permanent research positions, and 5% work in science communication. 55% study/work in STEM-related fields, and 26% are in astronomy.

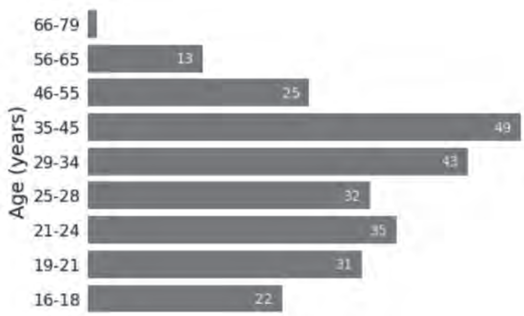

Figure 2. Ages at the time of completing the survey.

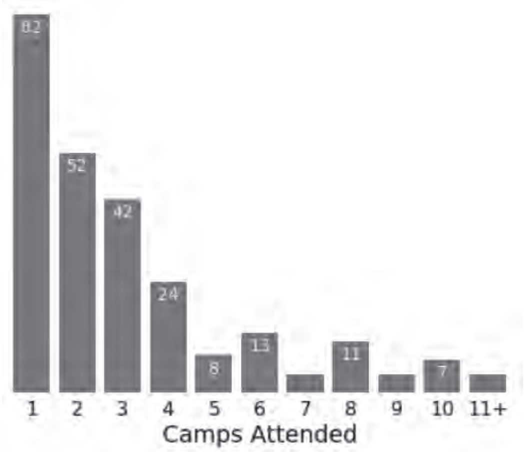

Figure 3. IAYCs attended at survey completion.

[100% / 99% / 96%] agreed that working with participants of different [international backgrounds / academic backgrounds / ages] was beneficial. 97% agreed that the IAYC method is beneficial (no lectures or exams – focus on research instead); 96% agreed that the camp had a positive influence on their life; 77% remain in regular contact. Further results of the survey will be published in a future paper.

4. Summary

The IAYC is successful in many ways. We have developed a system allowing us to run the camp in a different country each year with limited resources. Although our demographic is not as diverse as we would like, we have good gender balance. The survey clearly shows that almost everyone found the camp to be a positive influence, through research work and the life-long connections made. The IAYC achieves its main purpose: it enthuses, inspires, and educates the younger scientists of the future in a very wholesome and positive way, and helps to break down scientific barriers that a career in astronomy might pose. If anyone wishes to learn more feel free to contact us. We gratefully acknowledge funding from the RAS and IOP to support Hannah's attendance to CAP 2018.

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Developing a Free Astronomical Exhibition for Everybody: Lessons Learned

Mathias JÄGER*1, Tania JOHNSTON*1 and Lars L. CHRISTENSEN*1

Abstract. For the ESO Supernova Planetarium & Visitor Centre, the education and Public Outreach Department at the European Southern Observatory created a modern and interactive astronomical exhibition. While the team already had experience in creating exhibitions it faced many new challenges during this project and learned many valuable lessons.

1. Introduction

Within the last few years, the European Southern Observatory (ESO) has worked on the realisation of the ESO Supernova Planetarium & Visitor Centre, a modern and interactive science centre for astronomy. The ESO Supernova is a cooperation between ESO and the Heidelberg Institute for Theoretical Studies (HITS). The building is a donation from the Klaus Tschira Stiftung, a German foundation, and ESO runs the facility.

The ESO Supernova hosts an interactive astronomical exhibition. It allows visitors to see, hear and touch the Universe, to use real astronomical artefacts and to conduct experiments to get an idea of what it means to discover the Universe.

The physical framework of the exhibition was designed by Design und Mehr in collaboration with HITS and ESO. It extends over 2200 m^2 area and consists of 13 different themes.

2. Concept

The exhibition of the ESO Supernova builds on the idea that people are natural explorers. They are interested in their surroundings and constantly raise questions. Therefore, each station in the exhibition raises a fundamental astronomical question which is answered within the station. Each question is answered in three different levels, allowing the reader to choose the depth of information. The answer is supported by high-res images and videos. The whole exhibition is bilingual (English and German), digitally enhanced with touch screens, serious games and large screens. Large images don the walls and even some floors.

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3. Lessons learned

There are a number of things ESO learned during the conception and realisation of the exhibition, mainly on creating texts, gathering images and videos, creating serious games and hands-on stations and finding interesting exhibits.

3.1 Texts

Exhibition texts have to be short, to the point and easy to understand. ESO hired the writer Govert Schilling to write the texts for all the panels in the exhibition. Despite his experience with astronomy and educational texts he sometimes struggled — but always managed in the end — to explain complicated astronomical texts within the character limitation we gave him. We are quite sure that a less experienced writer would not have managed this.

Texts for the touch screens were mainly written by volunteers and only partly by members of the department. The volunteers had very diverse backgrounds — only a few in astronomy, and none in science communication. While the delivered texts were of great help to start with, they most often needed heavy editing and also some of the volunteers needed careful supervision. In the end outsourcing the texts to volunteers did not save us as much time as we hoped it would.

The translation was also done by volunteers and by members of ESO Science Outreach Network. These people were already used to the workflows and were familiar with the vocabulary. So the translation procedure worked very well.

With respect to the content of the texts we learned that it is very important to focus: Focus on the main topic of the exhibition and to focus on only one educational message per station. This adds up to another lesson learned: Short texts are essential for visitors to keep them entertained and interested. We set a maximum of 700 characters to answer a question. While this is more than enough text on one panel, it is challenging to explain complicated astronomical phenomena.

The creation of excellent texts takes time, so one should start as early as possible. At the same time, as astronomy is a quickly evolving field, one should edit and update them until the very end. A constant review process is needed (educational messages, scientific correctness, spelling, wording) to keep the texts at a high quality. While it is tempting to use many people for editing and review, our experience showed that a small team is actually more useful, as they are better aware of the overall project aims and established standards.

3.2 Images

Almost all astronomical images are available for free with hardly any restrictions. However, finding the very best high-res astronomical images for an exhibition is surprisingly time-consuming. Investing in a person who is already familiar with the material out there is very helpful to speed up the search and to raise the quality of the images being found. As a non-profit organisation ESO also encouraged artists and photographers, and even image stock libraries, to give us their images for free. To acknowledge them they are listed as exhibition partners on our webpage.

3.3 Videos

Well-made short video clips on astronomical phenomena are rare. The ones available are very different in style and of no use together in one exhibition. ESO therefore reused many clips from its archive and created new material with the help of its graphics team. Most of the videos were requested at the beginning of the project to give the team a total of three years to work on them.

3.4 Serious games and hands-on

The exhibition hosts several serious games (digital interactives) created by HITS. While all of the games are scientifically accurate we underestimated the importance of an easy-to-grasp graphic user interface (GUI). Tests with groups showed that without a well-thought-out GUI, visitors are afraid of using the game at all and keep moving to the next station.

To set a contrast to the screens in the exhibition, we also created several hands-on stations — experiments visitors can perform. Clear statements of work, including educational messages, for the company building the stations are essential. If possible, a construction company should be selected which has astronomers or physicists in their team to make sure that the hands-on station is physically correct. This would also reduce the amount of necessary supervision of the company.

3.5 Exhibits

Large and interesting artefacts are the core of any exhibition. However, finding them in astronomy is difficult. We learned that writing mass emails to staff at ESO didn’t lead to any responses. Walking around and knocking on office doors, however, worked fine as we could talk with the people who were able to present us with different artefacts (meteorites, instruments, models) which they were not aware would be interesting to see in an exhibition. As some exhibits are massive, and exhibitions often revolve around them, the search for them should start early on.

4. Summary

With good, careful planning and a good team, it is possible to create a large exhibition with limited manpower. The whole exhibition will be available for free and for reuse on supernova.eso.org.

|Parallel Session|

Astronomy News for Children – What it Means for Science Education and Science Literacy

Han T.D. TRAN[*1], Pedro RUSSO[*2] and Vincent DE BAKKER[*3]

Abstract. Learning science through news is a promising approach in science education. News provides meaningful real-life context, so it stimulates scientific inquiry-based learning while fosters science literacy practices, including reading, writing and reasoning with science text. Previous studies have reported that news improves science learning but there are some barriers to implement news as a teaching resource. The Space Scoop website is specially designed to bring the latest astronomy news to young readers in the form of short, easy-to-understand stories. In this study, we conducted structured interviews in order to understand opinions of teachers and educators (N=20) about Space Scoop as a teaching resource. This research also investigated the advantages and disadvantages of Space Scoop as compared to general news resources for science learning. Tests were conducted on Space Scoop articles to measure their readability. Our findings showed that Space Scoop is suitable for young children and motivates them to study science. Space Scoop has overcome the main barriers to teaching with news, namely, the advanced reading level and unreliability of information. Evidence from this exploratory study indicates that Space Scoop supports inquiry-based learning, improves science literacy skills and promotes lifelong learning.

1. Introduction

Science educators have shown considerable interest in learning science through news [1]. Because news provides real-life context, reading becomes part of scientific inquiry as students try to find answers to a question meaningful to them. The need to know drives students to explore and reason with the texts as well as conduct hands-on investigations to experience the phenomenon [2].

An innovative source of news, the Space Scoop website (www.spacescoop.com), is a platform that collects the latest space news from astronomical organizations worldwide and edits the news into short stories written in a language suitable for children aged 8–10 years. Space Scoop aims to use astronomy as a medium to spark interest in science and technology.

With the growing interest to promote science literacy via incorporation of news in science education, it is useful to research on how a news type like Space Scoop assists science learning. And, is it suitable for its target audience i.e. primary school students?

2. Methods

We conducted structured interviews with 10 teachers and 10 educators who have used Space Scoop in education (formal and informal) in different countries (e.g. UK, Spain, India, Greece, Romania, Croatia, etc.). Both teachers and educators (N=20) provided opinions about Space Scoop as compared to other news, its strengths and weaknesses. The teachers' interviews (N=10) provided specific information on the experience of teaching with Space Scoop in schools and its effects on students' learning.

Whether Space Scoop is suitable for primary school students was determined through the readability test, called WizeNoze, on English articles (N=70). The result was then compared with responses of teachers and educators from the interviews.

3. Space Scoop is suitable for young children

All interviewees agreed Space Scoop overcome the difficulties of teaching with general news sources.

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Scientific information in Space Scoop is more reliable (N=11). And Space Scoop is written with a more children-friendly language (N=18), which reduces the time and effort of teachers to modify the news for their students (N=4). The readability test also showed that most English Space Scoop articles match the reading level of students aged 9-10 years (WizeNoze score 3).

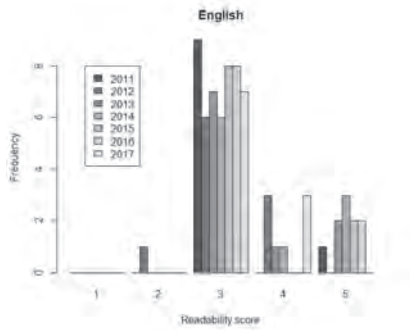

Fig. 1. Reading levels of English articles. For interpretation of WizeNoze readability test scores: https://www.wizenoze.com/readinglevels/

4. Teaching with Space Scoop and effects of Space Scoop on learning

Teachers have used Space Scoop in class for linking it to a lesson as an example, or for explaining a concept. Space Scoop stories are usually trendy and thereby attract students' interest in learning. For instance, a teacher used the Space Scoop "Is the Sun really a giant Pokemon?" to explain magnetism. Her students tried to explain the words from this Space Scoop with the physics they were learning in class.

Teachers reported Space Scoop inspired students to learn more about space and general science (N=10). Space Scoop caused students to discuss the related science topics more actively (N=10); and teachers believe this helped students learn curricular subjects better (N=8). Students were reported to read more news on their own (N=9). They brought news to class for discussion, mostly to explore further, and sometimes to relate, support or disprove what they have read previously. These are the proofs that lifelong learning habit for science through news has been formed. Space Scoop also improved the reading and writing ability of students (N=6).

Teachers and educators attributed the positive effects of Space Scoop to several features (Fig. 2). An important feature is its interdisciplinary link to many science subjects (maths, chemistry, biology, etc.) and non-science subjects (art, history, language, etc.).

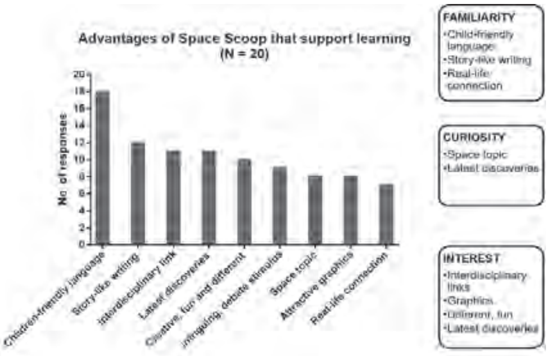

Fig. 2. The features of Space Scoop create interest, curiosity for discussion and a sense of familiarity.

Collectively, these features of Space Scoop make it an effective news resource to support inquiry-based learning and improve science literacy. As Space Scoop fosters interest, curiosity and familiarity, students are stimulated to learn science through questions that are relatable or meaningful to them. And simultaneously, through reading and discussion, students learn science literacy skills. Additionally, as students read and realize there are always interesting new things to learn about science, they can get used to learning science through news throughout their life.

5. Summary

Space Scoop was suggested to improve with additional interactive features such as community site and Q&A box. Space Scoop still needs to be studied more extensively as this research is only exploratory.

In science education, hands-on, inquiry-based learning has been emphasized over learning through texts because science texts can be uninteresting. But, science education is also responsible for fostering students' literacy skills, including understanding a science phenomenon through reading, constructing and communicating explanation or argumentation for their ideas. Space Scoop news has the features that allow students to learn science through inquiry and simultaneously learn the science literacy skills.

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|Parallel Session|

“Summer of Space”: Harnessing the Power of Conferences to Engage Public Participation in Astronomy

Clair MCSWEENEY*1, Niall SMITH*2, Niamh SHAW*3

Abstract. Commencing June 26 until August 25, 2017, Cork Institute of Technology (CIT) played host to the International Space University’s annual Space Studies Program (SSP17). In association with CIT, Cork County Council, the International Space University and Science Foundation Ireland, CIT’s Blackrock Castle Observatory ran "Summer of Space", a public engagement programme to celebrate Ireland’s hosting SSP17 and 10 years of Blackrock Castle Observatory. The public was invited to join 250 world-leading space experts at 55 exciting events nationwide to explore our spectacular Universe and humankind’s place in the vastness of Space. The extensive programme raised awareness of the benefits, challenges and inspiration brought by astronomy, space exploration and other space endeavours to over 6,000 people. "Summer of Space" was the broadest public engagement programme ever organised by a host country during a Space Studies Programme. The "Summer of Space" public engagement programme showcased the positive impact that can be made by aligning significant public outreach events with a major conference and simultaneously supporting national targets in education and public engagement.

1. Introduction

Cork Institute of Technology has a proud tradition of graduating engineers and scientists across a wide range of disciplines and in collaboration with its science and discovery centre at Blackrock Castle Observatory (BCO) secured the International Space University’s 30th Space Studies Programme (SSP17) in the summer of 2017 against intense international competition. The nine-week programme was the largest space event to ever come to Ireland or the UK and included intense academic research, lectures, rocket launches, robot wars, astronaut talks, and many educational outreach activities across Ireland. SSP17 was the longest international conference ever to come to Cork (and one of the city’s largest, if not actually its largest conference due in part to its longevity), attracting 370 delegates and visiting experts from 26 countries.

It generated in excess of €2 million for the local economy, according to Cork Convention Bureau, and put Cork on the map as a hub for the space industry worldwide.

An integral part of SSP17 was the associated public outreach programme, coordinated by BCO and entitled “Summer of Space”.

This was the largest public space event hosted in Ireland, with the public invited to participate in 55 exciting events in Cork and 5 more nationwide.

In Ireland awareness of science is quite general, but positive. 51% feel uninformed about STEM, yet 58% are interested in it. [1] “Summer of Space” was an excellent example of a collaborative education and public engagement programme to develop STEM awareness; involving stakeholders nationwide including CIT, Science Foundation Ireland (SFI) and Cork County Council. Activities were co-funded by Cork County Council’s Economic Development Fund.

By common consent of seasoned SSP staff, SSP17 was probably the best organised space studies programme ever with the highest impact. This attests to CIT’s ability to lead a major space initiative and Cork’s position as a significant tourist attraction. [2]

2. Impact

SSP17 was not only set apart from other events by its sheer scale, but by its massive external reach. SSP17 broke all records for the programme, with 18 million unique visitors to SSP17 social media channels from over 94 countries, and over 95 million views of the SSP hashtag. There were 17,261 tweets from 3,259 contributors, 204 pieces of TV, radio, print and online coverage with a 1.15 billion reach and 20,000 copies of a 32-page colour

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supplement in the Irish Examiner. The SFI funded PR campaign alone is valued at €382k.

Incredible branding opportunities took place such as the Cork and CIT flags flying through space on board the International Space Station; this made front page print news and national TV headlines when ESA astronaut Paulo Nespoli brandished the flags live from the Earth-orbiting Space Station.

“Summer of Space” captured public imagination with novel and engaging events such as Rocket Launches, Robot Challenges, ‘Space on the Road’ pop-ups, night-time ‘Moon-Cycles', the launch of the Cork Sky Friendly Campaign and a nationwide campaign for Dark Sky Awareness, a poster campaign celebrating the influence that Ireland continues to have in the fields of astronomy and space science; and all washed down with “Small Step” and “Giant Leap” Space Beers brewed especially for SSP17 by Rising Sons Brewery.

All events were free of charge to enable widest possible public participation. Innovative panel discussions were encouraged and ranged from the public’s opinion on space exploration, and disruptive and creative ideas from the current state of our space industry to the future of spaceflight.

The knock-on effect from the 9-week programme included a much-increased awareness of the visitor centre at BCO. Visitor numbers were up a staggering 51% from July 2016 to 2017. In a message for the launch of the programme, Dr Buzz Aldrin, Chancellor of the International Space University, commended the team at BCO for organizing and participating in Summer of Space.

One of the truly original outputs of SSP17 was the production of a document which will help to chart Ireland’s involvement in the global space industry (worth €310 billion per annum). This document will form the backbone for the Irish Government’s consultation on a National Space Strategy for Ireland. In this way, SSP17 has positioned Ireland to take advantage of the global space economy in a way that has never been achieved before in Ireland.

There are an increasing number of opportunities for Ireland to take advantage of our heritage in the space domain; working with Cork County and City Councils and Science Foundation Ireland BCO will maximize social and economic returns from SSP17.

Fig. 1. RTE TV News interviews former NASA astronaut, BCO Patron & SSP17 keynote Dan Tani at Cork Institute of Technology. Image Credit RTE.

3. Summary

SSP17 is not organised as a recurrent event in a given location, but the effect of SSP17 will be felt well into the future demonstrating how space can be a significant catalyst to inspire all people.

As a nation who is famous for our innate ability to be creative and imaginative, making outstanding contributions in literature, music, film-making and beyond, BCO is part of a movement to instil an equal sense of excellence and achievement in our global contribution to sciences. We will use stories developed as part of SSP17 to create a sense of awareness for scientific culture.

SSP17 showcased Ireland as a destination for astrotourism or dark sky tourism, taking advantage of our relative lack of light pollution and the increasing market amongst tourists who live in cities and wish to connect to the natural world. With the only Gold Tiered Dark Sky Reserve in the Northern Hemisphere and an increasing number of accredited Dark Sky Parks BCO will continue to work with stakeholders to raise awareness of Ireland as a Dark Sky destination.

“Summer of Space” was a fitting tribute to BCO, which celebrated its tenth anniversary in 2017 and close to 1 million visitors of all ages.

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Fostering Astrochemistry Knowledge in Society

Natalia RUIZ ZELMANOVITCH[*1], Marcelo CASTELLANOS[*2]

Abstract. "Gas and dust from the Stars to the Laboratory: Exploring the Nanocosmos" is the name of a project funded by the European Research Council (ERC) through a Synergy Grant with 15 million Euros. The group comprises three teams (two in Spain and one in France). The main goal of the project is to go in-depth on the understanding of how dust grains form in the envelopes of evolved sun-like stars. In order to do so, and besides observations, models and other developments, this Astrochemistry project has successfully developed an experimental set-up, called the Stardust machine, in the ICMM-CSIC (Madrid, Spain) whose goal is to reproduce those processes in an ultra-high vacuum environment. The importance of publishing scientific results based on NANOCOSMOS in the scientific literature goes without saying, but it is also important and a stated NANOCOSMOS objective to disseminate the achievements of the team and its scientific and technological results to a wider audience. In this presentation we will discuss the tools we are using to spread them to the society, from the traditional webpages or documentaries to an ERC_Comic.

1. Introduction

A star is dying somewhere in the universe. It is a mid-sized star, similar to our Sun. Its time has come to eject the matter to the interstellar medium, releas-ing to the empty space the molecules and dust that once formed it, in beating layers that pulse with the star winds, pushing the dust grains and the gas into a cosmic voyage. Most stars with masses between one and eight solar masses evolve into the Asymptotic Giant Branch stage, where the star cools and reaches a very large radius. This phase is characterized by strong stellar winds which, ultimately, will create a huge circumstellar envelope of gas and dust, one of the most beautiful objects in the sky. So cosmic dust is made in evolved stars. However, the processes involved in the formation and evolution of dust re-main so far unknown. This is the mission of the pro-ject "NANOCOSMOS, Gas and dust, from the Stars to the Laboratory: Exploring the Nanocosmos", funded by the European Research Council (ERC) under the European Union´s Seventh Framework Programme (FP7/2007-2013)/ERC-2013-SyG Grant Agreement nº 610256.

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NANOCOSMOS uses interferometers like ALMA and other antennas (Yebes, IRAM, etc.) to unveil the physical and chemical conditions in the dust formation zone of evolved stars. These observations, combined with novel top-level ultra-high vacuum experiments and astrophysical modelling, provide a cutting-edge view of cosmic dust. NANOCOSMOS has as a goal to disseminate the achievements of the project and its scientific and technological results to a wide audience through different outreach tools and events.

2. Outreach in NANOCOSMOS

NANOCOSMOS has a "Communication team", composed by the Manager and the Public Information Officer (PIO). They are the contact points for the NANOCOSMOS community to spread all the information created by the project teams. Once the scientist/engineer has a result (accepted paper) or considers any advance interesting to a wider audience, the team, through the Principal Investigator (PI), should bring this to the "Communication team" attention that will be in charge of developing the information.

NANOCOSMOS has a web page to publish and disseminate news and releases based on scientific results. This is a key tool to raise the image of the project and improve dissemination to specialists, potential users of the technologies being developed, politicians and public funding authorities, as well as the general public. Also social media accounts (facebook and twitter) are very useful to spread all the news and information generated in the website.

The procedure begins with the paper: from that scientific result we can obtain several products as press releases (for the mass media), outreach articles (to be published in the NANOCOSMOS website or in the Naukas web page, the main site for science outreach in Spanish), notes for the blog, social media posts (twitter and/or facebook), interviews (written or in video for the youtube NANOCOSMOS channel), videos and animations explaining those results, visits to the different machines where the experiments take place, talks, etc. We have also collaborated in radio programs talking about science.

3. Main Outreach NANOCOSMOS Projects

In the last two years we have been granted with two outreach projects: the first one, funded by the European Research Council (ERC) to make a comic called "**ESTRELLA**" (by the artist Lorenzo Palloni).

Fig. 1. Promotion of the "ESTRELLA" webcomic, from the ERCCOMICS project. Credit: Lorenzo Palloni

The second one is "**NANOCOSMOS: Un viaje a lo pequeño**", a 40 minutes road movie about laboratory astrophysics supported by FECYT, the Spanish Foundation for Science and Technology from the Spanish Ministry for Economy, Industry and Competitiveness and CSIC, the Spanish Council for Scientific Research, trough the European Research Council (ERC). This documentary is a journey to the origins of dust grains through Laboratory Astrophysics. The story unfolds in three levels: the journey of the recording team from Madrid (Spain) to Toulouse (France), the laboratory experiments explained by its principal investigators and the journey of the cosmic dust grains since they are born in the envelope of an evolved star until they become part of something bigger (a star, a planet or, why not, a living being).

Fig. 2. Promotion of the "NANOCOSMOS: Un viaje a lo pequeño" road movie. Credit: LuzLux.

This work wants to transmit the expectations of the teams struggling to understand this process, the **technological and human challenge** involved in building complex machines whith a goal: to reproduce in a laboratory what happens in space. The documentary will circulate along circuits of scientific movies and specific science channels for a year, and after that it will be available on the Nanocosmos' website. The movie is available in Spanish with subtitles in English and French.

4. Summary

Increasing resources invested to create knowledge and improving the mechanisms used to transfer such knowledge so that it benefits society as a whole must be top priorities of all governments. This is why our project pulls for science and science outreach as some of the best ways to make a better society. Our motto is:

References

[1] NANOCOSMOS web site: https://nanocosmos.iff.csic.es/
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[4] NANOCOSMOS Twitter: https://twitter.com/NANOCOSMOS_ERC
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|Parallel Session|

Astronomy Communication and Popularization Development With Limited Resources and Information

Ronny SYAMARA[*1,2], Widya SAWITAR[*1,2]

Abstract. One and a half decades after the inauguration of the Jakarta Planetarium in 1969, people's interest in astronomy has increased, especially in Jakarta the capital city of Indonesia. To accommodate the people's interest in astronomy, the Director of Jakarta Planetarium and Observatory gathered astronomy enthusiast in Jakarta and then formed an amateur astronomy club named Himpunan Astronomi Amatir Jakarta (HAAJ) on April 21, 1984. However, the lack of information, astronomy facilities and supporting instruments became challenges for HAAJ to implement its vision to socialize astronomy to the public. HAAJ aims to bridge professional astronomers with laypeople through various astronomy activities. Nearly 34 years after its formation, HAAJ is quite well established to organize its own regular activities with the astronomical instruments it has now. HAAJ is also actively involved in nurturing new astronomy clubs and forums in Jakarta and other cities to reach a broader range of audience and areas to popularize astronomy in Indonesia.

1. Introduction

Considered a 'luxurious' science and difficult to learn, astronomy is not yet as popular as other exact sciences in Indonesia [2]. There is also an opinion that if you want to learn astronomy you must have astronomical equipments such as binoculars or telescopes which are quite expensive. Some people also believe that being well-educated in science is required. If we look at the traces of history of astronomy since millennia ago, we understand that astronomy has played a very important role to help people to understand the sky while observing the heavens.

In the school curriculum in Indonesia, astronomy has not become the main subject yet. It is only a small part of Physics or Geography lesson [3]. In high schools, Physics and Geography teachers are still arguing about this. In addition, many teachers still find it hard to present the material due to little understanding of astronomy. They have a lack of teaching time as well. Nevertheless, schools are demanded by government to actively participate at Astronomy Olympiad to international level [1].

To overcome the problems mentioned above, HAAJ and Jakarta Planetarium have to change the paradigm. Both HAAJ and Jakarta Planetarium are to utilize existing resources and continue to strive to develop a variety of activities which are simple but attractive to people. Also build a wider astronomical network and work with government, non government organization and mass media to popularize astronomy in Indonesia.

2. Activities

To answer the above challenges, from the beginning, HAAJ has made some educational activities to the public. However, it was not regularly scheduled yet at first. In early 2000, HAAJ tried to arrange routine and non-routine activities scheduled for one year as will be explained below.

2.1. Routine Activities

The main routine activities are Biweekly Regular Meeting with popular lecture formats and discussions. Another activity is Star Party, which is held 4 times a year: once for the public and the rest are for the members only. The goal is to improve observation skill. There is also a larger scale event for the public, Astro Party. Collaborated with Cultural Centers from abroad, such as Russia (2004, 2007), Japan (2006), Italy (2009), Korea and United States (2013). HAAJ holds talks, seminars, exhibitions and film discussions. The other activity is giving workshops to make properties (Sundial, Theodolite, Spectroscope, Sun Surface Simulation, etc.) and also to perform simple calculations such as determining the circumference of Earth based on Eratosthenes, Earth-Sun distance, Moon/Sun angular diameter and determining the true north direction, etc. The purpose of the workshop is to give participants an idea of how simple equipments and calculations can explain various astronomical phenomena and to inspire students to participate in astronomy research.

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2.2. Non-Routine Activities

Besides routine activities, there are also non routine activities which include visits to certain institutions, a star party in schools which have a lack of access to information and also a star party held in remote areas to socialize astronomy to elementary school students there. HAAJ also holds activities related to international astronomical events (IYA 2009, Global Astronomy Month, World Space Week, International Observe the Moon Night, 100 Hours of Astronomy, etc.) in a standard-based format of the international committee. There are also Jakarta Astronomy Week participated by high school students in Jakarta and also observation for public which usually work together with Jakarta Planetarium or related institutions.

Fig.1. Social Star Party and Routine at State Elementary School Satu Atap 01, Pari Island, Thousand Islands – North Jakarta. Credit: HAAJ.

3. Building Astronomy Networks

To popularize astronomy, HAAJ also collaborates with some senior high schools to form astronomy club: LUNAR (SMA Negeri 3 Bogor, in 2001) and SIRIUS (SMA Negeri 89 Jakarta, in 2006). In 2008 HAAJ formed a communication forum for Youth Scientific Group (KIR) named Forum of Scientist Teenagers (FOSCA) and Astronomy Student Forum (FPA) in 2009 for students who have been participated in astronomy olympiad. After IYA 2009, HAAJ managed to inspire a few schools to form astronomy clubs in their schools. Now there are 9 astronomy clubs altogether and 2 communication forums.

HAAJ has also inspired the formation of amateur astronomy clubs in some cities, such as Surabaya Astronomy Club, Jogja Astro Club, Club Astronomi Santri As-Salaam (CASA-Solo), Himpunan Astronom Amatir Semarang, Astronom Amatir Makassar and Pusat Studi Astronomi Universitas Ahmad Dahlan Yogyakarta. In September 2017, initiated by HAAJ, a national astronomy community gathering event was held in Watukosek, Pasuruan – East Java. Hosted by the Indonesian National Institute of Aeronautics and Space (LAPAN), the event was attended by 38 out of 50 astronomy clubs that exist nowadays in Indonesia.

4. Conclusions

With the variety of activities and the formation of new astronomy clubs, it is expected that public will find astronomy fun and interesting. Cooperation with educational institutions and mass media also benefit for the development of astronomy. Moreover, the presence of mass media nowadays can be used to promote astronomy to the public.

Acknowledgments

RS would like to express his gratitude to LKBF for the grant to attend the CAP 2018 conference in Fukuoka, Japan. RS's gratitude also goes to Drs. Widya Sawitar, Dr. Hakim L. Malasan, Dra. Premana W. Premadi Ph.D., Dr. Mahasena Putra, Avivah Yamani, and Suci Purwanti for the their advices, guidance and encouragement. RS also wishes to express his appreciation to all HAAJ members and Jakarta Planetarium for their support.

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2017 Solar Eclipse from a XIX Century Observatory

Ramón Alejandro MÁRQUEZ-LUGO*[1], Durruty Jesús DE ALBA MARTÍNEZ**[1]

Abstract. The public observation of an eclipse is a great opportunity to put science in view of society. The eclipse of August 21, 2017 was observed by about three thousand people from the observatory facilities of the Instituto de Astronomía y Meteorología (IAM) of Universidad de Guadalajara (UdeG), an observatory of the 19th century adapted to the needs of the 21st Century.

1. Introduction

The Instituto de Astronomía y Meteorología of the Universidad de Guadalajara is a research center dependent on the Department of Physics. The staff of the IAM does research in astrophysics, mainly in planetary nebulae and galaxies, in the field of meteorology works on numerical models, agrometeorology, weather forecast and early warning. And additionally in the IAM there is an intense work of scientific dissemination and popularization, through a weekly cycle of talks called "Friday of Science", with days of open doors, receiving school groups and organizing activities for specific events such as the solar eclipse of 2017.

Fig. 1. Library IAM-UdeG, Collection *Severo Díaz Galindo* Special Funds

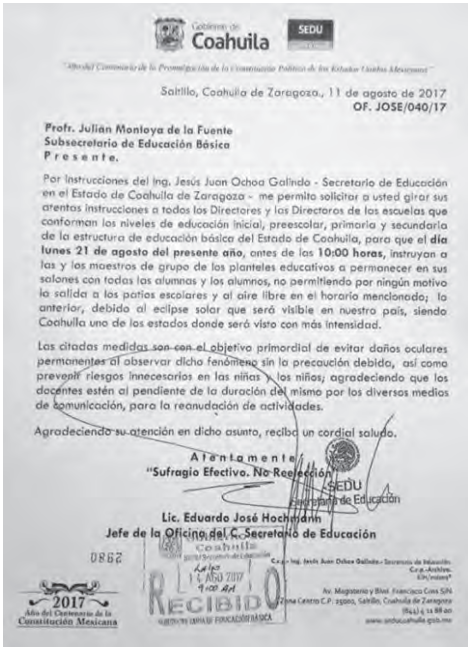
2. Brief historical background

The IAM is the heir to a long scientific tradition in western Mexico. On April 2, 1889, the Meteorological and Astronomical Observatory of the State of Jalisco was founded, it was incorporated in 1925 to the University of Guadalajara and in 1947 it is called Instituto de Astronomía y Meteorología.

It is relevant to say that since at least 1894 it has been in its current location [Fig. 1] and it is included in the State Inventory of the Cultural Heritage of Jalisco.

3. Social context for 2017 solar eclipse

The solar eclipse of 2017 has been considered the first and most important astronomical event of the era of social networks. This was partly due to its geographical location in one of the best covered regions of the world by the Internet resources [1].



Gobierno de Coahuila
SEDU

Saltillo, Coahuila de Zaragoza., 11 de agosto de 2017
OF. JOSE/040/17

Profr. Julián Montoya de la Fuente
Subsecretario de Educación Básica
P r e s e n t e.

Por instrucciones del Ing. Jesús Juan Ochoa Galindo - Secretario de Educación en el Estado de Coahuila de Zaragoza - me permito solicitar a usted girar sus atentas instrucciones a todos los Directores y las Directoras de las escuelas que conforman los niveles de educación inicial, preescolar, primaria y secundaria de la estructura de educación básica del Estado de Coahuila, para que el **día lunes 21 de agosto del presente año**, antes de las **10:00 horas**, instruyan a las y los maestros de grupo de los planteles educativos a permanecer en sus salones con todas las alumnas y los alumnos, no permitiendo por ningún motivo la salida a los patios escolares y al aire libre en el horario mencionado; lo anterior, debido al eclipse solar que será visible en nuestro país, siendo Coahuila uno de los estados donde será visto con más intensidad.

Las citadas medidas son con el objetivo primordial de evitar daños oculares permanentes al observar dicho fenómeno sin la precaución debida, así como prevenir riesgos innecesarios en las niñas y los niños; agradeciendo que los docentes estén al pendiente de la duración del mismo por los diversos medios de comunicación, para la reanudación de actividades.

Agradeciendo su atención en dicho asunto, reciba un cordial saludo.

A t e n t a m e n t e
"Sufragio Efectivo. No Reelección"

SEDU
Secretaría de Educación

Lic. Eduardo José Hochmann
Jefe de la Oficina del C. Secretario de Educación

0862

2017
Año del Centenario de la Constitución Mexicana

RECIBIDO
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9:00 AM

Av. Magisterio y Blvd. Francisco Coss S/N
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Fig. 2. Official statement from the Coahuila's State education authorities requesting the teachers to completely prohibit the observation of the eclipse to their students.

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Mexico was no exception to this state of expectation to observe the eclipse, even knowing that for the country it would only be a partial eclipse. Given that the eclipse took place in a working day, the enormous infantile and juvenile population of Mexico was in the schools, where in principle they could have the optimal conditions to realize a safe observation of the astronomical spectacle.

Unfortunately, some educational authorities of the country took coercive actions against the possibility of students to witness an astronomical phenomenon with the potential to change their perception of the world and motivate their scientific curiosity [Fig. 2].

4. Receiving public at historical observatory

Weeks before the eclipse, the population was invited to observe the phenomenon from the IAM facilities, and the response was massive.

Fig. 3. Children and young people who were in the IAM observing the eclipse in a safe way with and without solar telescope.

A solar telescope was placed to observe the eclipse directly and to show it by a monitor, glasses with safe filters were distributed to the assistants [Fig. 3], and in the auditorium was projected the transmission from totality eclipse zone of NASA TV.

Over the course of six hours about 4000 people were attended, they observed the eclipse with filters, projected or through live transmission from the totality zone.

5. Attending media both *in situ* and external

The attention to the communication media (traditional and internet media), was essential to provide the population with the necessary information to a safely observation of the eclipse.

20 days before the eclipse a brochure was published on the IAM Facebook page with instructions to safely observe the eclipse, local times, percentage of occultation and the physical mechanism of eclipses. The brochure was downloaded more than 23,000 times.

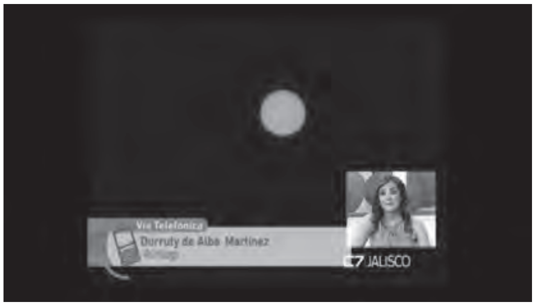

Fig. 4. Attending to the Cultural Television of the Government of Jalisco, to the telephone the "astrologer" Durruty de Alba Martínez.

On the day of the eclipse, dozens of media outlets (TV, radio and print media) were seen from 7 a.m. to 3 p.m. in studios, in the IAM or by telephone [Fig. 4].

6. Summary

The 2017 solar eclipse was an excellent occasion to communicate astronomy and to make public the importance of science and its predictive power. But above all, it was very important for the stimulation of scientific and technological vocations, the basic areas of knowledge for the development of a society.

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|Parallel Session|

“Millennium Trail of Astronomy in Kyoto” Outreach Activity: an Astronomical Walking Tour with Historical Features and Lectures

Seiichiro AOKI *1,*2

Abstract. Three guest stars recorded in the diary “Meigekki” written by a poet Fujiwara no Teika were identified as supernovae in modern astronomy, and they are getting much attention on the mechanism of particle acceleration. Through the relationship between ancient astronomical observation records and modern astronomy, we developed courses for a walking tour including significant historical sites related to astronomy with the title of “Millennium Trail of Astronomy in Kyoto”. My objective is to show how the participants who are interested in history became aware and engaged in astronomy. I would like to put emphasis on whom we should focus on when planning an astronomical tour with historical features based on the statistics taken from the tour.

1. Introduction

Focusing on the relationship between ancient astronomical observation records and modern astronomy, we developed outreach activities that consist of walking tours and lectures entitled “Millennium Trail of Astronomy in Kyoto”. I have been managing this outreach activity since April 2011.

2. The relationship between astronomical observation records in ancient documents and the modern astronomy

We are focusing on three guest stars recorded in the diary “Meigekki” written by a poet Fujiwara no Teika, that each appeared in 1006, 1054, and 1181. They are identified as supernovae in modern astronomy. A guest star is the star that suddenly appeared in the sky where once no star has been observed. The most famous one among them is the guest star that appeared in 1054 at the position where Crab Nebula (Fig.1a) exists now. Fig.1a was taken about 1000 years after the appearance of the guest star. Fig.1b is a computer graphic image reproducing the night sky at that time based on the record of this guest star. Fig.1c shows the supernova remnant which was taken by Dr. Koyama, professor emeritus at Kyoto University, with X-rays just 1000 years after the guest star appeared in 1006. Dr. Koyama has studied the mechanism of particle acceleration in supernova remnants at Kyoto University. He focuses on the guest star recorded in year 1006 described in “Meigekki”, that somehow is connected to modern astronomy. Through this connection, Dr. Koyama has come up with the idea of the tour.

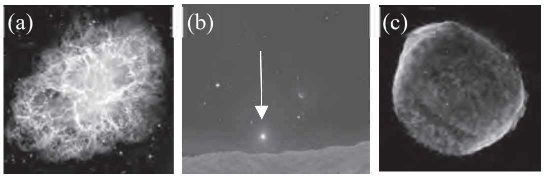

Figure 1 (a) Crab Nebula (copyright NASA)
(b) Computer graphic image of the night sky based on the record of the guest star that appeared in 1054 (copyright K. Sakka). White arrow indicates the position where the guest star appeared. (c) Supernova remnant located at the position where the guest star appeared in 1006 (copyright NASA)

"Meigekki" has been preserved so far in Kyoto by the Reizei family, descendants of Fujiwara no Teika. There are several astronomical facilities and historical sites such as the Reizei family house and Kyoto University located just along the Imadegawa Street

Figure 2 Map of historical sites related to astronomy in Kyoto (copyright Natsutaka).

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(Fig.2). The distance between them is quite short, so we developed courses for a walking tour that include several significant sites. This is the tour of the "Millennium Trail of Astronomy in Kyoto" (http://www.tenmon.org/).

The tour will highlight the following: 1) a walking tour on astronomy with historical features where professors who majored in astronomy will walk along through each course as an astronomical guide explaining about astronomical observations and features, 2) a tour guide will be explaining about the facts on the historical sites, 3) contents and information of the tour can be browsed on the ICT device such as the iPad (Fig. 3a). Fig.3b shows a snapshot of one of our tours. Let me mention that I take part as one of the astronomical guides in most of the tour courses.

Figure 3 (a) Sample Photo of Crab Nebula on the iPad, (b) Snapshot of a tour: (1) an astronomical guide, Dr. Sakka and (2) a tour guide, Mr. Sakata

We now have 13 courses in Japanese and one course in English for this tour. The English course was developed for English speaking tourists coming to Kyoto, and talks about the relationship between astronomical observation records such as the guest stars in "Meigekki" and modern astronomy, lunatic calendar introduced about 300 years ago, and other related topics. We held an educational tour, as part of an English course, during the International conferences in June 2015 and October 2017.

We give lectures called, "AstroTalk". It consists of an ordinary astronomical lecture and a special lecture with stereoscopic viewing using our original astronomical stereoscopic movies "Kyoto4D".

3. The Statistics of the "Millennium Trail of Astronomy in Kyoto" tour

Since the tour began in April 2011, 159 events were held and 1,502 people participated in. Since August 2011, there has been 34 "AstroTalks" that were held with a total number of 1,206 participants.

We hand out questionnaires for participants to get statistics of our tour. The number of male and female participants who joined in the tour is almost equal. As for age, those who are over 60 years old accounts for more than half of the participants (60's and over 70 in Fig.4a). About 39% of the participants who joined in were more interested to know about historical facts than astronomy (Fig. 4b). One of the feedbacks written by participants is "The tour was able to arouse my interest and gave me the desire to know and learn more about history and astronomy at the same time." And it is important to note that previous participants who got so involved in the tour later became members of our team as tour guides themselves.

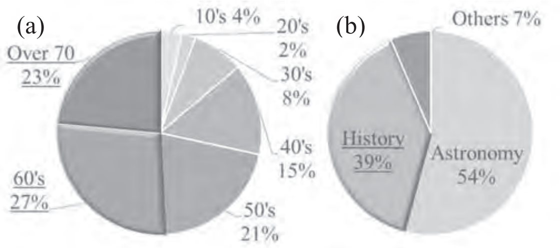

Figure 4 (a) "Age" group of participants, (b) Participants based on "Interest" before a tour

Souvenir items are being sold to complement the contents of the tour and to gain some profits to sustain our activities. The design motif of the star disc is the record of the guest star that appeared in 1054 which was described in "Meigekki" and Crab Nebula (Fig.5). We also sell books that contain the summary of the places visited during the tour and the explanation that goes with it. You can buy them during the tour and the "AstroTalk".

4. Summary

Figure 5 Star disc

1) The guest stars identified as supernovae were recorded in "Meigekki" by Fujiwara no Teika. They are currently being studied as supernova remnants after about 1000 years. The study of the mechanism of particle acceleration in supernova remnants is getting much attention in the modern astronomical research theme. 2) Participants interested in history that joined the "Millennium Trail of Astronomy in Kyoto" tour became aware and engaged in astronomy. 3) Approximately half of the "Millennium Trail of Astronomy in Kyoto" tour participants were over 60 years old. In planning an astronomical tour featuring historical sites, it is better to consider the elderly as the main participants.

|Parallel Session|

The Star-Sommelier Has Opened a New Way for a Wider Astronomy Communication

Shinpei SHIBATA*1, Masaki KOUDA, Eri WATANABE, Kyohei ANDO, Akihiko TOMITA, Masahiro MIZUTANI, Kouichi WADA, Kozue URIU and on behalf of the organization of the qualification system for the astronomy guide*2

Abstract. Star-Sommelier certification scheme is a successful scheme to enlarge the number of astronomy communicator in Japan. We present a basic idea of this scheme and the mechanism of its popularization, so called the happy squared law. It is shown that Star-Sommelier is very efficient in astronomy communication. Future importance of the scheme is also mentioned.

1. Introduction: Star-Sommelier

Do you know Sommelier? Sommelier is the national certification for wine in France. Sommeliers have rich knowledge on wine, and if you go to a restaurant, they understand the place, the season, the time and your favorites, they will provide you a great time with the best wine/drink and dishes with a sweet talk. In the same way, Star-Sommeliers have rich knowledge on astronomy, and if you go to a star gazing party, science museum, planetarium or where ever, they understand the place, the reason, the time and your favorites, which may be astrophysics, Greek Myth, astrology, Japanese culture on stars or what ever, then they will provide you a nice time with a talk.

Fig. 1 At an exhibition of the asteroid explorer Hayabusa, Star-Sommeliers gave guided tures.

Although Fig. 1 gives an example of very skilled Star-Sommeliers, we think of a simpler thing such that a Star-Sommelier in dark blue jacket in Fig 2 will say to his colleagues, "Look at that bright star. It is the Venus.". Although he does not know much about the Venus, it is more important that this makes his colleague happy.

Fig. 2. On his way back home, he put a small

telescope for people passing by so as to see the moon.

Fig. 2 also gives the idea of the Star-Sommelier, where they will say, "Oh, how lucky tonight, I've seen the moon for the first time! Thank you very much!"

2. When it started

In 2003, I opened our observatory at Yamagata University for public. We decided to give guided tours every Saturday night. I was very much particular about guided tour because it is fully interactive and fruitful. "Every Saturday nights" was a big problem because there are few people who can give guided tours. So, I began to develop human resources.

We developed a curriculum with a good balance

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for astronomy guide. The curriculum includes three categories: (1) astronomy as science, (2) skills for star gazing, from finding constellations to using telescopes, and (3) cultures related to astronomy, for example, calendar systems, Myths, religious ceremony concerning the sun, moon and stars, astrology and so on. In addition to these three, we put communication skills and safety for guided tour. In all, there are seven lectures of more than 100 minutes each.

We then made a certification scheme. We see that such an authorization has merits and demerits, but the merits seemed and later proven to be dominate. The certification is not aimed to bring up a very skilled astronomy communicator, but to push one to give confidence "I am able to talk about star to neighbors" and to go forward. The Star-Sommelier scheme is for people who just love stars.

This scheme worked well in Yamagata, so I released it in 2007 for any one who want to try it. It is rather surprise to me that organizations applying this scheme increase without any advertisement. Now 32 organizations use the Star-Sommelier (formally Astronomy-Guide) Certification System, and more than four thousands of Star-Sommelier are involved in astronomy communication.

3. What we found.

In the conference talk I showed some activities by Star-Sommelier with pictures. In this proceeding I cannot help omitting those pictures, but I put some words for the examples of the activity: a sommelier group in Ohfunato-city, which the disaster city by tsunami of the north-east-Japan mega earthquake, are responsible for monthly article on astronomy on a local newspaper; sommeliers give guided tours at resort hotels in Okinawa and other places; star gazing parties are very much common; workshops for hand-made telescopes; astronomy classes in elementary school by sommeliers; parties in shopping mall; on a rainy day at bus stop sommeliers give a lecture on big-bang theory to people waiting a bus. Although there is no picture, there are a plenty of *unseen* activities. For example, picking up his/her children in front of a nursery, sommeliers point stars or constellations with stories. Sommeliers provide topics on astronomy in everyday conversation. Integration of these small activities must be much larger effects than the visible part.

4. Happy squared law

Star-Sommelier activities seem to have self-growing nature. I did not understand the reason at first, and investigated. After some analysis, I found a law, which is now called "the happy squared law". When people learn astronomy, they fell happy. Sommeliers propagate what is learned to neighbors. This makes the neighbors happy. When the sommeliers see the neighbor’s happiness, happiness is squared. Once this is experienced, sommeliers are stimulated to next actions. This positive feedback makes self-glowing nature. Sharing a feeling about stars/universe makes happy.

The astronomy communicators are very small population in number. We gathering here belong to this small group. On the other hand, the number of people who just love star-gazing with getting peace of mind and are curious about astrophysics are very large. However most of such, just-a-star-lovers, take some distance from us. There seems to be a barrier in between. I heard an impressive speech at an awarding ceremony of star sommelier. She said, “Before I took the Star-Sommelier lectures, I feared talking astronomical things in daily conversation. I thought my topic will not be accepted by my friends. But now, I am able to talk about stars, and find that many people love stars. I have a lot of friends now.”

We have shown through our ten-year activities that Star Sommelier certification scheme succeeded in removing the barrier and that just-a-star-lovers can become Star-Sommelier and are involved in astronomy communication. A belief that only an expert can organize astronomy guided tour is now broken, a just-a-star lover can do.

5. Future

Our goal is “One Star-Sommelier in each street”. Then things about astronomy shall penetrate into every day conversation.

In this conference, in spite of usefulness of social network, defending the dangerous part of social network is a difficult problem. Star-Sommelier can be one of solution. If we have Star-Sommelier in every street, they with some knowledge on astronomy will have good interaction with neighbors. This provides stability.

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|Parallel Session|

Newsletters: A Powerful Tool For Public Engagement Without A Budget

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Abstract. Subscription-based email newsletters are a remarkably cost-effective tool in engaging with target audiences. Universe Awareness uses a digital newsletter for community building and communicating with its network of astronomers, teachers and educators. This newsletter has open rates and click rates of at least twice the industry average. Commercial newsletter services offer free tools for detailed analysis of various aspects of a newsletter, making newsletters a powerful tool for science communicators to gain traction on a shoestring budget. There are many ways of using newsletters for community engagement depending on the organisation, target audience, and intended action. There are no best and worst practices in public engagement with newsletters, except for adhering to international laws and policies. Therefore, good and bad practices are proposed for the designing and using newsletters for public engagement.

1. Introduction

Universe Awareness (UNAWE) of Leiden University Observatory uses a digital newsletter for community building and communicating with its network of astronomers, teachers and educators.

Commercial newsletter services can be used for free and offer tools for detailed analysis of the impact of engaging target audiences. This makes newsletters a powerful tool for science communicators to gain traction in public outreach on a shoestring budget.

In this publication, an overview is presented of using newsletters for public engagement and community building. Various design aspects of newsletters are discussed, using the Universe Awareness newsletter as an example, as well as good and bad practices to consider in using newsletters for public outreach.

2. Overview of digital newsletter services

Digital newsletters are used for internal and external communication strategies by marketers, businesses, academic institutes, NGOs, individuals and more. Common uses are funneling subscribers to websites, producing a call to action, as an additional source of information and for community building.

Various companies provide email newsletter services for a wide variety of customers. Many of these services allow for freemium use: tools are offered for free, whereas more advanced features require additional payment.

3. Newsletters and social media

The target audience is probably the most important aspect for choosing a communication medium. Since 2017, it is required by Canadian law for people to actively subscribe before receiving information via newsletter, so the target audience is already familiar with the organisation.

Social media however, allows for reposting of information by subscribers (often called followers) and non-subscribers, making it suitable for viral marketing and reaching new audiences.

With the emergence of communication tools like social media, as well as a decreasing amount of time spent on communications by consumers, the impact of newsletter emails has changed in recent years.

However, email is 40 times more effective than the most popular social media channels in establishing relations with subscribers [1].

In 2018, the market share for email accounts compared to social media accounts is larger than the two most popular social media services in the world (Table 1) [4][5].

Meanwhile, 90% of emails get delivered compared to 2% of Facebook posts. The main reason for this is that once an email arrives at an inbox, it stays there until it is archived or removed, whereas Facebook posts become lost in an endless stream of posts [2].

4. Using digital newsletters

Using digital marketing as an example for public engagement, the process of a public engagement cycle with newsletters can be described in seven stages: 1) know yourself, 2) know your

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audience, 3) present your image, 4) tell your story, 5) connect to your audience, 6) promote yourself, 7) observe and adjust [6].

In designing a digital newsletter, it is important to consider word economy and which images to use, if any. If subscribers prefer to use mobile devices, the design should be adjusted accordingly. Good practices are to consider word economy, checking for device used by subscribers, and combining newsletters with social media in communications strategies. Sending emails to unsubscribed recipients, sending on busy times or spamming emails should be avoided, as these are considered bad practices. Always include the contact details of the organisation, as this is part of international information and privacy laws.

Table 1. Number of accounts worldwide in 2018 for email and social media (in millions) [4][5]

	No. of accounts
Email	3,700
Facebook	2,200
WhatsApp	1,300
Instagram	800
Twitter	300

5. Analysing digital newsletters

Freemium newsletter services provide a wide array of tools to analyse almost every aspect of a newsletter, from number of emails delivered and opened, items clicked, comparisons to industry averages, forwards. as well as A/B-testing to test the subject line for example.

Unique codes and pixels included, which allow tracking when, where and by whom items are clicked. Visualised maps show which items are clicked and in which country (figure 1).

This information allows for a detailed analysis of how the target audience responds to the various aspects that make up a newsletter and provides the sender with a powerful tool for public engagement.

By combining a newsletter with social media and websites, the target audience can be analysed in greater detail and the communications strategy can be improved in its entirety.

6. Conclusion

An email newsletter is a powerful tool for science communicators in engaging the public and therefore needs careful consideration. Communicators should consider important aspects of the design process and adjust according to the analysis tools available with the newsletter services. Information on the use of digital newsletters in science outreach is scarce, so more academic research is needed for the astronomy (outreach) communication sector in order to better use available resources and engage target audiences.

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|Parallel Session|

Convey the Pleasure of Astronomy to People Interested in History

Harufumi TAMAZAWA[*1], Koichi WADA[*2] and Kunihisa KABUMOTO[*3]

Abstract. Each person may be more interested in each subject, something than astronomy or science. We have done outreach activities the target of which is people who are not interested in astronomy but other field. They took part in these events not because events and associated with astronomy but because with history. We should enter the other field in order to convey astronomy to people interested in other field.

1. Introduction

It is difficult to make a person who is not interested in science take part in a science event. Kano et al. (2013) found that major participants in events about science in Japan belonged to "the high engagement in Science and Technology" segment and that this tendency was true of public lectures and science festivals. Kano et al. (2013) also found that the following three formats have a potential to attract "the lowly engagement in Science and Technology" segment: 1) Theme relevant to people's lives, 2) Events held in a place where can serve food and drink including alcohols such as a bar, 3) theme looking collaborative with non-science area such as art or Japanese culture.

In order to disseminate astronomy to people who were not interested in astronomy, it is not effective just to talk about how wonderful astronomy is. It is also important to know what they are interested in have connection to astronomy. This attitude is important not only for outreach activities for citizens but also for the field of collaborative research on different fields.

In this article, we introduce examples of interdisciplinary research activities and outreach activities related to astronomy for people interested in other field, especially history.

2. Activities of Collaboration with other field

2.1. Academic research collaboration

The activity is the Unit of the Synergetic Studies of Space (USSS) is a good example of academic collaboration. USSS was established in Kyoto University to develop new research areas and create new areas of study based on common research themes of Space and Astronomy, using inter-departmental cooperation and taking advantage of the different areas of interest in each department.

Based on USSS, interdisciplinary projects about such as "spaceethics", "spaceanthropology", "palaeoastronoomy" go on as collaboration between astronomy/astrophysics/space science and ethics, anthropology, history, and so on.

For example, Hayakawa et al. (2017) showed that over 100 historical documents in East Asia attest that low-latitude aurora displays appeared in succession for almost nine nights during 1770 September 10-19 in low magnetic latitude areas.

2.2. Outreach using collaboration

In addition of academic activities, outreach activities are also based on collaboration with other field. These activities are divided by two. The One is events related astronomy held at other field space: talk event at Buddhism temple, Japanese Rakugo at the theater, etc., the other is events of other field held at astronomy-related places. For example, Kwasan Observatory, Kyoto University, have been used not only as education site but as event site such as concerts, walking tours, art events (Tamazawa et al. 2014).

3. Outreach activities using first stargazing event in Japan

3.1. Stargazing in Fushimi on 1796 Aug 26

On 1793 August 26, the first night-sky watching using the telescope in Japan was held in Fushimi, Kyoto. The organizer of the night-sky watching was Nankei Tachibana, a doctor. The telescope used at this event was made by Zenbei Iwahashi, a craftworker of eye-glasses. About 12 people, intellectuals at that time, participated this event. The document written about the event shows that they observed the Sun, and Moon, Jupiter, and Saturn. Tamazawa et al. (2017) pointed out that it is interesting from the viewpoint of research

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of history that the transition from traditional scientific view of science to modern scientific view can be seen and this stargazing with telescope was used as an intellectual play, over a mere scientific observation. Because this event was not well recognized even by local people of today, it can become a new regional resource for sightseeing as well as outreach to people interested in the history field.

3.2. Outreach activities against people interested in history

People who know about this stargazing gathered and started activities to use it as new contents of Fushimi area in 2015. In 2015 and 2016, town walking tours around the place related to the stargazing in Fushimi were held, and at the end of the tour, both the present telescope and the telescope made in the Edo period were used to observe the night-sky. Participants were mainly people who liked history or people in Fushimi, and the participants were moved by the fact that they were able to actually touch the telescope, the background that the stargazing was held in Fushimi in the past.

Pamphlets for citizens and children were made. For the general pamphlet completed in 2016, the explanation text of Tachibana and Iwahashi is the main (Left of Fig 1). The pamphlets for children were made in 2017 with the characters talk about the event and Fushimi.

The telescope created by Zenbei Iwahashi has a relatively simple structure as compared with the current ones, and a kind of kit was made. We also made a telescope workshop with a kit mainly for children at a local festival, and in addition, solar observation was done. In 2017, a lecture focusing on Tachibana at the library in Fushimi, and introduced the telescope made by Iwahashi, newly found (Kabumoto 2018). After the lectures, we observed with both old and present telescopes.

On the first day of CAP 2018, stargazing was held as public event of CAP2018, and we joined with old telescope.(Right of Fig. 1)

3.3. Comments from participants

The comments from participants of the public lecture showed that participates are interested in history, not in astronomy. The followings are some example of the comments.

- It is good because I can know new topic of history of Fushimi.
- The collaboration between the library and public lecture is good.
- It is good because I can see the telescope made in Edo-era.

They took part in these events because Events are associated with history, library, Fushimi, and so on.

Fig1. Left: top page of pamphlet Right: stargazing with old telescope (2018/3/24)

4. Summary

We introduced examples of outreach activities related to astronomy for people interested in other field, especially history. We can and should enter the other field and enjoy with astronomy to convey the pleasure of astronomy to people not Interested in astronomy but interested in other field.

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SESSION II:

Inclusion, Diversity, Equity and Empathy in Communicating Astronomy

Communicating Astronomy
with the Public Conference 2018

Human Factors to Foster Equal Participation

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Let me start by talking about internships. Many of you may be aware that internships offer a very short work experience that helps interns to acquire job experience. I've done around eleven internships in my life and I will never forget my first one—thanks to Dr. Adolfo Figueroa-Vinas. I always have to mention him who encouraged me to apply for an internship.

I remember that I could only walk without a cane at noontime on a very sunny cloudless day. I could walk without a cane, but that doesn't mean without accidents. My health was very weak at that time. I suffered daily seizures, and my grades were terrible, really bad. I had to take other classes. I was a masters' student in physics and I had to take other classes to keep balance so the university wouldn't kick me out of their program. I remember that I used to sneak a recorder into the physics classroom and then play the class back at home. The playback resulted in a full hour of monosyllables and "you put here …and there… and this is the result". And I would think, *the result of what? Where do I put things and why*?

I remember going to outreach activities too, but I never got to use an optical telescope or any kind of telescope—a telescope to me was a foreign thing, far away. Only people that are very special, an elite of selected people would use that. To me that experience was far away from my reach… I used to depend on someone else's perceptions or interpretations of whatever they were displaying in these outreach activities. The slides in their presentations, text books, the plots… So, something was lacking.

But going back to the internship, a miracle happened—and I got accepted to the internship and I was paired with this mentor who was flirting with the idea of translating into sound the measurements acquired by or stored in the database of the space physics data facility of his organization, with the intent of familiarising blind people with those measurements. And as soon as I arrived at the internship I was filled with insecurities, mainly because I could compare the access to information I had before and after I lost my sight. I went to him even before he could even say his name or he could explain the project to me, and I said: "I don't know any big scientific words. I study a lot, I never stop and my knowledge is really little". And he said: "I'm not worried, I'm not worried". And I chose to take that as my motivation. This is what I chose as my motivation to work really hard, so at the end of this summer, he wouldn't feel that he had lost his time with me. I did eleven internships with him, as I said at the beginning.

The project was to create the backend or the algorithm or the coding; and also the frontend or the graphic user interface of this program that would translate the numbers into sound so blind people could get familiar with the measurements. But I was a physics student. I was not a computer scientist. I knew how to write a code using dead languages, like Pascal, if you remember what that was. More than dead, right? Completely buried. So, I knew how to write a code, but I wasn't even familiar with algorithm engineering, user center design, human computing interaction, and I'm also not representative of all the coping strategies of all the blind people in the world… So at the end of the summer, we finished with a Wanda-centered prototype to translate into sound the numbers that were stored in that database.

Looking back at my situation at that moment, it was that I couldn't express my creativity doing science. I couldn't take the numbers and manipulate them and create plots, mainly because I couldn't see the plots, but also because of the interaction, I couldn't respond to the computer. Interaction implies a response. I didn't have all the elements of judgment to perform the science or to go and feel motivated and involved.

So, I decided to learn human computing interaction. How do I create a backend and frontend of a program that will allow people with impairments to come and get familiarized with the measurements and not have the prototype taken as the absolute solution for all people—for all the diversities of people to be able to participate. How do I create that?

The other thing is I need to explore if sounds are really an option for getting familiarized. I'm a scientist. I'm not going to lose time if it's not really an option. I'll move my gears to another side or to another option. But then I also ask why do they have a physics student creating an algorithm or a developer that has never taken a course on human computing interaction doing it? And these are valid questions, right? Research questions.

Historically, physics, in the beginnings around the 20s or 30s, astronomy comes from using audio and then suddenly it evolves to using mainly unimodal displays. So, why do we have people that have never taken a human computing interaction, not even a workshop, developing an interface that will be used by humans? This is what I had in mind at that time. I am not telling you what to do. This is what I had in mind because this project was giving me the option of getting familiar with whatever numbers from whatever devices or spacecraft were stored in that database.

So, my mentors then said: you need to do experiments to test if sound is an option. First you need to do perception experiments, because if you don't do the experiments, you will not finish your PhD, you are not graduating. You can find whatever you can find, but if you don't do the experiments—the enforcement was very strong, I needed to graduate. So, I did the experiments and we found that when you use sound as an adjunct to visual display, the sighted astronomer increases their sensitivity to events that otherwise would be blind to the eye by nature. So, why it was not available before? Why haven't we had these options widely available in science before? Why did I have to struggle so much feeling inadequate in my field?

The good thing is that (even though right now, the multimodal display of information exploration has to compete with the decades of evolution of visual displays) the good thing is that we have the technology to do it, regardless if it was because of— it was not because of perceptual evidence, but if it is because it is too expensive or because of other reasons or because Wanda was too lazy to develop it… Right now, because we have the technology is the time to do it, it is from today onwards.

Today we have people like all of you. You express your creativity in your science or in your art, this room is filled with artists and journalists, using technology to develop your skills—using technology. Technology is leading all of your communication on a daily basis. Actually, I write to many of you on a daily basis, repeat myself many times, because technology facilitates all that communication. And even though perceptual exploration of the data was not widely available and is not yet widely used or employed in our field. I know that technology is directly related to human development and because of that, I know that my field has contributed to that development by focusing on enhancing the work field, by paying attention to the multimodal ways of exploration of people; that means not underusing, misusing, or neglecting to use the full human potentials of people for exploration and enquiry.

I work in the IAU Office of Astronomy for Development, located in Cape Town, South Africa. And proudly, that is where I work as a post-doctoral person. My boss—his name is Kevin Govender—established the AstroSense initiative.

One day we were in the office, and he said: let us establish a project on inclusion and let us name it AstroSense.

The purpose of the project is to address, foster, and promote equal participation in all the processes that are natural of our scientific endeavour. Right now, AstroSense is focusing on perceptual research. It has been a 100 years after the IAU was established that we were able to, or that we had the willingness, or the technology, or the easiness of evidencing that multimodal perception can help in the exploration of data. We are focusing on multimodal perception to increase or to facilitate access to the exploration of the information symmetrically for outreach, for education from school to higher education, and for research. And we are also doing this because we read in the United Nations human development report that the distribution of the digital technologies in the world is uneven. So, given that, we thought access is one of the many factors contributing to prevent the capabilities of people to participate in the processes that are natural to the scientific endeavour. Access is really wide, right? We are talking about access not only to information that is being displayed, but also, access to decision making, access to employment, access to fairness in the job environment, is access in all the wide senses of the word. Access is one of the many factors that may be debilitating for the capacities of people to equally participate and progress in the field. So, while I do research, (while I listen to different data sets and find ways to analyze the data sets that, of course, are given to me as I do not have the freedom to select what to study because of access to data bases), we collaborate with the teachers of the Athlone School for the blind.

We aim to build a class schedule that is trying to defragment the disciplines the learners are exposed to daily in the classroom; with the goals of building relationships that will bring the learners to design an experiment and explore measurements. Inside their busy schedule, the teachers share the class program for the term and I work an astronomy class schedule that will integrate some of the subjects they have shared, for the learners to get to do data analysis. I adapted a rubric (ref) to evaluate cognitive load. The teachers provide honest sincere feedback. Some of the items in the rubric are: the in ACCESSIBILITY of all the different information that needed to be communicated, The inaccessibly of all the materials that needed to be used to communicate the information, the MENTAL EFFORT the teacher invested to communicate the content, used in the lesson, the mental effort the students invested to understand and perform during the lesson, how DISTRACTED the students were during the lesson, how much this improved the learner UNDERSTANDING of the subject or other subjects in the regular schedule.

One special focus when the teachers are assessing the inaccessibility of all the different information used is the use of words. How the learners are creating the concepts if they don’t have the incidental exposure to the perceptual information which is crucial for anchoring knowledge and assigning substance to concepts; like depth, change in position, etc.? How do they construct their skills if most of the time the words used are not related to the way they experience the world or the knowledge? This is at the Athlone School for the blind but the presence of unfamiliar words and complex grammar make this particularly difficult for Deaf people. Unfortunately, current technology does not support low-cost, accurate translations of online materials into Sign Language. However, current technology is relatively more advanced in allowing text simplification, while retaining content. Perhaps you’re familiar with research with deaf college students using a crossover design with a sample of 36 deaf and 38 hearing college students. Results indicated that hearing college students did equally well on both the original and simplified text versions. Deaf college students’ comprehension, in contrast, significantly benefitted from the simplified text (ref). In the case of Athlone, even when I do not speak their mother tongue we try to provide them with environmental, perceptual input that may help them to create the concepts, or assist them to interpret/understand what they hear. For those purposes as we do hands-on like soldering; and exchange information that is also perceptual to the learning experience, concepts are enhanced by naming, describing, pretending, explaining, talking about possible events, and discussing for the learner to start assigning substance to the discussion. This of course varies with the degree of sensorial deprivation of the learners.

There are many thesis written on this subject and I am just a person trying to help. We do it symmetrically because we are focusing on transitions from being interested, to school, to University to profession.

This makes me so happy because I heard that more or less 50% of economic development in the high income countries is due to scientific development and it means that my students may contribute to that economic development. Today it is very good because we find careers that did not exist 20 years ago. If we want our astronomy scientific force to strengthen the contribution to economic growth and, for instance, to have more probabilities of getting funding for your science, we must pay utmost attention to the development and inclusion of human capacities in research, education and outreach.

This kind of work is always in the opening stages, so it forces us to address it continuously. We are doing this in South Africa but this is something that is only imitating the good work of very strong groups and peoples like Amelia Ortiz-Gil in Spain, and in the IAU working group, Beatriz Garcia in Argentina, Cassandra Runyon in the United States, Erika Labbe Waghorn in Chile, and more.

Before I lost my sight I wouldn't think about the importance and seriousness of equal participation, (like, that is not me), so we may all produce and contribute to our science based on interest and empowerment and not based on obstacles. The disability surprised me. If I do this it’s because I do not want YOU or my students; that I encourage to do good science and to be enterprising, to be surprised. I realized how awful it was to be completely left out of the nuclear physics class when I was doing my masters. I know this has changed, because this room is filled today with people energetically committed to egalitarian participation.

|Plenary Talk|

Autism Spectrum Disorder and the Planetarium

Elizabeth AVERY*1

Abstract. The planetarium is a fantastic resource to help inspire and enthuse visitors about space science as astronomy. For visitors with Autism Spectrum Disorder (ASD) however it can be a very challenging, unfamiliar and even overstimulating environment. At the Royal Observatory Greenwich we have worked with ASD experts and local audiences to create a planetarium show specifically designed for ASD audiences. In this paper we discuss what we found worked well, what didn't and will share our lessons learned.

1. Introduction

At the Royal Observatory Greenwich we constantly strive to make our programmes as accessible as possible. After a school visit a few years ago a teacher told us that she wished she had brought the whole class along on the visit. She explained that the children with Autism Spectrum Disorder (ASD) had stayed back at school because she had thought the planetarium wouldn't be suitable for them. This was very upsetting to hear because it meant that a whole group of children had missed out on a visit due to their ASD. We decided to take action and do something about this to make our shows more accessible to ASD audiences.

2. The Creative Process

When starting a new project we start with what we know. Truthfully our knowledge of ASD audiences was limited so we enlisted the help of specialists from the National Autism Society[1] as well as local ASD networks so we could learn more. It is impossible to create a truly fit for purpose show without involving the intended audience in the process. Without audience involvement there is a risk of making something tokenistic that will have a limited lifetime. We wanted to create something that would live on, evolve and grow but also develop relationships with our ASD audiences and for them to see that our museum is a place for them. Our usual approach to new projects is bold, bright, noisy, busy and fast, filled with lots of excitement, surprise, humour and personality. We always create very structured shows where we can be sure the learning outcomes are being met and think about how sessions will impact our visitors' Science Capital [2] at every turn. Some of these approaches translated well when working with an ASD groups but some are the polar opposite of what we needed and it became clear very quickly that our approach needed to be modified.

3. Findings

Flexibility

We began with an existing component of our wider programme a 'Sky Tonight Live' planetarium show. This is a flexible, live, presenter-driven planetarium show with few constraints on subject matter or timing. Every ASD group we saw was different and every person's needs were different too as ASD is a spectrum disorder after all. We discovered that sometimes multiple aspects of a show had the potential to fail for a group had we not had the flexibility to quickly adapt and the 'Sky Tonight Live' format allowed us to do just that.

Lighting

Light levels were a huge factor that needed much consideration. We found that keeping the doors open and a low level of light on constantly during the show was helpful as everyone could clearly see the exit if they needed to leave. This did introduce some technical challenges as the images we used within the show needed to be carefully chosen to enable visitors to still get the contrast and colour saturation needed to clearly see them.

Immersion

The planetarium is an incredibly immersive environment but for an ASD audience this can be an issue because it is hard to look away and the experience can become over-stimulating. We found that letting visitors know they could leave if then needed to created a much calmer environment. Our approach was to create a show comprised of a gentle intro and outro, sandwiching modular blocks of content. The transition between each block was a gentle fade to darkness rather than using movement or sound. It meant that we needed to sacrifice some of the immersion to allow for a smoother, slower and gentler change between locations but for this audience that took priority over immersion.

Sound

We found that with some groups we could use a bed

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of music and/or narration under shows and they responded really well. Yet with others it was one sensory stimulant too many so we incorporated the ability to remove one or both elements if need be.

Visitor interaction
Visitors could sometimes be very vocal, shouting when they saw something familiar or singing if they heard words that reminded them of songs they knew. One of the pieces of feedback we had related directly to this when a carer said they were really relieved that the show was ASD specific because if her child did shout out - which he was prone to doing - everyone would understand and no one would mind.

Humour and personality
People with autism can sometimes have difficulty understanding sarcasm, humour, jokes, tone of voice – many of the techniques that our presenters use to inject personality into their shows. We found that humour became less of a useful tool and that the ability to create a calm and safe environment was much more important.

A visit is more than just a show
Under advice we created a visitor journey using images that teachers and carers could print off and show to their children. The story showed what our buildings looked like, what uniforms out staff wore and where they would go during their visit. This eliminated many elements of surprise which would be a terrible shame for many groups. For this specific group it made a visit possible because it reduced so much of the anxiety that surrounded being in a new and unfamiliar environment.

3. Testing and training

As with all of our shows we test them along the way and at the end of the process too. Our local family audiences were very important when doing this and helped us to tweak the show until we had something everyone was really happy with. We decided very early on that we would need to run some training with our staff on how to present to ASD groups, as the interaction is different and to do this through our Presenter Network [3]; a network we set up for anyone who presents to the public to share best and worst practice. I put a call out to people in our network for anyone with experience of working with ASD groups and we ran an informal sharing session together. This was highly effective as one of the main concerns our staff had was that they didn't want to upset or offend anyone but for visitors to have an enjoyable experience. This training gave our staff the opportunity to voice their concerns and allowed them to therefore feel more prepared to present the sessions.

4. Conclusion

What started off as one planetarium show has now developed into ASD friendly days for schools [4] and the general public [5]. We may have come to the end of this project but it will continue to grow and evolve over time. Our work is still not done though - and it won't be until every possible person who wants to visit our museum and planetarium can do so and feel that it is a place for them.

To conclude:

1. Planetarium shows absolutely do work for an ASD audience.
2. Creating programming for specialist groups such as ASD visitors is all about collaboration and getting to know your audience. Involving them from the beginning is crucial.
3. One size does not fit all – ASD is a spectrum disorder and requires great flexibility from the show structure and also the presenter.

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|Plenary Talk|

"In a Certain Place in the Universe…" and Other Multidisciplinary Projects of the Instituto de Astrofísica de Canarias

Carmen DEL PUERTO VARELA*1

Abstract. The Instituto de Astrofísica de Canarias (IAC), with a long experience in outreach initiatives, has carried out multidisciplinary projects, such as "Do puppets dream of the Cosmos?"; "Cosmic Fashion"; "Stars in the Vineyards"; "In a certain place in the Universe…", involving well known figures in contemporary Hispanic literature for a solidarity project related to Alzheimer's; "NIÉPCE, from the negative to the positive", a tribute to Photography; or "The return of Henrietta Leavitt. From school to a research career, via the Theatre", which includes theatre performances (a remake of *The Lost Honour of Henrietta Leavitt*) for schoolchildren and the general public (incorporating sign language), scientific lectures by young girls, workshops on measuring the Universe, a magazine and a video about women in Astronomy, and street art murals. In this communication, these projects and their results are presented.

1. Introduction

If Cervantes and Shakespeare talked of astronomical eclipses in their major works, why isn't there more astronomy and in fact more science in contemporary literature? So many years after *The two cultures,* by C.P. Snow, we are still talking about the split between science and the humanities and the lack of interaction between the two.

Fig. 1. Winning designs of the IAC cosmic fashion project inspired by the solar granulation and mirrors of the Gran Telescopio Canarias (GTC), the largest optical and infrared telescope in the world. Credit: Daniel López/IAC.

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The Instituto de Astrofísica de Canarias (IAC), which has long experience with outreach initiatives about astronomical knowledge, at present through its Science Communication and Culture Unit (UC3), is always keen to innovate in this field. So, this centre has set up and successfully completed a series of multidisciplinary projects: "Cosmic Fashion", "Stars in the Vineyards", "Do puppets dream of the Cosmos?" and "Astromemory" are some examples.

2. Celebrating Literature and Photography

In 2016 two anniversaries gave an excuse for bringing together Astronomy and other disciplines even more intimately. We celebrated the 400th anniversary of the deaths of Cervantes and Shakespeare, and the 200th anniversary of the first photographic negative in history. These events gave rise to two projects which are presently under way:

1) "In a certain place in the Universe…", aiming at a deeper interaction between the two languages, the literary and the scientific, involving well known figures in contemporary Hispanic literature, which also raises funds for a project of research in Alzheimer's disease; 2) "NIÉPCE, from the negative to the positive", a tribute to photography for its role in giving a major boost to the way data is obtained from telescopes (in 2018 we will celebrate the 200th anniversary of the first positive in history); the educational exhibition "100 Square Moons" is part of this project.

3. "The return of Henrietta Leavitt”

The latest multidisciplinary project of the IAC has been "The return of Henrietta Leavitt. From school to a research career, via the Theatre" carried out in collaboration with the Spanish Foundation for Science and Technology (FECYT) of the Spanish Ministry of Economy, Industry, and Competitivity. The objective was to give visibility to women in science and technology and to encourage younger girls to decide on scientific and technical careers.

This initiative included a series of activities, among them a remake of the multimedia theatre play *The Lost Honour of Henrietta Leavitt*, written by C. del Puerto, about the woman astronomer who, at the beginning of the 20th century, devised a "ruler" for measuring large distances in the universe. There were performances for schoolchildren and the general public (more than 2,500 people) and it was part of the cultural programme of the meeting *Gender in Physics Day Spain 2017*. The main innovation in this remake was theatre performances with sign language interpreters for people with hearing disabilities (the astronomers and characters of the play Henrietta Leavitt and Annie Cannon were deaf). This way we combine our commitments to outreach, equality and disability.

Fig. 2. A scene of the theatre play *The Lost Honour of Henrietta Leavitt,* in this remake with sign language interpreters. Credit: Daniel López/IAC.

Other activities in this project were a public talk and debate on “Who was Henrietta Leavitt?”; workshops for children on “Measuring the Universe with Henrietta Leavitt”; a series of home videos of 5 minutes, “Girls who broke a glass ceiling looking at the sky”, where some women astrophysicists and engineers of the IAC explain what they wanted to be as girls, what they studied at the university and what they are currently engaged in (each video lasts 5 minutes, with 4 women in each chapter); talks “With H for Henrietta” by schoolgirls aged 14-15 years old to their classmates after their experience with women scientists & technologists from the IAC; a special issue of the IAC magazine *Paralajes* “Women in Astronomy”; "Graffiti for Henrietta", an activity to disseminate the project through 2 street art murals in the urban environment (in the parking lot of the Faculty of Sciences of the University of La Laguna and in the streets of Tacoronte, Tenerife); and finally, posts in the IAC blog “Vía Láctea, S/N” and social networks with *#astronomaoculta* (hidden women astronomer) & selfie proposal with her.

Fig. 3. Street art murals by the artist Matías Mata (“Sabotaje al Montaje”) next to a very popular supermarket in Tacoronte. Credit: Daniel López/IAC.

4. Conclusions

To communicate Astronomy we need news "hooks": in journalistic slang, an argument to hold on to, a parallel instrument that supports what is really interesting to tell, a communication and outreach strategy. It could be an event, a date, time or season, a trend, news or fashion, reports or a subject. For example, 2009: The International Year of Astronomy was an opportunity to verify that Astronomy combines very well with everything, such as cinema, theatre, literature, poetry, games, talks, fashion, painting, workshops, experiments, publications, exhibitions, history, mass media, dance, humour, photography, music... In the IAC we have verified that the “cross-disciplinary” formula works.

Using Astronomy as a Tool to Promote Gender Equality in STEM Nigeria as a Case Study

Olayinka A. FAGBEMIRO [*1]

Abstract. This paper explains the steps and ways Astronomy is being used to engender gender equality in STEM among rural dwellers especially in the northern part of Nigeria. The various ways a team of young Astronomers who are members of Astronomers without Borders (AWB) in Nigeria are trying to encourage the female children to aspire to STEM just as much as their male counterparts and also to encourage parents to enrol their female children and also aspire for them to be great scientists in the nearest future just like many of the female members of the team. AWB go to different rural parts of the country, focusing more on the female children in other to bridge the gap that exists between male and female children school enrolment and STEM awareness particularly across the northern part of Nigeria. The inequality that exists between the male and female involvement in STEM, which is an extension of the issues associated with girl-child education in the rural parts of northern Nigeria. The gender apartheid places the girl-child in a disadvantaged position, where her potentials are suppressed and self-actualisation is not achieved. Girl-child education has then become a major issue of concern in most developing countries.

1. Introduction

The term 'girl-child' refers to a female between the ages of 6-18 years. However, the National Child Welfare Policy (1989) defines the girl-child as a female below 14 years of age.

There is gender apartheid in Nigeria, as it is with most African Countries today. This places the girl-child in a disadvantaged position, where her potentials are suppressed and self-actualization is not achieved. The girl therefore, becomes a victim of a pre-existing socio-cultural male exaggerated superiority.

Furthermore, on the account of gender, girl-children are subjected to all multiple forms of oppression, exploitation and discrimination. Girl-child education has then become a major issue of concern in most developing countries of the world today, especially in sub-Saharan Africa, where a large number of young girls do not attend school.

According to UNICEF (2007), the global figure for out-of-school children is estimated to be 121 million, out of which 65 million (approximately 53.8%) were girls and over 80 percent of these girls live in sub-Saharan Africa.

The northern Nigeria have the country's worst girl child education, highest female illiteracy, highest adolescent girl marriage, highest under 15 child bearing, and highest risk of maternal death and injury.

The report is published by Africa Health, Human and Social Development Information Service (Afri-Dev. Info), in partnership with African Coalition on Maternal Newborn and Child Health, and Pan African Campaign Against Forced Marriage of Under Age Children.

The scorecards underline the links between poor educational attainment for girls, forced marriage of underage children, and under age child bearing.

Statistics from the Federal Office of Statistics (2004) show that literate women constituted only 20% from the North. This indicates the levels of inequality of women compared to men in Northern Nigeria.

The National School Census (2006) reported that the number of children out of school in Northern Nigeria is particularly high and the proportion of girls to boys in school ranges from 1 girl to 2 boys and even 1 girl to 3 boys in some states.

The education of girls in the northern cluster has always been a thorny and unresolved issue. Typically, girl-child education in northern states follows a specific pattern which ends with the girls being denied from the system, the chances to attend primary school or further their education beyond primary school.

It is believed that gender inequality in Northern Nigeria is promoted by religious and communal customs (Boko Haram kidnappings in Chibok and Dapchi), which has grave consequences for both the individual and the society making her a dysfunctional member of the society.

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1. Implementation

My team (UNAWE/AWB) embarked on the mission to reduce gender inequality in STEM a few years back. The aim was to encourage the female children to aspire to STEM just as much as their male counterparts and also to encourage parents to enroll their female children and also aspire for them to be great scientists in the nearest future just like many of the female instructors on the team.

Fig. 1 Pictures showing various Astronomy outreach activities for girls.

Fig. 2 Pictures showing various Astronomy outreach activities for girls.

2. Conclusion

Gender Equality in STEM Through Astronomy
We are particularly focused on the female children in other to bridge the gap the existed (and still pretty much exists) between male and female children enrolment particularly across the northern part of Nigeria.

Fig. 3 Pictures showing various Astronomy outreach activities for girls.

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|Parallel Session|

Astronomy for a Better World.
More than a Powerful Slogan: a Life Philosophy, a Feasible Choice

Silvia CASU*[1], Alessia LUCA*[2], Ignazio PORCEDDU*[1], Sabrina MILIA*[1],
Paolo SOLETTA*[1] and Elio Turno ARTHEMALLE[3]

Abstract. "Astronomy for a better world" is the inspiring vision of the IAU Office of Astronomy for Development. It is a powerful slogan, but it is also a choice that can be pursued any day in designing almost every activity. In this paper we review the INAF-Cagliari Astronomical Observatory outreach and educational activities, trying to show that inclusion means not only doing things for special classes of persons, but, above all, better designing activities effective for all, ensuring anyone full access to same knowledge and opportunities.

1. Introduction

As most of the Astronomical Observatories, the Cagliari Astronomical Observatory (OAC), one of the 16 structures of the Italian National Institute for Astrophysics (INAF), is strongly involved in different public outreach and education projects. During last ten years, we had the opportunity to interact with various kind of public, from very small children to elder people. And we learned that **diversity** is a precious wealth, to be valorised and preserved. Unfortunately, in our daily life we experience different «society barriers»: the most widely recognized are the **physical barriers** (reduced mobility, visual and hearing impairments), but **social and economic state (**age and gender diversity, socially marginalized people), **different cultural backgrounds** (nationality, race, language, religion diversity,...), and, last but not least, **cognitive and intellectual disabilities** (the so-called Special Education Needs – SENs - such as Autism Disorder Spectrum and General Learning Disabilities - GLDs) could affect the real accessibility. On the other hand, it is widely recognised that astronomy is a «*universal*» science, appealing for people of any age, gender, race, social background, health state, cultural level, cognitive ability, etc. Astronomy, with its natural ability to inspire people curiosity and to stretch the imagination, with its unique way to involve science, technology and culture, is one of the most **accessible** sciences, and can be effectively a powerful tool contributing to build a "better world". This is the principle stated by the IAU Office of Astronomy for Development (OAD), and this is the driving philosophy of our activities. With this principle in mind, in the last years we tried to redesign all our activities using **INCLUSION** and **EQUITY** as fundamental keywords. In the following, we summarized some of recent projects developed at INAF-OAC.

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2. Inclusive design for Special Education Needs

Recent surveys conducted from the Italian Ministry of University, Research and Education show that 3.4% of students in primary school present some form of GLDs, such as dyslexia or dyscalculia. This means that any time we enter in a classroom, it is very likely that almost one student could experience such problems. Following the principle that "a good teaching is a good teaching" [1], instead of creating separate projects, even if appropriate, for students with GLDs, we decide to apply cognitivism, and constructivism, principles to teach astronomy in an inclusive way.

In the framework of the IYL2015, we developed, with the help of educational psychologists experts in SENs, an educational route for middle class students, based on the concept of light and its importance in astronomy. The project, called "A new light in the Sardinia schools"[2], involved 4 classes of two institutes (85 students – 10 with certified GLDs - and 11 teachers).

For a description of the project, see http://www.nuovalucexlascuola.it/.

We used four famous scientists (Galilei, Newton, Maxwell, and Einstein) lives to introduce hands on activities on different aspects of light and to talk of GLDs.

This project was the starting point for us to:

1. Begin to rethink all the INAF-OAC educational activities (in particular the multimedia contents, for example, interactive ebooks) following the guidelines of Instructional Design and Universal Design for Learning. We will published all the materials as soon as possible in the new INAF portal for education (http://edu.inaf.it), after teachers revisions.
2. Define general guidelines for researchers and educators to prepare effective "inclusive" outreach activities (see the http://www.oa-cagliari.inaf.it/divulgazione/ school activities section, in preparation)

3. Inclusive environments

In order to facilitate **cooperative and co-working environments,** to allow **multiple learning styles** including tactile, audio, and visual, and create an engaging environment, we equipped the new INAF-OAC educational room by means of both technologically innovative (interactive whiteboards and multi-touch table, 3D printers, virtual reality visors, tablets) and traditional infrastructures (desks, colored mats, blackboard, bookshelves,…).

The greatest benefit from the use of interactive whiteboards/tables is found with children with attentional and learning problems: the use of multimedia presentations, the possibility of interaction with the presented material and of "manipulation" of some abstract concepts (eg, geometry, physics, etc.) could be important facilities for students who find difficult to concentrate or to decode the paper texts (as the dyslexics). As an example, we are currently working on an interactive Stellarium based on the TUIO protocol [2]. These technologies (called also **assistive technologies**), being interactive, fablab ready and collaborative by nature, are perfect facilitators of new and innovative ways to learn, naturally breaking down the differences between students learning abilities.

Above all, they are suitable to facilitate different learning processes of ANY student.

4. Using astronomy with socially marginalized people

Another important use of astronomy is related to the possibility to interact with socially marginalized people. While it is very simple to engage people already interested in astronomy, it is a major challenge using astronomy to facilitate the interaction with people with social problems (such as drug addiction or imprisonment, or integration problems). In this framework, we recently collaborate with a Sardinian theatre association (Teatro Impossibile) and a welcoming/rehab house (Casa Emmaus) to a pilot project, named "Osservatorio Impossibile".

The main idea of the project is to link classical culture with theatre performances and astronomy contents. We worked with 4 different groups (drug addicted man, violence and prostitution victims women, migrants, unaccompanied minors), using different ancient mithes (Moon, Io, Arcade and the Bear, Europa), read and represented from the Ovidio "Metamorphosis", and different astronomical topics (the dark side of the Moon, minor bodies of the solar system, stars and constellations, space exploration). Astronomy was completely new for every one and, thanks to the constant presence of psychologists and cultural mediators, it has been used to begin fruitful discussions about our place and importance in the Universe and about life possibilities, without forcing people to talk about their own experiences.

As a major result of the project, it is actually in progress the definition of an agreement to allow one the house guests to work as a volunteer at the Cagliari Observatory to complete his rehabilitation path.

6. Summary

In this paper we outlined some recent activities of the INAF-OAC in the field of inclusion. We strongly believe in the active role of astronomy in the society to create environments able to improve life conditions and to ensure everyone full access to knowledge.

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|Parallel Session|

Different Ways to Increase the Diversity of the Audiences for Informal Astronomy Activities to Include Underserved and Underrepresented Groups

Donald LUBOWICH*1

Abstract. My outreach programs increased diversity and broadened the participation by underserved and underrepresented groups in astronomy. These included: Super Bowl (US football) and Halloween star parties (young girls); Camps for special needs kids (low-income/medical issues); outdoor concerts/festivals (women, minorities, low-income); activities for blind/visually impaired with edible materials; hospitals – observing the Moon, planets, stars through windows; Ronald McDonald Houses - free/low cost lodging for sick kids and their families (poverty-level or low income, African-American, Hispanics). One needs to identify underserved and underrepresented groups; contact concert/festival organizers, hospitals, summer camps, Ronald McDonald Houses to organize astronomy programs; bring science directly to these groups; and adapt for local cultures.

1. Introduction

I discuss how to create astronomy programs that can be adapted for local cultures to: attract young girls and women; for seriously ill or injured children, ethnic minorities, or low-income/poverty level children at summer camps, Ronald McDonald Houses, or hospitals; use edible hands-on astronomy activities for blind and visually impaired people using chocolate chips, cookies, marshmallows, popcorn, candy (Starburst and Twizzlers), bagels, potato chips, frosting, and pizza.

2. Super Bowl and Halloween Star Parties

A Super Bowl star party targets girls and women who are not football fans (66% of the US does not watch the Super Bowl). This can be adapted for astronomy during soccer games. My Halloween event also attracts girls in costume.

3. Outdoor Concerts at Parks or Festivals

My $308,000 NASA-funded Music and Astronomy Under the Stars (MAUS) program reached 50,000 music lovers at 60 local parks and the Central Park Jazz, Newport Folk, Ravinia, or Tanglewood Music festivals assisted by local astronomy clubs. 85% of the concerts are were free and 15% had low-cost lawn seats. Classical, folk, rock, pop, opera, country, and Latin music performers included: Yo-Yo-Ma, Chicago and Boston Symphony Orchestras, Ravi Coltrane, Esperanza Spalding, Phish, Blood Sweat & Tears, Deep Purple, Patti Smith, Tony Orlando, Debbie Boone, James Taylor, and Wilco. MAUS reached underserved groups and attracted large crowds before and after outdoor concerts and during intermission as all ethnic and economic groups come to these concerts (55% female; 50% families with young kids; 20% seniors; 20% couples; 10% mostly female friends). MAUS included solar, optical, and radio telescope observations; hands-on activities; a live image projection system; large posters (2.5m x 6m) and banners; videos; edible demonstrations; and information promoting science museums and citizen science projects. The Astronomy Festival on the National Mall (Washington DC) started as a MAUS event and is now the largest annual astronomy outreach event in the US (30,000 people since 2010; 8000 people/yr.).

96% of the participants all of ages, ethnicity, income, or interest in science found MAUS enjoyable and understandable; learned about astronomy; wanted to learn more; and increased their interest in science (average rating 3.4/4, 4 = strongly agree). The positive response was the same for both genders and all types of music. Bringing astronomy directly to the public is effective!

Fig.1. Halloween- Girl as Cinderella and an astronaut looking through telescopes. Image: D. Lubowich

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Fig. 2. Amateur astronomer showing Saturn; Chicago Symphony Orchestra concert. Image: D. Lubowich

Fig. 3. Reading astronomy posters; long lines to see the Sun at Oyster Fest. Image: D. Lubowich.

4. Low-income/Poverty-level Sick Kids/families

I have created astronomy programs for children hospitalized at the NYU/Winthrop University Hospital Children's Medical Center, (Mineola, NY) for low-income and special needs children for summer camps (Fresh Air Fund), and for extremely ill or traumatically injured children, their siblings, and family members staying at Ronald McDonald Houses (RMHs). The RMHs provide free or low-cost housing for kids undergoing surgery and medical treatments at nearby hospitals. The RMHs are 365 independent charities (171 in the US) and are not affiliated with McDonald's restaurants. The RMHs are a comfortable, supportive alternative atmosphere where family members sleep, eat, relax and find support from other families. Families are kept united when mutual support is as critical as the medical treatment itself. The children and their families stay for a few days or months because of chemotherapy, dialysis, or rehabilitative therapy. Most of the families are poverty-level, low-income, and minorities (Hispanics or African-American in the US), and 70% are female. This is an educational family-learning experience and a diversion from the stress of being sick or of having a sick family member. The IAU funded equipment at the Chicagoland RMHs (children from 50 states and 50 countries stay each year) and NASA funded the Long Island RMH (near NYC. I trained the RMH staff and volunteers to: use optical and solar telescopes; use the Stellarium program to show the night sky, identify objects, and plan observing sessions; conduct simple family oriented demonstrations (some with edible materials); demonstrate citizen science/Zooniverse activities; and provide information about local science museums and astronomy clubs. Local amateur astronomy clubs provide ongoing support.

Fig. 4. Diego saw the Moon before surgery; Lisa saw Saturn from her wheelchair. Image: D. Lubowich

5. Edible activities and demonstration

I am adapting edible hands-on astronomy activities for blind and visually impaired people. I present details of some edible demonstrations including: the expansion of the Universe (big-bang cookies); and planetary formation (chocolate, Starburst candy, and marshmallows); radioactivity (popcorn); plate tectonics (crackers with peanut butter/jelly); mud flows on Mars (chocolate poured on cake); formation of the Galactic Disk (pizza); lunar phases (Oreo cookies); open curvature of space (Pringles potato chips); making constellations patterns (chocolate chips and cookies); making lunar craters (candy dropped into frosting); and a black hole accretion disk with jets (bagel or donut with ice cream cone and Twizzler licorice sticks).

Fig. 5. Big-bang cookie- expanding universe: Left uncooked, M&M galaxies 3 cm apart; right baked 30 min, M&M galaxies 7 cm apart. Image: D. Lubowich

6. Summary

I describe the different activities and techniques that I have used to increase the diversity in the audiences for informal astronomy activities. These can be adapted for different cultures and under-served and underrepresented groups. My presentation including with videos is at: www.dropbox.com/s/wcq3f9gmnaqfnwo/CAP%202018-6.mp4?dl=0.

Challenges and Strategies for Developing Inclusive Outreach Using Buku Mentari Project

Ricka TANZILLA[*1], RATNAWATI[*2] and Yudhiakto PRAMUDYA[*3]

Abstract. Visual impaired students have visual limitations, therefore needing a learning media that can visualize a concept especially when addressing topics as the Solar System. Learning media in the form of a book can help visual impaired students understanding the Solar System. The Mentari Book's contains Braille and tactile pictures made by visual impaired students. This public outreach activity was implemented using the Buku Mentari (Mentari Book's) as a learning media to introduce astronomical concepts, especially regarding the Solar System to both visual impaired students and sighted students. The students were able to produce tactile images using easily obtained material. This activity was held in city library, junior and senior high schools in Yogyakarta. The cooperative learning methods were able to improve the collaboration and social interaction between students. The challenges of this project were mostly transforming the actual 3D objects to 2D images, writing process, and Braille printing cost.

1. Introduction

Astronomy is considered to be one of the most visual of science. Many students have experience with visual processing and react to astronomical information, beginning by looking at the night sky. Today, however, astronomy and astrophysics extend far beyond anything detectable to the human eye [1].

Dissemination Astronomy for the disabled is a great opportunity to help student with disabilities to conduct direct learning based on formal and informal education [2]. However, the schools and libraries lack of Braille books and tactile collection, especially in the topic of astronomy. The visual impaired students experienced less time of science learning compared to other class subjects. The learning strategy need to be designed in such way that can solve those challenges.

2. Method

This research is intended to provide a Braille book in the topic of Solar System for visual impaired students named Buku Mentari (Book of Mentari). There are some tactile image in the book. There are four tactile images in the book: Sun, Earth, Saturn and a Comet. Previous research used a tactile image of the Moon and explanations of the features of the Moon [3]. In addition, previous research also explains about the procedures and activities on the creation of tactile images of the Moon and on introducing the mythological characters in seven constellations in a tactile half-sphere and creating new constellations stories [4].

There are four steps in this inclusive public outreach activity: the facilitator presentation, workshop on tactile image-making, participants (students) presentations, and survey. These four steps are expected to increase the student's motivation. The steps are also assisting the visual impaired students and sighted students to collaborate in learning the solar system and study groups.

Fig. 1 The visual impaired students and the sighted students work together to create the tactile images.

3. Implementation

The first step is to provide an explanation of the Solar System. The topic covered in the short presentation are Mercury, Venus, Mars, Earth, Jupiter, Saturn, Uranus, Neptune and a Comet. The planet structures and their satellites are explained to increase students' understanding of the Solar System.

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The second step is to create a tactile image. There are the Sun, Earth, Saturn and a Comet images that are considered be representative of the objects of the Solar System. In the workshop [5] visual impaired students are assisted by the sighted students collaboration between them. Hence, the cooperation can be established between visual impaired students and sighted students. The visual impaired students increasingly understand about the structure and composition of the solar system. The images are 2 dimensional (2D) images. Hence, the students were able to construct image easily. However, it was difficult to explain to students about translating the actual 3 dimensional objects to the 2D representation images.

The third step is the visual impaired students' presentation. By implementing this step, the students were confident to present the tactile images, presenting some features of the Sun, Planets and a comet. By presenting to their colleagues, the students were expected to digest information and knowledge on the particular topic.

The fourth and final step is the survey. Two tools were employed as the survey instruments. The first being a multiple-choice questionnaire with the option to "strongly agree", "agree", "disagree" and "strongly disagree" and the second, an essay.

Fig. 2. Visual impaired Students are explaining to other students about tactile images.

4. Results and Conclusion

Mentari Book's is a media of learning for students with visual impairment so as to help students with visual impairment in visualizing the material of Solar System. In addition, visual impaired students can be motivated to study the material of the Solar System so that they become interested and easier to learn the solar system.

Visual impaired students feel the Mentari Book's quickly makes them understand by utilizing a direct practice in making Solar System objects with homemade tactile drawings.

With a given questionnaire of 92% stated the material in the Mentari Book's is more easily understood. Besides studying the Solar System there is something interesting. This is evidenced by as many as 87.5% agree and as many as 95.8% of students with visual impairment strongly agree that the material given according to their education level.

The depiction of the Solar System will be very easy to understand with 3D images. The challenge of this research is to make visually impaired students understand the tactile images they make in the form of 2D images. There are still some parts of the planet that are difficult for students to understand, 67% of students have difficulties in studying the Earth, 17% of students have difficulty keeping the Sun, and 17% of students have difficulty in learning about Saturn. This is because several factors such as the use of materials used in the manufacture of tactile images are still a little difficult to explain. In addition, for the visual impaired student who have been born will be difficult in terms of imagining the forms of the planet. For example is like a ball, then a ring and so forth.

One of the lessons learned in this research is the visual impaired students collaborating with students to create artificial tactile images of some planets and the Sun. After working with the students, the visual impaired student explains to other friends about the tactile image he has created. Learning is done using cooperative learning strategy. After reviewing research on cooperative learning, we concluded that cooperative learning is effective in improving students' academic performance, intergroup relations, and self-esteem [6].

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|Parallel Session|

Engaging the Public With Astronomy Through Multi-sensory Activities

Frédéric PITOUT*1 and Émeline MARAVAL*2

Abstract. We present two initiatives that aim at engaging the public with astronomy through the senses, in particular taste and smell. Our first initiative, initially intended for kids, mixes pastry baking and astronomy. As the public bakes cookies or cakes, whose shape or colour evoke some celestial body, we talk about basic astronomy. Our second initiative, for adults only, consists of tasting a wine, which is named after a celestial body or an astronomer, and using that wine as a starting point for a discussion. Not only are we convinced that our activities may help bring new publics to the world of astronomy but by mixing the senses, the transmission of knowledge may well be improved.

1. Introduction

Public surveys in science museums or science centres systematically reveal that mostly privileged social classes visit those places [1]. To attract and reach new publics is a true challenge. To achieve this goal, one can think of at least two solutions. The first one is to offer new activities that may sound more accessible and more familiar to the public with a low science capital [2]. If a whole part of the public is reluctant to or do not dare go and visit a science-dedicated place, the second solution is to bring science to this public wherever they are. To these ends, we propose two alternative means to engage astronomy with a broader public: pastry baking and wine tasting.

2. Astronomy and pastry baking

For the younger public, we propose to have a good time preparing cookies or cakes whose shape or colour has something to do with a celestial object and, doing so, we talk about astronomy. When we submitted that idea to a science centre in Toulouse, France, they liked the idea and requested that a parent or a grandparent could also take part in the activities, to tighten the family and inter-generational links. We called this activity “astronomy for the gourmands”.

So far, we have tested this activity on children aged 6 to 12 with the theme of constellations. The idea is to bake star-shaped cookies and to place them to form constellations. The activity should not last more than 2 hours.

It starts with a brief introduction to the night sky and the celestial vault. Then each child is asked to choose the constellation he or she is going to form. The next step is the preparation of the shortbread dough. This requires basic baking utensils (rolling pins) and ingredients (flour, butter, eggs and sugar). Once ready, the dough is spread and, with star-shaped cookie cutters, stars of different sizes (indicative of different apparent magnitudes) are made. While the cookies are in the oven, we draw everyone’s attention to the fact that stars have different colours and the children are invited to colour their stars with blue, white, yellow or red almond or sugar paste according to the actual colour (and surface temperature) of the stars. Besides, black or dark-blue almond paste is spread and used as a background. When the cookies are cooked, the children form their constellation (Fig. 1). They are then free to eat it or keep it (but usually, they do not keep it very long).

Fig. 1. After having chosen a constellation on a sky map, children form it with baked star-shaped biscuits. (Image credit: E. Maraval)

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3. Astronomy and wine tasting

The objective of this activity is to unveil the universe and its beauty through wines. We have listed more than 80 wines in 14 different countries that evoke the sky in general (Celeste) or that are named after a celestial object (Sirius), a phenomenon (Eclipse), an astronomer (Cassini), etc. (Fig. 2). The idea is to use those wines as a conveyor of information to tackle astronomy. After all, did the physicist Richard Feynman not write the whole universe was in a glass of wine?

This activity may take the form of a discussion over a glass of wine, or of a stargazing in a vineyard for instance, preceded or followed by wine tasting. We start with discussing what is needed to grow grapes: the Sun, the Earth, water and make the public realise that the wine they are drinking is the consequence of billions of years of evolution. Then we come to the bottle, we comment its label and name while we taste its content.

Even the wine makers themselves are encouraged to participate and share their practices, which may be discussed: is the concept of biodynamics effective and backed up by science? Does the solar cycle have an influence on the quality of the vintages? This is the opportunity to test everyone's critical thinking.

Fig. 2. Examples of wines relevant for our activity. (Image credit: F. Pitout)

4. Discussion

Our initial goal was to reach new publics and spend a good time with them but our activities eventually find an *ex post* justification in light of neuroscience, cognitive psychology and science of education. Indeed, past studies have shown that the learning process is tightly linked with emotions. The combination of a new notion with one or several senses seems to work to better teach and learn [5]. However, gustation and smell seem to be rarely used. In our first activity, the children touch, knead, smell, and taste. During wine tasting, the public also smells and tastes. The first returns from our activities are very promising: on top of enjoying their experience, children and adults seem to remember durably what they did, heard of, and learnt during those activities. Some even end up matching an astronomical object with a specific taste or smell.

5. Summary

We have presented two initiatives to engage astronomy with the public: baking pastry and wine tasting both serve as excuses to tackle astronomy. By offering these alternative activities and playing with the senses, we contribute i) to attract new publics to the world of astronomy, ii) to entertain and educate our public about astronomy, iii) incidentally, to initiate our public into pastry baking and oenology.

In fact, what they actually learn is not the most important thing; making them realise that science in general, and astronomy in particular, is accessible to anyone may well be our major achievement.

Acknowledgement

Our activity "astronomy for the gourmands" is supported by the French Society for Astronomy and Astrophysics (SF2A).

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|Parallel Session|

Working Together to Bring Science to the Community

Cordelia C. SCOTT[*1] and Victoria MASON[*2]

Abstract. This presentation shared best practice for running pop-up events with an underserved audience and working with local community collaborator. With a particular focus on the key elements of 3 astronomy events that made them successful for that audience, such as; making the events free to attend wherever possible, hosting it in an easily accessible location and having a heavy advertising drive before and during the event. This technique does seem to be reaching traditionally underserved audiences in this area of the UK. It is perhaps a model that could be replicated and tested elsewhere in the world.

1. Introduction

For the past 4 years the School of Physical Sciences has been collaborating with a new local Community Interest Company, Discovery Planet. Discovery Planet was set up to bring free/low-cost entertaining, educational and creative experiences directly to the heart of a community which does not usually have access to such opportunities and which experiences barriers to participation. Such barriers might be practical e.g. cost/transport, or personal e.g. lack of confidence/self-esteem. Discovery Planet wants everyone to have the chance to enrich their lives through community based activities which, in turn, promote community cohesion and animate town-centre spaces.

The aim of the School of Physical Sciences collaboration is to increase the science capital of under-served audiences in the area by bringing enriching STEM based educational opportunities to the heart of a community where there are significant barriers to accessing learning opportunities outside of formal educational contexts.

Funding for our projects has, over the years, come from a range of professional bodies in the UK such as: the Institute of Physics, Royal Society of Chemistry, UK Space Agency, Royal Academy of Engineering and Thanet Council. This has enabled the running of various science themed events in pop up locations within town centres, spanning from one day to up to a month.

2. Activities

Since 2014, the University of Kent has collaborated on 3 specific Astronomy events with Discovery Planet.

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2.1 Pop Up Planetarium

This event was funded by the Institute of Physics (IOP) with the aim to bring an enriching educational opportunity to people who would not normally have access to it, by weaving it in to the fabric of their everyday experiences. The target audience was adults that would not normally access or take advantage of an informal educational/cultural opportunity. Key points to note from this activity were:

- The entry was free and was held on Friday and Saturday - local school children attending on the Friday.
- Held in a central location – in a venue adjacent to the street market
- Highly visual event – high quality venue decoration that attracted people in and a visual planetarium show to participate in
- There were activities for those waiting to go into the planetarium, such as – Planisphere building, decorating a star to be displayed in the town centre after the event. There was also free tea and coffee, as well as local amateur astronomers to chat with.
- There was a large advertising drive before and during the event.

2.2 Night Sky Navigation

This was another Mobile Planetarium event which was funded by the local Thanet Council. This meant that astronomy was not the main focus of the event, instead the aim was to bring a fun and informative day of activities to Ramsgate to highlight its maritime heritage. This was to target families in Thanet that have previously not engaged with the districts coast or heritage. Key points to note from this activity were:

- The entry was free and was held on Friday and Saturday - local school children attending on the Friday

- There were interactive activities such as a celestial navigation based planetarium show with Q&A and a treasure hunt through the town centre and tourist attractions
- This initiated collaboration with other local organisations in the town that showcased the history, heritage sites and strong maritime links of the area.
- There was a strong advertising campaign before and during the event.

2.3 Thanet Space Lab

This was a UK Space Agency funded set of workshops designed to build upon previous events and relate current space news and academic research to the public, expanding their knowledge about the subject; particularly residents of the area that had not participated in a Discovery Planet event before. The key points to note from this activity were:

- The entry was free and was held on Friday and Saturday - local school children attending on the Friday
- Held in a prominent central location – empty shop on the highstreet next to the usual Saturday market
- Very interactive activities:
    - Build and test a spacecraft shielding prototype
    - Design and build a spacecraft lander within a budget
- Last minute change to the activity for the second weekend due to venue design (the were some large pillars in the middle of the room that obstructed people's view of demonstrations) and feedback received about a lack of information on space careers
- Heavy advertising campaign before during and after the event – including a competition to take part in on social media between weekends

3. Outcomes

Since 2014, through 9 events, we have learnt quite a lot about working with a typically underserved audience and creating pop-up style engagement activities, some things we have done well and some things we have done not so well.

3.1 Successes

- Worked with an organisation that lives and works in Thanet
    - They know the people and the barriers to participation
    - They have a more creative side and can come up with fantastic creative activities based on the science that we discuss with them
    - Gained the confidence of the audience, building a loyal fan base and brand
- Been adaptable to last minute changes of activities usually after feedback from a previous audience
- Very visual/hands-on simple activities that don't require too much supervision by a staff member which has allowed for conversation about the topic to happen instead
- Repeat weekends based on an over-arching topic to give incentive to return the following weekend(s)
- Applying for external funding
    - Since 2014 we've brought in roughly £27,000 to fund these events
- Made the events accessible to as many people as possible, by hold the location in central accessible locations and we continue to make them free to attend

3.2 Failures

- Been too ambitious
    - Complicated hands-on activities that required too much involvement from demonstrators to ensure that the desired outcome was reached by participants
    - Events that had too many things going on so the core science message was lost
- Sometimes gone too science heavy and the audience has feedback that they were confused and didn't always understand what was being conveyed to them
- Targeted more than one audience
    - Future work hope to work with more specific groups such as students with special behavioural needs

Something to note - we didn't initially seek this partnership out. It's grown naturally from Discovery Planet finding us. However, this area of outreach does appear to be reaching traditionally under-served audiences. It is hoped that sharing this collaboration more widely may encourage others to work with such companies as Discovery Planet, or indeed help with the formation of similar ones, which can really link a University with a specific community in need of new and innovative experiences.

4.Summary

As a result of the collaboration with Discovery Planet we do seem to be reaching a traditionally underserved audience in the UK that the University of Kent has not been able to do so before. Our advice to others: Be open to new collaborations from unexpected places.

|Parallel Session|

RAS200: Engaging Diverse Audiences with Astronomy and Geophysics

Megan ARGO[*1], on behalf of the RAS200 Steering Group[*2]

Abstract. The UK's Royal Astronomical Society will celebrate its 200th anniversary in 2020. As part of the preparations, it has inaugurated a £1 million outreach and engagement programme called "RAS200 Sky and Earth", with the explicit aim of working with diverse audiences and partners and engaging citizens who would not normally consider astronomy and geophysics as "for them". RAS200 is a bottom-up scheme, which has encouraged organisations and community groups to propose to the Society. Over the course of two rounds (2014-15 and 2016-17), RAS200 has provided funding of £90k - £100k to twelve national and community-based projects, including two Celtic cultural festivals, as well as "hard to reach" audiences amongst young people and prison inmates. This contribution will provide an overview of these projects and progress to date.

1. Introduction

The Royal Astronomical Society (RAS), founded in 1820, today has over 4000 members (known as Fellows) including professional researchers, students, and many advanced amateur astronomers. As the professional body for astronomy and geophysics in the UK, the RAS encourages and promotes the study of astronomy, solar-system science, geophysics and closely related branches of science. Part of its remit is to support education through grants and outreach activities, so to help celebrate the 200th anniversary of the Society £1 million was devoted to a fund to enable several major outreach and engagement projects with the aim of reaching new and more diverse audiences.

2. RAS200 Aims

The RAS200 project is a major investment from the reserves of the RAS, intended to encourage and support large outreach and engagement projects. As a whole, RAS200 has several aims:

- to have a lasting impact beyond 2020 and inspire a new generation to broaden their interest in science, technology, engineering, maths and medicine (STEMM);
- to go 'where no outreach project has gone before', engaging people from all age groups, ethnic and socioeconomic backgrounds etc.; and
- to harness the shared ambitions of world-leading researchers and national, local and community organisations.

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The funded initiatives are grass roots projects to reach new, less well-served areas of society. Each project uses astronomy and/or geophysics to empower fellow citizens, and work with a variety of partner organisations and groups. The overall aim is to set the RAS on course as an outward-looking, socially-engaged organisation for next 200 years.

There were two calls for proposals for RAS200, the first in 2014/5, and the second in 2016/7. Each call was accompanied by a series of Town Hall meetings around the UK, hosted by the RAS, where potential applicants could network with other organisations and RAS Fellows and discuss their ideas with representatives from the RAS.

In response to these two calls, over 150 proposals were received, both from the UK and further afield. In total, twelve projects were funded; eleven from the British Isles, and one from South Africa. The funded projects involve and are engaging with local, national and regional partners [1,2,3]. While many RAS Fellows are involved with projects, they are acting as a resource and are not driving the projects or determining directly what happens.

3. Funded projects

The projects funded through the RAS200 scheme cover a wide range of diverse audiences across large parts of both the United Kingdom and Ireland, with one project based in South Africa. In no particular order, the projects awarded funding are:

Stepping Out: Astronomy Short Breaks for Carers – run by Care 4 Carers, a voluntary organisation established in 1989 to provide support services to all carers. The aim of this project is to organise astronomy-themed residential and day breaks for carers in Scotland. This project was initially funded for two years, but extended to five years based on early success.

The Planets 360 - a full-dome, immersive, modular-format planetarium show based around Holst's Planet Suite, designed by the National Space Centre and NSC Creative, and available to all UK planetariums license free.

Astronomy and Geophysics through the Traditional Culture of Wales - activities led by experts in the arts, supported by scientists from several universities, that deliver performances, installations, competitions and compositions at the National and Urdd (youth) Eisteddfods of Wales.

Stars and Space - training courses and programmes to engage young people not in education, employment or training and develop their confidence and social skills, run by the Prince's Trust.

Open your eyes, look up to the sky – engaging with hard-to-reach groups through grass roots events and new STEMM courses, run by the Workers' Educational Association.

Space, Earth and Autism – a pilot project run by the National Autistic Society to enable people on the autistic spectrum to access and engage with other RAS200 programmes.

Sea to Stars – a roadshow project that will use a mobile science outreach unit to visit remote communities in the county of Cornwall, presenting astronomy and geophysics in terms of their local connections, such as fishing and navigation.

Making Space – a project aiming to focus on astronomy as a cultural pursuit as well as an economic driver. In addition to many musical events, Galway will gain an outdoor planetarium, an 8 km planetary walk, a scientist in residence at Galway Arts Festival, and community engagement and artistic events.

Reaching for the Stars – a project run by Girlguiding UK and involving the UK Space Agency, to give more girls and young women the opportunity to get hands-on with astronomy and space science through both local projects and at national Girlguiding events.

Beyond Prison Walls – a project run by the Bounce Back Foundation, working with prisoners and ex-offenders in the South-East aiming to provide learning opportunities in astronomy, geophysics and space science among prisoners, their families and local communities.

Geophysics in a Box – the only geophysics-specific project funded through RAS200, run by the National Youth Academy.

Astronomical data: from small and beautiful to big and overwhelming – the only project based outside of the British Isles, this project will cast a spotlight on South African astronomy and its progression from the early days of photographic plates all the way to the upcoming era of Big Data and the Square Kilometre Array.

4. Evaluation

The RAS has engaged Jenesys Associates, an independent research and evaluation consultancy, to conduct ongoing evaluation of all RAS200 projects. Jenesys are conducting regular surveys of each project, investigating the issues, challenges and key learning points faced by each project. Interviews are also being conducted with project participants and volunteers, and regular reports from Jenesys are made to the RAS200 steering group.

The aims of the evaluation of RAS200 are: 1) to monitor the demographic profile of and impact on audiences reached; 2) to identify any learning and improved practice from individual projects; 3) to see how and to what extent each project's aims have been met; and 4) to assess how and if the project outcomes contribute to the RAS outreach and public engagement programme.

One surprising and serendipitous interim result has already come to light through this early evaluation work. It has been found that participants gained social and emotional outcomes such as greater confidence, self-esteem, mindfulness, and resilience. It appears that astronomy has become the enabler, and the lead in the projects is the audience, their concerns and feelings, rather than the science. The evaluation process has also highlighted the importance of delivery to the correct audiences in an audience-appropriate way, and the importance of sharing best practice.

5. Summary

RAS200 is a major public engagement initiative, funding a series of innovative projects with the aim of reaching new and more diverse audiences than via more "traditional" outreach initiatives. Many projects are still in their early stages, but continuous evaluation is already showing positive outcomes.

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|Workshop|

The Tactile Universe: Accessible Astrophysics Public Engagement with the Vision Impaired Community

Nicolas J. BONNE*1, Coleman M. Krawczyk*2 and Jennifer A. Gupta*3

Abstract. The Tactile Universe is an on-going public engagement project to bring current topics in astrophysics research to the vision impaired community. In this workshop, we gave participants the opportunity to get hands-on with the 3D printed galaxies and other resources that we have created. We explained how we have used them in different classroom and public settings to date, and shared the lessons that we have learnt through the project so far.

1. Introduction

Astronomy is perceived to be a very visual science, both in the ways in which it is communicated to students and to the public, and the ways that astronomical research is performed. As a result, people with a vision impairment (VI) can often feel excluded from engaging with the subject.

There are a number of past and present public engagement projects which have aimed to bring broad topics in astronomy to the vision impaired (VI) community (e.g. A Touch of the Universe [1], AstroSense [2], and Touching Space [3]), but few have focused on current astrophysical research topics.

The Tactile Universe is an innovative public engagement project based at the University of Portsmouth's Institute of Cosmology and Gravitation in the UK. The project uses tactile (and will eventually include audio) representations of data to make current astrophysics research accessible to this community. In our CAP 2018 workshop, we allowed participants the opportunity to discover our tactile resources for themselves, whilst experimenting with different ways of explaining them to a partner.

2. Development of Resources

The primary resource developed by the Tactile Universe are 3D printed tactile representations of single-band galaxy images (e.g., visible red, blue and near infra-red (IR) light). Pictured in Figure 1, these models are made using a custom plug-in for open-source 3D modelling software Blender [4], then are 3D printed.

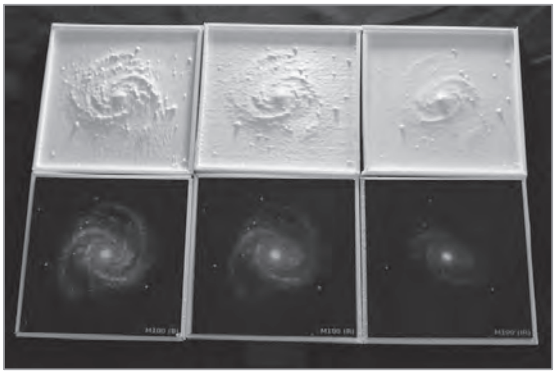

Fig. 1. Three tactile images of galaxy M100 in red, blue and near-IR. Their backs (bottom row) show the mirrored image used to produce each model. Users with some vision can look at this side while feeling the other. Image Credit: C Krawczyk

This custom plug-in takes any black and white image and makes the brightest (closest to white) image pixel the most raised point on the face of the model. The darkest (closest to black) image pixel is set as the lowest point. All other image pixels are scaled in height between these two.

The models were created during a six-month pilot project funded by the South East Physics Network (SEPnet). During this period we worked with a local adult vision impaired support group to determine the best model parameters (e.g. model size, projection height) and create inclusive activities. For further information about this process, see [5]. A picture of one of our test group interacting with a model may be seen in Figure 2.

3. Local and National Schools Engagement

Since the pilot, the focus of the project has shifted

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Figure 2. A vision impaired participant in a pilot event test session feels the shape of a galaxy using a tactile galaxy model. Image credit: J Gupta

from the general public to providing teaching aids for school-aged VI students who wish to learn about astronomy, or pursue an interest in STEM subjects. The shift from general public to schools was largely driven by our experiences during the pilot.

Some of our pilot events, notably the public event at the end of the pilot, were poorly attended by older VI members of the public. We believe that this was at least partly due to ingrained beliefs in this community that astronomy was something that would be too difficult for them.

The advantage of working with school aged children is that they present a 'captive' audience. They are also less likely to have such ingrained ideas about what they are capable of, and, as with other outreach interventions, their future interests and career choices can be more easily influenced by positive experiences and role models.

Currently, we are working with two local mainstream schools (one primary with children aged 5-11 and one secondary with children aged 11-16) who provide support to VI students. With their help, we have further improved our tactile models and have developed a number of lesson and activity plans.

For primary aged students, our two activities compliment the English science curriculum, focusing on the solar system (particularly on sizes and distances) and then moving on to galaxies (focusing on creating a galaxy sorting/classification scheme).

For the older students, these activities generally involve a number of visits, starting with basic concepts in astronomy, and building up to more complicated ideas regarding galaxy formation and evolution, always linking back to galaxy colour and shape.

All activities are being designed to work both with groups solely comprised of VI students, but also in mixed classes containing both sighted and VI students. The advantage of the latter is that every student will be able to participate at an equal level.

4. The Future of the Tactile Universe

Over the coming year, the Tactile Universe will expand nationally in the UK. We will organise training events throughout the UK so that teachers, science communicators and researchers who want to use the projects resources can learn from us. We will also produce physical kits to distribute to schools, universities and educators which will contain our models, best practice guidelines and lesson plans. As we document, test and improve our Blender plug-in, models and other teaching resources, we will make these freely available to all online under a creative commons license.

In addition to producing teaching resources, we will provide a consultancy service to promote ideas of universal access and design, and begin to change the way that researchers and science communicators approach communicating science to the public.

The project is also currently involved with the IAU OAD funded AstroBVI project, who will use our models to help educate VI children in South America.

6. Summary

The Tactile Universe project is currently in an exciting phase of expansion. To find out more and get involved, please visit us at www.tactileuniverse.org or find us on twitter or Facebook using @tactileuniverse

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|Workshop|

Encouraging Diversity Through Art-Based Approaches to Astronomy

Stephen M. POMPEA*1 and Nancy L. REGENS*2

Abstract. Art-based approaches to teaching astronomy have particular appeal to youth who identify themselves with art more than with science. In this workshop we introduce some new approaches to teaching astronomy based on the Visual Thinking Strategy (VTS) approach used in art museums and in art instruction. This approach promotes an appreciation of astronomical imagery and stimulates questions and inquiry. It also promotes an understanding of the science process rather than a knowledge of astronomical "factoids". The VTS technique can be applied to students and adults of any age and is particularly useful with diverse groups. It allows each person to interact intensely with astronomical images to notice patterns and relationships that lead to further questions and investigations. We will also describe how to use another approach pioneered in the recently completed National Science Foundation-sponsored project "Project STEAM: Integrating Art with Science to Build Science Identities among Girls" where we demonstrated the value of teaching science in an empathic way using a "Colors of Nature" approach in reaching girls who identified with art. We believe that the VTS approach, and other art-related approaches, can be very effective in promoting inclusion, diversity, equity, and empathy in communicating astronomy.

1. Introduction

How do you use astronomical imagery in your educational programs? This workshop was designed to introduce astronomical images in ways that are very accessible to early science learners. The same principles can be applied to older K-12 students, university level students, and adults. The workshop relies on Visual Thinking Strategies (VTS), an approach that has proven to be very effective in art and museum education [1].

2. Principles of VTS

VTS is a powerful and deceptively simple approach. It relies on the group of participants examining an image deeply and silently for at least a minute, and preferably for several minutes. Then a facilitator, the VTS leader begins a discussion about an image using three simple questions:

1. What do you see?
2. What is it that makes you say that?
3. What else do you see?

The discussion centers on these questions, with each person in the group answering. The facilitator reiterates the thoughts of the group and can point at parts of the image to clarify the evidence described in the sec-ond question.

This approach is much more engaging than when an expert gives a mini lecture on the image. When the expert teachers about the image, there may

be a lot of knowledge apparently transferred, but often little of it is retained. This is partly due to a look of personal engagement with the image. In some cases, the audience engages more with the speaker and has never really looked at the image. The VTS approach has proven powerful in teaching science concepts us-ing images since a deep look at the image reveals mul-tiple levels of meaning [2]. This approach, and other art-based approaches have been effective in programs attracting new audiences to science [3].

3. Images Used in the Workshop

For this workshop we used images from ground and space-based telescopes of star fields, nebulae, galaxies, the moon and planets, and clusters of galaxies. For each image, we hid the caption identifying the object and the source of the image, since these may be distractions. Pictures from the Astronomy Picture of the Day website are excellent as are various images from the "Best of Hubble" collections. Wide field and narrow field images can be used equally well. Images with representational color ("false color") are fine, but it may be best to start with more traditional images. Having a wide variety of images that are large enough so that a small group can see them clearly from a distance of 10 feet.

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The images can be taped to a wall or projected. It is useful for the participants to be able to move around an image and to examine it closeup and at a distance. Colorful images are attractive but not necessary. Generally, larger images are easier to work with.

4. Discussions around the Images

When the image is being discussed, the facilitator needs to be non-judgmental. He or she should not be agreeing or disagreeing with the observer but rather should work to clarify what the observer is saying. Some effort should be made to get everyone in the small group to participate. The process works best with groups of 4 to 8 people so each person can have a turn.

The observations about the image should focus on what is seen and can be described. This is not an attempt to guess what it is, or the name of an object. It is perfectly fine to avoid astronomical nomenclature and describe objects as "blue irregular blobs" or "small yellow balls" of "pink fuzzy objects that seem to be near the blue objects". Once the image has been well described, the next step is to generate a list of questions that can be investigated. These might include "what are the pink fuzzy-looking objects?" The questions may be about the distance of the objects or their size. Or the questions may be about the relationships between objects or about the patterns seen in the image.

These questions that are brought up can then be investigated using books, people, and web sites. The investigation should center around the questions of each individual.

5. Art-Science Connections

In the workshop we also described several projects at NOAO that address art-science connections [4]. These projects include two NSF-funded projects done in in collaboration with the Geophysical Institute of the University of Alaska Fairbanks and the University of Washington, Bothell [5][6] that use art science kits: Project STEAM: Integrating Art with Science to Build Science Identities among Girls" (Colors of Na-ture) and "Collaborative Research: Fostering STEAM through ISL Professional Development".

This second project also works with the Sitka Sound Science Center (SSSC), Sno-Isle Libraries, Pima County Public Libraries, and the Fairbanks North Star Borough School District (FNSBSD) to provide professional development to youth program leaders.

6. Summary

The workshop was designed to encourage the participants to harness the power of astronomical imagery in teaching science. The VTS approach allows strong student engagement and also reinforces the idea that science has a strong emphasis on visual thinking and analyzing images, in order to solve mysteries. This approach has proven to be effective in attracting diverse groups to science. It is also effective in making science more accessible to primary grade students, though the techniques can be used with all age levels.

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|Workshop|

Astronomy for Inclusion: Building Network and Sharing Hands-on Resources

Kumiko USUDA-SATO[*1], Shin MINESHIGE[*2] and Lina CANAS[*3]

Abstract. The goals of our workshops were (1) to share international and domestic resources of astronomy for inclusion to inspire and encourage participants to initiate their own activities, and (2) to build and strengthen our network. This is a joint effort between IAU Division C Commission C1 Working Group 3, IAU Office for Astronomy Outreach (IAU OAO), Kyoto University, and National Astronomical Observatory of Japan (NAOJ).

1. Introduction

Astronomy is for everybody, everybody has right to experience the Universe, and nobody should feel as if it was being left behind. Even with this "motto" being echoed more and more by different science outreach groups across the globe, even nowadays many people still do not have enough opportunities to enjoy astronomy. With this workshop, we presented international and domestic efforts such as the astronomy sign language project, tactile images and models of celestial bodies and a telescope, and so on.

2. Hands in the Stars: Sign Language Project

The IAU Division C Commission C1 Working Group (WG) 3 "Astronomy for Equity and Inclusion" (http://sion.frm.utn.edu.ar/iau-inclusion/) was established to build new strategies, tools, and resources in astronomy that will facilitate the access to astronomical resources and careers for people with special educational or physical needs, or those who might be excluded for their particular race or gender.

Astronomy words in sign language from various countries were collected by the WG, and the first list for 47 terms from more than 30 countries was released on December 7, 2017, at the IAU website. In Japan, we established a domestic sign language working group with hearing-impaired people and collected these words.

2. Domestic Resources in Japan

In Japan, we established the "Universal Design Working Group" in 2006 (until 2012) led by Shin Mineshige to collect and develop resources. We also held symposia of "Universal Design for Astronomy Education" in 2010, 2013, and 2016 to build the community of astronomy for inclusion. In 2010, we met and knew one another, and in 2013 we provided a longer discussion time to start work together. In 2016, we added international components. Some organizing committee members in 2016 were participants of the past symposia. With the consecutive symposia in addition to a working group mailing list, we strengthened the community.

Fig. 1. "Astronomy" signs in different countries. Most of them express a telescope tube to represent astronomical observations. (Credit: IAU)

2.1. Tactile Astronomy Textbooks

Multimodal astronomy textbooks in three levels (for college students, for high school students, and for young kids) were developed with the authors of Shin Mineshige (Kyoto University) and Jun Takahashi (Mitsukaido Daiichi High School). The books were published in different media: printed, braille, audio, and PC versions. Each figure was simplified and "translated" in dots to print a tactile image (fig. 2). This work has been done in collaboration with astronomy educators and visually impaired people.

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Also, a very detailed figure caption was added for each image. This caption is helpful not only for visually-impaired people but also for sighted non-professionals.

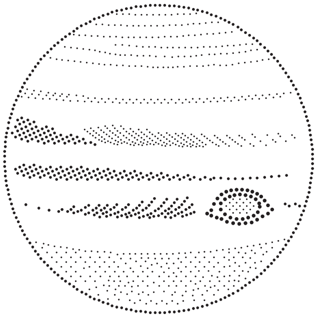

Fig. 2. Tactile image of Jupiter made with 3-sizes of dots.

2.2. 3D Tactile Model of the Subaru Telescope

The Subaru Telescope is an optical-infrared telescope of NAOJ located in Hawai‘i, USA. After the development of a prototype of the Subaru Telescope model made with a 3D printer, Usuda-Sato discussed with blind people and a science teacher of a special-needs school about the tactile model. Then two models were developed: (1) the simplified model for visually-impaired students who are learning how to touch a sample at science classes, and (2) the detailed model for experts of touching samples and for sighted people. In 2017, we visited a special-needs school in Tokyo and recognized that additional 2D tactile images are helpful to explain the structure of the telescope. In 2018, we will develop the additional images and a website on which 3D-printable files of the telescope models can be downloaded.

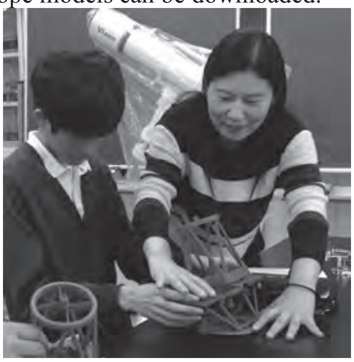

Fig. 3. A blind high school student enjoys touching the telescope model at a science class.

2.3. Tactile Planisphere

Tetsuya Watanabe (Niigata University) developed a tactile planisphere and constellation maps with PIAF (http://piaf-tactile.com), the tactile image maker with a heat-sensitive paper. PIAF is available in various countries, and these materials can be reproduced outside of Japan.

Fig. 4. Watanabe explains the tactile planisphere at his workshop of the symposium 2016 at NAOJ.

2.4. Hospital is a Planetarium

See the paper by Mariko Takanashi (Star Spinning Village) entitled “Stars for everyone – Practice of *Hospital is a Planetarium.*”

2.5. Extension Eyepiece

Jun-ichi Watanabe (NAOJ) and Taiji Okumura (a retired teacher of a special-needs school) developed an extension eyepiece for stargazing including people who cannot control their heads easily.

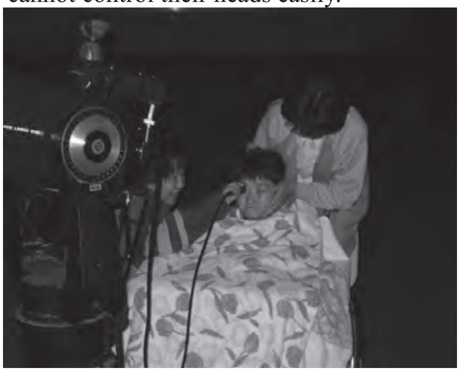

Fig. 5. A girl in a wheeled chair looks through the telescope using the extension eyepiece.

In the noisy room of the workshop, we could act flexibly: we used the “applause” and “happy” signs (according to Japanese sign language) instead of clapping hands to keep quiet. We think that this kind of attitude is the beginning of inclusion. We appreciate our participants’ and collaborators’ great ideas.

|Poster|

ASTRONOMY with STEM EDUCATION for Female Children

Vyjayanthi M. PERUMAL*1

Abstract. Astronomy is a subject that has drastically changed our view of our planet. We live in a world where divergent technologies satisfy our desires. It is an era of STEM fields which allow us to understand everything that we see around us and with advancements in these fields we came to know how huge our universe is and there is still a lot that we have to discover. There are numerous opportunities and channels of study in STEM & astronomy fields. But the participation of women in these fields are not high enough. This paper focuses on the initiative of targeting school children and encouraging them in hands on learning methodologies in the field of STEM Education and Astronomy.

1. Introduction

With a view to giving an exposure on the different aspects of the universe in which we exist, along with STEM subjects, astronomy is included as a subject of interest for the pupils and the focus is upon middle school children. There are numerous opportunities in these fields which would enhance the realm of knowledge of these young minds, making them future ready.

2. Why Women?

The barriers which are faced by women in STEM and Astronomy fields is reflected in the gender gap in classrooms or the workplace. In order to eliminate the under representation of women, several initiatives are completely focused on encouraging female representation and providing them freedom to think out of the box. Women are great at multitasking. A few women have created milestones in STEM fields despite all the struggles.

3. The STEM initiative in schools

SEEDSTEM, an initiative targeting Government aided primary and secondary schools for providing STEM and Astronomy Education to underprivileged children through hands on learning methodologies. The program induces new thoughts for scientific development and upgrades the thought process in young brains. Apart from the totally technical and subject related classes, children are also taught organic agriculture, waste management, sanitation, composting, arts and crafts etc for their all round growth.

Fig.1- SEEDSTEM children & Hands on Activities

4. Conclusion

This program has been envisaged and implemented in order to engage more school children in STEM & Astronomy fields, to develop a passion for discovery and innovation, to tap their latent talents, to make them think out of the box and to induce more women to choose these fields for their career.

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Astronomy for Justice-Involved Youth

Mario A. DE LEO-WINKLER*1

Abstract. This is an invitation to a dialogue between the author and attendees of the CAP 2018 meeting. After 4 years of communicating astronomy to justice-involved youth in Mexico and half a year in the USA, I want to share my findings and experiences to encourage people to approach these neglected communities in their home countries.

1. Introduction

Youths in court schools (Riverside, CA, USA) or adolescent communities (Mexico City, Mexico), are teenagers who have been accused of committing a crime and have to be kept in detention. These youths will eventually return to their respective communities, unfortunately reports show that recividism rates (reincarceration) are high in Mexico [1,2] and the USA [3]. However, research shows that education helps reduce these rates [4,5]. Astronomy has a significant edge over other sciences to call upon the interest of the public [6]. Astronomy-related activities in these court schools and communities are an effective way of getting teenagers engaged with science, and possibly continue their studies once they return to their respective communities.

2. Summary

In Mexico, teenagers are only sent to adolescent communities if they are older than 15 and their offense has been considered serious by the judge [1]. They are released when they reach the age of 18 (at the latest), without a criminal record [1]. Together with the free (or low-cost) public education system of the country, this allows teenagers to have an opportunity to retake their studies and consider pursing higher-level education. While staying within the Mexican adolescent communities, students receive an education, however, providing an education is not stated as a responsibility of the system; as an example, the total budget for educational supplies was zero in 2016 [2]. Additionally, once the students are released, there is no follow-up on their education. Therefore, the system relies on non-profit organizations to provide some or most of the (extracurricular) education [2]. I worked in Mexico City in 5 different adolescent communities during 4 years, to engage, excite, and informally educate youths. Activities included talks, hands-on experiments, movie screenings and telescope viewings. Our presence was sought out, appreciated, and awarded by administrators of the adolescent communities.

In the USA, teenagers in court schools are released with a criminal record. The court schools also report that 81% of their population is socioeconomically disadvantaged [7]. These two factors contribute to a vicious cycle, in particular considering the high cost of higher-education in the country, and background checks on students. However, the court schools do provide a structured education, and require that their population gets a high-school diploma while in the system or after being released. We found that this structure limited the amount of outreach and informal education we could achieve within the system. I performed activities in the court schools, and found a captive audience, but found that the administrators were not eager to make time for these informal education engagements. They either considered them unnecessary or disruptive of their educational schedule. We decided to temporarily stop the activities until we could review their pertinence.

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SESSION III:

Astronomy Communication for a Better World

Communicating Astronomy
with the Public Conference 2018

The Dark Side of the Universe for Everybody

Hitoshi MURAYAMA

Director of the Kavli Institute for the Physics and Mathematics of the Universe (Kavli IPMU), University of Tokyo

I'm not a professional science communicator, just one enthusiastic outreach practitioner. I'm not an astronomer either. So, why am I here? My answer to that is that I've given a lot of public lectures, written popular science books, shown up on TV—I did a lot of trial and error to see what way of explaining things wouldn't work, and what other ways actually do seem to work, so that's the strength I got, as I'm standing here in front of you today.

If you're looking at beautiful astronomy pictures, they really captivate the minds of young children, all the way up to grownups—it's not so difficult in astronomy to capture people's imagination and interest. But the minute you actually go beyond that, things become very difficult, because you get into thermonuclear equilibrium, magnetohydrodynamics, relativity and all that stuff, and we scientists are notoriously bad at talking to the general public and for good reason. First of all, we're weirdos—we all know that, and we care too much about making accurate statements, and that actually makes messages a bit difficult to absorb. And we use too much technical jargon, that's another problem we often have… but we do know what we're doing and we're excited about it.

So, there must be a way of communicating the forefront research and difficult concepts to the general public in some meaningful way. And the rest of my talk, the full explanation of the whole of the concepts—I'll present to you my trial and error and what seems to work—requires mathematics. And that doesn't work—clearly wouldn't work. But mathematics is a form of language, and if you can find a way of translating what's written in mathematical language into plain English, maybe at least we can convey the sense of what we're talking about. So, that is what we're trying to do here.

In general, if we're looking at modern cosmology, you're trying to answer questions like "How did we get here?" To understand that question, we need to study the evolution of the Universe, and for that purpose, we need a time machine. Okay. So, we want a time machine. And what are the time machines? The giant telescopes and particle accelerators. These are the time machines. And that's the way I introduce these instruments, and when I tell them that Andromeda is 2.3 million light years away from us, so while we're staring at a picture it's an image of 2.3 million years ago, that doesn't seem to get anywhere. But when I try to switch the roles around, and just tell them to imagine an alien in Andromeda pointing a telescope towards us, what are they going to see? And what they are going to see is us as apes, the way we used to be 2.3 million years ago. And just by switching the roles around, this seems to get much better attention and they seem to understand this a lot better. If you go to even farther objects like a cluster of galaxies, two billion light years away from us, an alien in the cluster of galaxies pointing a telescope at us would see us as a single cellular organism. So, this starts to give the general public an idea of the sort of élan involved in this business. And the most distant galaxy ever, as we all know, is 13.3 billion light years away from us, redshift of 9.6—of course, I don't mention that—but anybody living there pointing a telescope at us, what they are going to see? Nothing, because the Sun wasn't born, the Solar System wasn't here. So, this is the way I always try to convey the sense of the length of time, the vast length of time, and also the roles of the distance switching now into the time. And after explaining this, when I tell them, well, we think the Universe started 13.8 billion years ago, with a big bang, so if you actually look 13.8 billion light years away from us, you can see the Big Bang, you can see the hot dense Universe. The Cosmic Microwave Background Radiation is a picture of the Big Bang. So, if you look far away, you can see way far back in time and that is how we can even see the Big Bang today and that makes all the talks of Big Bang a little bit more real.

I also tell the general public that dark matter is our mom. So, dark matter has this slight variation in densities at the beginning and where dark matter is a little more dense, that's the gravity that pulls more stuff in, and then you have a more dense area that has even stronger gravity that pulls even more stuff in—at the end of the day, this develops into a big contrast between dense spots and sparse spots. This is my translation of the Jeans instability (gasp) into plain English. As a result, the stars and galaxies were born because of the gravitational pull by dark matter. We don't know what it is, but it played the role of "giving birth to us", so that's why I say dark matter is our mom. But nobody has met dark matter yet. We haven't met her, so this is the mom who got separated at birth, so that's why you want to go and chase her and see her and thank her—at the end of the day that is why we're interested in the nature of dark matter. So, this is the kind of single statement, a take-home message, dark matter is our mom, that people might hopefully remember. They may not remember all the arguments and evidence and pictures in the course of the talk, but they might remember the single statement that dark matter is our mom.

If you Google it, you can easily find a video by George Smoot, a Nobel Laureate who had taken a picture of the Big Bang for the first time, back in 1992–1993. What he did is to use the marching band of the UC Berkeley football team and let them reenact the Big Bang. So they gathered together in the middle of the field and they were playing a "fast tempo" music representing high temperature. Then they started to spread out, the people had to run like crazy and play a random motion for a while and George tells them to start finding six buddies and form an elliptical galaxy. Some others form a spiral galaxy, and there's the tuba section who don't want to run, of course, so they stay in the middle and create giant spirals, just like Andromeda or the Milky Way, and he's sitting at the middle of it, so he represents the super massive black hole. And 80% of the members of the marching band are dark matter, so you don't get to see them either, but that's the way the Universe evolved, from a very dense pack of stuff into the stars and galaxies we see today in telescopes.

I also talk about the idea that maybe we can make dark matter, and that the way you might be able to do it is to build giant particle accelerators—you can smash particles against each other to recreate what the Universe was like at the very beginning, and hopefully, we can make dark matter. That concept is also very foreign to most people.

And the way you explain it is by using tricycles. What you do is to run these tricycles like crazy to build up enormous speed and energy and smash them against each other, and once these tricycles have incredible energy, this is only one equation I show E equals MC squared, E is energy and M is mass, so, this incredible speed and energy of tricycles can turn it into mass and then out comes an airplane and a tank. And that is what particle accelerators do, right? You can create things that didn't exist before, energy turns them into something totally new. And if one of them, the tank, happens to be dark matter, we don't see it. But you can tell that, because there's an airplane. If something goes in that direction, it should be balanced by something else, so now we can tell that we made something invisible in a laboratory. So, that is the way I explain the concept of particle accelerators.

Now comes matter-antimatter symmetry. When the Universe was very hot and dense, there was a huge amount of matter and antimatter. Let us say for one billion antimatter, there was one billion matter, so that when matter and antimatter meet, the Universe expands and cools, they meet and matter and antimatter annihilate back into pure energy one-to-one, so we basically lose pretty much all of them, but there we are, that's us. So, if there weren't for this tiny bit of difference between matter and antimatter, you wouldn't be here today. So, this really has to do with a question: Why do we exist? How did we get here? Why are we here today? So, clearly, the matter won. Right? At the expense of a billion friends, we should be very grateful to them. We don't know why we won. And that is something we would like to understand too. So, as far as we can tell, matter and antimatter are always made one to one, so the Big Bang would lead to the same amount of matter and antimatter. If this were the case, they eventually meet, the one-to-one universe would be empty, and nobody would be sitting in the audience here today. So, something must have happened to turn one antimatter out of a billion into matter somehow. The only thing that can do is to take something that can turn from antimatter to matter, but we know antimatter and matter have opposite properties like electric charges. If the antimatter has charge 1, matter has charge -1, there is no way +1 can turn into -1. There's only one elementary particle that might be able to do it, and it's the neutrino. Because the neutrino doesn't have a charge, charge 0, antineutrino, and charge -0, the same thing as 0 neutrino, -0 and 0 are the same, so potentially, the neutrino can play the role of turning antimatter into matter so that we survived the Big Bang. So, to reinforce the point, I show a picture of The Incredibles with a neutrino in it. And so, this is the way of communicating the idea that neutrinos might have played the role of guardian that allowed us to survive the Big Bang. So, dark matter is mom, neutrino is the guardian. People often ask me, "Who's the father?" and I respond, that's inflation, because inflation was supposed to provide the seed of small variation that eventually got amplified by mother of dark matter to lead to stars and galaxies. So, that's the entire family here today. And that's the way I try to communicate that idea.

So, lessons learned after my all kinds of trials and errors is just try not to gloss over. Even if there's some difficult concepts, at least you can do something about them, and what we need to do is do a translation. And just like when you do a translation from Harry Potter in English to Harry Potter in Japanese, some things do get lost, you know, some nuances. Some jokes don't translate. The reason why you have to kiss under mistletoe, that's not the cultural background Japanese people share, so there are a lot of things that get lost in translation. But at least you get the story across, and that's what we need to do.

My goal with outreach is really meant to be entertainment. If you're giving a public lecture in an hour, there's no way you can teach physics and astrophysics. You can't tell your audience about laws of gravity, but at least you can try to fascinate them, and if they have a few take-home messages like dark matter is our mom, neutrinos maybe our guardian, I think that's a success—good enough for me in doing public outreach. This is the way I try to communicate the sense of what we're excited about, even though all the concepts at the front research are very difficult to absorb, hopefully, a lot of people can at least get the sense of what we're trying to do, why we're doing it. And in the end, that really touches on sort of the human nature we'd like to understand, where we come from, where we're going, and who are we? Why are we here? And all these questions tie up with—touch on—these fundamental questions of humanity, so I hope that science communicators who are much more professional than I am can get the hang of how to attack the dark side.


The Movie
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|Plenary Talk|

Astrophysics Engagement with Low Science Capital Communities: a Case Study in Blackpool, Lancashire

Robert W. WALSH*1 and Cherry CANOVAN*2

Abstract. Funded by the UK Science and Technology Facilities Council, Blackpool PIER (Physics: Inspire, Engage, Research) is an intensive, three-year longitudinal programme working with a targeted group of young people in an area of high deprivation in the North West of England. The project aims to increase the participants' science capital via a series of interventions including school visits and trips based on astronomy and astrophysics. The work includes a meticulous evaluation strategy to provide a sound evidence base of the efficacy of such interventions, which is benchmarked against results from the UK national ASPIRES survey.

1. Introduction: what is science capital?

Science capital is a concept developed to explain why some young people feel that science is 'for them' while others do not. It is used as a tool to determine what influences a young person's science identity and prospective future participation in science.

Factors influencing science capital include scientific knowledge but also elements such as participation in out-of-school activities, consumption of science-related media, and family attitudes.

Science capital theory was developed by Archer et al drawing on data from the national UK ASPIRES survey into young people's science and career aspirations [1]. ASPIRES carried out over 19,000 surveys over five years, gathering data from young people from a range of socioeconomic backgrounds in the 10-14 age group. Surveys were administered beginning in year 6, the last before the transition to secondary education, and ending in year 9.

Research from ASPIRES shows that while young people are generally interested in science, this does not translate into a desire to 'become a scientist' [1]. School pupils from underrepresented social groups are less likely to perceive the broad utility of science qualifications, or know what careers there are in science [2]. In addition, the stereotype of the 'brainy scientists' may be off-putting for some, with the family's science capital as a whole very important.

2. About Blackpool

Located on the Irish Sea coast of Lancashire, North West England, the seaside resort of Blackpool holds a unique place in the affections of generations of British holidaymakers. The town's iconic landmarks are well known – the Blackpool Tower, the Pleasure Beach as well as the three piers bounding a two-mile stretch of promenade known as the Golden Mile. After a busy summer season, early autumn in the resort focuses on the Blackpool Illuminations, an annual light show along this seafront.

However, for those living in large parts of Blackpool, life paints a very different picture. Official government statistics from the "2015 Indices of Multiple Deprivation" reveal Blackpool was ranked England's fourth most deprived area. The percentage of pupils achieving five or more A*-C grades at GCSE or equivalent including English and Maths in 2014/15 was less than 43% in Blackpool compared to a national average of 65%. Subsequently, less than 12% of young people will enter Higher Education. This town is an example of an area of low science capital.

3. About Blackpool PIER

In September 2017, the UK Science and Technology Facilities Council through their Leadership Fellowship in Public Engagement scheme funded Blackpool PIER (Physics: Inspire, Engage, Research). The fellowship focuses on working with low science capital young people in Blackpool, with activities designed to increase their overall science capital in four separate themes:

(i) What science/astronomy they know (scientific literacy);
(ii) Who they know who is involved in science/astronomy – have they met a scientist?;
(iii) How they think about science/astronomy – how useful is science?
(iv) What they do that is science (astronomy)-related (out of school, with family etc).

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The project consists of school visits, teacher CPD and community events, plus trips to specialized facilities at the University of Central Lancashire (the UCLan/Ri Young Scientist Centre and Alston Observatory) with astronomy-based activities. Complementary to the ASPIRES approach, PIER research and evaluation focuses upon the observable improvement of a series of science capital metrics based on the four themes above.

Blackpool PIER will run for three years tracking 90 school pupils as they progress from Year 6 (Primary; age 10-11) through to Year 8 (Secondary; 12-13). Pupils were surveyed and interviewed about their attitudes to science and their interest in space and astronomy at the beginning of the programme. A series of evaluations, allowing researchers to fully assess the impacts of the project, will take place at regular intervals for its duration.

3. Preliminary base-line survey

Participants were in general very enthusiastic about science, and particularly space science. We compared their science attitudes and aspirations to national data collected by the ASPIRES [1] and found that the PIER cohort were uniformly more positive. We attribute this to an initial intervention effect given the pupils' excitement about the project.

However this enthusiasm did not translate strongly into a desire to work in science or 'be a scientist' (see Fig. 1). This was one of the key findings of the ASPIRES study, which found that young people are interested in science but do not see it as 'for them'.

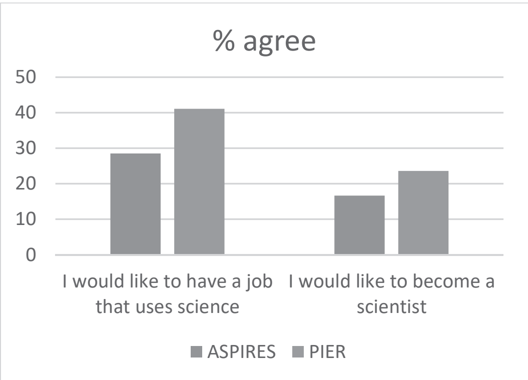

Fig. 1. Percentage of pupils who agree that they would like to work in science; PIER cohort and national ASPIRES findings.

When we focus on space science specifically, we find a similar pattern. Pupils were overwhelmingly interested in the subject; however less than a third of them knew how this could translate into a future career, and less than a quarter see themselves as potential 'rocket scientists' (see Fig. 2).

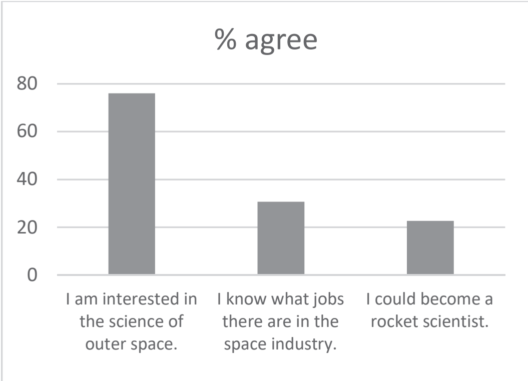

Fig. 2. PIER participants' interest in space science, knowledge of jobs, and belief that they could become a 'rocket scientist'.

In one-to-one interviews, the PIER children said that studying science was useful but were vague as to why. Similarly, participants thought that there might be lots of jobs in science but were unsure what these might be, with nebulous ideas about 'outer space' and 'mixing chemicals' the most frequently cited.

4. Summary

Blackpool PIER aims to address low science capital in a target geographical area through an intensive, longitudinal intervention combined with comprehensive evaluation designed to study the programme's efficacy. This will enable STFC and other widening participation bodies to position any future such endeavours within the context of a solid research base.

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GalileoMobile: 10 Years of “Under the Same Sky"

Marja K. SEIDEL*1, Sandra BENITEZ, Fabio DEL SORDO, Jorge RIVERO and GalileoMobile*2

Abstract. GalileoMobile is an itinerant, non-for-profit outreach project that shares astronomy with students and teachers in schools and communities worldwide. The team is comprised by a group of volunteer astronomers, educators and science communicators around the world. Since its inception in 2008, GalileoMobile has reached 1,400 teachers and 16,000 students, donating more than 100 telescopes and organizing public events for more than 2,500 people in 14 countries. GalileoMobile shares astronomy across the world in a spirit of inclusion, sustainability, and cultural exchange to create a feeling of unity under the same sky. In this contribution, we give an overview of GalileoMobile's vision and goals, we present major achievements and lessons learnt from the past 10 years, give recommendations to develop similar initiatives and discuss our plans for the 10th anniversary celebration, as well as the future of GalileoMobile.

1. Introduction

GalileoMobile's 10 years' journey has been remarkable from its very beginning in 2008, when we had our first meetings to prepare our first expedition during the International Year of Astronomy 2009. Since then, we have envisioned astronomy as a tool to bring people together, overcoming cultural and political difference, and this is exemplified by our latest project “Columba-Hypatia: Astronomy for Peace” in Cyprus, in 2017, where we reached out to children from both the Turkish-Cypriot and Greek-Cypriot communities in the island.

GalileoMobile has provided schools and teachers of 14 countries with the tools and knowledge to run astronomical activities independently, facilitating their sustainability through teacher workshops and community building. It also encouraged peace and mutual understanding by acknowledging, alongside modern scientific views, traditional knowledge related to astronomy and the cosmovision of the communities visited. In this respect it is important to highlight the continuous work of the project with indigenous communities in Brazil.

Over the past 10 years, GalileoMobile has collaborated with the major astronomical organizations worldwide and has been identified by the European Commission as an example of Best Practices in Science Education for Responsible Citizenship (European Union 2015).

The project has also inspired different organizations and individuals to organize similar initiatives in countries such as India, Nepal, Colombia, Dominican Republic, Haiti, and Chile as well as served as advisor for different astronomy outreach projects.

With three documentaries, several short films and a photo-book about our expeditions, the project also exploits the importance of audiovisual media and powerful storytelling to share our experience with a wide audience in order to inspire initiatives with similar vision.

Finally, GalileoMobile has also fostered a generation of astronomers, educators and science communicators who recognizes the power of astronomy for development and has independently build up an open platform to develop their passion and inspire others in their common journey.

2. Reaching rural communities

Reaching rural communities, usually distant from outreach initiatives, has been a main focus of GalileoMobile since its beginning. The materials for our workshops are therefore basic (transport is often a challenge) and yet effective.

Fig. 1: During one of our expeditions in India — looking at the Earth “from Space” without borders.

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We usually bring an inflatable Earth, where our planet is depicted exactly as seen from space, without political borders (see Fig. 1). With that, we start introducing the different perspective that astronomy offers of our planet in the vast Universe.

For more practical experiences, we also organize telescopes and educational material donations like books or posters for the participating schools.

3. Sustainability through teacher trainings

In order for our programs to continue, it is however crucial to have a strong group of local collaborators. During our expeditions, we always dedicate a significant amount of time to teacher trainings.

Figure 2 shows a group of teachers learning about one of the solar activities from our handbook. Over the years, we have not only compiled a number of different activities, but have also translated this handbook from English into 5 other languages, working on more. Downloadable versions can be found online.

Fig. 2: Teacher training during an expedition.

In some occasions, these programs have even inspired more locally lead initiatives in the spirit of GalileoMobile.

4. Sharing our experience

Apart from sharing our work through the activity handbook, we also have developed several documentaries, which again are public on our webpage and are available with subtitles in several languages. Figure 3 shows the opening of the documentary on our Africa expedition in Uganda.

These documentaries are intended to reach an even larger audience, share our work and inspire similar initiatives.

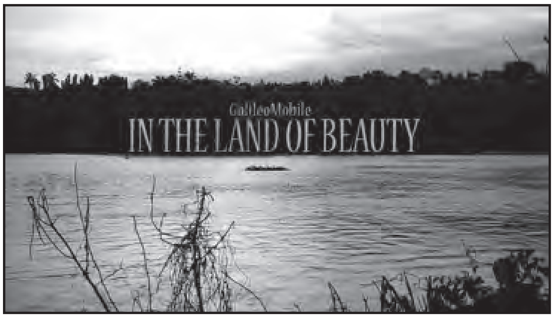

Fig. 3: GalileoMobile documentary on the Uganda expedition.

5. Summary and Conclusions

Over the last ten years, GalileoMobile has had indeed an impact on many people, summarized in numbers in table 1, also showing an estimate of our telescope donations.

Table 1. GalileoMobile in numbers

	Number of participants/tools
Students	~16000
Teachers	~1400
Telescope donations	~100
General Public	~2500
Countries visited	14

We are determined to continue our work in the future and are already planning and running new projects worldwide this year (2018).

More information about GalileoMobile can be found on our website: http://www.galileo-mobile.org/ our facebook: www.facebook.com/galileomobile.org/ and our twitter: www.twitter.com/galileomobile

|Parallel Session|

South East Asia Astronomy Network: from Familiar Friends to International Collaboration

Supaluck CHANTHAWAN*1

Abstract. In 2007 the South East Asia Astronomy Network (SEAAN) was founded by a group of old friends from the Indonesia, Malaysia, the Philippines and Thailand with its aims to strengthen the collaboration in research work and astronomy education in the region. Initially, the founders hope only to see the connection and participation between the astronomy-related people in these 10 countries. This is simply in order to exchange the knowledge and develop astronomy in the region. At that time, the four science-working groups are established; i.e., Radio Astronomy, Optical Astronomy, Theoretical Astrophysics & Cosmology and Cosmic Rays & Solar Physics. As one of the founder and as a Regional Office of Astronomy for Development, Thailand by National Astronomical Research Institute of Thailand (NARIT) takes an important role in facilitating the activities of SEAAN where the international collaboration was consolidated into a concrete initiation.

1. Introduction

NARIT initiated the Southeast Asia Astronomy Network (SEAAN) with its aim to strengthen the research work and education activities among the ten member countries in South East Asia, having SEA-ROAD as the vital driving mechanism. South East Asia has always been a fine example of regional cooperation in the field of astronomy and groups such as the South East Asian Astronomy Network and the South East Asian Young Astronomers collaboration show how the astronomy field can be developed more effectively as a region.

2. Idea for collaboration development

2.1 South-South bilateral collaboration

Myanmar

- Curriculum development for 41 Universities in Myanmar (funded by OAD in 2016) : Physics Department of Mandalay University aims to revitalize and promote astronomy education for undergraduate students in the country, therefore SEAAN willingly steps in to be a part of this project.
- Telescope donation and Workshop at Mandalay University

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- Telescope donation and Workshop at National University of Laos, Vientiane

Fig. 1 the 1st Solar Observation at Mandalay University

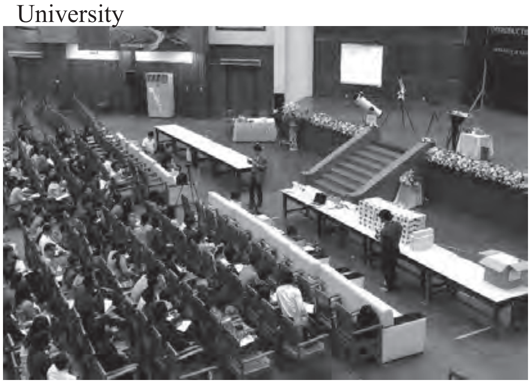

Fig. 2 Myanmar teachers during assembling Galileoscope with NAOJ

2.2 Recognition by government

As Human Capacity Building, Innovation society, Science, Technology and Innovation strategy are included in National roadmap of Thailand, SEAAN considers this as a good opportunity for astronomy development in the region, not only in education development but also in terms of fundraising.

After Agreement Signing between UNESCO and the Royal Thai Government for the establishment of International Training Centre in Astronomy under the auspices of UNESCO (ITCA) hosted by NARIT, the first-ever centre under the auspices UNESCO the in Astronomy, this centre is particularly important tool for Thailand in order to reserve a certain budget annually from the government.

Fig. 3 ITCA was endorsed in November 2015 during the 38th UNESCO Genernal Conference in Paris

Fig. 4 Agreement Signing between UNESCO and the Royal Thai Government for the establishment of International Training Centre in Astronomy under the auspices of UNESCO (ITCA)

Thailand International Cooperation Agency, Ministry of Foreign Affairs is one the organisation which is responsible for the implementation of Thailand's development cooperation programmes in neighbouring countries in particular with its aim to take a leading role in conducting the development cooperation with other countries especially CLMV. As such, Thailand joins ODA as a new donor.

Table 1. Bilateral Grant Aid as Non-DAC Donors* Sector: Astronomy

Country	In cash (THB)	In kind (THB)	Total (THB)
Cambodia (specialists)	-	332,748	332,748
Lao PDR (specialists and equipment)	-	266,392	266,392
Myanmar (fund, specialists, equipment)	200,000	652,760	852,760
Total	**200,000**	**1,251,900**	**1,451,900**

*This is only the Grant Aid offered by NARIT to CLMV, reported to Thailand International Cooperation Agency, Ministry of Foreign Affairs in 2017.

3. Summary

In SEA region, the concrete international collaboration can be initiated from the discussion between friends, networks and communities. However, in order to put forward the activities, Thailand still require to secure funding from the government. Awareness in society must be raised. Recognition by the government is essentially important as well as maintaining the good relationship and extending the collaboration.

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|Parallel Session|

Columba-Hypatia: Astronomy for Peace

Francesca FRAGKOUDI*1, Marja SEIDEL*2 , GalileoMobile*3
and the Association for Historical Dialogue and Research*4

Abstract. "Columba-Hypatia: Astronomy for Peace" is a joint astronomy outreach project by GalileoMobile and the Association for Historical Dialogue and Research (AHDR) which takes place on the island of Cyprus. The project aims to inspire young people, through astronomy, to be curious about science and the cosmos, while also using astronomy as a tool for promoting meaningful communication and a culture of peace and non-violence. We conduct educational astronomy activities and explore the cosmos with children and the public, bringing together individuals from the various communities of Cyprus 'under the same sky' to look beyond borders and inspire a sense of global citizenship.

1. Introduction

The "Columba-Hypatia project: Astronomy for Peace"[1] is a joint astronomy outreach project by GalileoMobile and the Association for Historical Dialogue and Research (AHDR) taking place on the island of Cyprus. The goal of the project is to use astronomy as tool to promote a culture of peace and non-violence on the island. The two main ethnic communities of the island, the Greek-Cypriots (GC) and Turkish-Cypriots (TC) have been living separated from one another for over 50 years in a post-conflict environment. While border crossings were opened in 2003 — which has allowed access to both sides of the island — interaction and cooperation between the two communities is still rare.

Through this grass-roots initiative, the Columba-Hypatia project aims to inspire children and the general public to be more curious about science and the Universe, while also bringing together children and adults from the two communities to break down prejudices and misconceptions, thus promoting meaningful communication.

The project had a pilot run in 2016 and subsequently ran throughout the year of 2017. It was funded by the International Astronomical Union's Office of Astronomy for Development (OAD). Additional educational materials were donated by the European Southern Observatory's education and Public Outreach Department (ESO ePOD), Universe Awareness (UNAWE) and telescopes were donated by Meade instruments .

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2. GalileoMobile & AHDR

GalileoMobile is an itinerant, non-profit outreach project that shares astronomy with students and teachers in schools and communities worldwide. The team is comprised by a group of volunteer astronomers, educators and science communicators around the world. Since its inception in 2008, GalileoMobile has reached 1,400 teachers and 16,000 students, donating more than 100 telescopes and organising public events for more than 2,500 people in 14 countries. GalileoMobile shares astronomy across the world in a spirit of inclusion, sustainability, and cultural exchange to create a feeling of unity under the same sky.

AHDR is an intercommunal organisation based in Cyprus whose mission is to contribute to the advancement of historical understanding amongst the public and more specifically amongst children, youth and educators by providing access to learning opportunities for individuals of every ability and every ethnic, religious, cultural and social background, based on the respect for diversity and the dialogue of ideas.

3. Execution of Project

The main phase of the project began in 2017, and ran throughout the entire year. The project involved mono-communal school visits — where trainers visited GC and TC schools separately in Cyprus — and bi-communal activity days, were children from GC and TC schools came together in the "buffer zone" at the Home for Cooperation, to meet each other and participate in astronomy activities. The buffer zone is a United Nations controlled area between the two communities. We also carried out afternoon/evening events for youth as well as for the general public, such as a bi-communal summer camp, astronomy outreach talks, astroparties, etc. The main focus of the project was on the mono-communal school visits and bi-communal activities, since these could reach the most diverse audience and have the largest impact. The numbers of participants are listed in Table 1. For the astronomy activities we used the GalileoMobile Handbook of activities[2] adapted for the activities and translated into Greek and Turkish.

Fig. 1. The Cyprus Golden Record, constructed by the participating children in one of the bi-communal activity days. *Credit: Columba-Hypatia project.*

3.1. Mono-communal visits

During the mono-communal visits we focused on introducing the children to the project, and to basic astronomical concepts. The activities were chosen to give the children an idea of the place of the Earth in the context of modern astronomy, to introduce them to the vast scales and sizes of the Universe (e.g. comparing the sizes of stars and planets, while also observing the Sun through solar telescopes). We also carried out activities with the UNAWE Earth Ball to show how the Earth looks from space and introduce the concept of man-made borders.

3.2. Bi-communal days

During the bi-communal days, children from the GC and TC communities came together in the buffer zone to participate in astronomy activities. The main two activities carried out were "Building a Cyprus Golden Record" and "Building Constellations in 3D". The former, allowed the children to be split into mixed groups and discuss between them what they would send to an alien civilisation as a representation of the whole of the island of Cyprus (see Fig. 1). This allowed the children to get to know each others' cultures, and to discover the many similarities between them.

The latter activity introduced the concept of viewing objects (in this case, a constellation), or indeed situations, from different angles, and how our perspective can change depending on our viewpoint.

Table 1. Number of participants

	Number of participants
School children	~190
Teachers	~20
Youth	~100
General Public	~150
Documentary views	~4300

4. Impressions, Feedback & Evaluation

The project was well received both by the teachers as well as the children who participated. The participants showed enthusiasm and genuine curiosity about members of the other community, and reported feelings of improved understanding and empathy of each-other after the bi-communal visits (c.f. the short documentary of the project [3]). In order to measure this effect in future instalments of the project we plan to evaluate the impact of the project and the "Pale blue dot effect". This latter effect is one in which "*…knowing one's place in the Universe alters perception and induces more empathy towards fellow humans.*"[4]

5. Summary

Through the Columba-Hypatia project, we experienced how effective astronomy is in promoting a feeling of global citizenship and a culture of peace, enabling children to broaden their views and interactively explore together their place on Earth and, specifically for our project, on the island of Cyprus. The project was implemented successfully during 2017, and current and future instalments are ongoing and planned for the coming years.

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|Parallel Session|

Astronomy Communication for a Better World: Teen Astronomy Cafés

Constance E. WALKER*[1] and Stephen M. POMPEA*[2]

Abstract. The Teen Astronomy Café program is a free out-of-school program that offers high school students opportunities to interact with scientists who work at the forefront of astronomy. The program aims to elevate student achievement and desire to go to college, and perhaps inspire some students to pursue a career in science, technology, engineering, or mathematics. Once a month on Saturday mornings, students explore the lives and deaths of stars, killer asteroids, the structure of the universe, gravitational lenses, dark energy, dark matter, colliding galaxies and more. After the scientists provide a short presentation, students experience a computer lab activity related to the short presentation, using actual computer programs and data that the scientists use. Dissemination to other communities is a possible plan in the future.

1. Overview

The Education and Public Outreach group at the U.S. National Optical Astronomy Observatory has designed an outside-of-school education program to excite the interest of talented youth in future big data projects like the Large Synoptic Survey Telescope (LSST) and the NOAO (archival) Data Lab – their data approaches and key science projects. Originally funded by the LSST Corporation, the Teen Astronomy Café program cultivates talented youth to enter Science, Technology, Engineering and Math (STEM) disciplines and serves as a model to disseminate to the 40+ institutions involved in LSST.

Fig. 1. A student youth leader reviews the progress of two high school students doing research using the computer programs provided by the astronomer. [C. Walker]

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One Saturday a month during the academic year, high school students have the opportunity to interact with expert astronomers who work with large astronomical data sets in their scientific work. Students learn about killer asteroids, the birth and death of stars, colliding galaxies, the structure of the universe, gravitational lenses, dark energy, dark matter, and more. The format for the Saturday science cafés has been a short presentation, discussion (plus food), computer lab activity and more discussion. They last about 2.5 hours and have been planned by a group of interested local high school students, an undergraduate student coordinator, the presenting astronomers, the program directors and an evaluator.

High school youth leaders help ensure an enjoyable and successful program for fellow students. They help their fellow students with the activities and help evaluate how well the science café went. Their remarks shape the next science café and improve the program. The experience offers youth leaders ownership of the program, opportunities to take on responsibilities and learn leadership and communication skills, as well as foster their continued interests in STEM.

Highlights from the extensive independent program evaluation from the January to May 2017 semester showed the program to be highly effective in exciting students about the process of science and the role of large datasets in astronomy investigations. Our science cafés demonstrated that NOAO scientists play a key role in increasing student interest and curiosity about their research and in helping students get a sense of scientists as people. The cafés also demonstrated that scientists can help students see how research connects with issues important to society, and with students' daily lives.

Fig. 2. Youth leaders (standing) facilitate a computer activity. [C. Walker]

Fig. 3. Dr. Lori Allen discusses killer asteroids, comets & meteors with a youth leader. [C. Walker]

Fig. 4. Students show Dr. Dara Norman results from simulating galaxies crashes. [C. Jones]

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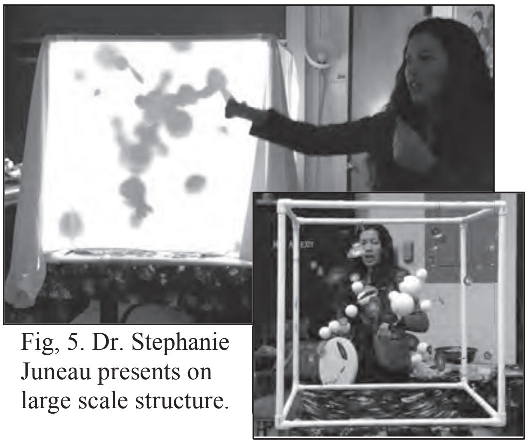

Fig, 5. Dr. Stephanie Juneau presents on large scale structure.

Our Teen Astronomy Cafés are running from October 2017 through May 2018 this academic year. We are working to highlight STEM career paths more explicitly in the discussion portions of each café, inviting graduate students to lead discussions. In another experiment we have integrated the use of a 3-D printer into the cafés in order to create some astrophysical models from the data. We would like to experiment with some additional tools for data visualization such as the Oculus Rift data virtual reality system and some augmented reality programs for cell phones. We are planning further expansions to the program next year.

Registration and further information can be found at www.teenastronomycafé.org.

Fig. 6. Dr. Gautham Narayan challenges students in a research activity on the life and death of stars. [C. Walker]

Using Both English and Kiswahili to Communicate Astronomy with the Public in Tanzania

Noorali. T. JIWAJI*1

Abstract. The natural fascination of astronomy among children and adults in Tanzania is contrasted sharply by the superstitious beliefs and misconceptions in understanding and appreciating the science to explain astronomical phenomena. To achieve maximum impact there is a need to produce astronomy materials in both English as well as the commonly used local language, Kiswahili, so as to cater for school children, learned people as well as lay audiences. Four decades of writing astronomy articles in newspapers and magazines, as well as recent experiences in organising the major Annular Solar Eclipse that crossed Tanzania on September 1, 2016 are used to show the effectiveness of the bilingual communication. To achieve further success, we highlight the ongoing work of creating sufficient, appropriate and easily understandable Kiswahili terminologies in Astronomy.

1. Introduction

Communicating astronomy to the public was in immediate focus after the International Schools for Young Astronomers (ISYAs) at Nsukka, Nigeria in 1978, and as the IAU Commission 46 Liaison the author gained extensive experience in writing in newspapers, magazines, and journals, producing regular night sky maps for local skies and times in Tanzania [1], [2] with lecture presentations and stargazing sessions in schools and in communities. The need to write in the local language was recognized very early on [3]. The International Year of Astronomy IYA2009 provided a formal opportunity of an international platform to translate the subtitles of the documentary on telescopes [4]. Local and international news media seek Kiswahili experts to explain current breaking Astronomy events in Kiswahili to their audiences in the eastern African region (Fig 1).

2. Extent of Kiswahili Language Use

Kiswahili language (often named Swahili) originated on the east African coastal strip through intermixing of indigenous Bantu people with Arab (Arabic: Sawahil) and Persian sea traders. It is now used by more than 100 million people in eastern African region, with Tanzania, Kenya, Uganda and Rwanda using it as a national language, and Burundi, Mozambique, and the Democratic Republic of the Congo (DRC) as a second language. Kiswahili has a predominantly Bantu grammatical and syntactic structure with several lexical terms borrowed mainly from Arabic and Persian [5], and several other languages [6]. Kiswahili is the largest Bantu language, is the lingua franca of the East African Community, and the working language of the African Union [6].

Fig. 1. Kiswahili speaking part of the world in eastern Africa. Image Credit [5]

3. Kiswahili Usage in Tanzania

Though Tanzania has more than 120 tribal languages, Kiswahili is used by almost the entire population of 50 million with nationalistic pride. Tanzania has triglossic language use, where English is the international language used in higher education, Kiswahili is the widespread national langue (90%), and a smaller African language is spoken in the home [6]. After independence in 1961 Kiswahili became a nationalistic vehicle in uniting the country to phase out tribal differences and is now a mother tongue for nearly 40% of the Tanzanian population [6]. By 5 to 7 years, children become widely exposed to Kiswahili, ready for use as a medium of instruction during the seven years of primary school. Pupils are introduced to English as a single subject without significant outside use. After primary school students have to switch to English, posing immense challenges to learning and performance has suffered [7].

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4. Use of English and Kiswahili

Students' English language shortcoming can be overcome by using attractive information simultaneously in both English and Kiswahili for students to relate technical terminologies and concepts with familiar words in Kiswahili. Astronomy provides this opportunity as was shown practically during the Annular Solar Eclipse event in Tanzania on September 1, 2016 with vigorous media coverage in both English and Kiswahili. Peoples' fears from superstitious and traditional beliefs were overcome to encourage thousands of people to come out to view the eclipse across the country [8]. There is a clear interest in learning astronomy by Kiswahili readers using Swahili Wikipedia pages, as seen from its usage statistics of about 500 pages per day [9]. One attempt to create new words in Kiswahili has started [10], using the 3000-word lexicon of Astronomy terminologies as recommended by the International Academy of Astronautics (IAA) as sufficient for communicating most of the astronomy concepts in the local language [11]. Kiswahili Astronomy dictionary and school texts are also planned. There is a need to derive words for new concepts using familiar Kiswahili words that users can relate the concept. Many attempts at encouraging translations have been presented at this CAP 2018 conference [12], [13] but relying mainly on volunteers. The practice of using professionals as reviewers is necessary as used by the Astronomy Translation Network [12]. Wide dissemination of new terminologies is required through school texts and adding to current dictionaries, in cooperation with editing and national oversight agencies, and airing regular astronomical topics in popular media.

5. Summary

Introduction of simultaneous material in English and Kiswahili for scientific and technical disciplines into the educational system in Tanzania will enhance student and public interest and understanding science concepts and technical competence. Concerted efforts are underway to achieve this using the attractive discipline of astronomy.

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|Parallel Session|

Astronomy for Everyone: The Universe for People Behind Bars

Hamid HAMIDANI[*1,2]

Abstract. In this article I present personal views on "Astronomy" and a very specific "Public". I cover a completely forgotten public; the 10 million people (prisoners) behind bars around the world. I particularly focus on the case of the USA and the challenge the American society is facing. I criticize the current costly and inefficient incarceration system, based on the available data. I review a very interesting initiative, "The Last Mile", where prisoners are taught how to code. I discuss introducing Astronomy teaching to prisoners, following the steps of the "The Last Mile". I argue that astronomy has the potential to succeed; in particular, by changing the prisoner's perspective of themselves and the world. Finally, I argue that astronomy through its nature and history, is a common heritage of all men; and thus should be shared everywhere, even those imprisoned.

1. Introduction

Incarceration is a very ancient invention to restore justice. The idea was that regret; and deep change; would emerge after a harsh punishment. In ancient times, when the world was very simple, it worked quite efficiently, and it kept justice in ancient societies. However, although the world since then is a much more complex place, incarceration has not evolved and is used, massively, with the very same old concept. An analogy to explain this present-day problem, with the language of math, would be as if: an efficient technique previously used to solve a simple problem (e.g. $x + 1 = 0$) with success, is desperately used on a much complex problem (e.g. Einstein field equations), with the expectation that it would work; of course it would not work. Here, I propose to improve the way to deal with prisoners by introducing Astronomy. This paper is organized as follows: in § 2 data is shown and the problem is identified. In § 3, I review a new initiative, "the last mile" and its success at dealing with the problem. In § 4 I present my view and my arguments about introducing astronomy teaching in prisons, in a similar way. A conclusion follows in § 5.

2. Alarming Statistics

The world in 2018 has a dark side, more than 10 million people are behind bars [1]. The USA, is the leading superpower, in economy, military, science, etc. However, it is in the USA where the incarceration problem is the most extreme. Although, the USA makes ~5% of the world's population about one forthof the world prisoners are in the USA. At first, such numbers seem illogical since wealth and development should to be related to stability. However, the reality is much more complex. One example, is wealth inequality; ~76% of the USA's wealth is in the hands of the top 10% while the bottom 50% hold ~1% [2]. Indeed, socially and economically disadvantaged groups are found to be overrepresented in prisons [3]. Moreover, such inequality is expected to worsen even more in the future [4]. This situation is worrying for the whole globe, since the USA's case is extreme because it represents the future. Below are some even more alarming numbers [5,6 & 7]:

i) Since the 1970s, the number of prisoners in the USA has increased by ~700%.
ii) Incarceration is extremely costly; for instance, New York state spends ~60 000 $ a year to keep one prisoner behind bars. (This is in the same order of what a Postdoctoral researcher costs NASA.)
iii) In a state like California, at least 67% of those released in 2005, came back to prison in the following three years.
iv) One in every 28 children in the USA has a parent behind bars.

To summarize, nowadays incarceration is very costly, and very inefficient. Many are trapped in an in-out cycle, and prisons seem to reinforce that trend.

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Mass incarceration with no support, is actually an ideal environment for radicalization, rather than change. A note worthy example, is that almost all individuals involved in recent terrorist attacks across Europe, have been arrested for minor offenses, and it was in prison where they became radicalized. To summarize, I think that a prison with no care or support, is a lazy way to change prisoners or to solve the complexity of the 21st century society's problems.

3. A New Hope: "The Last Mile"

There is hope in a very inspiring initiative "The Last Mile" (TLM) [6]. The initiative is about teaching prisoners how to code. Prisoners are exposed to a new environment of learning, technology and innovation, that would lead to personal "change" in the incarcerated individuals. One impressing statistic, is that none of TLM's graduates have gone back to jail [6]. Also, coding is a skill that enabled many of them to find job after their release. Furthermore, the initiative is financially sustainable.

One big lesson, is that prisoners could be highly committed and devoted learners once a chance is properly presented. As an astronomer, my reflection was, "what if prisoners had the choice: a chance learn and debate on the wonders of the Universe, observe with a telescope, or, go to the gym?".

4. Astronomy's Magic

Astronomy offers what no other discipline offers. Below are some examples: i) **Inclusion**: there is no ethnicity with astronomy, we are all stardust. Race is an insignificant detail. ii) **Humility**: in the scale of the Universe, we are very tiny, and what we sometimes fight so badly for are insignificant details. iii) **Imagination**: The Universe is immensely vast; one practical example: "there are more stars in the sky than grains of sand in all the Earth's beaches". iv) **Connection**: we human are suspended in one planet with no one else around; we are all connected through our planet and we share a common fate. These are some practical examples, but the most precious gift of Astronomy is that it has the power to change one's cosmic perspective, and offers a window for self-understanding and **self-reflection**; something desperately needed for our prisoners.

Furthermore, we are at an era where amateur astronomers can make major scientific contribution. Extraterrestrial planets, or micrometeorites, can now be discovered by amateurs with modest equipment [8]. It would be very interesting to have Astronomy clubs in prisons and to see prisoners learn, or even contribute as citizen scientists.

Note that some French astronomers have volunteered to visit prisoners to talk and discuss astronomy with them [9]. The results are promising, and some guidelines are presented in [9].

5. Conclusion

A paradigm shift is needed to deal with crimes and violence. Incarceration with no care or support can have very negative effects. However, as demonstrated by the last mile initiative, prisoners are committed learners once a chance properly presented. My message is that we should give prisoners the chance to learn, discuss and practice Astronomy. My two main arguments are: First, astronomy can be efficient at making an everlasting change in imprisoned individuals, and break the cycle of imprisonment. Second, above all, astronomy should be introduced to prisoners because its their right. Thousands of years ago, our ancestors started to wonder about the universe, and now that process has resulted in a spectacular understanding of the cosmos and our selves. Astronomy is everyone's heritage by its nature; regardless of the criminal record.

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Astronomy Communication for a Better World: A Workshop on the Quality Lighting Teaching Kit

Constance E. WALKER*[1] and Stephen M. POMPEA*[2]

Abstract. As an outcome of the International Year of Light 2015, the U.S. National Optical Astronomy Observatory's Education and Public Outreach group has produced a Quality Lighting Teaching Kit, The kits are designed around problem-based learning scenarios. The kit's six activities allow students to address real lighting problems that relate to wildlife, sky glow, aging eyes, energy consumption, safety, and light trespass. The activities are optimized for 11-14 year olds but can be expanded to younger and older. Most of the activities can be done within in a few minutes during class or afterschool and as stations or as stand-alones. Everything you need for the six activities is included in the kit. Tutorial videos on how to do the activities can be found at www.noao.edu/education/qltkit.php. Almost 100 kits have been distributed thus far.

1. Overview

The goal of the Quality Lighting Teaching (QLT) Kit program is to raise awareness of the importance of preserving our dark, starry night skies and learn ways to mitigate light pollution. Through the QLT Kit workshop, practitioners will learn how to inspire the public (mainly students) to take an active part in implementing solutions to light pollution.

The kit is designed around problem-based learning scenarios. The kit's six activities allow students to address real lighting problems that relate to wildlife, the night sky, aging eyes, energy consumption, safety, and light trespass. The activities are optimized for 11-14 year olds but are expandable to older and younger ages. They can be done within a few minutes except for the Energy Activity. The activities can be done during class or in an afterschool program and as stations that students rotate through or as stand-alones, one at a time.

In the activities the instructor serves as the mayor of a fictitious city in which the students live. The mayor has been receiving complaints from citizens of the city, which have to do with lights in the city. The students are assembled into six different task force groups to determine the underlying problems, organizing themselves as one task force group per complaint category. Students read the information presented in their group's poster. The poster also gives instructions for a hands-on activity to gain more understanding of the problems, as well as key phrases to do more online research. They use the kit's materials to complete the activity. Using what they have learned, they come up with feasible solutions.

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Fig. 1. The contents of the QLT Kit. [P. Marenfeld]

2. Energy Poster and Activity

In this activity, students are given an aerial nighttime view of Houston, Texas, USA. The students determine how much energy, cost, and carbon footprint this city uses and wastes each night. These values accurately reflect the actual energy usage of Houston as well as the type of lights currently used. Then they determine a more energy efficient scenario by changing the types and/or wattages of the lights, by limiting the time used and/or by limiting the number of lights. How much energy, cost and carbon footprint is saved is determined from the difference between the before and after scenarios. A going further challenges the students to use an ISS image of their city to seek the same objectives.

3. Safety Poster and Activity

It is a common misconception that more light is safer; however, this is not always true. While light is needed to see and be safe at night, poorly designed or placed lights can actually be less safe. Poorly shielded or glaring lights provide areas for criminals to hide; criminals also exploit the false sense of security people feel in overly lit areas. In this activity, students will use a lux meter to measure light levels of different scenarios and compare their results to standardized lighting levels. They determine what minimum light levels are needed for a variety of environments to still be safe while conserving energy, cost and carbon footprint.

4. Animals Poster and Activity

Students in this group will explore how light pollution affects animals, specifically birds. They will play a game in which they are Kirtland's Warblers, which migrate from the Bahamas to the Great Lakes region of the United States and back again. Along the way, they fly through many major cities. Birds and other animals use the sun or stars to navigate, and the lights can confuse the animals causing them to crash into the building or circle it and collapse from exhaustion. In addition, lights can cause eggs to hatch earlier than they would otherwise. All these issues are explored in the game.

5. Glare Poster and Activity

As one of the three main types of light pollution, glare is caused by an exposed bulb. An overly bright bulb can severely impair vision, especially while driving at night. Glare is worse for older adults with aging eyes. When a glaring light enters the pupil in an aging eye, the pupil may not contract and can let too much light in. Therefore, glare can be a significant problem for aging eyes.

In this activity, the students will explore glare from a "headlight" (a capless Mini-Maglite) at night (in a darkened room). They will try to read the eye chart posted 20 feet (6 meters) away. Looking through layers of inkjet transparencies will simulate varying degrees of cataracts from very mild to severe. The students will then explore how cataracts (both with and without a glaring light) can impair their reading ability.

6. Night Sky Poster and Activity

As a second major type of light pollution, sky glow is caused by unshielded lights from a city shining up into the sky. This light scatters off of dust, water, smog, clouds, and other things in the atmosphere creating a light dome or glow over the city. Sky glow washes out the stars from view; as a result, most people in cities have never seen a dark night sky.

In this activity, the students will use a star projector to determine how different kinds of lights and shields affect the number of stars that can seen. The students try different kinds of lights and shields to see the effects on the night sky and come up with possible solutions to mitigate the effect of light pollution.

7. Light Trespass Poster and Activity

The third type of light pollution is light trespass, where light goes where it is not needed, wanted, or intended. The most common example of light trespass is a streetlight shining into a window at night. This can make sleeping (even with curtains or blinds) difficult. Light at night, in particular, can have health effects on humans. Blue light (common in most LEDs) when used at night inhibits the production of melatonin. Melatonin is a hormone, which is only replenished when asleep in the dark.

In this activity, the students will have a 40:1 scale model of a street, complete with a house, a person, a streetlight with a slight drop-down Cobra lens (the book light) and a globe light (Mini-Maglight with the ping pong ball). Students try to recreate the problems voiced in the complaints poster and experiment with the position and angle of the light. They then come up with solutions to keep the light task-oriented.

8. Capstone

After students have completed their research and activities, they present this information to the mayor of the city and other task groups. Presentations can take many forms, such as oral (e.g. Powerpoint) presentations, posters, videos, skits, songs, or brochures. After all groups have presented, the instructor leads a discussion in which the groups meld their ideas. After the presentations and discussion have concluded a short assessment is given to evaluate student understanding and growth during the project. The instructor can include, adapt or omit as much or as little of the above steps as desired.

|Workshop|

What's In It for Me: Bridges among Big Projects and Local Communities

Saeko S. HAYASHI[*1]

Abstract. We, as science communicators, always ask ourselves how to incorporate knowledge gained by the large telescopes with the common understandings of the citizens in the local community. The disconnect be-tween the foreign-funded/operated telescope and the often-rural community where the telescope is located is still very conspicuous. Another gap lies between the citizens reside in the countries where the funding come from, and the telescopes they fund. The science communicators' role in bridging them is ever increasing. By using a couple of recent examples, workshop participants discussed and exchanged ideas what is relevant for their audience, and what aspect they can add to their communications.

1. Introduction

Discovery news on astronomy subject is global and addresses the fundamentals about this universe. That should not be the reason that such topics is out of this world, or has nothing to do with the people in the community. First of all, the quest of the astronomy originates from the curiosity any person would have. CAP Conferences empower the effort of communicators (irrespective of whether paid as such or not) in how to frame the new discoveries from the large telescopes in the context of indigenous culture where such facilities are located, as well as connecting them back with the people in the home countries.

2. Challenges

How do we bridge the questions citizens have with the research questions? How do we respond the request, "What's in it for me?" Quite often we witness that the discovery itself can excite students, especially younger pupils who are genuinely curious about what is happening in the nature. Adults need more persuasion such as the benefit of knowledge which can contribute to the better control of the environment, and the workforce issue in the local community. Take the examples of the telescopes on Maunakea, Hawaii. Their outreach effort has two main branches – one for the grade school students to encourage them to pursue STEM (science, technology, engineering and math) career, the other the human resource development for the local hire. The latter group becomes a powerful source for reaching out to the individuals in the community for long years to come, if properly equipped and empowered by the understandings of the achievement of the facilities they are working.

The workshop was to include anybody engaged in the science communication to discuss in what context the knowledge can be best delivered in their respective professions in their specific circumstances. Even though the knowledge is common, the settings the individuals live are not.

3. Exercises and Discussion

At the beginning of the workshop where about 20 people participated, they were divided into four groups to facilitate the closer interaction – according to the season the individual was born. It was easy for a Chilean participant who was born in July to join winter group. It was not so for people from equatorial regions. They chose their favorite season.

Icebreaker was to pick a favorite object in the sky, tell its name in the language each participant uses and explain the meaning, and if there is a folk tale to share, in English. Many were already in smiles when talking about their fascination.

Exercise 1 to tackle the detection of gravitational wave to discuss what that means for different audience/client – could be school students or general public. One can pick any of these serious items - stellar evolution, compact object, dense matter, stellar collision, nucleosynthesis inside the star or at the time of collision, gravitational wave, Einstein, and so on. I would spare a few minutes to mention the global collaboration that enabled such a study.

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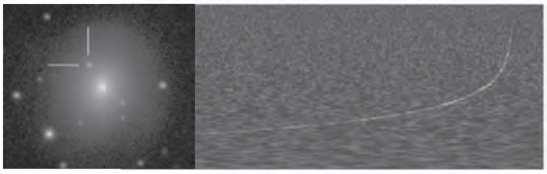

Figure 1. Signals from the first ever recorded collision between the neutron stars. Left is the optical/IR data (Credit: NAOJ/Nagoya University [1]), right is the gravitational wave (Courtesy Caltech/MIT/LIGO Laboratory [2]).

Exercise 2 - how about ‘Oumuamua (the scout), another good example which created much of the buzz in the social media as the first recorded interstellar traveler? One can raise awareness of the near-Earth objects, their implication of the life on Earth, etc. The discussion can go on with the definition of the Solar System versus interstellar space. One can use spacecrafts sent from Earth and now entering the interstellar space. Or one can touch on the technical aspect of the detection or monitoring.

Exercise 3. Suppose the ninth planet of our Solar System is pinpointed by a telescope on Maunakea. The new member will surely be included in the elementary school textbooks world-wide. Will it be something the people in the community can be proud of? How do we explain that the size of the Solar System is much bigger than we think of it is? Or the formation process of the planets and the relation to the natural resources we all use, including, of course, the air we breathe. Such discoveries can become good “talking point” for sharing what we know about our Solar System and the universe beyond.

It is likely that the current generation of telescopes will be able to identify candidate(s) of planet(s) in the far corners of the Solar System, while the characterization of such object(s) require the next generation telescopes. The exploration goes on.

Exercise 4 was to substitute Exercises 1-3 if they are not popular in one's settings with any discovery news from a nearby astronomy facility (or one that is known). One of the radio astronomers picked HL Tau as a good example of the advancement of our understandings of how stars and planets are born. The telescope technology enabled a big jump in the submillimeter wavelength observations when ALMA became operational.

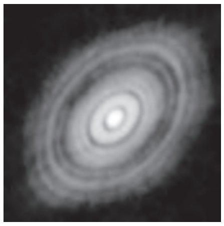

Figure 2. Rings of primordial materials (gas & dust) surrounding a baby star toward HL Tau. There may be planets forming in the gaps of these rings. (Credit:ALMA (ESO/NAOJ/NRAO) [3])

Exercise 5: Talking about the career aspect of the astronomy related work is also very important. To keep a big telescope operational throughout 365 nights a year, staff of special skills work together, and sometimes they may come from foreign countries. It is not only the staff working at the astronomy facilities but also the industries such facilities have dealings with, as well as the telescope builders to maintain their interest for the future projects. For example, the technology dependence of the telescopes requires tight collaborations with electronics suppliers, and as such, the transportation services as well.

Figure 3. Staff at the Subaru Telescope. Left is the daytime workers at the telescope site, right is the staff mainly working at its base facility in Hilo, Hawaii. Not pictured here but essential are of course night staff. (Credit: NAOJ)

4. Summary

Get to know your audience/client and deliver message that you would like to share, in a manner that is relevant for them. All can have fun in that way.

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|Poster|

Communicating Astronomy with the Public 2018: Efforts on Bringing Together the International Astronomy Communication Community

Lina CANAS[*1], Hidehiko AGATA[*2]; Hitoshi YAMAOKA[*3]; Shigeyuki KARINO[*2]

Abstract. Communicating Astronomy with the Public (CAP) Conferences series provides an open platform to exchange opinions and experiences regarding the latest challenges in communicating astronomy with the public. Seeing CAP as an ideal opportunity to bring the international astronomy community to Japan and to directly experience the most recent national and Asian advances in the field, the National Astronomical Observatory of Japan (NAOJ) and Fukuoka City, continuing the efforts made in the past years in Astronomy communication in the country, embarked on a journey to host CAP 2018 edition in Japan. CAP 2018 edition has become one of the largest and the most diverse CAP conferences organized so far. Here we present a quick overview of the lessons learnt & some of the actions carried by the Local Organization on planning and implementing, framing it in the Asia-Pacific context, focusing on the needs of the region and creating an opportunity to making a difference in Astronomy communication in the region.

1. CAP 2018 by NUMBERS - Lessons Learnt

Proposal

Present a clear and (nearly) complete planning since early stages of the proposal; If the conference it's not funded by the central organization, make it your priority to find sponsorship for the venue; Link the scientific goals to regional needs – why do you want to organise the conference? How will your country/ region benefit? Establish a global network since early stages and seek Letters of Endorsement from the community.

The network

Partner with International global institutions in the field to disseminate increase visibility and reach within the community.

Satellite events

Take advantage of the country's regional and local places of reference; Take the opportunity that the community gathered, and connect to other groups in the country or internationally that might want to host worthy events (e.g. Astronomy Education Meeting in Kagoshima, Visit the JAXA Tanegashima Space Center).

The teams

Four dedicated teams were established covering all organizational aspects of the conference: Operations Team; Public Relations Team; Finance Team; Social Program Team. The Local Organization additionally set a National Committee (high-level) to strategically link to other institutions to widen the reach of the conference and engagement within Japan.

Participant support

Identify early needs and possible struggles the participants might find; Lower the Registration Fee by getting full sponsorship for the Venue; Provide grants for the region oriented (e.g. NAOJ Crowdfunding Campaign & NAOJ Grant); Promote workshops tailored to the needs of the region.

Invited speakers & Social program

Seek for the expertise of the Scientific Organizing Committee – they have the network and knowhow; Mind diversity and representativeness of your chosen panel – it will make a difference in inspiring the next generation of people in your audience. Our premise was that, by immersing the participants in some aspects of the Japanese culture would inspire and promote an environment of tolerance and peace that would transpire into our work as communicators. (e.g. Japanese traditional tea ceremony and Noh theatrical play and traditional theatre.)

Summary

NUMBER OF PARTICIPANTS 455
NUMBER OF 1-DAY/2-DAY PARTICIPANTS 54
NUMBER OF COUNTRIES 53
NUMBER OF PARTICIPANTS FROM ASIA-PACIFIC COUNTRIES* 89
NUMBER OF JAPANESE PARTICIPANTS 200
GENDER BALANCE 47% M 33% F (20% NA)
(data obtained from preliminary data gathered on February 2018)
**excluding Japan, accounted for as separate item*

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Astronomy for Development: Communicating How Astronomy is Contributing to Sustainable Development

Ramasamy VENUGOPAL*1

Abstract. Our modern, technological world owes much to science research and investment. But in the recent past, science has alienated itself from the public and public support for science is dwindling in several countries. The relevance of pure science research is being increasingly questioned. Curiosity about the natural world is no longer an accepted justification for science investments. Recently, a handful of organizations from various disciplines (Physics for Development, Data for development, Astronomy for Development) have taken the lead on using scientific knowledge to contribute to the United Nations Sustainable Development Goals (SDG). Using science to directly impact on the world's biggest challenges could both bolster the public view of science and scientists as well as bring science closer to the people.

Since 2011, the IAU Office of Astronomy for Development has been funding and coordinating projects that use astronomy to benefit society. These projects contribute to the OAD vision of using 'Astronomy for a better world'. Astronomy for development, and broadly science for development, provide an approach for communicating the continued relevance of science with the emphasis on people and society. This poster conceptualizes the idea of Astronomy for development including a few practical examples of OAD funded projects that have used Astronomy to impact lives.

1. Introduction

Astronomy is a field that combines science and technology with inspiration and excitement. As such, it can play a pivotal role in facilitating education and human capital development. The skills related to the field of astronomy can be applied to further sustainable development throughout the world. The Office of Astronomy for Development (OAD) is a global office which funds and coordinates projects that use Astronomy as a tool to address one or more of the UN SDGs. The OAD also has 10 Regional Offices and Language Centers which focus on geographic or cultural or language regions around the world.

2. Astronomy for Development: Project Examples

A few examples of 'Astronomy for Development' projects funded by the OAD include: Astro-tourism projects around observatories and astronomy heritage centers to support local economies; using astronomy in the curriculum to spur the interest of students; using astronomy to support inclusion practices to take science to those communities who may have been under-represented etc. These are a few examples from around 125 projects funded by the OAD since 2013.

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3. Science for Development

Every scientific field has its own strengths which can contribute to furthering the SDGs. And working together with other fields is necessary in order to best benefit from such contributions. This leads to a broader Science for Development agenda which provides a medium to communicate the continued relevance of science in society.

4. Summary

In summary, Science for Development makes the relevance of science clearer and provides an approach to communicate science. It could also perhaps influence more members of the science community to take up for-development programs.

|Poster|

Kamus Astro Beta Version: The Indonesian Astronomical Glossary

Ratna SATYANINGSIH[*1], Avivah YAMANI[*1,2] and Wicak SOEGIJOKO[*1]

Abstract. Langitselatan promotes astronomy and shares knowledge to public by providing articles and news on astronomy. In writing those articles we encountered several challenges, such as explaining astronomical terminologies in an easy-to-understand manner and briefly explaining the terminologies without becoming an encyclopedia or wiki article. Moreover, to our knowledge, astronomical terminologies used in academic and professional astronomer communities are mostly in loanwords. Therefore, we develop a glossary site in Bahasa Indonesia named Kamus Astro, which provides description for the terminologies.

1. Introduction

As one of its endeavors to promote astronomy and share knowledge to public, langitselatan provides articles on astronomy with various contents, including the latest findings in field of space science and astronomy. In writing those articles, it is inevitable that we need to explain astronomical terminologies in an easy-to-understand manner. As the same terms are very likely to be used multiple times in different articles, in our opinion a glossary of astronomical terminologies is a necessary. Moreover, to our knowledge, astronomical terminologies used in academic and professional astronomer communities are mostly loanwords, such as supernova, exoplanet, albedo, nebula, zenith, azimuth, perigee, and apogee. For science popularization, we think that this kind of terms require further description to be comprehensible without becoming an encyclopedia or a wiki article. In the light of those circumstances, we have developed an online glossary, whose entries can be linked to the articles published in langitselatan site [1].

2. The Site and the Progress

Kamus Astro is targeted to langitselatan readers, new visitors, astronomy communities, and journalists. The glossary can be accessed at http://kamusastro.com. The dedicated site for astronomy glossary comprises list of terminologies, which has alphabetical index and search column; about the site; and open suggestion to enrich the content [2]. Fig.1 shows the workflow in Kamus Astro, which involves review and feedback processes. All entries and their respective definitions are in Indonesian while the original terms are not displayed in this current version. To familiarize the terms and to engage with potential users, we also published the terms in Kamus Astro, langitselatan, and Gerhana.info social medias.

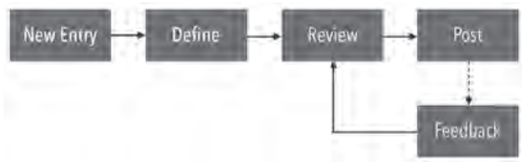

Fig. 1. The workflow of Kamus Astro.

As per March 2018, there are 320 entries with 20 of them are suggested by 5 people. Apart from langitselatan, top referrers include Google, Twitter, Facebook, and National Geographic Indonesia [3].

3. Summary and Way Forward

Kamus Astro is an astronomy glossary aimed to be an extensive database for astronomy glossary and become a standard for usage of astronomical terminologies in Indonesian language.

We will post new entries regularly both in the site and social media, involve public and astronomy communities to suggest terms, invite more contributors from professional and amateur astronomers, and add index for English/original terms. As for long-term plan, we will provide basic articles or infographics based on the entries, collaborate with The Language Development and Fostering Agency, and develop a mobile apps.

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Astronomy Communication for a Better World: Globe at Night

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Abstract. Globe at Night is an international citizen-science campaign to raise public awareness of the impact of light pollution by inviting citizen-scientists to measure and submit their night sky brightness observations. With over 175,000 observations from 180 countries, the Globe at Night (open) database is a powerful resource for multidisciplinary projects. Students and scientists have used the data to monitor levels of sky brightness worldwide. The campaign has been used to help understand light pollution's effects on energy consumption, plants, wildlife and human health, as well as our ability to enjoy a starry night sky.

Citizen-science is a rewardingly inclusive way to bring awareness to the public on the disappearance of the starry night sky, its cause and solutions. Globe at Night (GaN) encourages citizen-scientists worldwide to record the brightness of the night sky. During ten-days per month of moonless evenings, children and adults match the appearance of a specific constellation with 7 star maps of progressively fainter stars found at *www.globeatnight.org*. They then submit their choice of star map in-situ using the "webapp" on a smart device. In twelve years of the program, over 175,000 observations from 180 countries have been contributed to the campaign.

The Globe at Night (open) database is a source of research projects, even with other disciplines. For example, students conducted research to understand the lesser long-nosed bats' avoidance of city center at night. On-the-fly mapping enables citizen-scientists to see contributed observations immediately. The 12 campaigns per year offer 4 ways of taking measurements. The online app for data submission is in 28 languages. STEM activities for young children and problem-based learning activities for older students were created to experience real-life scenarios: role-playing sea turtles hatching (misdirected by lights on shore) or analyzing an ISS image of Houston to estimate the wasted energy, cost and carbon footprint. In-situ and on-line workshops have been given on using GaN in all its capacities, as well as for the activities. Our Facebook page exists to encourage dialogue and bring cutting edge news. To entice interest, we had monthly newsletters and serial podcasts starring the Dark Skies Crusader.

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GaN has been part of special campaigns like with the National Park Service, the Na-tional Geographic BioBlitz and Tucson in 2011. Partnerships also include SciStarter (working with participants through an online dashboard), STARS4ALL (working with light pollution initia-tives), and Fieldscope (working with data analysis). We have built a community of practitioners world-wide and will continue to help reduce the effects of light pollution through awareness and action.

Fig. 1. Globe at Night measurements (2006-2015) in Europe. Brighter dots mean brighter night skies; darker dots mean darker night skies. [M. Newhouse]

Globe at Night has provided the public with a variety of ways to be better stewards in minimizing the disappearance of our potentially starry night sky. Globe at Night is a flagship program of the National Optical Astronomy Observatory (NOAO). NOAO is the U.S. national observatory operated by the Association of Universities for Research in Astronomy, Inc. under cooperative agreement with the National Science Foundation.

|Poster|

Bringing the Universe to the World

Chris IMPEY*1 and Matthew WENGER*1

Abstract. We have developed an online astronomy MOOC that has been hosted by the providers Coursera (and Udemy), with over 120,000 enrolled, 75,000 of whom are in 160 countries outside the United States. The overall goals of the project are to (1) reach very large audiences of lifelong learners with astronomy informed by recent research, (2) understand the demographics and motivations of informal learners, and (3) develop new tools for on-line education that demonstrate how to bring evidence-based instructional strategies and assessments into on-line learning environments. Massive open online classes can bridge the gap between formal university-based learning and informal lifelong learning.

1. Introduction

Astronomy is one of the most dynamic research areas in all science, with discoveries almost daily and enormous public interest. As such, it is a great vehicle for harnessing the potential of massive open online classes (MOOCs) to reach a worldwide adult audience with free and open content.

The content covers the whole of astronomy but concentrates on topics at the cutting edge of current research – Mars and the moons of the giant planets, exoplanets, black holes and collapsed stellar objects, distant galaxies, dark matter and dark energy, and astrobiology. The course has a core of video lectures, with quizzes and enrichment materials that include lecture slides, text readings, and podcast interviews with leading local researchers. There are live sessions, discussion threads, and extensive use of social media such as Facebook and Twitter. Part of the evaluation is based on peer reviewed writing assignments, and each learner is expected to do one or more citizen science activities.

2. Participation and Completion

Coursera provides the platform for delivering the video lectures. The rich data environment facilitates research on the MOOC, where the challenges are to maximize student learning and engagement, and to overcome the typically low completion rates in such a course. We have successfully experimented with using amateur astronomers who are enrolled in the course as meta-experts to help other learners.

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We have used the instrument of Glynn [1] to look at the motivations of MOOC learners and traditional students in an astronomy class for non-science majors. Compared to college students, MOOC learners have higher intrinsic motivation and self-efficacy, and are less motivated by grades and social interactions.

Fig. 1. Course completion was correlated with participation in the quizzes and writing assignments.

Learners did short writing assignments based on recent research. Participation in peer-reviewed writing was associated with learner success (Figure 1). While the promise of MOOCs remains unfulfilled, they have enormous potential to democratize higher education and lifelong learning, increase scientific literacy, and inspire people worldwide with astronomical knowledge and discoveries.

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SESSION IV:

Media, Social Media, Multimedia, Immersive Environments and other Technologies for Public Engagement with Astronomy

Communicating Astronomy with the Public Conference 2018

Communicating Science in New Media Environments

Dominique BROSSARD

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I am here today to talk about communicating science in new media environments, but in fact, they are not so new -- they have been around for quite a while now and, as time passes, we have newer challenges that all of us that want to communicate science have to face to reach the public in a meaningful way. What has changed and what can be done to address those challenges?

The first thing that we need to keep in mind is that there is a global trend worldwide as far as where people read news about science. Data from 35 countries collected by Reuters International, show that the global trend is for younger groups to use social media as main sources of news. That means that they won't go to the website of a news organizations, they do not buy a newspaper, they do not read magazines or look at television news, but they are focusing mainly on social media to get their news about science. And when we think about social media, most of us would think of the platforms that we are used to interacting with; mainly Facebook, that has been a lot in the news lately, but also Twitter, Instagram, Wikipedia, Snapchat, obviously Blogs and YouTube; are coming up a lot as news media environments right now, even for science. However, what gets complicated for us who are interested in reaching a global public for science news, is that those platforms will depend on the country where you are and some being more popular than others in some countries --in the Japanese context, YouTube is actually the first platform that is used for social media by younger audiences to find out about science and other issues, which means that even for issues such as astronomy, if you want to increase your likelihood of reaching those youngsters, you need to actually reach them on those platforms. So take-home message number one, obviously, is going to be to actually adapt our social media strategy to the audience we want to reach.

The second thing that has changed is that science reporting of diverse quality can be encountered online. All of you in communication know the importance of the words we use to communicate about different topics. There was a recent story stating that scientists say alien life may exist in our Solar System on one of Saturn's moons. You also have the "New Scientist" reporting that we may have already found signs of alien microbes and the "Daily Star" reporting that “NASA rocked by ´living´ alien report.” Unsurprisingly this story was sent around the most because this is much more exciting, we have the proof we have alien reports on Saturn. So there is nowadays the increased likelihood that what I call “iffy” science news are sent around. It is not that they are fake science stories since they are most often based on a grain of truth, but they may be totally distorted because that way they are much more appealing to the public.

So, why do we share things on social media? This is something that we need to think about and we need to actually totally control if you want to make sure we communicate accurately about science. We share things on social media, because of different reasons. Number one, because they match our worldviews. There is a process called confirmation bias in psychology, which is the idea that we prefer ideas that confirm our own. We will share stories that confirm our beliefs, so for example, if you believe the Earth is flat -- a number of people do unfortunately; you will share stories that seem to confirm that the

Earth is flat and you will actually contradict stories that say otherwise. The second thing that we tend to do is share stories because they give us hope, so for example, let us say we want to believe there is alien life somewhere because it gives us hope, we will make sure that we send stories that not only confirm our beliefs but also gives hope. A third thing to keep in mind particularly for younger audiences, is that they tend to send things that they find amusing. If it is funny it is shareable. It does not mean that they are going to check if the science story is accurate or not, they will share it because it is fun. So, in a nutshell the idea around sharing science stories that seem "fake" is not that there a problem with the media platform. The problem is not social media or new media environment), what is important (and the problem) is human psychology. People gossiped for centuries, for millennia people shared stories because they were funny, hopeful and so on, in a salon, in the café, at the bar, in the community, in schools, at churches and so on, but now they do it also on social media platforms.

The other important thing that I'd like to remind you and that is becoming trickier and trickier is that the way the media is organized is going to increase the likelihood for people to only find things that they already like -- we call that narrowcasting. Media will make sure that you see things that you are likely to want to see. Algorithms are used as editors to make sure that what you find on Google, or other platforms, is based on your use of different websites, on what you have shopped around for, on what you have bought and what you have read or what you have listened to and watched on YouTube. The idea that search results are created based on your personal preferences and prior use is something we call narrowcasting, and unfortunately, you may not like it, but this is something that does create what has been called "filter bubbles." We communicators, we have to really think about it carefully, how do we break those filter bubbles? How do we make sure that others see the stories that we would like them to see? This is something we need to ponder very carefully, because the reality is that the micro-targeting by media organizations, that narrowcasting, are here to stay. The survival of the media will depend on these processes because their survival depends on giving readers what they really want, how they want it, when they want it and not spending too much money producing what the readers do not want. This is critical for us as communicators to understand, as we ponder how to address new media environments. Certain anecdotal evidence seems to suggest that these processes raise the likelihood for some scientists to make their scientific results more interesting than they are in order to gather media attention.

So, what can be done? Is it the audiences' responsibility to make sure iffy science news are not shared around? Among all of us here, how many of you have shared something on social media? Now, we are all human beings, so the idea that we should technically check everything we read before sharing it is something that has been mentioned. The Association of Librarians of the United States have put together a poster that asks people to be critical when they see a science story: they should consider the source, read beyond the headline, check the author, check the date the story was published -- a lot of people repost old stories – make sure it is not a joke, check your bias, consider if your beliefs would affect your judgment and to ask the experts. So this is really great and fine and dandy, right? But how many of us will do all these things? Most of us won't do that, or maybe we will do one or two of those things, that would actually be really good, but most of us actually do not do most of those things.

So what is the solution to bad science news stories then? Maybe research institutions and scientists themselves should be the ones that actually should be involved in fixing this. First of all, when you have a press release about a study or a peer-reviewed publication that is published by an organization, there will be media coverage that comes up later on using the press release. Who has the responsibility to check, to make sure the media coverage is correct afterwards? One could claim that it should be the organization itself that should check on that and make sure that the coverage is good afterwards. One could also claim that the scientists also should check these and make sure that there is enough quality coverage for people who discuss their own studies. However, that implies that there is quite a bit of a capacity in those organizations to be able to do all this, to track the quality of coverage and so on. On the other hand, we could imagine that we could use intelligent algorithms to actually follow the coverage of everything that comes out of the university, you know, an observatory, an organization to track the coverage, so it is not that it is impossible, and it is certainly something that should be pondered.

The second thing that I think could be changed is actually recognizing the fact that all of us are involved in public engagement activities and that this should be recognized as something that needs to be part of a scientist's job as part of their regular activities. Scientists are not just in, let us say, in the ivory tower. So this actually precludes that we need to train scientists on the science of science communication in order for them to understand the challenges and to some extent, to make sure that the dynamics of new media environment that can lead to public opinion about science that is inaccurate or potentially deceptive need to be taken into account.

Is it the journalist's responsibility? There are more and more attempts to create tools for journalists worldwide to help them debunk stories. The problem that we face and we have to actually recognize it, is that very often journalists do not have the time to use those tools. They are under pressure to publish their stories and they won't use those tools in a way that actually could be potentially positive and productive. So is it the journalist's responsibility? Potentially, but quite difficult to actually force them to do so in this new media environment.

Or, I would claim, is it the responsibility of somebody like me and my group -- the Science Media and Public Research Group at the University of Wisconsin-Madison, to actually try to find science solutions to the problem or better said, social sciences solution to the problem? So, we have the problem of filter bubbles, and we need to find social science solutions to them. I told you earlier there were different types of filters that are involved when we process media information. The media-centric filters will tend to make specific news accessible to specific audiences with specific viewpoints. In this case algorithms are used as editors and will make people encounter news that match their beliefs. The audience-centric filters are created by the individuals themselves. When we are in a social network, we are with people that think like us, our own attention and exposure is based on a selection of news that match our own worldview use. Between the media centric filter and the audience centric filter we have the self-reinforcing searches. Whenever we put a keyword on Google search, the search is going to change what we are going to find later on and change it again and change it again. The social science question is to find a way to actually break those dynamics in order for people to read the stories that we would like them to read. My research group focuses on the effects of the cues people get in social media environment. We did a lot of research on the effects of comments in blogs and we found that reading comments that are rude tend to make people think that the science story is biased, compared to people that see comments that are not rude. So just the fact that the comment is rude changed their perception of the story. This effect has been called the nasty effect and got quite a bit of media attention because it was the first study that was actually based on good social sciences to look at the effect of rude comments. So based in part on our study, online newspapers in the United States began to stop allowing comments and tried to find ways to moderate these comments in a way to promote good public discourse. So this is important if you are using comments on your blogs and so on.

The thought I would like to finish with is that any organization that is involved in science communication on social media should take into account how audiences will engage with their posts in different media environment and need to find ways to actually break the dynamics we discussed in order for people to read the stories that we would like them to read.

The Audience-driven Spaceship: Giving the Audiences Control Through Interactive Planetarium Shows

Pecier Paul C. DECIERDO*1

Abstract. It can be argued that a fully interactive live planetarium show is one in which the audience has a certain degree of control over the flow of the show. In the interest of making some of my shows interactive in this way, I designed one called "Playing With The Universe" (PWTU) in which the audience is given control over the flow of the show. The audience's control over the flow of the show is similar to a reader's control over the flow of the show in a choose-you-own-adventure book. The audience controls the flow of the show with the help of laser pointers that are entrusted to groups. There are risks involved in giving a laser pointer to young people. Based on experience, an oral contract at the start of the show helps the students police each other on the proper use of the tool. The social dynamics of the class therefore acts as my main tool for managing the class' behavior. PWTU allows for a lot of interaction not only between the facilitator and the audience, but also between different members of the audience.

1. Introduction

Science communicators working in planetariums are always experimenting with new ways to make their guests' experiences have more impact, especially as it relates to understanding and comprehension of the scientific concepts being discussed.

One ways planetarium workers make this possible is through making live planetarium shows more interactive. One way a planetarium show can be interactive is when members of the audience get to interact with the facilitator or "navigator", such as by asking or answering questions.

It can be argued that a fully interactive planetarium show is one in which the audience has some degree of control over the flow of the show. Even better, an interactive show is one in which there is interaction between different members of the audience.

To accomplish this degree of interactivity in my planetarium shows at The Mind Museum in the Philippines, I designed the program "Playing With The Universe".

2. Design of Program

"Playing With The Universe" (PWTU) is an interactive live planetarium show where audience members have some degree of control over the flow of the show. This is similar to the reader having some control over the plot in a choose-your-own-adventure book.

Every session of PWTU has a pre-designed set of decisions that the audience can make regarding the direction of the show. Examples of topics would be: the planets of the Solar System, the life story of a star, and exoplanets.

The audience makes the decisions using laser pointers that they aim at the dome or projection screen. Upon trial and error, there are some conditions that must be met for this format to work.

3. Conditions for Program

For the format to work, the audience members must be composed of students belonging to the same class or at least to the same school.

Next, the students must be grouped in medium-sized groups (4 to 6 students). The laser pointers must be entrusted to each group, not to each individual.

Then, different members of each group must be given the chance to hold the laser pointer.

Finally, the students must enter into an oral class contract wherein they should follow strict rules on the use of the laser pointer to avoid eye injury. Violation of the contract will mean that the group loses their privilege to use the laser pointer (and therefore to have a say in the direction the show will take).

All of these result in group dynamics that enable the students to police each other and their group mates on the proper use of the laser pointer. Furthermore, this interaction also has other positive benefits to the interactivity of the show.

4. Group Dynamics

Aside from making the show interactive in that the audience can control the direction the show will take, the format also enhances the interaction between different members of the audience.

The act of helping each other on deciding how to vote as a group encourages the group members to interact with their group mates.

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The interactivity of the show gave the students a sense of ownership over the topics being covered, which in turn made them attentive.

5. Teacher Responses

Teachers whose previous classes have attended PWTU have since returned to have their next classes attend. They also encourage their fellow teachers to book their classes for the show.

Teachers have expressed how the interactivity of the show has made the class more interested in astronomy in the classroom.

6. Future Directions

Because of the potential for injury with laser pointers, a version of PWTU is currently being designed so that groups can vote using colored LED lights inside the planetarium.

Inside an inflatable planetarium without seats, another possibility would be to allow the audience to stand and move around to vote.

7. Summary

In an age where many students are used to technologies that bring their interactive and immersive learning, astronomy communicators, including those who work in the planetarium, should continue to find ways to make the learning experience fully interactive. Such ways can involve high technology, or could be simple and inexpensive.

From our experience with PWTU, a fully interactive live planetarium show, while not possible for all audiences and venues, might have great advantages over other formats in situations where it is appropriate.

Storytelling Through Social Media

Thilina HEENATIGALA[*1,2]

Abstract. Social media is a key communication resource in astronomy outreach. From amateur astronomy clubs to large scale governmental space agencies use social media as the key resource for public engagement. However, with the large number of content being created, the level of 'noise' in social media has become larger. Getting heard through the noise on social media is a key challenge for the astronomy communicators. Social media is already integrated in our daily lives, at home, and at work. It has become the go to source for information for many in the daily lives. The amount of content shared daily makes it difficult to reach a big audience and getting the message across as it gets lost in the noise. Looking at the fields such as art, fashion, advertising, and tech, this paper discusses the strategies that works on social media and what requires creating engaging content.

1. Introduction

The astronomy communication community uses social media as a main or one of the channels to do outreach and education. As the community grow, with the increasing number of social networking sites, and the amount of content created, it becomes noise - making it difficult to reach the audience. As an ever-evolving field, social media provides new tools and methods to create unique content. While a handful of astronomy organisations and communicators use the new tools, and features to create attractive content that helps to stand out and gain more public attention and trust, majority of the content makers in astronomy are settled with, now traditional, content such as Facebook posts, and Tweets.

One of the most powerful strategy for astronomy communication is storytelling [2]. Narratives offer increased comprehension, interest and engagement over other fact-based forms of science communication. Narratives can be more persuasive than lists of facts, because they communicate concepts and values in a format that humans are primed to recognise and remember. Astronomy content combined with storytelling helps to communicate with increased impact in social media for the public. Narrative engage with people more than facts.

2. Creating engaging content

Latest social media tools and resources open an opportunity to put the storytelling in the astronomy content. This also applies to the traditional social media content such as Facebook posts, Tweets, blog posts, etc. Creating narrative content to tell a science story has a higher impact. When it comes to creatingengaging content, it's important to consider the key aspects such as; choosing the right platform, developing a narrative, being relevant to the audience, focusing on one message, humanising the story, and evaluating the strategy to adjust.

2.1 Select the right platform

There are hundreds of social media platforms and choosing the right one can be quite challenging. To decide which platform to use and how many different ones should be used, a checklist of questions could be used; does the platform support the social media strategy objectives, which platform the target audience is using, what channels does the collaborators use, what type of content to create, and how many channels practically can be managed? In case of lack of human resources, it’s recommended to use one key platform to communicate as having many will spread the human resource too thin, making it difficult to build an audience.

2.2 Developing a narrative

While a high-quality image is important for an imagery post, a captivating caption can help to complete the story by sharing a narrative. This could be done by three-ingredient-narrative method where the story will include a protagonist (centre of the story), a goal (the brand pursues), development (if the brand/protagonist is point A and the goal is point B, development is how it moves from one to the next.

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2.3 Relevant content to the audience

The demography of audience is different in each platform on social media [2]. Therefore, it's important to change the language according to platform and audience as the same content doesn't work across different platforms [3].

2.4 Focus on one message

Keeping the story clear and short helps to focus the goal of the message. By applying the 'less is more' exercises we can conclude that focusing on one message brings more clarity to our message. This helps quite a lot in outreach, especially if there's a message involved in the outreach effort [4].

2.5 Humanise the story

As people connect well with people, not brands or institutions, giving a human voice to the brand will make the audience to be comfortable with the engagement. It's important to avoid functional language and use human language with emotions [5].

Real-time engagement is also important as scheduled posts doesn't build interaction, but rather push content online creating one-way communication.

3. Evaluation and adjusting

By focusing the evaluation on one story or a campaign helps to learn about the audience in depth. People will react differently to the same story in different platform. Using evaluation tools such as; Facebook Insights, Twitter Analytics, Google Analytics, Keyhole, will help to evaluate and re-adjust the content to relate to the audience.

4. Summary

Cutting through the noise is a challenge in social media. This is where the question - how do we make our story rise above - comes in to play. Telling a story is the key. Social media storytelling is about creating a compelling personal story for specific audience and platform that inspires people to take a desired action with the brand.

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Curating Social Media Content for a Dichotomy of Audiences

Alexis K. ACOHIDO*1

Abstract. The burgeoning popularity of social media has opened many new avenues of communication with and for everyone, and our work in sharing astronomy with the public is no exception. At Gemini as well as other observatories, we identify two groups of our primary audiences - our user community and the scientifically engaged public. Our greatest challenge is how best to leverage social media for communication with our audiences. We can do this by having well-defined objectives to ensure consistent and targeted messaging. Once we've defined our objectives, we identify metrics against which we can measure the success of our content. Learn how we at Gemini define our communications and more specifically our social media objectives, measure the success of our content using analytics, and utilize best practices when authoring content.

1. Introduction

Gemini Observatory is comprised of twin optical/infrared telescopes, one on Cerro Pachón in Chile, and another on Maunakea in Hawaiʻi. Gemini is funded by the United States, Canada, Argentina, Brazil, and Chile. We also have a diverse social media audience. We identify two groups of our primary audience - our user community and the scientifically engaged public. I will explain Gemini's strategy for social media content, as well as how we create profiles for our audience, and how we use website analytics to assess the impact of our content.

2. Setting Objectives

Anyone that curates any sort of content, whether that's for a website, social media, video, etc., needs to have a strategy for their content. Define how you're going to use your content to meet your organization's goals and your audience's needs, and come up with a plan for the life cycle of your content - from ideation to publishing to archiving. Having a content strategy sets benchmarks against which we measure the success of our content, and guides our plans for the creation, delivery, and governance of content. [1]

We outline all of our objectives, including our social media objectives in Gemini's Strategic Communications Plan. Our objectives align with our Observatory Mission: *To advance our knowledge of the Universe by providing the international Gemini Community with forefront access to the entire sky,* as well as our Statement of Purpose: *Exploring the Universe, Sharing its Wonders.* It is important to note that while our objectives align with our Mission and Statement of Purpose, they are not the same.

The following are some of Gemini's Communications Objectives:

- **Increase awareness, involvement and engagement** with astronomers in our participating communities such that users feel like a **privileged member of the "Gemini Community";**
- Extend opportunities to educate users about the **tools, capabilities, and support** available from Gemini staff, NGO, and other users;
- **Expand awareness, engagement, and diversity** in the opportunities provided by Gemini in **local and international workforces;**
- **Demonstrate and generate positive impressions on Geminiʻs stewardship** of our astronomical sites (e.g. light pollution, minimal site impacts) and our planet (e.g. energy conservation and minimizing our carbon footprint);
- **Increase understanding and appreciation** regarding Geminiʻs impact on humanityʻs understanding of the Universe.

3. Audience Profiles

Creating profiles for our audiences helps us anticipate the type of content that they want to see. We define our user community as past/present/future telescope users, people that want to commission/build our instruments, as well as stakeholders. The scientifically engaged public includes teachers, students, and the science-literate public, particularly those that live

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in our host communities of Hilo, Hawai‘i and La Serena, Chile.

4. Best Practices

To maximize visibility of our social media content there are certain attributes we use for every post. For every post (excluding the video posts) we will include an image. We also put out "calls to action" (e.g. click the link to read our release), and we will engage with our audience in comments and messages. Finally, we schedule our posts at different times depending on the audience. We have to take into account different time zones for different sites as well as our international partners. Generally speaking, people will check up on news in the early morning hours (7AM-10AM) and will check up on social pages in the evening (5PM-12AM). [2]

5. Analytics

We check our analytics to measure the success of our content. Most of our page views come from organic search. This tells us that we should focus on optimizing our content for search engines. That same figure also shows that a significant portion of our traffic comes from social channels.

We can also use analytics to see how our audience behaves on our webpage. The bounce rate for our traffic coming in from our social channels is pretty high. This is not necessarily a bad thing! The scientifically-engaged public coming in from social may not be interested in more than what we are promoting. For example, we can infer that someone clicking through to a blog post of ours may not be interested in our Gemini Multi-Object Spectrograph specifications and may click away after they've read our blog post.

6. Summary

When curating social media content, have some sort of strategy that guides the life of your content, and define your communications objectives. Then create profiles for your audience, so that you have a better idea of what kind of information your audience is looking for. Finally, use analytics to get the most information you can out of your content. Use it to infer behaviors and monitor trends.

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The Social Media Razor: Astronomy Exploited

Avivah YAMANI[*1,2] and Wicak SOEGIJOKO[*1]

Abstract. Social media has changed people's lives. The first thing people do when they wake up is turn to their phone to check if there are any messages or notifications from their social media, including astronomy related issues. Social media such as Facebook, Twitter, Instagram, Line and Whatsapp are powerful tools for communicating astronomy immediately. Usually, the media reports take legitimate astronomy information and then simplifies it for the audience, often times "distorted". Other than that, no matter what the news source is, people rely on "instant information", which is fast reading and/or with a bombastic title then share it to their circles or even publicly.

Good news: we can communicate astronomy easily and quickly. Bad news: social media also becomes a gateway to spread hoax and misinformation. This is also the case in Indonesia where misinformation and hoaxes are easily spread and amplified in social medias, often times amplified as in an "echo chamber". The recent case is flat earth which become very popular and received broad attention from public and traditional media.

We will use langitselatan, the astronomy media in Indonesia to show the best practices to deal with various issue of astronomy and reach social media users.

1. Introduction

In recent years, internet has become a primary need for public. The internet penetration in 2018 shows that 53% of global population or more than 4 billion people around the world are using Internet. Social media became the keypart of modern lifestyles with more than 3 billion users. In 2018, Indonesia social media users grew by 13% to 130 million users with Facebook and Whatsapp as most popular platforms [1]. This fact inevitably changed the way people communicate and increased the need for connectivity.

The first thing people do when they wake up is checking their phones for any updates. According to Deloitte global mobile consumer survey, 61% of people check their phones 5 minutes after waking up and 89% check their phones within an hour. Before sleeping, 81% of people will check their phones and 48% of people will check their phones for update in the middle of the night [2]. This is an advantage, because social media is a powerful tool to communicate astronomy with the public. Adversely, it also a powerful tool to spread misinformation and hoax.

In 2007, we built an astronomy online media named langitselatan to communicate and educate public with astronomy. In this paper we will use our best practice to engage with public and deal with hoax.

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2. Two Sides of the Social Media

Mobile internet has given us an opportunity to have immediate access to all the information we need and do not need. The rise of social media has changed the way we communicate with others. We can reach people globally and have global exposure by having focused conversations on certain topics. This means, we can use social media to communicate science with the public. However social media can also amplify ignorance, hoax and fake news, as people easily believe and share the news shared by their friends and colleague as trustworthy news.

3. Evolutions of Digital News Landscape

With the adoption of smartphones, digital news and social media became the primary source of information for the public. People are looking for instant information, content producers want news and information that can grab the reader’s attention and keep it long enough to read the message and if possible share it. In Indonesia, 81% of people read news via social media while only 47% of people go directly to a digital news outlet [3]. This fact, changes the way news outlets present their information and how they publish. They take legitimate astronomy information or discovery and report partial (often incomplete) aspects of the studies, misinterpretations of the findings, inaccurate simplification of scientific results, and highlight on what the editor thinks are unusual claims. Combine this with a click bait (attention grabbing) headline, the media can easily attract the public attention to read the headline, click on it, see the advertisements, and then quickly share the news.

4. Social Media Echo Chambers

The good news about social media proliferation, we can use this to communicate astronomy easily and quickly. Bad news: the ability to filter discussion, join a group with like-minded people, and unfollow those with different opinions will limit the news consumption and amplifies existing beliefs (right or wrong). This behavior creates an *echo chamber* in social media and filters the information based on the users particular (existing) opinion and beliefs. Social media echo chambers often make people unable to distinguish fake news from real news and in the end amplify the hoaxes.

General literacy in Indonesia is low with only 55% of internet users reading articles and 22% reading educational content [4]. Based on a survey by the Indonesia Telematics Society, 92% of hoax is distributed via social media, 62% in chat messengers, while 8.7% in television and 5% in printed media [5].

The recent case in Indonesia is flat earth, which started in mid 2016 and become a trending topic based on google trends. Since then, according to Facebook, there are more than 30 flat earth discussion group and online communities on their platform.

5. Dealing with Astronomy Hoax in Indonesia

In 2007, after the commercial failure of an astronomy magazine, langitselatan was introduced. Its purpose to introduce astronomy to the public and provide astronomy news and discovery, basic astronomy, hands-on activities and community report. Since its creation in 2007, we have dealt with various hoax and misinformation such as moon hoax, mars hoax, geocentric vs heliocentric, 2012 doomsday, solar and lunar eclipse myth, flat earth, and many other issues. We counter hoaxes with proper scientific information without hype or use of click bait titles. We also provide basic astronomy article to educate the public because education in Indonesia emphasis more rote learning than creative thinking.

Since 2016, we began publishing infographics to attract the short attention span public to understand astronomy basics and possibly encourage them to read longer articles with in-depth content. To engage with the public, we use social media channels such as Facebook, Twitter and Instagram. We create tweets storms (Serial tweets) and infographics on astronomy and events to engage with the public in social media.

Another way to counter hoax is by networking and collaborating with science journalists and news media outlets. By doing this they will have a trusted source in astronomy for their news. It can be a source for interview, quoting langitselatan articles, or crossposting on their site.

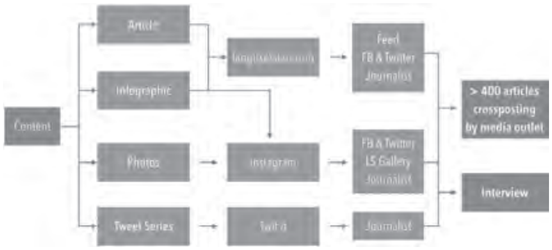

Fig. 1. langitselatan workflow. Credit: langitselatan

6. Summary

Social media is a tool that we can maximise for communicating astronomy but it can also amplify hoax and create echo chambers. To counter hoax and echo chambers, we provide various channels that provide the correct and accurate information. We also provide various methods on presenting the information, article and infographics. We also work together with science journalists, news outlets and traditional media to present the correct and accurate information.

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Costellazione Manga: a Space Journey Through Astronomy, Japanese Comics and Animation

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Abstract. We present Costellazione Manga, an outreach format that considers astronomical references present in manga and anime and highlights the physics behind them. We take the cue from realistic comics to illustrate the harsh reality of space travel. We use works with a more fantastic perspective to introduce general topics: the difference between stars, planets and galaxies, and the possibility of finding life on other planets. This format has been well received by the public and can be considered a powerful pedagogical tool.

1. Introduction

Comics and animation have a long history as tools for teaching and outreach. Walt Disney was a strong supporter of educational animation [1], and since the 1940s the Disney studios produced a number of short animated films on different themes, such as psychology, medicine, health, and economy. Sweden has a tradition of animated documentaries. In Italy, artist Bruno Bozzetto won prizes for the animations made for the science outreach TV programme *Quark*. Japan is no exception, with planetarium shows [2,3] inspired by animated cartoons such as Leiji Matsumoto's *Galaxy Express 999,* or with books that discuss history in the form of comics where the characters are represented as dogs [4].

However, most comics and animation works are made with entertainment purposes rather than teaching. Yet many of them offer several connecting points from which to start discussing astronomy. Our project *Costellazione Manga* (in English: Manga Constellation; hereafter CM) builds on Japanese mainstream works that are effective in catching the attention of the public. This approach is similar to that followed by books that explain physics and astronomy taking cues from American superhero comics [5] or Japanese cartoons [6].

In the following, we briefly describe our approach and our results. We refer Japanese comics and cartoons by their Japanese names *manga* and *anime*, respectively. More details and updates can be found www.costellazionemanga.eu or on [7].

2. Birth of a common language: popularity of anime and manga in Italy

Anime started to be imported and screened on European TVs in the late 1970s; among the first works were co-productions between European coun-tries and Japan (e.g., *Vicky the Viking; Barbapapa)*, and Japanese works based on European books and comics (*Heidi, Girl of the Alps)*. The first science-fiction work to be imported in Italy was *UFO Robot Grendizer*, which sparked wide interest across the country, was a subject of debate in the parliament, and whose (Italian-written) opening song single sold more than 1 million copies [8].

Local TV broadcasting had been liberalised in Italy in 1976, and after the success of the first imports by national broadcaster RAI, local TVs turned to the Japanese market to acquire massive amounts of animation to fill their schedule. This situation persisted even after many local TVs consolidated into national networks, for all the 1980s and 1990s. Manga popularity grew slowly, but since the 1990s manga represent an important fraction of all comics published in Italy.

Therefore there are two generations that have had anime and manga as staples of TV and printed entertainment. They share a *common language* made of references to cartoon plot lines, graphics and tropes.

Similar phenomena occurred also in other countries, ranging from the United States to Europe to the Middle East, making the popularity of anime and manga more than just an Italian circumstance.

3. The Costellazione Manga project

The CM adventure started in October 2011 as a cultural event organized by the Association for Cultural Exchanges between Italy and Japan (ASCIG) and the *Rheyta* Amateur Astronomers Association (ARAR), both in Ravenna, Italy, and has been often hosted by the Planetarium of Ravenna. Since the first conference we started to collect ideas and materials from several manga and anime. We considered both mainstream and avant-garde works. The proposed stories are often pure fantasy or sci-fi, yet they offer many cues that can lead to the discussion of astronomy and physics topics. CM is an outreach show that aims to conduct the public through an unusual uni-

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Fig.1 The Costellazione Manga logo.

verse, where fiction and reality both concur to increase knowledge.

For a typical event, we choose three or four anime that are well-known by the local public. We recall the cartoons by showing images and playing their opening tunes. We briefly recap the plot lines, and we identify some connections with astronomy from where we start to discuss contemporary knowledge. For example, in *Galaxy Express 999*, *Starzinger* and *Starblazers* (original title: *Space Battleship Yamato*) the main characters visit many planets, some in our Solar System, and some outside of it. We take the cue from it to review what astronomers know about planets, and to show the latest discoveries in the field of extra-solar planets. Nowadays, more than 3000 extra-solar planets are known: they are of different types, sizes and chemical compositions. Depending on their orbit, they can have freezing or scalding climates. Some of them lie in the so-called "habitable zone", where temperatures are mild and liquid water might be present, but we still don't know any planet whose climate is similar to that of Earth. Sometimes we have "bad news": the fans of *UFO Robot Grendizer* might be disappointed to learn that astronomers have found no signs of planets around the star Vega [9], from which their favourite giant robot supposedly comes from.

Among the animes that get regularly featured in Costellazione Manga there are also *Fist of the North star* and *Saint Seiya*. From both of them we introduce the topic of constellations, both according to the Western tradition, and to the Chinese-Japanese one.

Some works deal with more adult and authorial topics, e.g. *2001 Nights* or *Planetes*. They can introduce introspection on the relationship between humanity and space: what are the risks, the benefits, and how fragile is the human presence in space?

4. Reception and summary

Costellazione Manga has been proposed in several forms: as planetarium shows, as night observations of the sky, or as seminars. All times we had enthusiastic reactions from our public, that included both adults and children. Adults were familiar with the cultural references and enjoyed connecting childhood memories to science. Children were less familiar with some of the material but after our introductions they were immediately engaged with the stories and curious about the astronomical aspects of the series. Children and their parents (and grandparents too!) were linked together by a common fascination for astronomy. A nice and somewhat unexpected outcome was that they started sharing appreciation for the stories and heroes, therefore establishing a fruitful dialogue between generations.

Thus Costellazione Manga has demonstrated to be a really efficient and pedagogical tool to popularise and communicate astronomy. The use of comics and anime deeply engages the public. It also stimulates important aspects of the learning development as the critical thinking and the curiosity of the discovery; moreover it motivates people to read more about the astronomical references, and helps them in remembering concepts and building connections between different topics and subjects, which is a fundamental part of the deep learning processes.

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Sensing the Universe: Outreach Activities for Inclusion

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Abstract. We have developed different constructivist hands-on activities to communicate astronomy through five different senses. Activities involve smelling and tasting different molecules that have been found in the Universe and pairing them with astrophysical phenomena in a critical thinking exercise after being given some clues; touching meteorites and through them learning about physical characteristics of objects; hearing and feeling vibrations of energy released by astronomical objects in different wavelengths. The activities have been very successful in gaining the public's attention, especially smell and taste, which are not usually associated with the Universe; secondly, they have been successfully implemented with very diverse audiences, our experience with over 2,000 people includes people with a physical disability, students of English as a second language (ESL), justice-involved youth, or very young audiences. These activities have resulted in positive experiences for the public, who at the same time learn about the Universe in a new and exciting way.

1. Introduction

At the University of California, Riverside, we have designed and tested several astronomy-related hands-on activities based on the senses. We also want for participants to have a positive experience with science, these experiences can trigger a future and long-lasting engagement with the sciences [1,2]. Most activities are designed with underrepresented groups in mind.

2. Underrepresented groups

The Deaf community has mostly been overlooked when the astronomy community designs activities. Low-income communities cannot continuously benefit from outreach activities if they cannot be recreated in-site due to high costs. Justice-involved youth rarely have contact with informal educational activities related with astronomy. ESL students can benefit from hands-on activities that are more of an experience and less of a talk. Our experience performing these new activities show that they cater well to all of these groups.

3. Constructivism

The activities are based on constructivism, where participants learn by constructing on previous knowledge while accommodating new information [3]. This learning method benefits from hands-on activities, where all senses are involved, and different areas of the brain are stimulated [4]. Critical-thinking is also sought after in constructivism, fostered by group work, discussion and participants making higher-level questions [5].

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4. Sensing the Universe

Smelling and Tasting the Universe is a critical-thinking activity based on molecular studies of the interstellar medium, planets, moons and other cosmic phenomena. These studies match similar molecules that exist in space with some that exist on Earth and which are responsible for flavors or tastes [6,7]. Our activity exposes students to the chemistry of these molecules and the physical characteristics of the cosmic phenomena that contain them. They are then left to discuss and pair them with Earth-based flavors and tastes based on the clues that have been provided. The activity is appropriate for: low-income communities due to the regular and inexpensive cooking ingredients it uses; for the Deaf or Blind community due to its sensorial approach; for justice-involved youth in court schools due to the safe nature of the ingredients; for ESL students due to its sensorial nature.

Touching the Universe is a hands-on activity that focuses on the physical properties of meteorites and is designed with elementary school students in mind. Weight, density, texture, color, magnetic properties, transparency, and constitution are some of the properties that can be learned through these objects. Other properties from the meteorites can be assessed through critical thinking: Why is the exterior charred but not the interior?

Why do pallasites stick to magnets but achondrites fail to do so? Why are moldavites and pallasites partially transparent but other meteorites are opaque? The activity is appropriate for: low-income communities as inexpensive meteorites can be found and used repeatedly; for the Deaf or Blind community due to its sensorial approach; small meteorites are deemed safe by the safety personnel in court schools; for ESL students due to its sensorial nature.

The Sounds of the Universe is a multi-sensorial activity that involves electro-magnetic energy emissions of different cosmic phenomena. This energy can directly produce sound (in the radio spectrum/audification) or can be turned into sounds (sonification). We used several publicly available sounds, audifications and sonifications of astronomical data and produced a video showing how cosmic phenomena can produce sound, even though it doesn't travel through the vacuum of space, or how data can be translated into sound. Additionally, we created a lower-frequency version to transmit the vibrations produced by the sound to Deaf people, through a specially designed floor. The activity is appropriate for: low-income communities as the sounds are publicly available, and transmitting it requires a mobile phone or tablet and some headphones; for the Deaf community through vibrations; for the Blind community through sound; the materials are deemed safe for use in court schools; ESL students due to the sensorial nature of the activity.

5. Conclusions

Astronomy-related outreach activities based on smell, taste and hearing have been the exception. We present a series of new activities that can serve underrepresented groups, as well as the general public, and provide additional constructivist learning tools as well as offer a positive experience in science.

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4-D Digital Universe to You!

Hinako FUKUSHI[*1], Eiichiro KOKUBO[*2], Hirotaka NAKAYAMA[*2], Satoki HASEGAWA[*2] and Tsunehiko KATO[*2]

Abstract. Four-Dimensional Digital Universe (4D2U) Project at National Astronomical Observatory of Japan produces visualization materials presenting celestial bodies and astronomical phenomena in 4 dimensions (3-D in space and 1-D in time). As the name implies, this project aims to bring the Universe in 4D "to you (2U)", using scientifically correct visualizations based on numerical simulations provided by supercomputers and astronomical observations obtained by telescopes. The 4D2U products are useful not only for scientific research and education, but for various purposes such as entertainment.

1. Introduction

In astronomy research, a large amount of data is obtained by observations and simulations. These data have some spatial dimensions and time variations. Four-Dimensional Digital Universe (4D2U) Project at National Astronomical Observatory of Japan (NAOJ)[1] visualizes these data in four dimensions, three spatial dimensions and one time dimension. This project has mainly two targets for making 4D2U products, namely astronomical researchers and general public. Originally this project started for helping astronomers understand astronomical data. However, the products made in this way were also impressive for general public. Now 4D2U products are used in education and traditional outreach activities as well as in entertainment, art, culture, and so on.

2. The 4D2U products

The 4D2U project mainly produces two types of visualization products.

- **4D2U Movies**: Fig.1 (a)-(g) show some examples 4D2U movies. They are visualized based on research-use numerical simulation data. These movies are provided as HD movies, fulldome format, stereoscopic movies and VR format.
- **Four-Dimensional Digital Universe Viewer "Mitaka" (Software) :** Fig.1 (h) shows a screenshot of Mitaka. This software contains various astronomical data and visualizes them. Users can seamlessly navigate across the universe from the earth to the edge of the observable universe. Mitaka is compatible with a stereoscopic projection and a fulldome projection. The source code of Mitaka is opened with MIT license. Mitaka supports nine languages.

4D2U Project provides 4D2U movie contents and Mitaka on the project website[2]. All the products are provided with no charge. For personal use and school

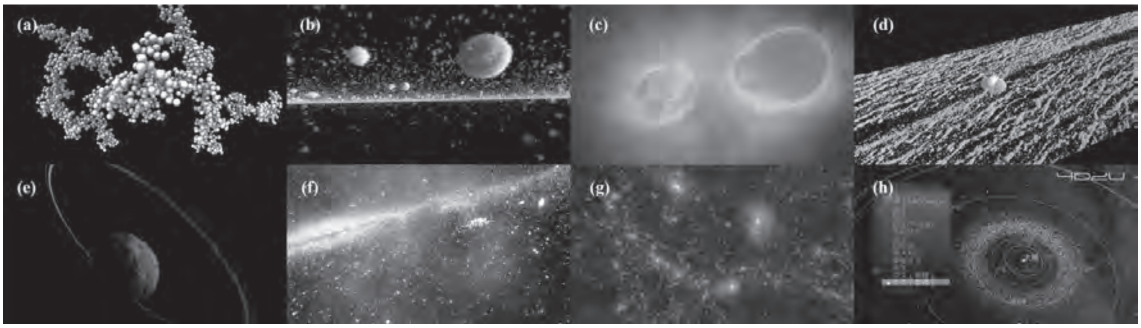

Fig. 1. Snapshots of 4D2U movie contents ((a)-(g)) and software (h). (a) "Collisional Growth of Dust", (b) "Formation of planetesimals", (c) "Giant Impact of Protoplanets", (d) "Dynamics of Saturn's Ring (II. Propeller Structure)", (e) "Chariklo's Double Rings", (f) "A Journey Through the Milky Way", (g) "Formation and Evolution of Dark Matter Halos (II. Formation of the Large-Scale Structure of the Universe)", (h) Four-Dimensional Digital Universe Viewer "Mitaka".

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use, anyone can use these products without permission. For using at museums and planetariums, in TV programs and publications, users should submit an application for permission. Application form can be downloaded on the 4D2U website[3].

3. Examples of use of the 4D2U products

4D2U products are used for various purposes. The most frequent use is showing in public astronomy lectures. In addition, there are various examples not only to show the 4D2U products themselves but also to integrate them with other products. Here we introduce two examples.

- **In museums:** In some science museums, the 4D2U products are used as exhibition contents. Fig. 2 shows one of the exhibitions in Fukuoka City Science Museum. This exhibition is based on the modified Mitaka to travel through the universe with your foot.

Fig. 2. The exhibition “Shape of the Milky Way Galaxy” at Fukuoka City Science Museum.

- **In TV programs:** 4D2U Project provides products for TV programs. Many of these TV programs are science educational programs, however, recently demands from entertainment TV programs like comedy[4] and animation[5] have increased. These entertainment programs pursued scientifically correct views of the universe. By using scientific images, these programs aimed some effects of education and deepening the story.

4. 4D2U VR products

Recently, 4D2U Project makes challenges to develop virtual reality products. Both of simulation movies and Mitaka are available with VR devices. Mitaka for VR can be used with Oculus Rift and HTC Vive. This VR system can provide experiences of virtual space trip without a large dome theater.

VR movie contents are provided on the 4D2U YouTube channel. People can enjoy all direction movie with their smartphone and YouTube App. One of the 4D2U VR movies, “A Journey Through the Milky Way” won a BEST VR SCIENCE EXPERIENCE of Lumiere Award presented by Advanced Imaging Society in this year[6][7].

These VR materials have potentials to be used in science education for understanding the 3D structure of the universe[8].

5. Summary

Scientifically correct visualized materials are needed for educational use as well as for entertainment and culture. Visualization of scientific data is a powerful method to spread and to radicate science research results. In addition, developing materials for new devices like VR opens up the possibility of understanding and enjoying the universe for wider public.

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Creative Planetarium Experiences Provided by a Local Volunteer Association

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Abstract. We are a local volunteer association that has established grass-root activities for astronomical education. "Big Buddy Association" is a local volunteer association composed by fathers of students. We are not experts in astronomy, and our activities are not limited to astronomy, but one of our activities is to take children camping during summer holidays and let them watch the stars. We started using the DIY planetarium since 2014 and we have created a unique experience different from either professional planetaria or schools. Our activities stimulate the local community, provide educational experiences using the latest technology and help connect with various people.

1. Introduction

In Japan, due to safety concerns it is somewhat difficult for schools to do educational activities at night. In urban areas, light pollution is also a serious issue. Because of this, schools use local planetariums for astronomical education. However, we found the other big potential in it. The "Big Buddy Association" (a local volunteer association) is trying to provide educational activities that are difficult in class rooms.

2. DIY Planetarium

We produced DIY planetarium show with our children, during a local autumn event of that elementary school (many groups open flea market, crape stand, perform a chorus, etc.) from planning to carrying the show.

3. Method

All of us were just amateur volunteers. We used a DIY inflatable dome and a projector, with a fisheye conversion lens, everyone can use this system easily. It was difficult for us to create fulldome videos of starry sky, so we asked "Niconico Planetarium Club" to help us. They kindly created fulldome videos of a starry sky based on a script written by our group. They used their starry engine to create beautiful and authentic starry skies.

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Most of materials are borrowed and we just had to pay for shipping cost.

Projection system: One Full HD projector with a fisheye conversion lens, laptop computer (niconico Planetarium Club)
Projection software: AMATERAS Dome Player (ORIHALCON Technologies, Inc. Free Version).
Starry sky image: fulldome video clips made by MMD(Freeware) + MME(Freeware) + “Starry Winds” for MMD(Freeware) (niconico Planetarium Club)
Dome: DIY inflatable dome with diameter of 5.6m. (Future University Hakodate)
Anaglyph 3D: glasses, models (Higekita Lab)

Fig. 1. Left: DIY inflatable dome, Right: Full HD projector with a fisheye conversion lens.

4. Tips

Members should try to maximize the fun, by utilizing their occupational abilities and hobby skills, e.g. scripting to introduce the starry sky, drawing pictures for the booklet, playing an ukulele in the dome, narrating in the presentation and showing artworks in the dome. Therefore, it was a very creative show where everyone was involved.

Additionally, to make sure the contents were correct, we we consulted with some planetaria.

Fig. 2. Upper: High school students (OB, OG of that elementary school) recorded the BGM at a local piano school, Lower: Adults members took pictures of the skyline from the roof of the school.

Fig. 3. Left: sketch by children, Center: clean-up via crowd sourcing, Right: overlay by "hiconico Planetarium Club".

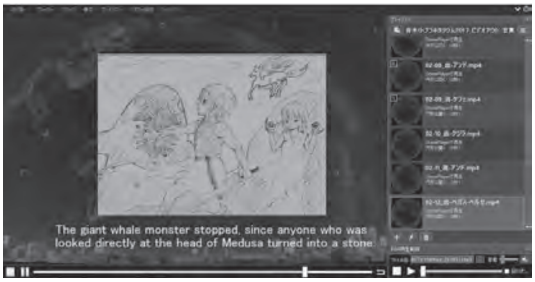

Fig. 4. Fulldome video and Picture-cads were projected by a PC (Operation screen).

5. Results

The children were impressed with the quality of the starry sky, as it was very beautiful, 3D shadow show was very fun and scientific.
We received many requests to repeat the experience.

Fig. 5. Left: 30 people x 20 times watched our show, Right: analog 3D shadow show.

We created a unique experience. DIY planetarium, involving the local community, provided a lot of educational experiences, using the latest technology, and most importantly, connect with various people.

6. Conclusion

It was a good combination of a DIY planetarium and the local community, to provide an educational science experience for children. It triggered our motivation, ensured the scientific accuracy, while keeping grass-roots independence.

However, it is not easy for amateurs to create wide variety of scientific contents. Therefore, we would like to ask help from professionals to encourage amateur activities like ours. For example, fulldome video clip libraries, freeware that can be used for dome projection, friendly advices, etc.

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Far From Reality: Scientific Visualization

Stefania VARANO*1

Abstract. Universe is generally perceived as made of colorful and detailed objects, in which lights and shadows reveal fascinating geometries. Nonetheless, astronomical observations are mainly made of numbers representing the incoming data, which are often converted into images, in order to be better understood. The display process implies a set of rules for encoding the information in a visual form, but this code is not always acknowledged. When visual representations are used to display invisible data using highly figurative analogies (i.e. imitations of reality), they can lead to misinterpret nature of the data. We propose the use of more arbitrary and less figurative representations and investigate the suitability of multi-sensorial representations, testing them with both seeing and visually impaired people.

1. Introduction

In this article I present my PhD research project in Science Cognition and Technology at the Philosophy Department of University of Bologna, Italy, with which I graduated in June 2016. The title of my thesis is “Visual and sensory representation of invisible science”. The main aim of the study was to inspect the use of images in scientific communication (also from a semiotic, semantic, philosophical, perceptive and cognitive perspective) and to examine the opportunity of using alternative sensorial representations.

Scientific visualization is the visual representation of data, in order to better understand and illustrate them to all possible audiences. The display process involves a code, i.e. a set of rules giving the correspondence between data and visual parameters [1], [2]. Normally the code is complex; not infrequently, however, it is tacit. This can cause the misinterpretation of the representation, particularly it shows invisible data in a densely figurative way [3], i.e. in strong analogy with visual referents and real objects (for example “artist impressions” of exoplanets, radio waves from a Quasar in false colors or gravitational waves represented as a sound).

We argue that, mainly in case of invisible signals, the use of more arbitrary and less figurative representations can harvest a more conscious fruition, also allowing to overcome some of the cognitive limits of images.

2. Description of the study

Scientific visualization is intended here as any visual representation of quantitative data, directly observed and measured or indirectly extrapolated and calculated. According to this definition, visual representations not necessarily are images: they can be diagrams, plots, etc. Within this framework, we make a distinction between different forms of data and representations: *data* can be *abstract* (percentage of literacy) or *concrete* (temperature, pressure, dimensions); representations can be *arbitrary* (plots, diagrams) or *figurative* (images, isophotes).

We focus on *figurative* representations of *concrete* data, *physically non-visible*. “Non-visible” objects are the ones that:

- do not emit light (Fig.1a);
- are too small to interact with light (Fig.1b);
- are not accessible to instruments capable of receiving the emitted/reflected light (Fig.2).

Fig 1. (a) Pseudo-colors representing the temperature (Infrared camera, false colors reported in greyscale); (b) Acarus close to a nanotech motor (Scanning electron microscope, greyscale).

Fig.2 Artist's concept of one possible appearance of the planet Kepler-452b.

The use of images implies, as for many other cases in communication (such as metaphors, for

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example) a *reading contract* [4], i.e. the code to be used to “interpret” the representation. This “contract” is usually stated in the original caption of the image, which not always complements the image in all its uses. In addition to that, sometimes visual representations are designed in order to be the most realistic possible and to recall reality. Nonetheless, since we represent numbers, we could in principle use whatever other sensorial stimuli capable of representing the presence of a signal overcoming the background noise. This necessary implies the use of abstract, non–figurative representations.

We explored the option of creating multisensorial representations and we studied the potential of such representations. First of all, we studied the state-of-the-art of alternative sensorial representations of scientific subjects (not only astronomical), determining how the less realistic ones seem to pose less displaying constraints (due to their estrangement from reality): this means they can enclose more parameters, i.e. more data. Abstract representations are also more engaging and challenging, even if perhaps less «emotional». Moreover, synesthetic representations have the potential of reaching different sensorial abilities.

With these findings in mind, we designed our own non-figurative representation and tested different version of it with various audiences, in order to attest its possibilities and limits.

3. Experimentation

We produced a tactile and acoustic map of radio waves emitted from celestial objects in a region of the sky, which makes use of tactile and auditory parameters not necessarily corresponding to their visual analogues.

Fig.3 Our synesthetic representation of the sky.

We carried out a complete experimentation using a tactile, an acoustic and a synesthetic map of the sky (showed in Fig.3), the spatial position representing the position of the object in that portion of the sky; the physical heights of the bolts’ column the different intensities of the signal (according to a direct proportionality) and different frequencies (different pitches of sound) the different distances from Earth, according to the relation “higher frequencies → closer objects”.

The testing involved both seeing and visually impaired audiences: while using representations involving touch, we also acknowledged their diverse abilities and habits.

4. Results

This study showed as facing and exploring very abstract representations can be really hard in terms of noticing and choosing the elements worthy focusing on, since each feature seems equally important. We believe this gives strength to the experience, since this is exactly how science works: choosing what to study deeper in detail among many apparently equal possibilities.

While exploring the representations, many looked for analogies with their personal experience: larger extension of the arm was interpreted as a bigger distance by blind users, users that knew about the Doppler Effect related the difference of the pitches to the fact that signals were approaching or moving away from them. This means that the parameters of the representation have to be carefully and consciously chosen in order to be as much possible unrelated to reality

The representations implied low emotional engagement (no «wow» effect). This triggered an easier identification of the presence of a code, the understanding of which re-introduced the emotion (this is what the Universe “looks like” when you study the invisible).

Our results show a significant progress in terms of engagement of a disabled audience, presenting interesting cues for future research in education, implementations for science centres and creation of projects for the integration of sensory impairment.

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Stars for Everyone: The Practices of "Hospital is a Planetarium"

Mariko TAKAHASHI*1

Abstract. "Star Spinning Village" provides outreach activities to bring the starry skies to the people who cannot see the real stars for reasons such as illness, handicaps or environment, those who are far away from information about stars and the universe.

The "Hospital is a Planetarium" Project mainly visits long-period hospitalised children and the patients with incurable diseases. Visit offers have been increasing every year as follows: 15 offers (2014), 25 offers (2015), 43 offers (2016) and 53 offers (2017). In this paper, we show the practices and challenges of the project.

1. Introduction

Starry skies teach us that "we are all beings in the universe and that that is the reason why we are so tiny and lovable". This reasoning helps us improve our self-confidence and brings us hope in achieving our full potential.

I worked at a planetarium in the Yamanashi Prefectural Science Center for a long time before becoming independent (freelance), and now I run an association named "Star Spinning Village" (*Hoshitsumugi-no-mura* in Japanese) to bring the starry skies to our audiences.

Our mission is to connect people through stars and generate happiness together. The main activities are bringing a mobile planetarium with a space navigator, star-gazing opportunities and workshops to hospitalized children, people with handicaps and those who have suffered from natural disasters. There are over 90 volunteer members in our association.

2. History

The history of the project named "Hospital is a planetarium" started when I encountered Dr. Takeshi Inukai, a paediatrician in University of Yamanashi who loves astronomy. At first, I projected a toy-planetarium in a hospital school once a year. Then, after becoming independent in 2013 and receiving funds, I projected it 15 times in the first year, and the number of times increased rapidly to 25, 43 and 53 times each year. I also demonstrated the planetarium show at the Japanese Society of Pediatric Hematology/ Oncology in 2015, for over 200 doctors and nurses.

In total, we projected it 136 times and it was experienced by over 8000 people all over Japan during the four years.

3. Projection style

There are several styles of projection. One is projecting it on a 4-meter air-dome where wheelchairs, stretchers, intravenous drips and breathing/respiratory equipment can be taken in. We set it in a hospital school, play room, etc. 10 children and several staffs or about 6 wheelchairs can go in there. The programme, which takes about 20 to 30 minutes, is performed 5 to 8 times a day.

Fig. 1. A 4-meter air-dome and patients (Kofu National Hospital).

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Another style is projecting it on the ceiling. Most bedridden patients stare at the white ceiling all day. We project stars there. It is for those who cannot even come out to a play room but are staying in a private room, NICU or clean room. When it is for one person, we project the starry skies of the day of their birthday.

Fig. 2. Projecting stars on the ceiling (Fukushima Hospital).

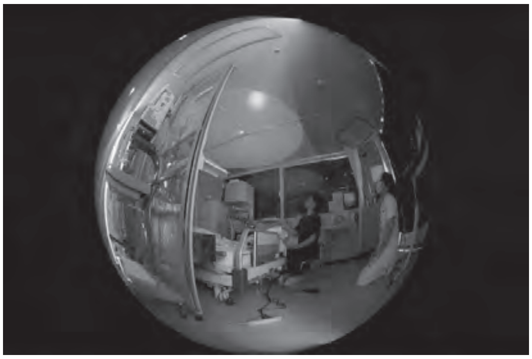

Fig.3. Showing stars to a child in a clean room (University of Hirosaki Hospital)

4. Feedback

We have received a lot of positive feedback from the places we visited. For instance, a child who was so ill in the morning surprised a nurse by saying that he was uplifted after seeing the planetarium. Also, other children wrote "what I wished was to be cured from the illness" and, "I thought that it is a miracle to be alive", etc. Moreover, a child who was knitting their brows and shouting at another child beside them became cheerful and said "I want to watch it again" and another child asked "will you come again tomorrow?" It is also a relaxing time for carers, such as nurses and doctors.

We encountered many other examples. For example, a teenage boy with a blank expression did not react when we greeted him on his stretcher. His mother beside him also did not change her facial expression, but when the planetarium began and at the moment when it became filled of stars, his eyes opened wide and his face started to shine as we traveled through the cosmos. When we returned to Earth, his facial expression was as if he was shouting "here is Earth!". He did not produce a sound, but his facial expression became clearly beautiful and his mother burst into tears as she saw him.

Another case was that, a 5-year-old boy who was depressed as he did not want to have an operation, was able to walk into an operation room without hesitation after seeing the planetarium.

Furthermore, the planetarium show has a big meaning for the parents whose children have passed, as they believe, "into the heavens". Parents who lost their 3-year old daughter told us that they often look up at the stars to find her.

5. Summary

Since visit offers have been increasing every year, I am giving training to other members to enable them to carry out the same activity. We are establishing a sustainable system.

The planetarium is necessary not only for patients but also for the carers, such as nurses and the families of the patients.

It is also necessary to start researching the planetarium's effects and provide them to the medical and welfare research areas, and to create a concept of "Planetarium therapy".

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Astronews: Scientific Journalism in Developing Countries

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Abstract. Astronomy is undoubtedly an attractive field and presents a major opportunity to promote science anywhere in the world. Nevertheless, this is a major challenge in developing countries, where investment in outreach is small, and the inflow of information from press offices in wealthier nations is dominant. The end result is a lack of awareness and/or interest in science, or alternatively an impression of monopoly in scientific discoveries by developed economies. In this work we present a Brazilian project started in 2017 and financed by the IAU Office of Astronomy for Development that aims to address the problem. More specifically, we have created a working group dedicated to promoting national science, acting as liaison between the academic community and the press, with a goal to raise public awareness, attract new talents, and hopefully encourage economic development through investment in science. We discuss the challenges faced thus far, the strategies used in establishing contact with journalists and our recent attempts to expand the project to other Latin American countries.

1. Introduction

Astronomy is one of the main scientific topics covered by news channels in the world, drawing the attention of millions of readers and viewers daily. This represents a great opportunity to the academic community, since it helps build support for science within the general public and challenge stereotypes of scientists [1,2], potentially attracting talents and investments for future research. Furthermore, scientists have the moral obligation of building a dialogue with the general public, so that the investment made in science can benefit a wider range of individuals.

In developed countries, the investment in outreach activities has increased greatly in the last decades, reflecting a recognition by funding agencies of the importance of science communication as a whole. Nevertheless, this investment is still severely lacking in developing countries.

In this work we present a pioneer initiative in science communication in Brazil — which we named Astronews — with the potential of extension to other developing countries in the future.

2. Astronomy communication in Brazil

As is the case in other countries, astronomy receives considerable attention in the Brazilian media. When starting the current project, we have evaluated that 10—30% of all news in Science sections of newspapers in Brazil are related to astronomical topics, depending on the vehicle evaluated.

Nevertheless, typically less than 10% of those are related to research developed within Brazil, with the vast majority covering discoveries made in developed countries. This reflects the aforementioned lack of investment and enhances any preexisting inequalities.

This has served as inspiration for a project including Brazilian scientists and communicators to act as *de facto* public information officers (PIOs) for the Brazilian astronomical community. The project is done in collaboration with the Brazilian Astronomical Society (SAB) to ensure appropriate synergy with researchers.

Astronews has been created with UNESCO Sustainable Development goals in mind. From the beginning, our main goal has been to reduce inequalities between countries, fomenting scientific awareness in a country severely lacking — while at the same time providing the public with quality education.

Our activities comprise what is usually regarded as the mission of institutional PIOs: selecting relevant and intriguing research results, writing press releases and acting as liaison with the press and journalists.

The innovative aspect of the project is how unconventional it is within the Brazilian landscape: although commonplace in developed countries, there has never been a nationwide project of this kind in astronomy in Brazil. Some research institutions host their own communication offices, many with considerable impact, but most of these is outside astronomy. In most cases, universities have a single journalist to work as communication officer for the whole institution, and this is evidently not enough to meet the demand.

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We have had great success in implementing this strategy. Since the beginning of the project, in February 2017, approximately 30 news stories (based on 10 individual releases) have been published in Brazilian newspapers and magazines, in addition to two TV pieces in public-access channels. We have also received requests for interviews, connecting specialists in a given field with journalists for a total of 20 published interviews. Most of the newspapers have circulations between 100,000 and 1,000,000 copies.

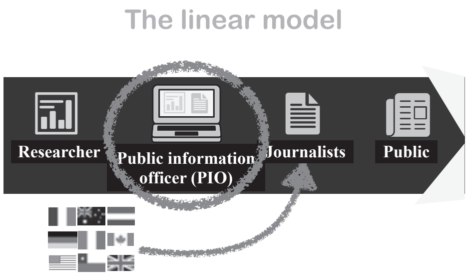

Fig. 1. The linear model and the information vacuum filled by foreign research.

3. Challenges and perspectives

The main challenge we have faced is to generate interest in the media. Although news vehicles have a tradition of giving attention to astronomy-related stories, journalists are generally not aware of work done within the country.

The previous lack of investment in this type of communication has generated a severe gap in the dialogue between scientists and the general public in Brazil (see Figure 1). Illustrating the problem from the point of view of the "linear model" ([3] and references therein), the lack of enough active PIOs within Brazilian astronomy has produced an information vacuum in the national press. Given the current abundance of discoveries and press releases originated in developed countries, this vacuum has been filled by research done abroad.

We believe we have performed well in mitigating this problem. Our strategy has been to focus on the local aspect of astronomical research, attempting to highlight the national contribution of science as a whole and the work done by Brazilian scientists in order to make news more relatable and, therefore, more attractive to publishers.

Another challenge is the prevalence of non-specialist communicators in Brazil, especially in social media and Youtube. Those communicators have excellent skills and great creativity in dealing with scientific content, but sometimes lack the technical knowledge necessary. Again, this is filled by foreign press releases, and their activity can even enhance a perception of inequality that is not real, but simply due to the inactivity of the academic community in outreach efforts.

SAB has begun a trial collaborative project with these communicators, providing them with scientific consultants in order to improve their content and ensure technical accuracy. This has had mixed success thus far; although in some cases it has produced great results, in others there has been little interaction between communicator and the consultant. We believe this has been due in part to a lack of recognition of Brazilian scientists as authorities in the subject, and hope Astronews itself will be able to change that perception.

Finally, we also emphasize the need to recognize the problem of regionality within Brazil. There are areas severely lacking in investment in science, with strong correlation with the economic situation therein. In these cases, it might be harder to reach the public, since there is little to no research done there. We have tried to highlight projects from scientists away from the wealthiest parts of the country — namely Rio de Janeiro and Sao Paulo — but this is still a challenge. Therefore, we have difficulties balancing inequalities not only between developed and developing countries, but also within Brazil itself.

We hope this initiative serves as inspiration and a starting point for similar projects in other developing nations. This is of fundamental importance to promote scientific literacy and investments in regions where many still believe they are impossible or inaccessible.

4. Summary

Astronews is an initiative to connect Brazilian astronomers and the Brazilian press. We act as a liaison between researchers and journalists. We have been able to have tens of news stories printed, but still face a challenge due to a historical lack of awareness of national science within the public. We hope to mitigate this problem with continued efforts in science communication.

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The Roles of Print Media and Social Media in Communicating and Increasing Enthusiasm in Astronomy for School Children and their Challenges in Thailand

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Abstract. Astronomy, despite its attractiveness, not many of young sky observers will turn themselves into astronomy lovers, or even to learn more deeply in astronomy. Therefore, related materials and media are necessary to motivate, increase their enthusiasm and to cumulative their interests in astronomy.

In Thailand, there are several modern media in many formats including print media, television, the Internet, etc. To communicate astronomy's contents with young school children, the communicator must understand their pros and cons in relaying their messages to the audiences by selecting the most effective ways to communicate those stories.

The speaker will show the result of study of current situation and trend of print medias and social media in astronomy among school children, in Thailand, and compare practical ways to communicate effectively with kids between different forms of them. The information was collected by using questionnaire, secondary sources of information and observation.

The findings of this study will explore the roles and challenges of the media in communicating and increasing enthusiasm in astronomy for children, which may bring about development of suitable contents and formats in communicating astronomy in the said media.

1. Introduction

One of the most challenging group of audiences to communicate science with is children, as the science communicator needs to simplify their sophisticated scientific contents to its most fundamental and easy - to –learn subjects. National Astronomical Research Institute of Thailand or NARIT has been trying to enhance and promote awareness in astronomy, and astronomy education for years, as it is undeniable that astronomy is one of the effective tools to convince children and youth to learn science in Thailand.

Knowing its necessary in promoting awareness in astronomy in school children, only astronomical events and courses in school curriculums are not enough, and media are also playing an important role in helping it. For this reason, this study was conducted in order to research current situation and trend of print media and social media Thailand, and also focusing on astronomical media among school children in Thailand, astronomical media consumption analysis, and the most appropriate media to communicate astronomy in the view of the target group.

2. Methods

The study was conducted by several methods including researching secondary data from publications and news about media consumption behavior in Thailand both print media and social media such as magazine, television, social media sites, radio, to name but a few. The information about challenges of those media were also gathered and analyzed. After getting enough secondary data, the questionnaire was designed to survey the media consumption behavior of the target group, which were in total 248 students between grade 1 to grade 12 from random provinces in Thailand. Additionally, in-depth Interviews with science communicators were also conducted to understand the point of view of science communicators in conveying message about astronomy to the young recipients.

3. Results

Refer to the statistics from several sources [1][2][3], it was shown clearly that the situation of print media in Thailand has been getting worse, due to declining of readership, and one of the main causes was the role of digital media which days by days intervened our daily life. The amount of print media consumption, especially magazines, dropped dramatically and some of them needed to stop their business. But at the same time, digital media, including websites, social media, search engine, etc. have become an important part of our life. The statistics [4] showed that 82 percent, or 57 million of Thais have accessed to the internet, and 74 percent, or 54 million were active social media users. In other words, while print media business needed to adapt themselves to survive, social media enjoyed their increasing amount of users.

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Facebook has been the most popular social media platform, used by 47 million people. However, Twitter and Instagram had higher increasing percentage than Facebook, as shown in the diagram below;

Concerning the questionnaire survey, 70 percent of the students always consumed digital media, followed by television, which was approximately 12 percent, while radio, newspaper, magazine, and brochure/flyer/leaflet were consumed even less than 3 percent. In addition, online video, search engine, and Facebook were the media they used the most respectively.

Being asked to rate the media they accessed to astronomical contents in 2017 the most, and the most appropriate media for communicating astronomy, the results were similar, social media, online video, website, and television were voted the highest rank correspondingly, while other media suffered their unpopular ratings.

4. Conclusions

Social media has played an important role in astronomy communication among school children comparing to the print media, which are getting less popular. Therefore, print media may need to adapt themselves to survive, some of them may need to provide digital media too. Also, social media sites other than Facebook are needed to be considered as they have been growing up. At the end of the day, astronomy is still one of the science fields that inspire children to be interested in science and technology, therefore, building awareness in learning astronomy among them by any means are needed to be performed the best we can do, even by private sectors, governments, individuals, not only for the society, for our countries, but for our better world in the future.

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33 years of *Astronomía* Magazine in Spain

Ángel G. ROLDÁN*1

Abstract. 2018 marks the 33rd year of history of the only astronomy magazine in Spain. This article will deal with the evolution and adaptation we have experienced in the ever-changing world of astronomical magazines, and our compromise with the future and the Spanish-speaking astronomical community.

1. Introduction

Astronomía is the first Spanish magazine that was put on sale in a kiosk dedicated entirely to the popularization of astronomy, astrophysics and space sciences.

In December 1985, the first issue of the magazine *Tribuna de Astronomía* (its original name) was published on a monthly basis. For the lovers of astronomy, 1985 is mainly remembered as the year in which one of the most famous astronomical objects of all times started to be visible in the Earth skies: the periodic comet Halley, returning to the inner Solar System after 75 years. And it was also, even in the pre-Internet era, a defining moment for the astronomical outreach worldwide.

That is why a small group of independent amateur astronomers in Spain's capital, Madrid, decided to launch a monthly magazine devoted to astronomy, astrophysics and space sciences. The popular and media interest in Halley's comet was the catalyst.

Also, in 1985, another very important astronomical-related event took place in Spain: the inaugural ceremony of the international observatories of the Canary Islands Astrophysical Institute in the summits of Tenerife and La Palma.

Both events, the return of Halley's comet, and the beginning of the astrophysical Institute in the Canaries, aroused a great amount of popular interest in Spain, and we thought that the time was ripe to start with the adventure of an astronomical magazine.

2. History and Trajectory

As a result, in 2018, 33 years of uninterrupted publication have been completed. And, from 1985 until today (April 2018), 390 issues later, we have not received ANY public grants or subsidies, relying solely on our own scarce resources.

The profile of the publication makes special emphasis on the quality of the information together with a careful editing and presentation. *Astronomía* is distinguished by publishing almost exclusively Spanish or Spanish-speaking authors, both amateur and professional astronomers, paying special attention to the works developed by the scientific community, being a collaborating journal of the Spanish Society of Astronomy and the Federation of Astronomical Associations of Spain. Our mainstream audiences are amateur astronomers, the majority faithful readers from a long time. We are deeply committed to the amateur community in Spain, because it is in our roots. That is why we try to participate and collaborate actively with as many star-parties and similar events as possible. Since January 1990, we have had a Scientific Advisory Board, made up of professionals of recognized prestige from Spain and Latin America, 4 men and 4 women, with HM the King Felipe VI as the Honorary Chairman of the Board.

Almost all of the usual contributors to the magazine (about 25 people) are either amateur or professional astronomers from all over Spain, and from time to time we organize informal meetings to strengthen our bonds.

But we have not been the only kid in town: we were the firsts, but in all these years, another astronomical magazines in Spain rose –and set–, like *Cosmos*, *Universo* and *Espacio*. In fact, *Tribuna de Astronomía* and *Universo* merged in 1999, and the new magazine blended the two names: *Tribuna de Astronomía y Universo*. In 2005, only *Astronomía*, our current header, remained. During the International Year of Astronomy in 2009, we were Media Partner of the Event Secretariat in order to write and report the activities of that year. The interest in astronomy received a great impulse in that year, also in Spain, where we reached our peak sales in all our history. But the upcoming economical crisis was as devastating as a supernova, and today we sell just a third of the print-run that we used to have on those golden years…

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Throughout the history of the magazine, and nowadays, the pages of *Astronomía* have always been and will be open to researchers, and for that reason the magazine has become a unique tool to maintain and enhance the contact between professional and amateur astronomers.
The greatest value of our magazine is to have a large group of collaborators who are the soul of the publication, a team of editors composed of the best experts in each of their fields, which has given *Astronomía* a great prestige. Thus, one of our objectives is to show the works of the growing community of amateur astronomers, being configured throughout all these years as the reference magazine for lovers of astronomy in Spain. In recognition of this work, *Astronomía* received in 2016 the Special Prize of the Jury in the XXIXth edition of the Prismas Prizes for Outreach of the Scientific Coruña Museums, the most prestigious of Spain in its category.
Finally, what about the future? We still think that the magazines like us can play an important role in the popularization of astronomy. We have tried to adapt to the ever changing and, perhaps, too fast, digital world. In addition to our traditional paper edition, we have a PDF one, and also an active role in the social media through our newly refurbished webpage, Facebook, Twitter and Instagram accounts, summing up more than 28 000 followers.

2. Figure

Fig. 1. Cover of April 2018 issue of *Astronomía.*

3. Conclusions

In summary, our strengths are:

- Tradition, reliability and prestige.
- High quality content.
- Attention to detail.
- Consolidated core of loyal readers.
- Excellent relationship with both amateur and professional astronomical community.

We would mention a last one: passion. The passion that all our team have in sharing astronomy with the people.
And a closing note: in a little more than five years from now, in 2023, our old friend, comet Halley, will reach its farthest point from the Sun, at a distance of 5.3 billion kilometers. Of course, we are planning an extra issue celebrating the aphelion, because our trajectory is linked to the comet, as well as this story…
We do not know if our magazine will still be around in the next visit of Halley’s comet, 43 years in the future, but we aim high… It was a real pleasure to share this vision with all of you at Fukuoka!

27 Years of Astronomy in Newspapers

Durruty Jesús DE ALBA MARTÍNEZ *1

Abstract. As undergraduate physics' student and also as administrative employee in research deparment of a state university the author was fortuitously involved to contribute in the science page of a regional newspaper, such collaboration followed from graduate student to academic technician in a research institute where remains and it was spread to other newspapers and even in radio broadcasts. Such experiences during 27 years are reported and some examples are shown.

1. Introduction

Here are described the author's experiences along 27 years in different printed newspapers from the second largest city in México, some of them also with web versions, perhaps a suitable initial question is: Are still alive printed newspapers? In Guadalajara City are now eleven printed commercial newspapers (see table below) [1], are not included gazettes from universities and unions in wich author also published contributions; a quick classification is: Dayly (**D**), weekly (**W**); by financial support independent (**I**), part of a regional or national network (**N**); for distribution local or metropolitan (**L**), regional or state (**R**).

	Year of foundation[2]	Type
El Informador	1917	D, I, R.
El Occidental	1942	D, N, R.
Milenio	1997	D, N, R.
Mural	2000	D, N, L.
El Tren	2000	W, I, L.
Metro	2005	D, N, R.
Página 24	2008	D, N, L.
Publímetro	2011	D, N, L.
La Crónica de Hoy J.	2015	D, N, L.
El Diario NTR	2015	D, N, L.
Noticel	2017	W, I, L.

Table 1. Printed Newspapers in Guadalajara

2. From Local to Science section

As undergraduate physics' student and also as administrative employee in research deparment of a state university the author was fortuitously involved to contribute in *El Occidental* newspaper, second oldest in Guadalajara that is part of a national network, Organización Editorial Mexicana (OEM), he was asked to write an article concerning science for Local section, has in those days was the anniversary of Facultad de Ciencias (Faculty of Sciences) of the Universidad de Guadalajara (UdeG), it was the theme of the article.


Diez Años de la Facultad de Ciencias

Fig. 1. First article in *El Occidental*, Sept. 02, 1990

In the years previous to the generalization of the Word Wide Web in México began a column called *Hojas del Cosmos*, in *El Occidental* at Science page, such article made a brief review of books on popularization of Astronomy, and column continues today almost each Sunday covering from Astronomy news to scientific related meetings or activities, from Cuba, to Honduras and USA and of course México, lectures and meetings gave material for the column, just in an American Physical Society meeting he discovered that great scientists (this case a Nobel prize) generally are well disposed to talk on their own work and how useful could be carry and use a photographic camera, also learned in a press conference that international science journalists make

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questions like dissertation examiners, later chatting at coffee break or toasts, he knew that many of them holds degrees both in science and journalism majors.

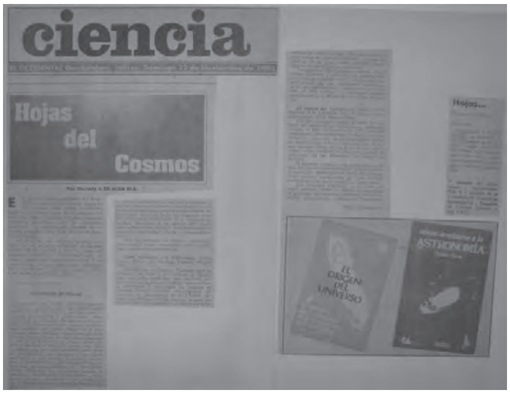

Fig. 2. First issue of *Hojas del Cosmos* column

CIENCIA Y SALUD

EL OCCIDENTAL

GUADALAJARA, JAL. DOMINGO 8 DE MAYO DE 2005

5D

Hojas del Cosmos

Megaciencia, necesidad del micromundo

DURRUTY JESUS DE ALBA MARTINEZ *

Para entender el momento y los procesos desarrollados durante el inicio del universo, se hace necesaria la conjunción de la ciencia de lo muy grande, la cosmología y la ciencia de lo muy pequeño, la física de las partículas elementales; esta última tiene como escenario experimental los grandes aceleradores de partículas, con los cuales se hacen colisionar partículas de diferente naturaleza y en algunos experimentos se pueden lograr, en muy pequeña escala, condiciones similares a las que se piensa pudieron existir en los primeros instantes del Universo.

DURRUTY de Alba y el doctor Leon Lederman durante el congreso de la APS en Tampa, Florida.

Una detallada y amena historia de la naturaleza submicroscópica (física de partículas) fue relatada en el pasado congreso de la Sociedad Americana de Física (APS por sus siglas en inglés) por el doctor Leon Lederman, uno de sus principales actores, quien compartió en 1988 el premio Nobel de Física con Melvin Schwartz y Jack Steinberger por "el método de irradiación de neutrinos y la demostración de la estructura en doblete de los leptones a través del descubrimiento del muón neutrino".

Director emérito del famoso Fermilab en Batavia, Illinois, el doctor Lederman también recibió en el congreso de la APS en Tampa la medalla "Karl Taylor Compton" por su "liderazgo en la Física" que le otorgó el Instituto Americano de Física (AIP por sus siglas en inglés).

Durante su exposición titulada "La naturaleza submicroscópica necesita megaciencia", que fue parte de la sesión patrocinada por el Foro de Historia de la Física de la APS, hizo un divertido recuento de algo así como cincuenta años de la física de partículas, describiendo el incremento en equipos, investigadores y presupuestos, desde el pequeño ciclotrón de 37 pulgadas construido por Ernest Lawrence en los cincuentas, hasta el kilométrico (27 Km) Gran Colisionador de Hadrones (LHC por sus siglas en inglés) que ahora se construye en Europa, involucrando centenares de físicos, técnicos e ingenieros en proyectos que pretenden hurgar la estructura de la materia.

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Fig. 3. *Hojas del Cosmos* in Sc. & Health page

Three years ago received an invitation to collaborate with an editorial column in the then newest newspaper: *El Diario NTR* where he deals with issues of the history of science, column name is *El pegaso de Sigüenza*, honoring the first modern scientist of Latin America, Carlos de Sigüenza y Góngora (1645-1700).

3. Between journalism and science popularization

Institutional efforts to make science popularization they took to the UdeG to an agreement with *El Informador* to make a supplement (now ceased) named *Presencia Universitaria*, in such was published two articles, one of them cover issue and latter was reproduced in a book edited by UdeG.

4. Conclusions

Some reflections on the process lead us to following *advices*:

- Popularization is timeless, Journalism have a deadline.
- Where you go, you can write.
- A camera always open doors.
- Great scientists most in cases are available for talk on their work.
- A double-way communication should be open between editor and reporter/science writer.

References and notes

[1] When this manuscript was in preparation the author discovered a new weekly printed and web newspaper: *Noticel*, and an omission in the table showed at talk: *Milenio*.

[2] Information from the newspapers or Secretaría de Gobernación, *Padrón Nacional de Medios Impresos*: https://pnmi.segob.gob.mx/

Astronomical News Stories in the Two Largest Japanese Newspaper Companies

Osamu NAKAMURA*1

Abstract. This study aims to investigate how frequently astronomy is reported and what topics of astronomy are covered by newspapers. To achieve these purposes, articles on astronomy were collected from the two largest Japanese newspaper companies, Yomiuri and Asahi. The publication years were limited to the four years (1987, 1997, 2007, 2017) to reduce the sample volume, and 6674 articles were obtained in total. Text analysis technique was applied to the articles, and 22 clusters of articles were extracted by hierarchical cluster analysis on word-vs.-article matrix. The associated words with each cluster were inspected to infer what topic the cluster of articles was about. In this way, the 22 clusters were interpreted as 22 topics. Finally, the number distribution of the 22 topics were investigated. This study will help shed light on science communication in astronomy.

1. Introduction

Although the internet is getting more popular to obtain social information and news stories in these days, newspapers still keep a large number of circulation in Japan[1]. Topics reported in those newspapers should play an important role in public understanding of science, but little work has targeted newspapers in terms of astronomy. Hence it is essential to know how often astronomical topics appear in newspapers and what about astronomy are focused. To answer to these questions, this study aims to reveal how frequently the word ‘astronomy’ and its equivalent words have been used in Japanese newspapers and in what context they have been quoted by a quantitative approach.

2. Method

The largest two Japanese newspaper companies, Yomiuri Shimbun and Asahi Shimbun, were selected for this study. They both have Japanese and English editions, and this study focused only on the Japanese ones. The articles were collected from the databases of the two companies with the following conditions:

- Published in Tokyo.
- Appeared on main pages (i.e., non-regional ones).
- Had at least one of the following three Japanese words: 'Tenmon', 'Tentai', 'Ucyu'. The corresponding English words are 'astronomy/astro-', 'heavenly body', 'space/universe/cosmos', respectively.
- Published in 1987, 1997, 2007, or 2017, to reduce the sample volume.

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The numbers of articles collected with these conditions were 3495 and 3179 for Yomiuri and Asahi, respectively. Then KH Coder[2], a free software for quantitative content analysis, was used to perform text analysis. The procedure was first to extract words used in the articles, then to make hierarchical cluster analysis of the articles based on word distribution in the articles. To run the cluster analysis within a feasible time, the words which appeared in 6% of the total articles (i.e., (3495+3179)*0.06=400 articles) or more were only used. This threshold roughly controls how deeply minor topics are explored and detected. The number of words chosen in this way counted 315 in total. It means that each article had at least 315*0.06 (=19) words on average for the cluster analysis. After the analysis, 22 clusters of articles were obtained. The number of clusters was determined based on the cluster agglomeration. The inverse of 6%, 1/0.06=17, could also give a brief estimate of valid number of clusters, and the two were consistent within a reasonable range.

3. Results

The list of associated words with each cluster was obtained with reference to Jaccard coefficient between the words and the clusters. Table 1 shows the top 10 words in order of the coefficient for cluster-10, 16, and 17 to give an example. The numbers in the second line show how many articles belong to the clusters. The words in the table have been translated into English. The reason the same words sometimes appear is because different Japanese words correspond to a single English word in those cases.

Each cluster was then examined to infer what topic it represented based on the associated words. For example, Cluster-10 was inferred to represent a topic on the sun. In the same way, cluster-16 was inferred a topic on the space activity of Russia, while cluster-17 was on that of the U.S. In this way, the 22 clusters of articles were interpreted as 22 different topics, and they are shown in Table 2. The degrees of abstraction for these topics seem to be different from each other (e.g., 'Films/Stories' is a part of 'Culture'), but they are the numerical result of word distribution regardless of our interpretation. The 22 topics could further be categorized into four meta-topics ('Pure Science/Astronomy', 'Nearby Space Activity', 'International Politics', 'Culture/Life'), which are also indicated in Table 2.

Table 1. List of top 10 associated words for Cluster-10, 16, and 17.

	Cluster-10 112 articles	Cluster-16 158 articles	Cluster-17 383 articles
1	flare	Mir	space shuttle
2	solar	Russia	Takao
3	battery	station	shuttle
4	sunspot	Mir	DOI
5	plasma	docking	station
6	surface	malfunction	fly
7	panel	Moscow	NASA
8	Midori	Soyuz	boarding
9	magnetic force	Baikonur	ISS
10	temperature	Russia	Columbia

Table 2. List of 22 clusters and topics

ID	Topic	ID	Topic
Pure Science /Astronomy		**International Politics**	
18	Science Research	20	Economy/Policy
13	Telescopic Obs.	21	International
11	Instruments/Obs.	6	Military
9	Heavenly Bodies	22	Missile
12	The earth/Environment	5	Russia
10	The sun	19	China
Nearby Space Activity		**Culture/Life**	
17	Space Act. of US	2	Culture
16	Space Act. of Russia	1	Films/Stories
14	Rockets of Japan	3	Art
15	Satellites of Japan	4	Life
8	The moon		
7	Mars		

Finally, the number distribution of articles in each cluster was calculated and is presented in Figure 1. It turned out that many topics have been on the newspapers constantly, but those on 'International Politics' decreased drastically in 1997 following the end of the cold war.

4. Summary

This study investigated how frequently astronomy and its equivalent words were used in the largest two Japanese newspapers and in what context they were quoted by a quantitative content analysis. As a result, 22 topics were extracted, and four meta-topics were suggested. The page distribution of the articles was also investigated but was excluded from the 15 min. talk. They will be detailed elsewhere.

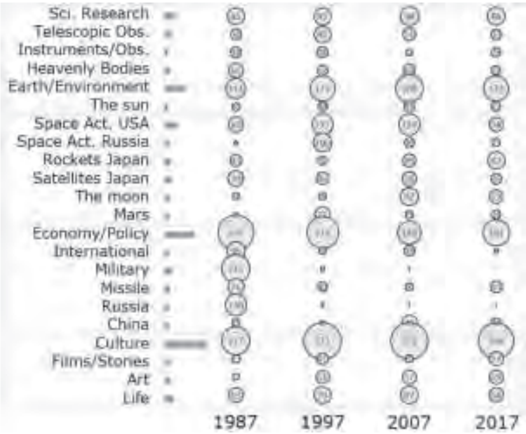

Fig. 1. The number distribution of articles in 22 topics. The area of each circle is proportional to the number of articles. The four rectangles enclosing the topics correspond to the four meta-topics.

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Learning Astronomy In 60 Seconds

Alfean AZIZ [*1]

Abstract. Astronomy in 60 Seconds highlights astronomy to the social media viewers in just 60 seconds in the simplest way. Produced in-house by staff and internees of Planetarium Sultan Iskandar (PSI), it provides more information for students and general viewers who requires information on basic astronomy in our local language - Bahasa Malaysia. The video is published through one of our YouTube channel named Astronomy in 60 Seconds. We have videos produced under the channel Astronomy in 60 Seconds and it covers a variety of astronomy topics ranging from planets, gravity, the sun and solar system to mysterious dark matter. The purpose of this video production is to promote astronomy to public and younger generation which have limited attention span and to improve their understanding and comprehension in astronomy. Besides, videos are much more engaging and shareable than text content. Indeed, introducing this astronomy video on YouTube is a great opportunity for PSI to create a platform to attract people's attention in astronomy and inspire future generations. Furthermore, participants attended school holiday programme are required to create 60 seconds video as one of the activities in the programme.

1. Introduction

In the age of social media where your breakfast, lunch and dinner becomes your photography inspirations, where hashtags are as important as your passwords and waiting for about 10 seconds for a web page to load means an eternity.

A study by Microsoft concluded that the average attention span had fallen to eight second, down from 12 in the year 2000. We now have a shorter attention span than goldfish, the study found.

Promoting astronomy to students and general public is not easy especially when English is their second language. Learning astronomy using social media especially through YouTube is not a new concept coming from English language community.

Language is always a barrier for students with little understanding of English, even though in Malaysia, Science and Mathematics is taught in English.

2. Why 60 seconds?

The idea of Astronomy in 60 Seconds came from a column published in CAP journal, Explained in 60 Seconds. You may think, what can you deliver in 60 seconds? Bits of information in a short time is the best method to inform the audience in these day and age, especially when your target audience are students.

Is it enough to deliver information in just 60 seconds using video? It depends on your perspective on how to inform the audience. The aim of the project is not to teach, but by giving information, so it may spark interest in looking more on the topic discussed in the videos.

In my community, astronomy and physics is seen as subjects not easy to understand as such explaining the theory of relativity. Well it's not. My role as an astronomy communicator is to make sure that the audience understand the basics of astronomy.

In 2010, my interns introduced 'green screen' as a way how to make video more interesting. Learning the technology can be as technical as it can be and you need your STEM (Science, Technology, Engineering and Mathematics) and your artistic skills to create the videos.

The difference between the video that we produce is that it is using our local language, which is Bahasa Melayu or Malay Language. Producing video in local language is important because currently there a lot of video on astronomy in English language. If your audience do not understand the content of your message, especially in a country where English is the second language, then it is a failure for us communicator to spread the awareness on astronomy to the public. I am not saying that all Malaysian do not converse proficiently in English, but my main audience is to those in the rural area where my plan is to use this video as one of the tools to teach astronomy in the rural area.

3. Learning by teaching astronomy in 60 seconds

To produce more of content in astronomy means we need to work harder so that there will be enough content for the audience. Unfortunately, you can do so much if your men power were interns stationed in the office on temporary basis.

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The next best thing I can do is to use video making in one of my school holiday programme.

In one of the activities in our School Holiday Astronomy Programme, the participants which all of them aged between 13 to 17 years are required to do a video on Astronomy in 60 Seconds.

Their task is to extract information given to them and make a 60 seconds video. It is not a straightforward process because when dealing with participants aged 13 to 17 years old, you need to teach them the whole process of video making from writing a script which is extracting information taken from the internet, doing the recording process which involved recording in front of a green screen and finally the editing process.

During the editing process, not all of the participant knows how to use video editing software, which I also give a tutorial to them on how to use the software and how to make it look professional.

The result usually are quite interesting because some of the participant are good in making video, so this will give them opportunity to the show their skills in editing and also in incorporating green screen in their video.

4. Conclusions

Learning by reading and teaching others using video is one of the way to teach the participant on astronomy and giving them the early skills to do a good video editing with green screen technology.

Learning through teaching others may help the participant to promote the videos to their friends because it is a way to show that they did something fun and informative when attending our programme.

I hope that this will help them to understand what astronomy is especially in a world where social media play an important role in communicating astronomy to the society.

AstroGPS Mobile App and Website with all Events in Poland Related to Astronomy and Space

Krzysztof CZART[*1,2], Tomasz BRUDZIŃSKI[*2], Paweł Z. GROCHOWALSKI[*2,3], Agnieszka NOWAK[*2,4], Dawid PAŁKA[*2] and Krzysztof PĘCEK[*2]

Abstract. AstroGPS is a mobile app and a website containing a database of all events related to astronomy and space which are organized in Poland. Every year there are organized hundred events or more. Our app tries to gather them all and make available to users in a useful, user-friendly and modern way. Events are held on various range or level: big national, regional scale, and also small local events. There are also many kinds of events, like workshops, conferences, prelections, stargazing parties, science festivals, contests, astro camps, and even radio or TV programs emissions or planetarium shows. The AstroGPS system will be launched to the public in 2018.

1. Introduction – idea, reasons, needs

Each year there are at least hundreds of events related to astronomy and space in Poland. They are organized at various levels: big nationwide, regional scale and many local events. Information about them is scattered in various sources. Sometimes it is difficult even for people professionally working in astronomy outreach (science journalists, astronomy communicators) to find some of them or they are discovered too late to be able to participate or to give it media coverage for their audience.

There is also another problem – coordination between organizers of big events at the planning stage, when they set dates for their activities, could be better. Sometimes two competitive events are planned for the same time in a situation when such overlapping could be avoided.

To overcome the above problems, we developed an AstroGPS system with a mobile app and a website. AstroGPS gathers information about (potentially) all events related to astronomy and space: contests, talks, lectures, astro picnics, stargazing parties, astro shows, science festivals, workshops, conferences, exhibitions, TV and radio programs, planetarium shows, etc. The information is gathered in a database and made available to users in a way which is easily accessible and useful for them. Since today almost everyone is using a mobile phone, so a mobile app is the most convenient way for usability of such system. AstroGPS system is going to be launched in Poland in 2018 as Android and iOS mobile app and www.AstroGPS.pl website.

The idea of AstroGPS was first widely presented and discussed during meeting of majority Polish organizations related to astronomy and space which was held in Poznań on September 6th, 2015. Later it was also discussed at several other conferences, including the Polish Astronomical Society Meeting in Zielona Góra in September 2017 [1]. The idea received very positive reception and interest on the part of various institutions and astronomy amateurs.

We hope that after a few month experience during 2018, the AstroGPS system will be very useful during 2019 events. It is easily expandable in future by adding additional modules and functionnalities, might also cooperate with other useful apps.

2. Who is AstroGPS.pl for?

We may divide an audience for AstroGPS system into a few groups. The first group consists of creators of events – institutions, organizations and other entities which organize events. The second one are attendances of events – communities of people interested in astronomy and space, as well as general public. Third group are those who describe events and inform about them – various kinds of media, from newspapers and magazines, to online media and bloggers. We might also distinguish schools as a separate group – teachers and students. For all these groups, the app might help in their functioning and activities in astronomy-space related areas.

Communities – people who are in some way interested in astronomy and space might using AstroGPS be up to date with all events in their

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*4 Polish Astronomy Amateurs Society, a.nowak@astrogps.pl

neighborhood or for example be able to check in an easy way, whether in a place to which they go for holiday, there is planned something interesting related to their hobby. During periods of large events or medially sensational discoveries, an app might also gather interest of general public.

Organizers of events – institutions, companies and societies organizing events usually intend to spread information to as big audience possible. For those entities AstroGPS would be a good, free channel of distribution of information, supporting their other efforts in this area.

Media – AstroGPS might be very helpful for journalists in their work. Easy to check which events are ongoing and might be worth presenting to the media audience and easier to plan in advance journalist presence at various events.

Schools – our app might be useful for example for astronomy clubs or for planning school excursions related to astronomy and space.

What isn't AstroGPS for? It is not designed as a competitor for news portals about astronomy and space. It would rather cooperate with them. AstroGPS does not publish editorial materials, just basic information, dates of events, short descriptions and links to websites where users can find more detailed information about the specific event.

3. Who is behind AstroGPS.pl?

Database and service was developed by the Polish Astronomical Society (as publisher), some editors of magazine and web portal "Urania – Postępy Astronomii" (www.urania.edu.pl) which is a well-known brand in the Polish professional/amateur astronomy and space communities (one may find more about Urania in [2] and [3]), and volunteer programmers. Financial support was given by the Ministry of Science and Higher Education.

4. Other countries

We have designed the system as multilanguage ready, so cloning it for another country should be relatively easy. After official start in Poland we could share our experience and a system with organizations or institutions in other countries which are capable of maintaining such system for their country. You may contact us at redakcja@AstroGPS.pl.

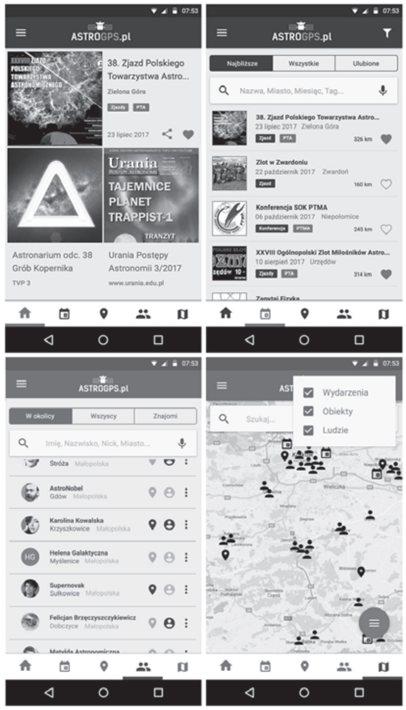

Fig. 1. Sample screenshots from the AstroGPS mobile app beta version.

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Acknowledgment

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Astronomy on Reddit: Outreach Using the Front Page of the Internet

Yvette N. CENDES[*1]

Abstract. I report on my experiences as one of the Top 100 users on the website Reddit, where my posts are predominantly on topics pertaining to astronomy. These proceedings relate to how Reddit is one of the most powerful social media tools in the world, where content has the potential to reach millions of people, and how this can be harnessed for astronomical outreach. In addition to an overview of how Reddit works and popular features, case studies of successful astronomical outreach on the platform are also presented.

1. Introduction

Reddit is an entertainment and news website where registered users can submit content, and comment on submissions. As of March 15, 2018 it is the sixth most visited website in the world, and fourth most popular in the USA (after Google, Facebook, and YouTube), with an estimated 4.5 million users per day [1]. Commonly referred to as "the front page of the Internet," Reddit is one of the most pop culturally influential websites on the Internet today. According to a survey conducted in 2015, 64% of users are between the ages of 18-29, 67% identify as male, and are more likely to get their news from social media than any other source [2].

Content on Reddit is governed by voting, where a user can upvote posts they like, and downvote those that do not. An algorithm sorts the rank of posts on the page, based on a combination of upvotes and time since submission. Successful content can be viewed by millions of people, making Reddit a powerful tool for outreach.

Over time, I have become one of the Top 100 commenters on Reddit. This is primarily through my astronomy-related posts, where my user name, /u/Andromeda321, is recognized for her cheerful "astronomer here!" comments on various scientific topics. These proceedings will cover my experiences with communicating astronomy on Reddit, and a brief overview of features that may be of interest to other science communicators.

2. Reddit and Astronomy

Reddit is made up of thousands of "subreddits," which are sub-forums devoted to a particular topic, ranging from politics to travel to cat pictures. (The top post at any given time on a subreddit will then appear on a user's "front page" agglomeration of subreddits he or she follows.) In particular, however, Reddit users are very interested in astronomy and subreddits focused on the topic are some of the most popular. A selection of subreddits and their popularity on the site, and number of subscribers as of March 15, 2018, can be found in Table 1.

Table 1. Number of Visitors to a Subset of Popular Astronomy and Science Subreddits (As of March 15, 2018)

Subreddit	Site Rank	Subscribers
/r/science	5	18,321,396
/r/askscience	18	15,197,492
/r/space	25	13,553,323
/r/astronomy	393	310,014
/r/astrophotography	678	184,338

Submission rules vary from one subreddit to another, and should be read before submission of any content (for example, /r/science requires a paper to be accepted to a journal before it can be posted). Many of the most popular science subreddits, such as /r/science and /r/askscience, will also assign a special badge to experts who request it to show expertise.

Further, a subreddit can be about any topic. As an example, I created my own subreddit, in order to facilitate answering questions from the Reddit community, which now also includes information about my career as a research astronomer, available at https://www.reddit.com/r/Andromeda321/. As of May 4, 2018, it has 6,254 subscribers.

If submitted content to a subreddit is popular, it can be viewed by many thousands of people. In particular, a post, which reaches the top of the subreddit through upvotes and then appears on a user's front-page agglomeration of all their subreddits can reach hundreds of thousands of views. For example, the author's post which reached the top of /r/space on December 17, 2017 received ~475,000

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views, and approximately 53,000 upvotes.

Comments are also a very important part of Reddit, although their reach is more difficult to quantify because the total number of views is unknown. Upvotes, however, are logged for comments: for example, one popular comment on the Hubble constant and expansion of the universe on March 8, 2018 received ~14,200 upvotes. It is unknown what percentage of viewers on a comment upvote it, but we can assume several times more people view a comment than vote on it.

3. Ask Me Anything!

There are many forms of content on Reddit that would be too numerous to list here, but one type popular on Reddit which has great potential use for outreach is an "Ask Me Anything!", or AMA, event. An AMA is an interview, where commenters ask questions for a poster to answer. AMA events typically need to be about a topic uncommon that plays a central role in one's life, or a truly unique and interesting event. As most astronomical activity falls into one of these categories for the general public, an AMA can be a used by an individual or organization to reach thousands of people with minimal resources.

The primary subreddit for AMAs is /r/iama, but scientific ones can also be scheduled for a specific date on time on /r/science and /r/askscience. It is important to consider the story you want to share to ensure your AMA is successful, such as a new scientific result or special event. The level is supposed to be fairly informal, and if multiple people are engaging in the AMA they should consider in advance how they will coordinate their answers.

For context, I have conducted three AMA events, dating to September 28, 2014, November 17, 2015, and November 6, 2017, respectively. Each event reached the front page and led to hundreds of questions from the public on topics ranging from my research to general space topics. The most recent AMA, the only one for which the number of views is available, was viewed by ~76,800 people [2].

4. Case Study

Although measuring the effectiveness of comments is difficult, several dozen people have reached out to me to describe how my astronomy comments and posts on Reddit have touched them, from conversations in their daily lives to career trajectories. As an example, I will highlight the case study of User X, a teenager who first wrote to me in 2015 asking questions after reading one of my comments on astronomy that piqued their interest. In 2017, User X reached out to me again to say they have since pursued astronomy to the level of conducting Near Earth Asteroid observations (and one potential Main Belt asteroid discovery), and was going to just begin an aeronautical engineering program at university. "If I hadn't stumbled upon that AskReddit thread [with the comment] that kindled the flame that became a fire, I wouldn't be where I am today," User X wrote. "With all seriousness and gratitude, thank you for everything!"

5. Summary

Because of its large scale and inherent interest in astronomical topics, Reddit has great potential for public outreach. I highly recommend those in outreach consider incorporating posting to Reddit, both as groups and individuals.

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An Innovative Web Site for Astronomy Outreach

Chris IMPEY*1 and Alexander DANEHY*1

Abstract. Teach Astronomy is a free and open access web site designed to support learning about astronomy (http://www.teachastronomy.com). The core of the site is a fully featured online textbook, with images, associated quiz questions, and an interactive glossary. Other resources include thousands of images, podcasts, and short summaries of research articles (provided by agreement with educational partners). There is also a "walled garden" of the astronomy content in Wikipedia. An innovative use of text clustering and a visual tool called a Wikimap allows users to surf related items of content. The web site is mobile-friendly, and an upcoming app will allow the user to ask questions in natural language text and get video clip answers, and ask astronomy questions to devices like Amazon Alexa and Google Home.

1. Introduction

Teach Astronomy is a free and open access web site designed for all informal and formal learners of astronomy [1] (http://www.teachastronomy.com).

2. Content

The site features an online textbook of 530 articles and 450,000 words, with pop-up glossary definitions. There is also a quiz tool that dynamically generates multiple choice quizzes drawing from 2000 questions, based on textbook chapter or a keyword search. There are 1200 images built into the textbook (Figure 1).

Fig. 1. Textbook article from Teach Astronomy.

Teach Astronomy hosts two other archives of astronomy images: APOD or "Astronomy Picture of the Day," with 7500 images (http://apod.nasa.gov), and NASA's "AstroPix," with more than 7100 images from ground-based and space-based telescopes (http://astropix.ipac.caltech.edu). The site also hosts over 1200 short video clips on all astronomy subtopics, organized into 29 playlists on major topics. The video clips play on a YouTube viewer set into the web page. They can be searched by keyword or bundled into one playlist as a complete, thirty-hour video course.

Other examples of partner content includes 2000 podcasts from the "365 Days of Astronomy" project (http://365daysofastronomy.org), 1200 summaries of research papers, written by astronomy students at a non-technical level (http://astrobites.org), and concise summaries of astronomy news stories from Science Daily's RSS feed (http://sciencedaily.com).

3. Statistics

The web site has an international reach (Figure 2). Google Analytics data show a million sessions from 750,000 unique users over the past two years, recently averaging 19,000 visits per week. Most of the users are in the United States (62%), with the next most frequent users being in Canada (5.8%), U.K. (5.7%), India (3.4%), Australia (3.2%), and the Philippines (3.2%). Foreign visitors can use Google Translate.

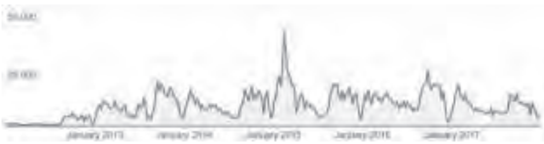

Fig. 2. Visits to Teach Astronomy since 2012.

4. Technology

Teach Astronomy has several unique features. Sophisticated algorithms index the text of items of

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content and cluster them according to keyword overlap. The result is presented using a graphical display called a Wikimap. The central node of the Wikimap is the closest match to a search and nearest neighbors are shown as nodes emerging radially from the central node. Clicking an outlying node centers it and displays a new set of nearest neighbors. The visual Wikimap provides an appealing method for browsing or "surfing" related content (Figure 3).

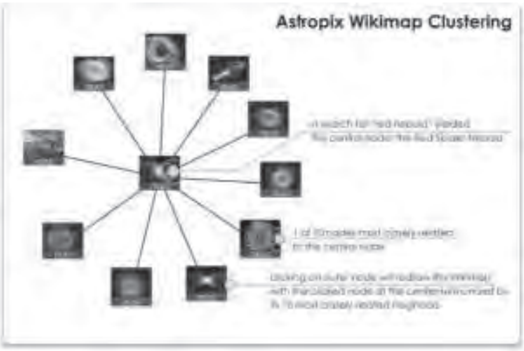

Fig. 3. A Wikimap display of Astropix images.

The clustering is based on a Lucene index of the text associated with any type of content. We cluster images using captions and videos using transcripts. The web site is optimized for mobile users, displaying suitably on tablets and smart phones (Figure 4).

Fig. 4. Teach Astronomy on a mobile device.

We have used machine learning algorithms to gather and organize astronomy content. A powerful application of this technology is the creation of a "walled garden" of the Wikipdia astronomy content. This involved filtering astronomy articles from among over 4 million in the overall Wikipedia resource. After training a Bayes classifier to identify the astronomy content, we host 42,000 articles, accessed by keyword search and explored using the Wikimap.

5. Innovation

We have developed a unique video FAQ tool using two years of live Q&A sessions that we have been conducting for two massive open online classes. The questions are asked in random order, so even though the video streams are on YouTube, they are of limited utility. After capturing the Google Hangouts video stream and the questions, all questions are given an appropriate time tag in the video. Users type questions into a text box and get the closest answers based on keyword match, with the video cued up to play at the correct time. Finally, we have built an astronomy "skill" for the intelligent personal assistants Google Home and Amazon Alexa, allowing the device to answer questions and deliver information from our database. These tools will be rolled out in an app later in 2018 (see the beta version interface in Figure 5).

Fig. 5. Interface for the Teach Astronomy app.

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Comics With Augmented Reality and Astronomical Content: Didactic Strategy for Teaching Space Sciences in Ecuador and Panama

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Abstract. Astronomy requires interactive programs for all audiences that allow breaking paradigms about their benefit to society. The project focuses on the axis of the Space Sciences Didactics, whose objective is to support astronomy learning communities in several Latin American countries to strengthen formal and systematic learning with the help of multimedia. Using the TPACK model, an interactive content structure has been designed for the creation of comics with augmented reality (AR) and astronomical content that helps both in the teaching - learning process and the assessment process. The comics with augmented reality as a didactic strategy allow to impact the learning of the students of elementary, middle and high school, encouraging the performance of a more active role in the teaching process and making them feel protagonists of their own learning when controlling and managing the application.

1. Introduction

The Space Sciences in Ecuador and Panama have played a secondary role due to the essence of it in educational system. The different ways curricula is organized within each country prioritize knowledge rather than astronomy makes it not to be part of daily learning in an early age.
Astronomy requires interactive programs for all audiences that allow breaking paradigms about their benefit to society. The project focuses on the axis of the Space Sciences Didactics, whose objective is to support astronomy learning communities in several Latin American countries to strengthen formal and systematic learning with the help of multimedia. Using the TPACK model, an interactive content structure has been designed for the creation of comics with augmented reality (AR) and astronomical content that helps both in the teaching - learning process and the assessment process.
The comics with augmented reality as a didactic strategy allow to impact the learning of the students of elementary, middle and high school, encouraging the performance of a more active role in the teaching process and making them feel protagonists of their own learning when controlling and managing the application.
The project has been developed within an in-situ study in educational institutions of Ecuador and Panama, which statistical variables allowed us to know the educational market and the needs that students and teachers need to find in the didactic material. In this process, there are many tools like surveys, talks and workshops which were used to collect the information and, on the other hand, surveys and interviews with experts in design and pedagogy. Both to satisfy teachers and students needs.

Interactive comics with augmented reality, being a didactic product that has had great impact in the educational area, integrating scientific content with technology and pedagogy. It is an innovative and unique concept within any educational field in Ecuador and Panama, which has support from the Technical University of Cotopaxi (UTC) - Ecuador in partnership with the National Secretariat of Science and Technology and Innovation (SENACYT) of Panama. Within the project researchers from both institutions work and as extra support university students from UTC in the logistics for field study, graphic design, illustration and comic structure.

The comic with AR is a format that expresses a great variety of narrations based on illustrations and texts with a high degree of versatility for being simple and easy to use with no sophisticated instruments. The comic with AR and astronomical content can help students to improve their understanding of science and above all obtain through a specific content, such as Space Sciences, a better space – temporal understanding and logical mathematical reasoning. In the present investigation, the aim is to adapt the AR within the evaluation process in the structure of the comic.

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" Augmented reality is a technology that integrates signals captured from the real world (typically video and audio) with signals generated by computers (three-dimensional graphic objects); it makes them correspond to build new coherent worlds, complemented and enriched - makes coexist objects of the real world and objects of the virtual world in cyberspace, Heras, L., & Villarreal, J. L. (2004), pg. 4 [2]*"*. Augmented reality is considered a useful tool in education, as it allows us to explore beyond our imagination. *"To participate in this task, we must start by imagining worlds that can not physically exist, or in a virtual space; and build stories as the people have done over the years: for their entertainment, to transfer their traditions, teach their young people and record their exploits" Heras, L., & Villarreal, J. L. (2004), pg. 8* [2].

To create characters the morphology of the characters is studied, besides a research about real and current components of the astronauts, spaceships, and all the objects that are used in astronautics to reach a level of realism and veracity in the content of the comic. Likewise, we consider laws, principles, fundamentals, characteristics, etc., of Astronomy, Physics and all it is branches in order to create the content of the comic. Therefore, the material we are presenting is scientifically and above all educational nature that allows the student to know the reality of Space Science. *"Analyzing the illustrations in physics and chemistry textbooks supposes considering their formal and semantic aspects. One might think that the formal analysis only interests the graphic artist or the editor, whereas the semantic analysis would correspond to the teacher or the researcher in science didactics; however, the results of the published research show that it is difficult to separate both dimensions and it is essential to contemplate them as a whole´´ Perales & Jiménez, 2002 pg. 370* [4].

With regards to the line of research in education and pedagogy, we are working on the basis of the Cognitive Development of the Theories of Piaget and Vygotsky. According to Piaget, the stages of cognitive development are four: sensorimotor stage, preoperational stage, stage of concrete operations and stage of formal operations. These stages are presented in age ranges. For our statistical study we intend to work with students between 8 and 17 years old, where the concrete operations and stage of formal operations are contemplated and help us to understand radical transformations and the knowledge acquisition in students. Within this analysis we will work with qualitative and quantitative variables to know the educational market in which we operate.

The first edition of the project is being built, which will be tested in schools and colleges of the countries of Ecuador and Panama, in addition, it will be evaluated by qualified people in the field of Astronomy and related sciences, pedagogy and education and finally of graphic design, so that after the evaluation, the edition will be corrected and improved to make it available to all audiences in both Spanish and English.

2. Conclusions

Our project arises from the desire to introduce Space Sciences in our countries, and spread it when working with elementary up to secondary education students, give them the opportunity to know new lines of research and deliver teaching materials that can be used in the schools and colleges of our countries.

The use of multimedia and comics has become strong mainly in the disciplines of training and learning, which is integrated into environments based on the use of electronic devices, allowing multiple learning experiences that facilitate education. The application of multimedia technologies in the teaching – learning process, changes the role of the members involved in it and forces the student to have a more active role.

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Digitizing Galileo

Morgan E. ARONSON*[1]

Abstract. The Smithsonian Libraries is actively seeking to engage a diverse audience in the history of astronomy. Using its world-renowned collection of historical astronomical works, the Dibner Library of the History of Science and Technology is engaging youth, scholars, museum curators, and independent researchers in new and varied ways. From more straightforward digitization, to "I See Wonder" opportunities for children, the Smithsonian Libraries is taking advantage of the latest technologies and ideas and implementing them for education in, and engagement, with the history of astronomy.

1. Introduction

Engaging youth and public audiences in the history of astronomy using primary source material is the topic of this short paper. I'll discuss digitization efforts at the Smithsonian Libraries, how we're using technology to make available the history of astron-omy, where all of that digitized data goes, and how to make it appealing and consumable to new audi-ences.

But first, why do we care? Prioritizing these types of projects in a cultural institution isn't always easy. At the Smithsonian, our new strategic plan requires us to build on our unique strengths to engage and to inspire more people, where they are, with greater im-pact, while catalyzing critical conversation on issues affecting our nation and the world. We are able to justify our activities because of the Smithsonian In-stitution's stated endorsement of these goals. I hope they may be of help to readers in your own attempts to advocate for the use of funds on projects like these.

As one of the largest museum and research complexes in the world, like other research institutions our focus for many years was on our traditional audiences. First as in-house research support to museum curators, then to outside scholars, fellows, and doctoral students as the outreach efforts of the Smithsonian Libraries grew. But in recent years we have made it a conscious effort, a priority, to engage with non-traditional audi-ences. To define terms, non-traditional audiences for a research facility like ours includes K-12 students, undergraduates, and members of the public. Whether it is inspiring future astronomers, science fiction mov-ies, or instagram posts, any engagement with the pri-mary source material is positive.

2. Digitization

First, we're digitizing material. I don't have to tell you digitized material is more widely accessible than requiring users to come into the library. But it's not enough just to digitize material, there has to be a concerted strategy that encourages active and engaged use of this material. Digital surrogates are more accessible, searchable, and more easily manipulated than the original formats. Studies show that students using digital surrogates from institutions across the world are more able to focus on the meaning of the sources and encourage more original thinking about the past.

One of our key astronomical digitization projects is the digitization of Bern Dibner's Heralds of Science. Bern Dibner, part of whose private collection now makes up the core of the Dibner Library, collected what he identified as the most important records of discovery, eventually amounting to over 40,000 books and 1600 manuscript groups. Using his bibliography, the Heralds of Science, which enumerate and describe the 200 most important texts in the history of science, we are digitizing the most important scientific works in our collection.

We are also digitizing the Dibner manuscript collection. Our manuscripts, like printed texts, are digi-tally accessible through the Smithsonian Libraries Digital Library. But to combat the widespread un-derutilization of digital primary source materials the manuscripts are also uploaded to the Smithsonian's Transcription Center to be transcribed by volunteers for greater research accessibility.

3. Teaching Tools

A problem identified in the literature is that digital collections were not produced with teaching in mind. While the Transcription Center is a tool that

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can be used by teachers, the I See Wonder Education Initiative was designed especially for educators and education. One way in which we can improve our communication of the history of astronomy is by us-ing primary source material to spark inquiry, analysis and discussion. Using visuals from original materi-als, our Education team is bringing special collec-tions into the classrooms, encouraging engagement with the material through questionnaires and embed-ded clues.

4. Accessibility

Digitized texts are great for traditional audi-ences like researchers, but in order to encourage non-traditional use of the material we need to make it en-gaging, create a context for it that takes it out of the 16th or 17th century and makes it relevant today.

Fig. 1. On left, the Ptolemaic System, from *Liber chronicarum mundi (Nuremberg Chronicle) edited by Har-mann Schedel* (Nuremberg, 1493). On right, Copernicus's he-liocentric model, from *De revolutionibus orbium caelestium* (Nuremberg, 1543).

As an example, take the 1540s. The 1540s changed the world. Copernicus's heliocentric world replaced Ptolemy's geocentric cosmography, Vesalius in the same year would published an equivalent discipline-revolutionizing text with his anatomical Fabrica. Fuchs the year before created the most comprehen-sive study with scientific illustrations of plants to date, changing the study of flora forever. In the space of a little more than a year three distinct scientific disciplines were changed forever. A digital exhibit comparing places of publication, numbers of edi-tions, stylistic choices, wear of woodcuts and even known provenance of specific copies could allow us to discover new information about these tremendous endeavours to understand and document the world around them.

Another example I want to share with you is the case of Galileo's Sidereus Nuncius. The plague wasn't the only thing going viral in the 1600s! We all know the story Galileo, the first to use a telescope to look at the moon sees a whole new terrain with and wants to publish immediately, much like researchers today. His small pamphlet describing his discovery was first published in Venice in 1610 using detailed copper plate illustrations of the moon. In that same year, 1610, a copy was published in Frankfurt.

The Frankfurt edition re-created the illustrations with poorer quality simplified woodcuts. The very fact that the text could travel to Frankfurt, the type could be set, the woodcuts copied and engraved and the whole thing put to press and completed in the very same year as the original is astonishing. When we imagine news in the 17th c. we don't imagine it moving so quickly, but the publication history of his book reveals that Galileo's illustrations of the moon was huge news. Knowing this, the audience for this material is suddenly widened not just to researchers of book history or news, but people interested in 17th century travel, exploration, discovery, art historians, and intellectual property.

5. Conclusion

New studies show that students' learning preferences are changing, they favor audiovisual over textual information and thrive on experiential learning where they can learn by doing. Engaging with primary source material directly encourages critical thinking and encourages students to engage with the construction and interpretation of history.

There is a lot that remains to be done. As technol-ogy evolves we have a responsibility to ensure we use it to illuminate not just our future, but our past. As we discover more about the heavens with each passing year, communicating the wonder that comes with simply looking up at the stars and understanding what you see, much like our astronomical ancestors did, cannot be taken for granted. We must use the new technological resources available to ensure our foundational astronomy is accessible.

Astronomy and its Digital Sex appeal: the Art Behind Making People Fall in Love through the Social Networks.

Marggie RIAZA*1

Abstract. The times have changed and social networks as well. In a stage that every day is renewed, and where the great amount of information dispersed and confused more and more to the public, it is important that the institutions dedicated to research and disclosure of the space sciences learn how to seduce, in more creative and emotional ways, to the cybernauts. The epochs for publications merely informative (such us timetables, fares and the cultural agendas) in social networks have been left behind. We must change from been "summoners" to real "science popularizers" and the social media is the ideal environment to reach new users, especially those who have never been in contact with Astronomy, and make them fall in love with it. This is the experience of the Planetario de Medellín, the most followed in social networks in Colombia and one of the most recognized in South America. We have taken astronomy to a more emotional, simple and fun level.

1. Introduction

6,7 hours a day is the time colombians spend in social networks[1], the most used platforms are Facebook and Whatsapp[2] and it is estimated that by 2018, the impact of these media in the region would be 84,5%[3]. As a museum and a astronomy social appropriation center, the Planetario de Medellín takes advantage of these platforms for stimulating curiosity and promoting interest towards these topics in didactical, emotional and esthetic ways. These are some of the successful strategies that we have used during the year 2017 on Facebook, Twitter, Instagram and Youtube.

2. Successful cases and findings

1. Equilibrium: The main purpose of our social networks strategies is not just about increase the number of visitors, or communicate our cultural agenda. We believe that our mission, above all, is help people to get curious and motivated about astronomy. That's the reason why we seek for an equilibrium: 80% of our publications are astronomical content such as news, discoveries, facts and trending topics, but only 20% are promotional content. In that way, we connect better with our publics, transforming publicity in stories and value content.
2. Use non related topics to talk about astronomy: We can also talk about soccer, sports and other things to reach more people.

Fig. 1. Meme of a dark skies scale inviting to an astrophotography exhibition.

Fig. 2. Colombian athlete Caterine Ibargüen during the Olympic Games. The publication proposed a conjunction Moon and star (the athlete).

3. Local astrophotography: Everyone loves to see astronomical landscapes, and even more when it is near you. We started to publish photos taken in the region, and the results were extraordinary, we

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just don't capture the attention of our followers, but also of photographers that wanted to publish in our social networks. This, in addition, ended in the creation of a photography contest called Mi Cielo, which led to an exhibition and fences in the streets of Medellín.

Fig. 3. Santiago Reina, participant, with his photo exhibited in the city of Medellín.

4. Local heroes: An important thing that we do, and that has given us very good results, is to show the work in astronomy that some people do in our city. For example, Agustin, a boy that at his 17 years old won the Latin American Astronomy Olympics -OLAA. That is a huge achievement, and even more because in Colombia the schools do not teach Astronomy. No one knew this in Medellín, and no paper want to publish it until our planetarium posted in the social media.

Fig. 4 Agustín, champion OLAA 2016 .

5. Cómic and web series: It is the perfect way to show specialized content, and make it easier for followers to understand. Comics and animations can be transformed into digital series[4] of several chapters on the same subject, which can be published every day on social networks. It's the perfect way to engage your followers and make them wait for your content.

Fig. 5 Comic that explains the types of eclipses that exist. Publication to invite an event in the Planetarium.

6. Summary

Captivate our audiences in social networks is becoming increasingly difficult due, among other reasons, to the over information that exists in these platforms and the constant changes in their algorithms. As communicators of astronomy, we have the mission to innovate in our formats, storytelling and content, that makes science more attractive especially for those who do not have it among their interests.

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Podcasting 102: It's About More Than Audio

Avivah YAMANI*1,2 and Pamela L. GAY*1

Abstract. Podcasting is now a teenager! This audio-only form of outreach lets communicators create content that can be downloaded and listened to when no internet connection is available. Podcasting can also take a visual science like astronomy and make it accessible to the visually impaired.

We use the long-running *365 Days of Astronomy* podcast as a case study for presenting many different kinds of content. We also use in-reach into Southeast Asia as an example of exploring ways to meet audience needs and on how to attract non-science audiences to science. Language is the first barrier for the non-English speaking countries, but we can also see this as an advantage as people can use podcasts to learn new languages. In this paper, we discuss *365 days Of Astronomy* best practices on how to effectively engage non-science listeners, including factors like: topic, duration, and delivery of the podcast using various social media channels.

1. Introduction

It has been 14 years since the term podcast made its debut on 2004 [1]. Podcasting is now a teenager! During this nearly a decade and a half, Podcasts have become a powerful tool for astronomy outreach by allowing communicators to freely create diverse content to engage the public. Audio can be downloaded and listened to whenever, from wherever (including where there is no internet!). This on-the-go content can be consumed while people commute, perform household tasks, or are otherwise engaged with their hands and eyes, but still want content to engage their brains. In this paper, we will discuss how to start your own podcast and 365 Days Of Astronomy best practices on how to effectively engage non-science listeners, including factors like: topic, duration, and delivery of the podcast using various social media channels.

2. The Reason to Start Your Podcast

Audio never lost its popularity even though visual communication has become more popular with the public. In the US, 44% of people listen to podcasts and typically subscribe to at least 6 shows. Among them, 49% are listening to podcast at home while 22% choose to listen while driving.

Additionally, podcast listeners are generally active on social media platform. This means, potential audience members can be reached by sharing news about new shows through social media.

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The kinds of audiences that can be reached through podcasting is almost unlimited. Research [2] has also shown that podcasts with transcripts can aid in the learning of languages, and will be sought for language learning and keep being listened to for the science learning. Transcripts also allow the hearing impaired to consume the audio content, while audio podcasting is a powerful way to reach the visually impaired. Since most modern phones support audio podcasting, this medium also reaches into communities where computers are rare, and cell phones are the primary means of accessing the internet. With good content and storytelling, we can inspire our listeners to learn more about astronomy.

3. Start Your Own Podcast

Podcasts connects content creator and listeners in a very personal way. Our voices carry our content into the ears of our audience. People often listen in bed, while commuting, or exercising. Since we will step into people's lives, we must take care to define who we want to speak to so we can use appropriate complexity and use stories that will speak to their needs. The depth of content and presentation style will differ between adults, teenagers, and children. With a defined target audience, we are ready to name the podcast series and define topics.

The next step is to define your podcast's format, such as monolog / solo podcast, multi-host podcasts, interviews, or round-table discussions. Each format has its own strengths and weaknesses, and podcasters should reflect on what they can consistently do best. Additionally, podcasters must decide if they will focus on timely news or lasting info. Finally, it is important to set a target length. Generally, people seek podcasts that fit within their commute time. That said, some content, such as monologues, is more effective when only 5–10 minutes in-length while interviews can easily be up to 60 minutes.

Once everything is decided, creators can prepare episode outlines and/or write scripts. The most effective ways to engage public is by having each episode tell a story. People love storytelling because they touch both emotional and intellectual notes.

4. Software and Equipment

With a script or outline in hand, it is time to start recording. In general, the best audio recorder is the one you have. While lower in quality, anyone can record with their smartphone and standard earphones or headphones. For next-level productions, we have found consistently high-quality using systems made by Zoom or Blue Audio. For most, the best path is to start with existing equipment, and to invest in a good headphones, and a digital recorder or microphone(s) with potentially a mixer. Additionally, a studio (even if its just in a closet) will lead to the best results.

The best shows edit recorded audio to remove gaffs and correct audio defects. There is good freeware, such as Audacity and Leverage. High-cost options also exist, but are often not needed. In addition to enhancing the audio, these tools allow podcasters to add metadata, such as the name of the series, a title, brief descriptions, and even an image.

5. Publish Your Podcast!

The final step is publishing your audio. It's easy to either self-hosting or to use a podcast hosting company. Before selecting an option, make sure to check if your host charges you based on web-traffic and calculate the cost of too much success! To get your posted audio into people's podcatchers, you must create and share your RSS feed via iTunes and / or Google Play; choose the platform(s) your audience most uses. While not required, it is best to also create a website (free sites like Blogger or Wordpress.com work!) to publish posts, link to audio and transcripts for each episode, and create a lasting archive. There are several free platforms, such as Wordpress and Blogger. With your audio recorded and edited, your RSS posted, and your blog and posts setup, you're ready to promote on all social media channel.

6. Best Practice of 365 days Of Astronomy

The 365 Days of Astronomy is a legacy project of the International Year of Astronomy (IYA) 2009. It started with an idea to publish one astronomy audio show a day, every day of that year to celebrate astronomy and its contributions to society and culture. Over a decade, thousands of original and inspirational podcasts have aired, addressing topics spanning cultural astronomy, news, and even science fiction. Podcasts come from many creators who send us content monthly or even weekly, as well as people who wish to share a single, special recording.

We do simple processing of all contributed audio to add intros & outros and check audio levels, and host with Libsyn.com. Our show can be found on iTunes and Google Play, with new shows everyday. To those without smartphone, we also make audio playable on our website. Through a combination of website updates and steady social media, we've built an audience who have downloaded episodes more than 13 million times.

7. Hands-on

During the workshop we asked participants to define their own podcast and record a simple advertisement. This resulted in several excellent new ideas for podcasts, as well as a possible plan to redistribute a radio show as a podcast.

8. Summary

Podcasts can reach everyone. From smartphones to desktops, podcasts can be downloaded and consumed on almost any periodically internet - attached device. Reach millions wherever they are with potentially no costs other than your time.

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Experience Design for Astronomy Outreach Activities

Pablo ÁLVAREZ*[1], Loreto NAVARRETE and Felipe RAMOS

Abstract. Using the Experience Design (ED) approach for developing new astronomy outreach activities or improving existing ones can be of great help for engaging current audiences, which demand more emotions and surprises than ever before and are more exposed to a wide variety of stimulus that compete for their attention. Using an ED approach forces you to focus your analysis and subsequent design in the subjective experience of your audiences: their needs, preferences, knowledge, and emotions. And in how these dimensions can be affected and will affect the experience you are providing them. Based in Chile, VERDE Consultants has been studying and providing technical assistance on ED for many years, mainly related with astro-tourism activities.

1. Introduction

Between 2014 and 2016, the Chilean Government commissioned VERDE Ltda. –a consultancy firm specialised in science outreach, heritage and tourism– the development of the country's National Astro-Tourism Strategy. One of the main surveys carried out by this project was a global state-of-the-art report on astro-tourism experience design, which included best practices analysis of experiences in Canary Islands, Catalunya, United Kingdom and the United States (Arizona, California and Hawaii). Based on the main findings of this report –and added to elements from existing models for experience design and design thinking, and to VERDES's own consultancy experience– VERDE wrote the 'Guide for Astro-tourism Experience Design' in 20162 , which is the base of the following article.

Although using ED approach has been a common practice in astro-tourism it can also be used for designing all sorts of new astronomy outreach activities –or improving existing ones–, helping to increase their engagement and impact, specially nowadays, when target audiences demand more surprises and emotions and receive permanent stimulus of all kinds that compete for their attention.

2. Experiences as products

In common speech –as it is registered by standard dictionaries– an experience usually refers to "An event or occurrence which leaves an impression on someone"3 , or to "The effect on a person of anything or everything that has happened to that person"4. In experience design, however, we understand an experience as something much more specific: A special type of product, that might satisfy a want or need and that can be offered for consumption in the market.

What usually characterises this type of product is that it:

− Integrates different goods and services
− Appeals to multiple senses
− Engages several human dimensions
− Has a narrative
− Involves some action of who lives it (besides pure contemplation)

And, what possibly is more important than all the above:

− Only gets fulfilled by those who experience it.

It should be noticed that the first five characteristics are phenomenological, because they describe how an experience happens and can be observed. The last one, however, refers to how an experience is understood by experience designers and implies that experiences are considered as subjective phenomena, where it is every single person that lives it –and not the designer nor anybody else– who determines how good (or bad) it is. Obviously, this approach forces you to develop a deep understanding of your audiences while you are designing your experience.

3. Basic elements of an experience

Experiences occur in time. Each one of them can be understood as a temporary succession of events, organized according to a certain previous design: the script.

The script establishes the main events of the experience, and the way in which they acquire coherence and meaning, based on a certain narrative (that refer to the larger themes that inspire and organise the experience).

For design –and implementation– purposes, the events of an experience can be organized into episodes: meaningful units, each one with its own characteristics and actions.

As in classic drama, a good experience requires a good dramatic curve. The script should be capable of provoking in the audience a certain sequence of emotion intensities that serves well for maintaining their interest and engagement in a high level.

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Fig. 1. Elements of an episode (Verde model)

At each episode, there are a number of elements that should be taken into account when you are designing the experience.

The protagonist is the person –or group– that will live the experience. When it is a group, interaction between individuals could also be intentionally designed.

Certain actions will take place, some of them considered essential for your design and some auxiliary (i.e.: going to the restroom, etc.). All actions happen in a certain place, which can include elements related to landscape, architecture, furniture, colors, aromas, sounds, etc.

Many experiences include facilitators, people that interact with the protagonists and usually assume the role of guiding the actions to make sure they occur in the way they have been designed to. Sometimes you can also find facilitating elements, like panels, videos, models, etc.

Stories, a specific set of messages that will be communicated by facilitators or facilitating elements will serve the essential purpose of providing meaning to what is happening.

4. Experience design in 9 steps

The process of ED can be carried out following a step by step methodology that includes the following phases:

1. Know your audiences
2. Know your environment and resources
3. Know your competitors
4. Define your experience fundamentals
5. Define actions and roles for each episode
6. Design places, stories and other elements
7. Carry out your experience
8. Design your promotion plan
9. Evaluate and correct

Usually, going through all these steps demands learning basic contents and making a lot of practical exercises, both individually and in groups. Best ED process commonly involves a lot of co-creation. Although it can –and should– be conducted by someone (the ED Director), best results require gathering information and points of view from many different people.

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From Earth to the Edge of the Universe: Mitaka Software as a Tool for Education and Communication

Tsunehiko KATO[*1*2], Hidehiko AGATA[*2], Kumiko USUDA-SATO[*2], Lina CANAS[*2], Seiichiro NAITO[*2], Satomi HATANO[*2], Shoichi ITOH[*2], Tomoya NAGAI[*3], Noriko TAKABATAKE[*2], Hinako FUKUSHI[*2]

Abstract. Mitaka is a software to visualize the known Universe using up-to-date observational data and theoretical models developed by the Four-Dimensional Digital Universe Project of the National Astronomical Observatory of Japan. It has been used for personal use, education, and communicating astronomy at science museums or astronomy events and other locations. In the opportunity of the CAP 2018, we held a workshop of Mitaka software.

1. Introduction

Mitaka is a software to visualize the known Universe with up-to-date observational data and theoretical models developed by the Four-Dimensional Digital Universe (4D2U) Project [1] of the National Astronomical Observatory of Japan (NAOJ). It is an interactive software and users can seamlessly navigate through space, from the Earth to the edge of the known Universe, by their own operation. Mitaka supports multiple languages (currently 9 languages). Therefore, it can be used in their native language in many countries. It also supports a lot of stereoscopic modes and recently virtual reality (VR) mode.

For more than 10 years, Mitaka software has been used on live shows for the public in the 4D2U Dome Theater at NAOJ's Mitaka headquarters with stereoscopic visualizations [2]. Furthermore, Mitaka software is released as freeware for Windows PCs, and anyone can download it from the Mitaka's official website [3]. Hence, Mitaka software has been used by users for many purposes: personal use, education, and communicating astronomy at science museums or astronomy events and other locations.

In the opportunity of the CAP 2018, we held a Mitaka workshop. This is the third workshop of Mitaka software held in international conferences following the CAP 2016 and the Global Hands-On Universe (GHOU) 2016.

2. Workshop

The workshop was held at the workshop day, 27 March 2018. About 40 participants came to the workshop from a variety of countries.

2.1. Workshop Structure

The workshop consisted of three parts: a presentation, a tutorial session, and a VR/Screening session. The workshop started with the presentation. Then, the participants took two sessions: the tutorial session and the VR/Screening session. The workshop room was divided into two sections for the two sessions, and the participants were also divided into two groups. Thus, they took both sessions through two parallel sessions, exchanging their places between the two parallel sessions.

2.2. Presentation

At the beginning of the workshop, an introductory presentation of Mitaka software was given by Kato, the developer of Mitaka software, for about 15 minutes including a 3-minutes demonstration from the Earth to the edge of the observable Universe (Fig. 1).

Fig. 1. Presentation part

2.3. Tutorial Session

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In the tutorial session conducted by Usuda-Sato and Naito, the participants learned basic operations using their own laptop PCs (or those provided by us) (Fig. 2). The tutorial session started with how to install Mitaka software. Then, participants learned two modes: the planetarium mode and the space mode. In the space mode, they learned how to depart from the Earth and to go to the edge of the observable Universe.

Fig. 2. Tutorial Session

2.4. VR/Screening Session

In the VR and screening session (Fig. 3), the participants had VR experience one by one. At other times, they enjoyed the stereoscopic screening.

In the VR experience part conducted by Kato, Hatano and Nagai, the participants experienced the Universe visualized by Mitaka software in the VR space with a so-called "Room-scale VR" system, although the experience time was very short (about 1 minute). First, each participant chose one of the celestial bodies to visit, such as the Earth or Saturn. Then, they wore a VR head-mounted display and observed the selected object from various angles in the VR space walking around in the available *real* space (approximately 3m by 4m).

In the stereoscopic screening part by Itoh, participants looked at demonstrations of Mitaka software projected on a screen in a live show style, navigating through space from the Earth to the edge of the known Universe. Wearing stereoscopic glasses, they could see the screening in 3D. After the screening was over, applicants were able to experience to operate Mitaka software by themselves with a game pad.

Fig. 3. VR/Screening Session

3. Summary

We held a Mitaka workshop at the CAP 2018. Although it was plenty of contents in the 90 minutes workshop time, we think that it was a good opportunity for the participants to experience the Mitaka software. We hope the Mitaka software will be an effective tool for communicating astronomy in various countries.

Acknowledgements

We are grateful to many people who helped us for this workshop.

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The Presenter Network

Elizabeth AVERY *1

Abstract. The Presenter Network is a local, national and international network set up by presenters exclusively for presenters to share best and worst practice. In this article we will explain what the network is, how it operates, the rewards organizations can reap from becoming local a Presenter Network hub and how to go about establishing your own local hub.

1. Introduction

Since establishing the network in 2014 we have run regular sessions in collaboration with other organisations covering every aspect of presenting you could ever imagine; using comedy effectively, working with challenging audience members, how to look after your voice and everything in between. The network is now expanding and hubs are being established both nationally and internationally under the Presenter Network [1] banner and aligning with the same Presenter Network Manifesto [2] and we would like to create more.

2. Vision and Values

To understand the power and benefit of the Presenter Network it is useful to understand the vision and values of the group first.

Our vision is to:

- Network presenters from a wide range of sectors on a local, national and international level.
- Establish the Presenter Network as the go-to community for presenters to share best and worst practice.
- Create a model of best practice for specific networking groups within the sector.

We believe that:

- There is a wealth of invaluable experience locked away within the presenting community that is best unlocked and shared through the Presenter Network.
- Presenters share the same skill set whether they work in science and discovery centres, academia, charities, trusts, museums and heritage or the media.
- Running sessions in a nurturing and positive environment leads to presenters feeling comfortable enough to engage in discussion, get more out of the sessions and ultimately become a better presenter as a result.
- We should share not only our good experiences but our bad ones too.
- Everyone from early career presenters to experienced professionals who have been in the sector for their whole careers can grow and develop further by engaging with the network.
- Everyone has something of value to contribute to a session, no matter what their experience level is.

3. Why does the network exist?

For individual presenters

Presenting comes with many challenges; from learning the ropes in the first place to maintaining a fresh approach years down the line. As a presenter finding the time and funds to attend meaningful and useful training and networking sessions is difficult to justify because you are always presenting. This network provides focused, valuable experiences that will supplement and compliment all past and future training programmes you may take part in to help you develop and become the best presenter you can be.

For organisations

Training and retaining presenting staff is a challenge. Whilst of course in-house training is essential, capturing and sharing valuable experiences is difficult through formal training days where more of a focus naturally has to go on staff learning the content, rather than developing their presenting skills, to be able to deliver sessions as quickly as possible. This network exists to fill the gap between presenters attending formal training and becoming a well-rounded, adaptable, engaged and confident presenter. It does this by exposing its members of a whole sector on a

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global level of people with huge amounts of advice and guidance to share. The sessions we run through the network will never conflict with your institutional training but will instead reinforce it.

For the sector

With so much experience locked away with individuals within the sector, if we do not have a forum such as the Presenter Network to share this information we risk it being lost forever along with any lessons learned. The network allows this wealth of experience to be transferred, utilised and built on by existing and future presenters.

4. Why do you focus on presenting?

Quite simply because there is a demand for it. There are many fantastic science communication, museum and education networks out there with a much wider remit than just presenting. We don't compete with them but rather compliment them by dedicating our focus to addressing a very specific aspect of public communication that the sector has identified through this process as needing attention.

5. How is the network run?

The Royal Observatory Greenwich coordinates the network as a whole but also act as the hub centre for London and South East. Local hubs are now being established to meet demand in specific areas in Europe. We are always keen to help set up more networks around the world and can offer a lot of help, advice and resources to get you started and also keep the momentum of your network going too.

6. Your own local hub

It is easy to set your own hub up. Next you will find answers to the most frequently asked questions when it comes to starting a hub. If you would like a full pack with greater detail including a guide on how to get started please do contact me.

7. How much does it cost?

The only cost for hubs is the staff time it takes to manage the network database and to organise sessions which really is minimal. Taking part in network events is FREE for members. Hosts never offer nor would we encourage others running events for the network to provide catering as it can become expensive and put organisations off hosting. This group operates purely on the good will of our members with all meet-ups leaders, speakers and workshops facilitators offering their time and experience for free.

8. Who runs Hub sessions?

It is a collaboration which is why it works so well. Hubs are encouraged to draw from the experiences of people in and outside of the network. For example, a very popular session in the UK has been about how to look after your voice. We asked a local university if one of their vocal coaches from the music department would mind sharing their tips with the group and they were more than happy to – for free.

9. What is the session structure and how often do they run?

We recommend meeting once every three-four months and if possible somewhere different each time so members can see how different organisations do things. We have found that sticking to the same structure each time works really well as it provides consistency. The order of the sessions we run consists of 1 hour taking part in a facilitated session followed by a 1 hour discussion on that session led by the presenters who delivered it.

10. How do you choose the topics for sessions?

Every topic idea comes from the network. This could be that someone has presented something new and learned things they want to share or they could be having difficulty with something and looking for advice. We have a session called 'Presenting 101' that we can help you deliver at your first meeting if you would like to. This is a very helpful session because it includes activities that will allow your group to get to know one another and you too.

11. Conclusion

The Presenter Network is a fantastic way to nurture existing staff and volunteers, provide invaluable training opportunities and establish your own organisation as a centre for best practice when it comes to public engagement. If you would like to talk more about setting up a hub please contact me on eavery@rmg.co.uk.

References

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Major Reach: Immersing the Public in the Live Observing Experience

Robert P. HOLLOW[*1], James A. GREEN[*1], George HOBBS[*1] and Kristina S. JOHNSON[*2]

Abstract. Many modern major ground-based observing facilities permit remote observing for users. Web-based portals and interfaces provide visual feedback of the remote telescope and show the data stream live. Whilst this approach is now routine for many professional astronomers few institutions or facilities currently run programs whereby a broader audience can view or participate in observing sessions with these telescopes. There is great potential to engage fresh audiences and inform them of the capabilities or modern facilities and the processes of science. We use the iconic CSIRO 64m Parkes radio telescope ("The Dish") remotely and in real time to observe pulsars, obtain, then analyse data in sessions for school students and the public. The interface is the same as used by our professional observers whilst data is viewed via a tool developed to support the successful PULSE@Parkes education and outreach program. A new simulation is under development that can be used in parallel with use of the actual telescope. One outcome we would like from the workshop is to establish a network of groups interested in live/public observing with the intention of sharing ideas and techniques.

1. Introduction

With many major telescopes now routinely controlled remotely there is an opportunity to share the live observing experience with a wider audience. By carefully scaffolding the experience and developing a suite of tools to show what the telescope is doing, what the data is and what can be done with it the public can gain a greater appreciation of what observational astronomy involves. This can lead to a better informed and engaged public.

2. Why Live Experiences?

Organisations should consider several key questions before committing to trialing live observing in a public domain:

-What are the benefits of allocating telescope and staff time?

- Who is your target audience?
- What are the risks and potential problems?
- What additional tools or material needs to be developed to support such a program?

Our experience at CSIRO Astronomy and Space Science (CASS) in using the Parkes 64m radio telescope through the PULSE@Parkes program http://pulseatparkes.atnf.csiro.au/ has been extremely positive. Whilst initially designed as an educational program for high school students [1] the flexibility of the program and the new tools designed to support it have allowed us to run several sessions at science festivals and in international events such as conferences. These have validated the value of live observing as a means of engaging a wider audience and demonstrating the capabilities of our facilities. Through careful design of the data stream and archive the time allocated to sessions enabled meaningful science to be produced [2], [3] thus minimising any potential opposition from other telescope users or Time Allocation Committees.

3. Tools and Techniques

CASS facilities are now all routinely controlled remotely, allowing observations to be conducted from anywhere with reliable web internet access. A web interface, *FROG* provides details on telescope pointing, weather, receiver, clocks and a live external webcam of the dish.

At present the telescope must be controlled by the dedicated *Telescope Control Software* (TCS) via VPN and VNC though this will soon change to a new web interface.

Pulsar data can be viewed live via another web monitor initially developed for PULSE@Parkes: http://www.parkes.atnf.csiro.au/online/psrmon/

We are currently developing a telescope simulator that allows a user to steer a model telescope to a pulsar and by altering the pulsar parameters observe the effect on the resultant pulse profile. Using this in parallel with actual observing provides more interactive opportunities for participants and should help us explain what pulsars are.

One feature of the current remote observing system is the inclusion of audio feedback. This includes FROG giving statements such as "*Tracking*"

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or "*Slewing five minutes*" whilst TCS includes short files of Australian bird sounds, each of which indicates something different such as the completion of an observing cycle or a warning.

4. Audiences

Live observing sessions have been held over 140 times reaching more than 2,200 students, teachers and the public. Whilst most sessions have targeted high school students there is increasing demand for sessions at conferences, to demonstrate capabilities to other astronomers, educators and communicators. Planning was underway for a large (~2,00 person) public science festival that would have involved a large stage and display though festival funding fell through. We are currently planning a live session for *ABC Stargazing Live* that will be shown on national television in Australia.

4. Figures and Tables

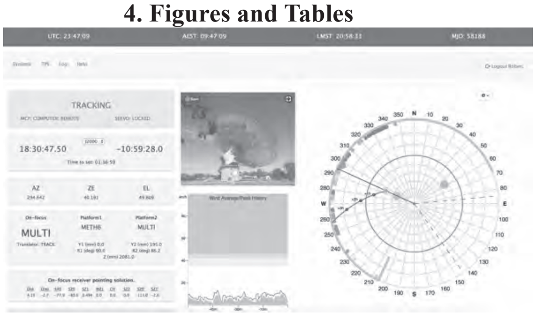

Fig. 1. *FROG*, the web interface used by observers to show telescope status, pointing, webcam, wind, clocks and receiver. Image Credit: CSIRO

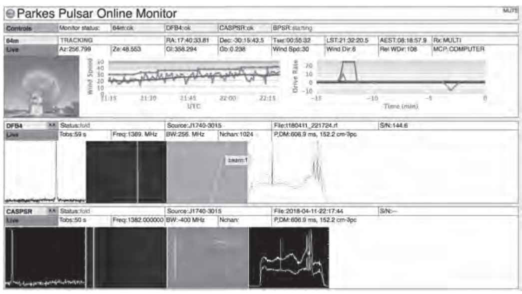

Fig. 2. *Pulsar Monitor*, a web interface showing the live data stream when observing pulsars. Includes a live webcam view too. Image Credit: CSIRO

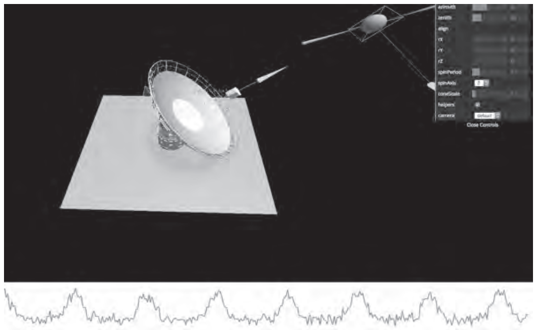

Fig. 3. *Parkes Telescope Simulator*, a web interface showing the live data stream when observing pulsars. Includes a live webcam view too. Image Credit: CSIRO

5 What We Have Learnt

Where possible use web interfaces for ease of setup. Visual and audio feedbacks help engage audiences and provide cues to initiate further discussion. Using multiple monitors or displays, the larger the better is extremely valuable. Being able to view data almost live is essential. This is one reason why pulsars are excellent sources to introduce people to radio astronomy as they are dynamic and pulse profiles can be relatively easily visualised.

6. Summary

We have successfully demonstrated the ability to run interactive, live observing experiences in a diverse range of settings and for a variety of audiences.

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2D Cartoons as Science Showmakers

Mikhail LOKTIONOV*1 and Yelyzaveta LOKTIONOVA*2

Abstract. Rapidly growing involvement of kids and teenagers into modern social networks appeals to inventing and applying appropriate methods of communicating science in general and astronomy in particular. Basing on recent (sometimes, contradictory though) researches of the internet usage trends all over the world lead to embarrassing conclusion: the new generation seems not be able to focus on a subject for a long time! In this paper we discuss producing short videos hosted by custom-designed cartoon characters as a possible way to revive interest and keep the focus on popular scientific matters. Further creative implementations of this idea may be used by planetariums, science outreach sites, blogs, as well as by live TV shows, internet media, schools, colleges, universities and other educational organizations.

1. Introduction

In contrast to other areas of science, astronomy can be very grateful for science communicator because of its highly attractive content, outstanding visual aesthetics and richest possible feedback given by the public – especially in social networks, where publishing beautiful images of nebulae, galaxies and star clusters done by the powerful space and ground based telescopes like Hubble Space Telescope (HST) or Very Large Telescope (VLT), may easily get highest possible number of hits, shares and likes.

However, some researches of social networks – like the one performed by Microsoft company in 2015 [1] - resulted in one quite embarrassing fact: an overwhelming majority of all users forget the post immediately after scrolling it out of the field of view in their news roll. This leads to an average life of any post in the network got down to only 6 hours [2]!

What astronomy communicator can oppose to this trend?

2. Idea

One of the ideas is trying to communicate science with kids in the language they got used to from the very beginning of their lives – with animated cartoon characters put in various environment - in space, on planets surfaces and so on. Short videos presenting different scientific concepts as adventures of cartoon characters in play form may become popular series similar to popular cartoon series our kids watching on Cartoon Networks or in YouTube.

Armed with the passion to see how it works, we started our research and attempts.

3. Realization

The surprising variety of the modern software animation products available on the market and their relative simplicity allow to make learning curve shorter and get the needed results quicker.

It should be admitted that we intentionally decided to stop on the 2D animations while choosing between 3D and 2D animation software packages just because of more affordable time and effort required for the full video production cycle, and therefore this decision limited our primary audience mostly as kids, since teenagers would tend to prefer 3D animations because of tremendous number of computer games published in 3D technology during the past years.

We have chosen Reallusion product line [3] as our primary animation pipeline with some additional 3rd party tools extending its functionality as needed along with Vegas Movie Studio Platinum Software [4] as main video authoring and mastering tool. One of the key aspects was ease of learning vs functionality vs price, and this relation for the mentioned products turned to be optimal for our small private Internet TV Channel. This software provided the full range of 2D characters – portraits and full-sized vector and bitmap based characters with pseudo 3D rendering of scenes. Creating a series of bitmap images with alpha channel allowed rendering of characters on any background – from spaceship interior to exoplanet surface, from virtual studio to ISS and from observation sites to any exotic place on Earth you have ever thought about.

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3. Results

The animation pipeline allowed us to animate portraits of famous scientists of the past – like Newton, Galileo, Copernicus, Kepler, Sir William and John Herschels, Charles Messier, Johann Elert Bode and many, many others – as well as custom characters created by us in bitmap editors.

Fig.1. William Herschel, Johann Elert Bode and Charles Messier are looking for their audience.

Fig.2. Animation of portraits works great even for fully customized characters designed from the scratch – like this portrait of our main character Albina Onestone.

Full-sized 2D animated characters got their legend, profession and temper to communicate astronomy.

Fig.3. Using various space simulating tools, royalty free/public domain backgrounds as well as 3rd party interiors provides a vivid sci-fi picture

4. Discussion

Our experience of creating the videos with animated characters showed that to gain success and popularity, just animation is not enough.

First, it is crucially important to start with a really interesting scenario well-adopted for the audience – kids in our case. Several experiments with the advanced astronomical topics confirmed that cartoon characters are better accepted when they talk simple on relatively simple, often historical topics [5].

Second, the creator should pay attention to all tiny details in order the cartoon to look natural, sound natural and conduct natural. In our case we encountered a problem with nicely sounding female voice of our main character Albina, since the results we obtained even with the advanced voice morphing software were not satisfactory enough and confused about 1/3 of our audience.

5. Conclusion

The suggested animation pipeline provides maximal achievable result in minimal terms even with a medium skill of animation and video producing. With the mentioned software products it takes just mendays - not even menweeks - to create a 5-minute long film with animated character, what can be considered as very good result [6]. And all of this can be done by just one person, not a huge animation studio!

Consider the outreach prospective this fact suggests.

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Astrochannel, the Standalone Internet TV of the Italian National Institute for Astrophysics

Marco MALASPINA[*1], Francesca ALOISIO[*1], Davide COERO BORGA[*1], Eleonora FERRONI[*1], Marco GALLIANI[*1] and Stefano PARISINI[*1]

Abstract. We present Astrochannel, an open-source standalone internet TV written in Javascript, Jquery and Php to provide a 24/7 continuous flow of textual news, video and information on astrophysics through an unlimited and unattended network of heterogeneous players. Initially designed as a tool for internal communication in a geographically distributed institution such as INAF, Astrochannel can be effectively adopted as a multimedia informative system for the general public as well.

1. Introduction

Astrochannel (astrochannel.media.inaf.it) is a web TV on the activities of the Italian National Institute for Astrophysics (INAF). Designed as a stand-alone application to be projected 24/7 in the 17 INAF centers throughout Italy, its ideal location is in the cafeterias of astrophysical institutes and departments.

The show schedule of Astrochannel is updated automatically, and takes its contents via Json calls from several sources: the INAF online magazine (www.media.inaf.it, a website with an average production of 4/5 news per day), the INAF YouTube channel (www.youtube.com/user/inaftv, one new video per day), the job opportunities, scientific seminars and public outreach events stored on the INAF database, and the Rss feed of ANSA, the main Italian news agency.

2. Coding and devices

As regards coding and specifications, Astrochannel is an open source software written in Javascript, Jquery and Php. It can be left running unattended on nodes connected to Internet. Any operating system can be used, as long as it has a browser with Javascript capabilities.

It has already been running for years, 24 hours per day, on a number of different devices (suspended screens connected to compact PCs, tablets, etc.), automatically updating their show schedule via Json calls to the Astrochannel server. Seamless integration between the textual and video content is provided by a dedicated Wordpress plugin which also takes care of displaying the video previews on the Wordpress site.

3. Layout and content

Apart from the short news summaries taken from ANSA (scrolling in loop at the bottom of the screen), all the videos and textual contents displayed on Astrochannel are produced by the Media INAF newsroom. They include: original articles and highlights, daily video news, exclusive video interviews, animations and scribings, covering astronomy, space, physics, technology, and related outreach activities.

Fig. 1. Astrochannel and its sections: 1) Custom header (one for each of the 17 INAF centers); 2) Job opportunities and agenda; 3) Scientific seminars; 4) News ticker with national and regional breaking news; 5) Latest videos from MediaInaf Tv; 6) Latest news from Media Inaf.

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|Poster|

The Interactive Planetarium Show and the Trend of what Astronomical Topics Citizens are Interested In.

Kyohei ANDO, Ai ENDO, Moto ONODERA, Masahiko SAKUMA*1

Abstract. We introduced Full Dome digital planetarium system furnished in our planetarium in 2012. It became triggered event, so we started interactive planetarium show method between planetarian and audiences. In response to the interests of the audiences, it is possible for the planetarian to increase the interest of the audiences about the astronomy. Also, through this show, we can see what astronomical topics citizens are interested in.

1. Method of the show and utilization of planetarium

Specific methods of this show (interactive planetarium show between planetarian and audiences) are as follows.

(1)Before the planetarium show, we give audiences a questionnaire and ask them to write freely what they want to know about astronomy.

(2)Assistant planetarian collects questionnaire and classifies question contents into each field, and then announce the question contents and the age of the questioner.

(3)Planetarian operates the planetarium projector, and answer with images which are planetarium contents to help understanding. In some cases, planetarian has a microphone and goes to the questioner and thinks together while talking..

A digital planetarium that can present any space image on the spot is a very powerful tool to introduce astronomy. In order to master this tool, it is necessary to become familiar with the operation method and accumulate a lot of images (short contents, illustration, etc.). It is also important to have a broad knowledge of astronomy so that planetarian can answer any questions on the spot. In addition, if these elements are provided, it can be said that new possibilities are spreading to introduce astronomy.

2. Trend of Interest in Astronomy from Questions

We categorized the questions in this show.（Past 4 years・685 question・Youngest:2 years old）

To understand the trend of the question contents（what is required in the planetarium? / what' s the astronomical topics citizens are interested in? etc.）

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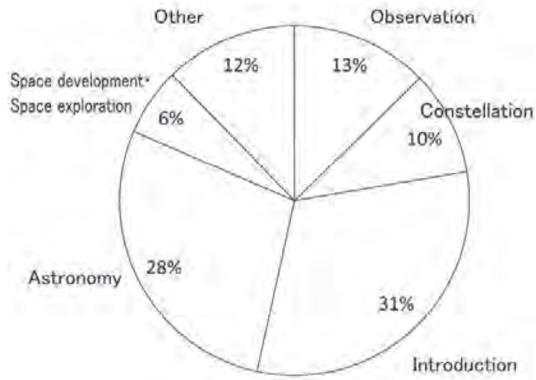

Fig. 1.Overall trend

<Annotation in classification>

「Introduction」 Questions that learned at elementary and middle schooler expect numeric answers. 「Astronomy」 Questions that expect a theoretical commentary

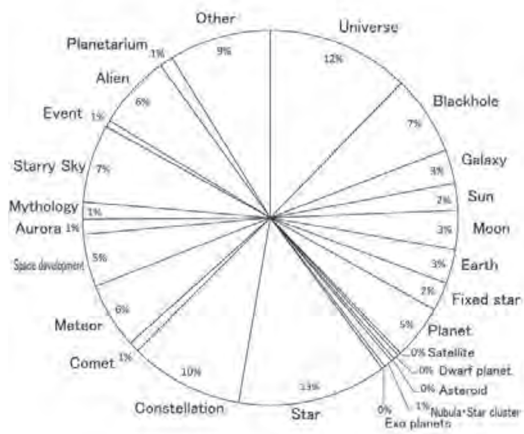

Fig. 2.Classification by keyword

Science Live Show UNIVERSE at CAP 2018

Kazuhisa KAMEGAI[*1], Kentaro YAJI[*2], Ryo SUGAWARA[*3], and Chimons

Abstract. Since 1996 Chimons, a team of students that manages the science live show UNIVERSE, performs every Saturday afternoon at the Science Museum, Tokyo. For 22 years, there have been more than 2100 live shows given by real scientists and received over 100,000 people. Here we present Chimons' activities and contents of the live show.

1. Introduction

Science live show UNIVERSE[1] is a weekly show hosted by scientists at the Science Museum, Tokyo. A scientist as a "navigator" performs two live shows, with a duration of 40-minnutes, every Saturday afternoon using several real-time scientific simulations projected on the dome screen. All of the shows are managed and operated by the team of students Chimons. Chimons consists of undergraduate and graduate students: three out of eighteen members have a major in astronomy, and the others have majors in other various fields. Details of the live show are described in another article by K. Kamegai in this proceedings [2]. In this article, we focus on the activities of Chimons team.

2. What We Do

The main job of Chimons is to operate the live show as "assistants". The assistants operate the simulations on site and show the powerful scientific pictures to our audiences. The contents of the live show cover not only astronomy but also other fields of science as follows:

- **Towards the Space End**
  shows our solar system and galaxy and flies you to the end of the universe using 3D projection and space engines. Our audience definitely loves to dive through the Saturn's ring.
- **Interstellar Voyage**
  shows you how it would be to fly to distant stars from the solar system as fast as light speed. Here we also see a starry sky that dates back thousands of years.
- **Magic of Gravity**
  Here we need a little help of the audience. We ask them to add another Sun on screen and see what happens by the effect of gravitation among the suns and the planets. (No worries! It's a simulation.)
- **In the Molecular Scale**
  shows 3D images of molecules: sugar, vinegar, MSG (flavour enhancers), and alcohol. It also shows the simulation of salt molecules melting and evaporating.
- **Live Observation**
  We have correspondents at Yerkes Observatory in U.S.A. Live observations with them provide the audience with real celestial images during the daytime in Tokyo using the time difference and Internet.

Fig 1 – A scene from the Live Show UNIVERSE

3. Summary

We are convinced that so many people visited our show to experience the presence of genuine scientists showing up-to-date scientific images and utilising immersive 3D dome projection. We spare no effort to keep improving the contents of our live show and to engage many visitors in astronomy and science.

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|Poster|

An Astronomy Student Becomes a YouTuber!?: YouTube is an Effective Tool for Astronomy Communication

Mayuko Mori*1

Abstract. We are managing a YouTube channel named 'BottleGogh', and some of our video series are about astronomy. Using YouTube for science communication is an effective way to appeal to young generation, but the number of scientific channels is still very small in Japan. I would like to share our activity and discuss how to combine astronomy communication with new media.

1. Introduction

Nowadays YouTube is watched by over 1 billion people in the world. Especially, it is popular among young generation. I myself was a big fan of YouTube, and I started to think of using YouTube for science communication.

2. Overview of Our Channel

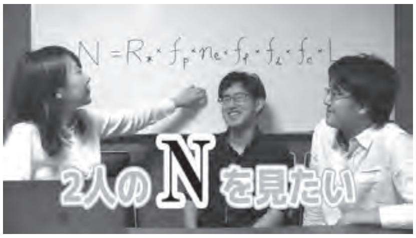

Fig.1. A scene from one of our videos, 'Calculating the number of intelligent life-forms. Discussing Life in the Universe! Part 4'.

We started our channel named 'BottleGogh' in May, 2017. The total number of views is 21,493 (as of April 16, 2018). Our viewers are mostly men, and in the age group 18-34 (see Fig.2). We have three members, and all of us were undergraduates. Among variety of videos, we made some videos related to astronomy. The examples of the topics are as follows:

- Which Solar System objects are likely to harbor life?
- How cute spacecrafts are!
- How to see shooting stars?

We want to keep our videos easy, catchy and friendly. Therefore, we are trying to make most videos within 7min, and to explain in conversation style, with easy words, using illustration and animation.

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Fig.2. Statistical data of our viewers.

3. The Effectiveness of YouTube

There are some advantages of using YouTube. First, YouTube is watched by young generation. In comparison to this, main targets of science outreach activities tend to be children and parents. This means that YouTube enables to make approach to potential needs. Second, YouTube is freely available to anyone with access to the Internet. It allows us to utilize this video platform for various purposes. For example, in your lecture, you can ask people to watch YouTube for supplementary information. If you are a science communicator, you can advertise your activity through YouTube. Being watched by many people online is a good way to get them know who you are.

Of course, there are some difficulties to use YouTube, e.g. demand of specialized skills of video editing and copyright issues. For viewers, the problem is that it is difficult to distinguish between true and fake information on YouTube. Maintaining the quality of videos and giving supportive evidence is important.

4. Summary

If you google 'science YouTuber', you can find over 50 popular scientific channels. However, almost all of those videos are in English. There must be a huge demand for science channels in various languages. Now I am thinking of switching over to a new channel, which is specialized in science. I believe YouTube has unlimited potential!

"Obsesión por el Cielo": A Weekly Astronomy Radio Show and Podcast

Pedro A. VALDÉS-SADA*1, Edgar ARMADA*1

Abstract. "Obsesión por el Cielo" (Obsession for the Sky) is a weekly radio show in Spanish about astronomy and space exploration. It is transmitted live to the city of Monterrey, México, every Tuesday (7:00-8:00pm CT) from the studios of the Universidad de Monterrey radio station (Radio UDEM – 90.5 MHz FM).

1. History

This radio show started production in its present form in the spring of the year 2000 as an extension of the university's Introductory Astronomy course and Astronomy Club. We initiated this radio program at the behest of the Communication Sciences Department of the university, that was interested in expanding its educational programming. We also inherited the concept and title from an ex-student who had originated the show.

In 2005 the transmission power of the radio station was increased and a new antenna was installed, and we were thus able to reach the entire metropolitan area of Monterrey. In 2006 we started to stream the show live over the Internet, and in 2010 we started to record all the programs and release them in the form of a free podcast. At this time, we also enhanced our web presence with a Facebook page, and now we also host a regular website where listeners can find more information, search by topic, and follow links to all the shows.

2. Content

Each "Obsesión por el Cielo" program includes: brief informational segments, a section with the relevant weekly news related to astronomy, another section with descriptions of the astronomical events that can be observed the following week, and in the main segment of the show we chat and comment on a selected topic of the week related to the Universe. We also answer questions from the audience and occasionally host special guests.

3. Reach

Besides the local on-the-air audience, the podcast counts about 100,000 downloads per year, which translates to about 2,000 listeners per weekly show. Two thirds of our podcast audience hails from Spain and Mexico, but there are also many listeners from the United States, Colombia, Argentina and Chile.

Fig. 1: Countries where "Obsesión por el Cielo" is heard the most.

4. Audio Aids

In 2015, with the support of a grant from the IAU Office of Astronomy for Development, we designed and produced a set of four audio recordings in Spanish, one for each season, that help the listeners identify the constellations and learn about their mythology and the objects of interest within. The project is called "Un Paseo por el Cielo" (A Stroll Around the Sky) and is also freely available at our website.

5. Links

Website: https://obsesionporelcielo.net/
Podcast: https://obsesionporelcielo.podbean.com/
Facebook: https://www.facebook.com/obsesionporelcielo/
RadioUDEM: http://www.udem.edu.mx/Esp/Vida-Estudiantil/Pages/radioUdem/Obsesion-por-el-cielo.aspx

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|Poster|

Planeterrella in the Dome: Unveiling the Polar Lights

Rodrigo ALVAREZ*1

Abstract. A Planeterrella is a polar light simulator, first initiated by Prof. Jean Lilensten (CNRS) at the Institute of Planetology and Astrophysics in Grenoble (France). It simulates the aurora phenomenon thanks to magnetic spheres inside a small vacuum chamber.

1. Introduction

The Planeterrella experiment is fascinating: reddish iridescence allows to see the magnetic geometries of auroral lights. It is very didactic and very flexible, as it can be used to explain auroral light production as well as various other astrophysical phenomena. It is perfectly suited to planetaria or science centres.

2. Ease-of-use

The device is unfortunately not so easy to use: (i) several hours are needed to reach the correct level of vacuum, (ii) the room should be darkened, (iii) it is not simple to transport (the vacuum chamber is 50 cm in width and 60 cm in height), (iv) the device makes some noise.

3. The Planeterrella in Brussels

An enhanced version (less noise, better vacuum maintenance, portable system) is currently elaborated by the Royal Belgian Institute for Space Aeronomy (www.bira.be). The prototype will be installed in the dome of the Planetarium of the Royal Observatory of Belgium (Brussels) in order to be tested with school audience.

3. Educative value

Apart from auroral lights, the device simulates quantity of interactions between stars and planets: Uranus and Neptune with their tilted axes, the interaction between Ganymède and Jupiter, stellar jets and ring and even the interaction between a magnetized extrasolar planet and a close star.

Fig. 1. The Planeterrella in a classroom. © Simon Lericque

6. Summary

The Planeterrella and its amazing visualization of terrestrial and astrophysical phenomena generated enthusiasm and inspiration among school groups of all ages.

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Outreach, Media and Education Strategy for the Solar Eclipse of 2019 in Chile

Camila IBARLUCEA[*1], C. SMITH[*1], Juan SEGUEL[*2], Fernanda URRUTIA[*3]

Abstract. The Solar Eclipse of July 2nd, 2019 is an astronomical event that will concentrate a huge audience in the Coquimbo Region, Chile. This place- that will be in the center of totality-also host one of the largest top of the art worldwide astronomy research facilities. The Association of Universities for Research in Astronomy, (AURA) who administrates Gemini, SOAR, CTIO and LSST telescopes, is leading and promoting an outreach, media and education strategy for the Solar Eclipse event. AURA in Chile is leading the initiative of the organization with local work groups of stakeholder from the government and private sector, to define a master plan for the municipalities that are in the path of totality. This poster will provide information regarding how to lead an event of this magnitude in South America.

1. Introduction

The Solar Eclipse on July 2nd, 2019 in Chile is a unique opportunity for the Coquimbo Region and specially for the astro tourism industry, but it also faces many challenges. This project developed by the Association of Universities for Research in Astronomy (AURA) aims to contribute with the Chilean local community by supporting them with scientific knowledge and strategic collaboration.

2. Project

The project "Solar Eclipse 2019" is carried out by AURA Director´s Office in Chile and the Education and Outreach Department of Gemini and CTIO telescopes. The purpose of this project is to provide scientific information and safety guidelines to teachers, schools, touristic guides, regional authorities, media, and general public about this important solar event through our annual outreach programs, and training sessions throughout the year.

One of the most important part of this project is communicating through the media.

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With the creation of a new webpage www.eclipsesolar2019.cl -available from July 2nd, 2018 -AURA will gather and communicate in social media all relevant information about the eclipse in the region for general public. In addition to this plan, we will partner with the Regional Journalism Association to provide training and astrophotography for the regional mass media and how they can communicate science in an easy and fun way.

The Project also involve general public talks about the Eclipse throughout the Coquimbo region, participation in fairs and events about astronomy in different public institutions. We believe that La Serena and Coquimbo will host a huge amount of tourists and eclipse chasers, that is why we are also informing and advising local authorities and key stakeholders in the tourism industry about the Solar Eclipse 2019 and the ways to plan, control and inform people about science in this massive event.

3. Conclusions

Collaboration between our scientific observatory, public and private entities and the community is essential for this project. AURA need to emphasize to regional authorities that strategic coordination and safety is key to provide a successful international event.

|Poster|

Introduction of the Science Poster: "Diagram of Our Universe"

Jun KOSAKA[*1], Akira KATAGIRI[*2], Naohiro TAKANASHI[*3*4], Hidehiko AGATA[*5]
and “Diagram of Our Universe” Production Committee

Abstract. "Diagram of Our Universe" is a science poster published in Japan. The first version was published in 2007, the second version was published in 2013, and the third version has published in 2018. The poster provides a panoramic view of the Universe by showing the extent both in space and time, which includes a wide range of astronomical topics and describes their relationship.

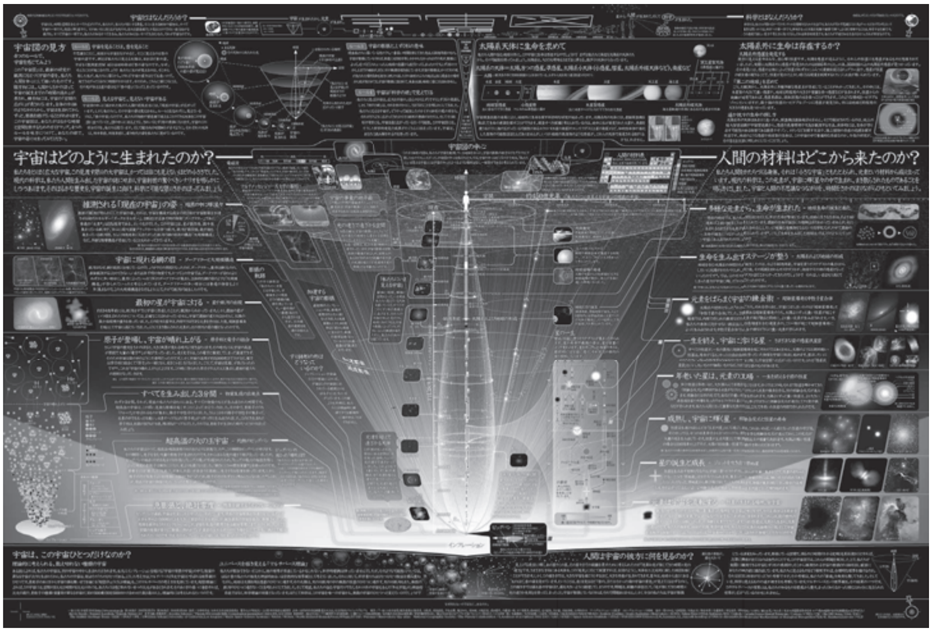

Fig.1. Diagram of our Universe 2018

1. Introduction

This poster was originally planned in 2007 as one of the science poster series “Ikka ni Ichi-mai (poster for every home)” published by Japanese Ministry of Education, Culture, Sports, Science and Technology (MEXT). The series started from 2005 and release a new poster every year. Those posters are distributed to and displayed at all elementary / junior high / high schools in Japan (~38,000 schools). They are also sold at on-line and off-line shops. You can download PDF files (English / Japanese) from the MEXT website (http://stw.mext.go.jp/series.html).

After the first publication, the poster was updated two times due to the development of Astronomy and our growth of understandings. The latest version has been published on 20th March, 2018.

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2. Meaning

This poster is useful when you communicate Astronomy with the public. For example, you can use the poster as a guiding map of Astronomy world. Readers can find any topics related to the Universe on this poster, and meanings of the topics could be understood from point of view of the whole of Universe. Since the cutting edge of Astronomy becomes more detailed, panoramic view provided by the poster becomes more meaningful.

3. Summary

English and Japanese version of the poster are now available. However, we want to translate this poster in other languages and distribute them around the world. Don't you want to publish this poster with your native language? If you are interested in translation, please contact us (info@tenpla.net).

SESSION V:

Current Challenges in Astronomy Communication

Communicating Astronomy
with the Public Conference 2018

|Plenary Talk|

We Have Not Found Earth 2.0: Debunking the Media

Elizabeth TASKER*1, Joshua TAN*2, Stephen KANE*3 and David SPIEGEL*4

Abstract. The discovery of extrasolar planets is frequently covered in the news and media. These reports are often over-hyped, making comparisons with Earth and habitability that current data cannot support. Such unrealistic portrayals of the field is exacerbated by poor or lazy use of language by researchers and knowledgable science communicators. To prevent public disillusionment and damage to field credibility we should take care to describe the state of the field accurately.

1. Introduction

At the start of the 1990s, we only knew of the planets in our Solar System. This has now changed in an explosion of discoveries of worlds beyond our Sun that shows no sign of abating. We now know of over 3,700 planets [1] with roughly a third with radii less than twice that of the Earth. This profusion of likely-rocky planets has inspired researchers, reporters and the general public alike to discuss how Earth-like or habitable these alien worlds could be.

Unfortunately, the data that is available for individual planets is presently quite sparse. 96% of extrasolar planets have been discovered by either the "transit" or "radial velocity" technique. The former detects the tiny drop in brightness as a planet passes (or transits) in front of the star. The second measures the small wobble in the star's position due to the tug of the planet's gravity. In both cases, only two bulk properties about the planet are acquired: (1) The level of radiation received from the star and (2) either the radius (for a transit measurement) or the minimum planet mass. In rare cases, both types of detection have been possible, yielding a true (not minimum) mass measurement and bulk density for the planet.

Our next generation of telescopes including the NASA James Webb Space Telescope (launch 2020) an the European Space Agency's ARIEL telescope (launch 2028) as well as ground-based facilities will be able to begin detecting the atmosphere around a small selection of these worlds. This will provide information about what these planets may be like on their surface. However, until this data is available, our knowledge is restricted to typically two bulk property measurements, neither of which probe surface conditions.

Given this situation, we are only able to say that planets are "Earth-sized" not if they are "Earth-like". We cannot meaningfully speculate on the atmosphere, water content, geology, magnetic fields or other Earth-like conditions for most exoplanets, which makes habitability discussions mute.

Yet despite this, media headlines frequently utilise phrases such as "most habitable", "most Earth-like" or "could harbour life". If this cannot be deduced from the data, why is this happening? The answer —at least in part— is bad language.

2. The Habitable Zone (and friends)

One of the more unfortunate naming conventions for planetary scientists is the so-called "Habitable Zone". Rather than meaning a region where orbiting planets could support life, the actual calculation of its boundaries typically only applies to the Earth. The classical Habitable Zone (which is the one used outside research involving detailed climate models) is the region around a star where the Earth could support liquid water on its surface. Closer to the star than the Habitable Zone inner edge, and the Earth's water would evaporate. Further out than the Habitable Zone outer edge and our warming greenhouse carbon dioxide gas would condense into clouds and begin to reflect, rather than trap, heat [2].

The fact this definition of the Habitable Zone only applies to the Earth can be easily seen around our own Sun. The Earth is in the Habitable Zone, but so are the Moon and Mars, neither of which support lake-side retreats. We have also currently discovered around 15 times as many planets more likely to be gas giants similar

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*4 Analytics & Algorithms, Stitch Fix

to Jupiter and Neptune within the Habitable Zone, than those that could feasibly have a solid surface. The correct definition of the Habitable Zone would therefore be a region where an Earth-like planet could support liquid water on its surface.

Despite this, the Habitable Zone is frequently described incorrectly by prominent researchers, university press offices and leading science media. Descriptions include phrases such as "numerous habitable planets" for planets within the Habitable Zone, "region where planets may be expected to possess liquid water" or "where terrestrial water-based life could exist". Such language from trusted experts suggests that a quantitive debate about the habitability of exoplanets is possible.

Similar problems have also arisen in the past with metrics that rank exoplanet discoveries. A few of these metrics do have a genuine scientific use, as they can be a guide to selecting planets for future observational campaigns. However, all these rankings must be based on the two (at most three) bulk properties that can currently be measured, and so none can provide a quantitive measurement of how habitable a planet's surface may be. As a result, there is no correlation between the ranking number and the suitability for life.

3. A case study: Gliese (GJ) 832c

In 2014, a planet was discovered with the radial velocity technique. It had a minimum mass of roughly five times the Earth and received a similar level of radiation as the Earth, placing it in the Habitable Zone. The research paper noted in the abstract that the high mass of the planet made it likely that its gravity had attracted a thick atmosphere and thus, this planet was more likely to be a "super Venus" than a "super Earth" [3].

Despite the surface temperature of Venus being 460°C, the copious reports about the planet's discovery in the media focused on its likely habitability. This was driven both by the planet's position in the Habitable Zone and on its high "Earth Similarity Index" (ESI): a metric that compares planet properties to that of the Earth [4]. At the time, there was a popular claim originating from an academic institute that an ESI greater than 0.8 would mean the planet could support life. By deriving the metric's comparison properties from the two measured values for the planet, the ESI for GJ 832c came out as 0.81, despite the lack of data making any meaningful comparison with the Earth impossible.

To counter this problem a series of articles were written for the media by the authors to explain what is currently observable and thus, knowable, about extrasolar planets. These articles were published on online media sites such as "The Conversation", "io9", "Physics Focus" and "Scientific American" blogs.

We followed this up last year with a comment piece published in "Nature Astronomy" discussing the use of language in exoplanet news and the poor representation of the Habitable Zone and other metrics [5].

The result has been a notable decrease in the use of the ESI in the media and the start of a more nuanced discussion about habitability.

4. Summary

The last 25 years has seen the discovery of thousands of exoplanets, but the data available for individual planets outside our Solar System is presently too limited to discuss habitability.

While it can be tempting to forgo accuracy to achieve an attention-grabbing headline, the long term consequences can be grave. Astronomical instruments that have the capability to investigate planet atmospheres (and therefore potentially habitability) are now being built but have a very heavy price tag. Their success (and that of their successors) therefore depends on public support. Repeated claims of discovering habitable planets when the data cannot support this claim risks field credibility and the future of exoplanet observations.

To combat this, researchers and science communicators should take care to speak accurately when describing terms such as "Habitable Zone". Feasibly, such terms that imply a very different understanding from common vehicular could be replaced by less confusing language, such as "Temperate Zone". However, it is most important to explain jargon and watch your language!

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|Plenary Talk|

Future Scientists Communicating Science

João RETRÊ*1, José AFONSO*2 and Rui AGOSTINHO*3

Abstract. Viver Astronomia (Living Astronomy) is an informal educational programme in Astronomy that aims to nurture a culture of science communication among science students. The programme consists of training aimed at students and their involvement in science communication initiatives. In this format, they receive monthly training in astronomy and astrophysics, as well as in science communication. The programme also aims to reinforce formal science education and stimulate the development of communication skills.

1. Introduction

There is a need for a growing number of motivated people who are able to create a bridge between scientific research and the public, with a strong scientific component and communication skills. Investing and developing these qualities in science students and future researchers is essential.

Viver Astronomia (Living Astronomy) is a successful informal educational programme in astronomy, that makes use of the practice of science communication as a way to create awareness, among students, of the importance of science communication in the context of scientific research, enhance formal science education, and stimulate the development of communication skills.

2. Young scientists communicating science

The programme consists of training aimed at students and their involvement in science communication events. In this format, they receive monthly training in astronomy & astrophysics and in science communication concepts. They also receive practical training in the use of small telescopes and how to conduct guided tours of the sky. This training is given voluntarily by researchers in astronomy & astrophysics, as well as by science communication professionals.

The knowledge acquired by the students is actively put into practice in periodic public outreach activities, where they have an active role in organising events, interacting with the public and communicating scientific knowledge.

The training in astronomy & astrophysics prepares the students to correctly communicate scientific knowledge to the public. This training also enables the reinforcement of the formal knowledge they acquire in school/university.

With the training in science communication, the students learn how to communicate with several types of audiences, including with their future peers. They also learn how to develop outreach activities. The fact that they apply the knowledge acquired in the training in real outreach activities, allows them to develop more confidence in front of an audience. They also become more aware of the importance of science communication, being more proactive in organising and participating in science communication activities promoted by other institutions or by themselves.

3. Temporal evolution

The training and activities are developed in a very relaxed and informal environment, which is a key characteristic of this programme and one of the main reasons why students join and remain in the programme. In fact, when asked about what they like the

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most about it, most of the students' answers referred the informality, together with the opportunity to receive training in astronomy and science communication. These were followed by the possibility to participate in real outreach activities and to use telescopes.

The project began in 2009 with 14 bachelor students from the Physics course of the Faculty of Sciences of the University of Lisbon. Since then, more than 300 students have already experienced it, and the programme has currently an average enrolment of two students per month, without the need of recruitment.

One of the main reasons for this self-sustained enrolment of students, is the fact that the students in the programme enjoy participating in it and so they spread the word to their colleagues and friends. This happens not only at their own faculty, but the word has spread to other educational institutions as well. Today, more than eight years since its creation, Viver Astronomia has the active participation of 70 students from different areas of knowledge, colleges and universities.

4. Diversity of students

Having initially been designed for students in the first cycle of higher education, currently the programme also includes high school students, as well as MSc and PhD students. These students come from 11 faculties, 8 universities and 6 high schools. In addition to these, community members and university professors are also involved.

Concerning the gender and ages of the students, 57% are women and 43% men, with ages ranging from 15 to 44 years old and an average age of 22 years old. The students' areas of study are also currently very diverse (physics, biology, agronomy, meteorology, medicine, geology, mathematics, geophysics, etc...).

5. Extensibility to other areas

With a high diversity in areas of study, a relevant question is if this programme is extensible to other areas or if it is exclusive of astronomy. When inquired about the reason why they joined the programme, the students' main answer was their interest in astronomy, but other reasons were also mentioned, like the opportunity to meet researchers or their prior interest in science communication. Despite their strong interest in Astronomy, only 40% of the students want to actually follow astrophysics as a career path. The remaining don't want to (35%), or don't know yet which career to follow (15%).

About 40% of the students who don't want to follow astrophysics, answered positively to the hypothesis of participating in a similar programme in their own area of study, if this was available. This seems to indicate that there is an interest in replicating the programme in other areas, but it does not show if a programme of this kind would actually work outside the current model, which uses the interest in astronomy as a way to attract and captivate the students.

6. Summary

Viver Astronomia is a successful programme that enables students to develop communication and social skills, teamwork and responsibility, and helps to reinforce their acquired formal knowledge.

The diversity among the students (e.g. gender and academic backgrounds), enables the connection between different fields of knowledge and a creative environment for new ideas in public engagement [1].

The programme enables an informality to public activities which can attract more audiences [2]. It also enables the recruitment of future scientists (possibly future astronomers) and the development of the awareness in students of the importance of science communication in the context of their future science careers – creating future scientist communicating science.

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|Plenary Talk|

Astronomy Translation Network: the Challenges of Translating Astronomy Resources Globally

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Abstract. The Astronomy Translation Network represents the first attempt to implement a global network connecting translation needs with volunteers' efforts for providing high-quality astronomy education and outreach materials in different languages. In this paper, we share what we learned in the test phase of this project from three challenges: "How to keep volunteers motivated," "How to select good resources" and "How to keep high quality contents."

1. Background

There are many excellent astronomy resources in education and outreach, but most of them are in English. For most people in the world, it is not accessible. As the International Astronomical Union (IAU) strategic Plan 2020-2030 includes "facilitate international communication through exchanges and translations"[1] as a goal, translation is an essential aspect of astronomy communication. Translation efforts exist individually, but they are limited and lack visibility. Furthermore, the language barriers often cause individuals to reinvest the same resources. IAU Office for Astronomy Outreach along with National Astronomical Observatory of Japan have recognized the issue and identified the need of a global network for translation to centralize materials and connect translation needs to volunteers' efforts in a global framework. This idea is very ambitious and challenging, and we did not know how to design the framework. We started to discuss this initial idea with stakeholders in the Communicating Astronomy with the Public 2016 (CAP2016) in Colombia.

To understand global translation needs in astronomy communication, we conducted interviews with 12 people from Algeria, Quebec in Canada, Colombia, Ecuador, India, Japan, Sri Lanka, Indonesia and Taiwan, who were participants in CAP2016 or the Symposium on Universal Design for Astronomy Education 2016 in Japan. Through the interviews, we found that eight of the interviewees feel that translation is necessary for their country or region. Especially, teachers have difficulties with English, because they use local language at schools. The interviewees felt both difficulties and benefits from their translation experiences. Listed obstacles include the lack of time, difficulties in assessing the quality of the documents and the lack of language skills. Listed benefits include the opportunity to learn language and astronomy. They also mentioned the following elements as essential in maintaining volunteers' motivation: reaching many people, providing visibility, recognition and a human network to the volunteers, proposing good materials and providing good management.

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2. The Astronomy Translation Network

Guided by this preliminary research, we made the plan of the project with the assistance of Thilina Heenatigala. The project goals became to create a volunteer network able to support translation needs and to provide good astronomy materials accessible to everyone without the language barrier while preserving their high quality. To keep the quality of translated documents, we came up with a workflow in which after the translation a proofreader checks the general writing quality and a scientific reviewer checks the scientific accuracy and the use of terminology. In August 2017, we opened volunteer registration and started to test the workflow of translation and review from English into other languages by using existing tools, namely Basecamp, Google drive, and email. Starting from May we will shift to an upgraded test phase allowing the translation of non-English materials into English and open a request form for individuals to submit materials to translate. Combining the previously listed tools is not efficient, so if additional budget is secured, we need to develop a user-friendly web platform to handle the whole workflow and database for sustainability.

The project will translate astronomy outreach and educational materials. During the test phase, we selected twenty resources from IAU astroEDU project, which are peer-reviewed activities for science education, IAU website contents, and activities of astronomy for inclusion.

3. Current Activities

We have now 143 registered volunteers across 34 languages. In the test phase, we established the Indonesian, Portuguese, Chinese, French and Spanish language groups. German and Japanese volunteers are translating individually. The completed translations are published on the project website with credits for the translators, proofreaders, and scientific reviewers. Fortunately, we could receive support from the translation experts. Mathieu Isidro from the Square Kilometre Array facilitated contact with ISIT, a translation school located in Paris. It allowed us to work with two groups of students. One group is creating guidelines and a glossary format to be followed by volunteers. Another group worked on benchmarking and platform design. The test phase of this project has taught us about best practices in translation, platform design and management.

4. Challenges

This project represents the first attempt to implement a sustainable global translation network in astronomy communication, and we are facing many challenges. Here we focus on three main challenges.

The first challenge is "How to keep volunteers motivated." Volunteer's motivation directly affects the results of this project. Along with the ISIT students, we surveyed the volunteers to learn their satisfaction regarding group communication and their needs concerning the project management system. This survey showed that most of the respondents were very satisfied or slightly satisfied with group communication, but 22 % of the respondents were very dissatisfied or slightly dissatisfied. Dissatisfied people said that the "Job flow between each role is not clear." and "In view of the voluntary nature of the work, I believe that an authoritative tone on the part of the reviewers does not help the progress of the work." For these reasons, guidelines are required to clarify the role of volunteers. To compare volunteers' needs and unfulfilled elements in the current system, the ISIT students applied the idea of user experience design[2]. As a result, "pleasure-stimulation," "relatedness-belongings" and "competence-effectives" are highly needed, but are not fulfilled in the current system. To satisfy the volunteers' needs we plan to implement a selection process of resources including volunteers and a user feedback function, and improve communication within volunteer groups.

Second, to consider "How to select good resources," we set up a survey with Mike Simmons and Astronomers Without Borders to ask people to recommend resources to translate. Gabrielle Simard, our project assistant, analyzed 155 responses, and we propose that the resource selection process includes a contact with the content creator to confirm whether any translation exists, a distribution plan for the translation, and a Creative Commons license. For upcoming steps, we will adapt this selection process for each type of resource, involving volunteers and testing the process within active language groups.

The third challenge is "How to keep quality content." Now we are struggling with finding scientific reviewers. We feel a need for criteria based on education and experiences. IAU National Outreach Contacts could help to choose appropriate scientific reviewers in their country. We also think that the knowledge pool generated by the IAU's 10,000 members is a tremendously valuable resource for maintaining the quality of translations. We believe that the IAU members could become an important part of the project.

5. Discussion: How To Be Sustainable

Now, we are at a turning point with the project regarding development and sustainability. In addition to the listed challenges, we are facing the issues of funding and human resources management. Since this project is a bottom-up project, there is no direct budget for platform development. We need to prove the feasibility of the project by using the outcomes of the test phase to acquire funding. This project also needs collaborators to connect people, disseminate translations and promote the activities.

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|Plenary Talk|

Operating an Interpretive Center as part of Federal Government

Dennis R. Crabtree[*1], James E. Hesser[*2], Ben Dorman[*3], and Don Moffatt[*3]

Abstract. While governments often support science and provide funding, including for public engagement, operating a facility as part of a government department means dealing with, e.g., rules on procurement, advertising, human resources and many others. The Centre of the Universe (CU) opened in 2001 as a purpose-built public interpretive centre dedicated to astronomy and its associated technologies. It was built and operated by the National Research Council (NRC), a department of the Canadian federal government. It was closed in 2013, a closing seen as part of the then government's "war on science". In this talk we will detail how the CU was affected by operating as part of a federal government department and how the community dealt with its closing. We will also describe the approach that has been taken to reopen the CU in a sustainable fashion. The many lessons learned from the seventeen year history of the Centre of the Universe will be summarized in the hope that others may benefit from our experience.

1. Introduction

The Dominion Astrophysical Observatory (DAO) officially opened in June, 1918 and was the world's largest operating telescope at the time. Right from the beginning, the Observatory was used for public outreach (see Fig. 1).

2. The Center of the Universe

Outreach activities at the DAO was very popular with the public and the number of visitors reached 39,000 (equivalent to Victoria's population) in 1929. Events like the Great Depression and WWII diminished the number of visitors but outreach was maintained continuously for the next 80 years thanks to the dedicated scientific staff, student positions and short-term outreach positions.

In 2001 a dedicated interpretive center, The Center of the Universe (CU) was opened to take outreach at the DAO "to the next level". The CU featured professionally developed displays, professional staff, a small planetarium, artifacts, models, interactive displays and much more. It also featured a very cool position titled, "Manager, Centre of the Universe"! The CU proved to be very popular and provided rewarding experiences to thousands of people.

OBSERVATORY OPEN TO PUBLIC TONIGHT

Commencing This Evening, Astronomers Will Be in Attendance Every Saturday Night to Explain Use of Telescope.

At the opening of the Dominion Astro-Physical Observatory, Saanich, on Tuesday evening announcement was made by Dr. J. S. Plaskett, director, that the institution would be open to the public every Saturday night hereafter from 8 to 10 o'clock, commencing this evening.

Dr. Plaskett and the assistant-astronomer, Dr. Young, are busy almost nightly making spectra of the new star, Nova Aquila, but it will be perhaps a week or so before anything further is ready for publication in connection with observations of the phenomenon made with the assistance of the big telescope and the spectrascope.

Fig. 1. Newspaper article from June 12, 1918 noting that the telescope would be open to the public every Saturday night

3. Challenges

While the CU was successful in reaching school student and the general public, it faced many challenges in its operations.

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Fig 2. The interior of the CU

The 9/11 event happened which caused a significant decrease in tourism world-wide and resulted in a decreased number of visitors, just as happened in the 1930s and 1940s. Also, there was difficulties in hiring (bilingual) staff, and most importantly, turnover in the Manager position.

The CU is located 12 km north of the city, outside of the usual tourist haunts. This makes advertising especially important to increasing awareness and the number of visitors. In the early years of CU operations, the ability advertise and market the CU were severely constrained by government limits on such activities. These restrictions followed in the wake of a government “sponsorship” scandal. While these restrictions were slowly lifted several years later, advertising and marketing were always a challenge.

When the CU was proposed, there was a lot of effort put into the business case. Consultants were brought in and produced a report that indicated the CU would be able operate without a subsidy after a period of a few years. With the challenges faced the CU was never able to generate enough revenue to come even close to breaking even.

In August if 2013, the NRC President closed the CU, nominally due to budget pressures. In reality, science outreach did not fit with the new NRC approach of industry-focused, applied research. The closure of the CU did not sit well with the local community and those involved with public outreach such as the amateur astronomers. At a meeting of stakeholders an agreement was reached whereby NRC would pay for the maintenance, heat, light, etc. of the CU if another organization wished to take on its operation.

4. Community Involvement and Lessons Learned

A small group of local residents including a former astronomer, a former astronomy outreach specialist and amateur astronomers came together to eventually form a non-profit society, the Friends of the Dominion Astrophysical Observatory (FDAO). The FDAO now has a Right-to-Occupy license for the CU, essentially they are renting for free, and are leading the effort to restart the education programs offered by the CU when it was operated by NRC.

Their biggest challenge is in raising sufficient funds so they can hire one or two employees. Nonetheless, they are making consistent headway to increasing the science outreach offered by the CU. This is made easier in that they are unencumbered by several of the challenges that faced the CU when it was operated by government.

There are several lessons to be learned from the 18-year history of the CU. While the thought of operating as a part of government is appealing (money available!) it does come with many strings attached. These strings can be especially tricky if the government organization is not used to running a commercial enterprise (few government organizations are).

The challenges faced by advertising and marketing restrictions can be very limiting. Challenges in hiring staff using government hiring practices can also be daunting. There is also the risk of a change in government making for an unfriendly environment for doing science outreach. While this applies to all organizations doing outreach, doing it from inside government is more at risk.

Finally, building linkages with community organizations to run the outreach in partnership is a powerful hybrid model. The community aspect means there are many less strings attached and the outreach activities can operate under less bureaucracy and probably be more efficient.

|Plenary Talk|

Experiences Related to the TMT Site Problem in Japan

Wako AOKI*1 and Miki ISHII*1

Abstract. The Thirty Meter Telescope (TMT) project is an international project to construct a next-generation large optical/infrared telescope atop Maunakea in Hawaii. The project has been facing difficulty with the onsite construction for the past three years. With cooperation with the TMT International Observatory, the TMT-J project office has been attempting to provide correct information, including release of background information, and participation of discussions about such topics as relations between local culture and a science project, to promote understanding of this issue in Japan. We report on our efforts and experiences related to the TMT site issue.

1. Introduction

TMT is a next generation large optical/infrared telescope with a primary mirror of 30 meter diameter planned by international collaboration of six organizations in five countries: Canada, China, India, Japan and the USA. The planned construction site is close to the summit of Maunakea in Hawaii. The telescope is currently scheduled to see first light in 2027.

The construction of the telescope is managed by the TMT International Observatory (TIO) established as a limited-liability company in the USA in 2014. The board of governors composed by representatives of the member organizations makes important decisions on TIO such as schedules. A major part of the construction work is conducted pursuant to agreements between TIO and the members that set out their contribution requirements, respectively.

The construction site of the telescope is located on the summit region of Maunakea in Hawaii, about 1km away from the Subaru Telescope that is the Japanese large telescope constructed in 1999, and is at altitude of about 4000m. This high altitude, as well as good conditions of the upper layer of the atmosphere for Adaptive Optics (AO) observations, makes it an ideal site particularly for infrared astronomy. The northern sky is covered by observations from Hawaii. This is complementary to the sky coverage from Chile where the next-generation large telescopes E-ELT and GMT are planned. Astronomers in Japan are conducting wide-field imaging surveys using the prime focus camera of the Subaru Telescope, and also have further plans of spectroscopic surveys with new instruments of its telescope. TMT is expected to provide opportunities to follow-up such survey projects when constructed in Hawaii.

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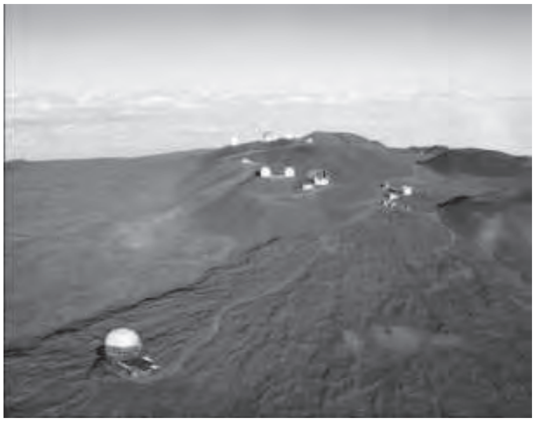

Figure 1. The summit region of Maunakea in Hawaii. The CG image of TMT is found at the bottom left.

2. Construction site issue

The summit region of Maunakea has a science reserve of the state of Hawaii. Constructing a new telescope requires a Conservation District Use Permit (CDUP) from the Board of Land and Natural Resources of the state. The University of Hawaii, which manages the summit region of the mountain, applied for a CDUP for the TMT construction, and had its first approval in April 2013.

However, opposition to the TMT construction on Maunakea became apparent when the groundbreaking ceremony was held in October 2014 and also when the onsite construction was attempted in spring of 2015. Some of those opponents filed an action with the court in 2013 to invalidate the CDUP approved by the state. The matter was appealed before the Hawaii Supreme Court (HSC) in 2015. In December 2015, the HSC invalidated the original CDUP approved in 2013 on the ground that the approval process had been conducted inappropriately.

The opponents' reasons against the TMT construction on Maunakea include possible impact on the natural environment of the mountain such as biological resources, and negative impacts on cultural practices, archaeologic resources and scenic views. These potential impacts have been already investigated and reported through an Environmental Impact Statement in advance. It should be noted here that the historical background lies behind their opposition in terms of the cultural issue in Hawaii. They also raise the problem involving the management of activities on Maunakea, demanding in relation to astronomy the limit on the number of telescopes at the summit region and improvement in the treatment of the land use fee.

Following the decision of the HSC in December 2015, a new process for the CDUP started in 2016. The contested case hearing was held in total of 44 days from October 2016 to March 2017. The CDUP was re-approved by the Board of Land and Natural Resources of the state of Hawaii in September 2017. Hence, the TMT project has permission to restart the onsite construction in Hawaii as of the date of this Fukuoka conference (March 2018). However, another appeal against the validity of the state's approved CDUP was submitted. Further communication with people of the local community is obviously required.

3. Communications and activities in Hawaii

Some TIO board members, including the representative of TMT-J, have visited Hawaii many times to engage in communication with stakeholders, including governor of the state, mayor of the county. They also have continuous communication with key persons of the local community such as those who work in education in Hawaii.

The Subaru Telescope holds a series of seminars for the observatory staff to learn about the culture and history of Hawaii by inviting persons in the local community.

Outreach activities on astronomy and other science events actively take place in Hawaii, including ones held at a farmers market in Hilo, planned and organized by Maunakea observatories to which TIO also contributes. In addition, the educational program called the Journey through the Universe is offered to hold lectures on request from schools of the Big Island every March, to which TMT-J members have been contributing. TMT-J members also have opportunities to give public lectures at events and museums.

Recent poll reported in a newspaper about the TMT construction shows an increase in the number of those who support the project all over the state. We need, however, to bear in mind that there are a wide variety of opinions, and to continue dialogues with people in the community.

4. Experiences in Japan

The TMT site issue is not well known in Japan, but has been featured by some TV news programs and newspapers. Most of them contacted the TMT-J project office to obtain correct information before reporting. However, a few reports contained misleading contents. Since the most important action of the project for preventing such misleading reports is to provide correct information on the construction site issue, TMT-J releases information through its web page (in Japanese), and responds to the media when needed.

Whereas the TMT site issue is not well known among the general public, it is a great concern for those interested in astronomy. We need special care in public talks about the TMT project, inter alia, being careful when stating about the schedule and prospects on the site issue as well as on the backup plan in which La Palma in Spain is the alternative site. We also report progresses in the construction work conducted in Japan, including mostly completed final design of the telescope structure and an ongoing fabrication of the segments of primary mirrors. Such progress reports also help to understand the current status of the project.

Challenges we face in the course of those activities are to decide in how much detail and when we should announce topics on the site issue in web releases, and how we should treat this issue in public lectures. These might be general problems found in any project through PR/outreach activities. Another challenge we face is to keep consistency of releases between members of the international collaboration. Close communication among the member institutes is a key to solving this issue.

The TMT site issue is seen at some meetings from a perspective of relations between culture/local community and advanced science. TMT-J members have contributed to those meetings and seminars. We also have discussions with researchers in Japan who are conversant with the culture and history of Hawaii, helping us to consider the TMT site issue in a broader context.

|Plenary Talk|

The Potential of the Public in Astronomy for Development

Vanessa McBRIDE[*1,2,3], Ramasamy VENUGOPAL[1,3] and Kevin GOVENDER[1,3]

Abstract. At the Office of Astronomy for Development (OAD), one of our priorities is to look at how the skills and techniques of astronomy may be used to contribute to the global goals of sustainable development. The complex nature of development challenges requires navigating territory where social, economic and technical concerns must all be considered. This compels input from a wide variety of actors across diverse disciplinary backgrounds, and many of these actors make up the 'public' that attend astronomy outreach or communication events. Astronomy communicators, at the nexus of academic research and interaction with the public, fulfil a valuable role in the astronomy for development context. In this article we consider how almost every communi-cation interaction has the potential to inspire this sector of the public to engage in interdisciplinary projects ad-dressing issues of sustainable development.

1. Astronomy for Development

Part of the appeal of astronomy is that astronomy connects exotic science, cutting edge technology and a sense of cultural connection or inspiration. Taking advantage of this appeal, astronomy can be used as a vehicle to draw attention to, and possibly even address issues of sustainable development. In 2015, world leaders agreed to seventeen goals for improving life on earth by 2030 [1] -- the United Nations Sustainable Development Goals (SDGs). These goals range across issues of health, economic prosperity, environment preservation and equality.

At the Office of Astronomy for Development (OAD), we consider how the tools, skills and methods of astronomy can be used to work towards the SDGs. In addition to the OAD's global coordinating office in Cape Town, there are ten regional or language offices across the globe, where the SDGs are afforded regional priority and implementation. Our approach is both grassroots -- through the award of seed funding (from the International Astronomical Union) to grow local astronomy-for-development interventions -- and at the academic level, where the OAD partners with researchers and non-profit organisations on specific, development-related projects.

2. Astronomy in the context of Science for Development

Astronomy is one of many disciplines across the natural and human sciences that has potential to focus on the SDGs. The context is illustrated in Fig.1, which shows how physics and astronomy, both requiring big data and coding skills, may be used as a basis for actions such as a "Big data workshop", eventually contributing to the global goals of education and decent work and economic growth. This is just one example among a myriad which demonstrates how tools from different disciplines may be combined so that the product, or 'whole' may be 'greater than the sum of its parts'.

3. Multidisciplinary Projects: Examples

There are a number of multidisciplinary projects already playing out across the science-for-development landscape. These include an astronomy and ecology research collaboration, where infrared images from drone photography are analysed using techniques adapted from astronomy image processing, and the results used for wildlife tracking and conservation [2].

The STFC Food Network [3] brings together experts from across astronomy, agriculture and engineering, among others, to look at issues which affect

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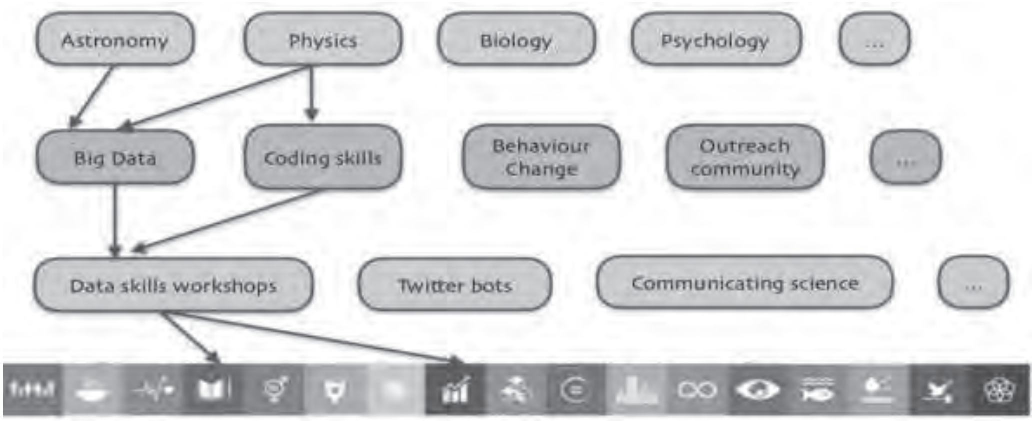

Fig. 1. A roadmap to science for development, illustrating the disciplines at the top, tools in the second horizontal layer, actions in the third, and the SDGs at the bottom. See text for a description of the arrows.

food security. Some of these issues, such as monitoring of crop health, use techniques related to astronomy (i.e. galaxy detection in surveys) to contribute to the Zero Hunger SDG.

The OAD is in the early stage of a collaboration with development economists studying satellite imaging of the informal economy through a combination of citizen science and machine learning techniques.

The crux of the matter is that multidisciplinary projects are difficult: not only because they require skills that are by definition outside of our comfort zones, but also because they require translation of understanding across different and often perplexing discipline-specific vocabularies. However, multidisciplinary projects are crucial in working towards the sustainable development goals.

5. Potential of the Public

What does this mean for communicating astronomy to the public? Public astronomy events tend to bring together a wide range of interested, engaged experts across the spectrum of natural and human science disciplines. Every public talk, star party, eclipse viewing and outreach event is an opportunity to interact with such professionals and experts. Such interactions are incredibly valuable for the multidisciplinary actions needed to address the SDGs. If science communicators could use their platforms not only to excite the audience about astronomy, but also about astronomy-for-development (and even science-for-development), then we have an amazing opportunity to use all our skills, as a united "general public", in projects or conversations about the 2030 agenda for sustainable development.

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Artistic Metaphors in Astronomy Communication

Jan ŚWIERKOWSKI*1

Abstract. In the era of digitization and computerization astronomy seems to become more and more alienated and unfathomable. Scientific language mainly based on mathematical equations or complicated definitions becomes hermetic and comprehensible only to a small group of the society. Astronomers, increasingly delving into niches delimited by narrow specialization, are often able to exchange comments on their daily work only with a small group of 'professional colleagues' during conferences or through per reviewed magazines In this paper I briefly present my idea of the usage of the cognitive metaphor theory and art as a way of communicating with the general public and at the same time way of staying scientifically "correct".

1. Introduction

The essence of *'a cognitive metaphor'* is to understand and experience one thing in the terms of the other [1]. The theoretical background of this fact lays in sciences of cognition and the idea that the way we perceive the Universe has a largely metaphorical character. This happens both in everyday language and in research, because when people conceptualize their experience and formulate conclusions, especially for new phenomena that has never been observed and cannot be understood otherwise, they usually rely on metaphors [2].

The thesis that I investigate is based on the idea that the distant astronomical objects described by equations lack qualitative and metaphorical representations. My idea is to develop a consistent method of creating such metaphors based on conceptual blending theory [3] with the addition of the cognitive semiotic approach [4].

2. Methodology

The connection between cognitive metaphors and visualization of astronomical phenomena that we are 'unable to make a picture of' opens a huge possibility for development of new methodology of science translations based on artistic intervention. For more than nine years I have been implementing this idea as a curator of a group of nearly 20 artists and scientists called Institute B61, that works following an experimental method in which scientists present their knowledge to artists, then the group works together at meetings or during residences to produce new scientific metaphors.

In this art and science project I have focused on the ways of visualization and cognition of distant cosmic objects that can't be popularized otherwise than through metaphors. Throughout 9 years different multimodal metaphors of the inconceivable white dwarfs, red giants, neutron stars and many more have been created by artists of different nationalities. The project has been evolving in a twofold and complementary way within a twin-track approach, simultaneous and complementary to each other.

The first of them is a site-specific physical space Stars enriched by performances and installations using images, sounds, touch and even taste to enhance the experience of the unknown. During the performance the viewers are taken to a secret Institute B61 in which they visit laboratories - all representing a certain stage of star's life cycle.

The second approach is an interactive Chatbot that transfers the ephemeral pop-up research Institute experience to virtual reality based on the concept of digital storytelling. As a result it can be reached from any point on Earth through commonly accessible and free Facebook Messenger app. While starting the conversation with the Chatbot, the user is informed about the top-secret nature of the project. The old school roughness of the Chatbot brings up the likeness of HAL 9000 from "Space Odyssey". Once the conversation starts the decision to move to particular stage of the life cycle of a star belongs to the user. Subsequent elements of the story are generated after entering certain commands. In other words, the viewer controls new content during a simple conversation with the imaginary prof. Joseph Brewster.

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3. Results

Picture 1. *Multimodal metaphor of the core of a Main Sequence Star [5].*

Several art-metaphors were created, inspired by modern science and closely related to the most recent astronomical models of the Universe. Multiple sample groups made from 20,000 randomly selected volunteers from 5 countries have been involved in interacting with the findings of our interdisciplinary team. Even if some of them are not fully understandable, all of them are a spark to introduce a scientific problem that for many people, before meeting the Institute B61 activities, has never even existed.

Picture 2. *Multimodal metaphor of the White Dwarf [6].*

Art and metaphors are platforms for the communication of scientific content, which first of all, eliminates the fear of the unknown among those who experience it. The language of art tames the world of mathematical equations and has space within it for laughter and freedom. It also helps people to quickly familiarize themselves with the world of mathematical formulas. Obviously, our intense interaction and attractive, even absurd actions stand out in contrast to the traditional school of teaching science, commonly regarded as a boring package of knowledge to believe in, without understanding its roots.

4. Conclusions

Creation of new scientific metaphors can be extremely valuable for education, contemporary art and science/technology museums. The theoretical schema proposed by Brandt and Brandt seems to provide necessary background for the experimental and empirical process that will produce new metaphors. It is essential that after the creation the metaphors have to be evaluated in order to determine if they are well-worn. The best indicators seem to be connected with the use of games, mobile applications and interactive movies. I assume that the method is limited only to qualitative understanding. Further research should confirm that multimodal metaphors cannot be used for quantitative models.

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Using AAS Nova and Astrobites to Make Current Astronomy Research Accessible

Susanna KOHLER[*1]

Abstract. AAS Nova and Astrobites are two resources available for the astronomy community and the general public to keep up with some of the most recent research published across the field of astronomy. Both supported by the American Astronomical Society, these two daily astrophysical literature blogs provide accessible summaries of recent publications on the arXiv and in AAS journals. We present the two different models for AAS Nova and Astrobites, and we discuss the challenges and successes we've had in using these platforms not only to share the latest results in astrophysical research with the public, but also to simultaneously convey the process of science.

1. Introduction

Though roles in astronomy communication are varied — from media to educators to outreach practitioners — all astronomy communicators can benefit from access to results from recent astronomical research studies. In education and outreach settings, bringing recent research into our discussions with the public and with students is how we share the excitement of our field with them. In addition, this is how we convey the *process* of science with the public.

Unfortunately, astronomy research studies are often presented in obscure and complex language, creating a challenge for communicators seeking to share these studies. Several tools exist to help make astronomical research results more accessible, however, and in the following proceeding we introduce two of them: AAS Nova and Astrobites.

2. Two Resources Available

2.1. AAS Nova

AAS Nova (https://aasnova.org) is a website developed by the American Astronomical Society (AAS) in 2015. The main goal of the site is to present curated summaries of recent astronomy research that has been published in the journals of the AAS, with the goal of making this work more accessible to a broad variety of groups.

Articles featured on the website are selected by AAS journal editors as research of especially large impact or likely to be of interest to a broad audience. While highlighted articles sometimes include major research results that receive independent press attention, they are more often studies with important but less-flashy results, which might not have otherwise been noticed without the attention brought to them via AAS Nova.

AAS Nova highlights are published three times per week and are typically around 400–500 words long. Highlights always link back to the original study, they include and explain figures from the original paper, and they add context and background, emphasizing the main results of the study and why they are important.

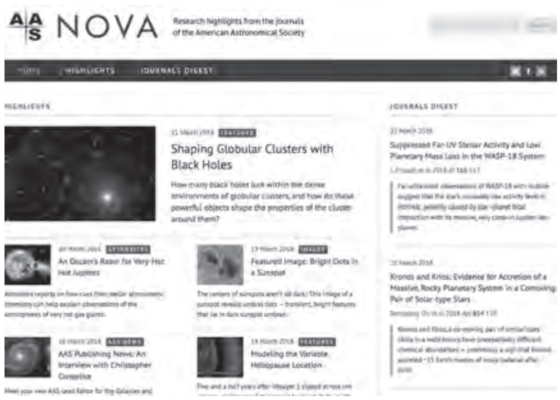

Fig. 1. The landing page for aasnova.org.

2.2. Astrobites

Astrobites (https://astrobites.org) is a website that provides summaries of recent astronomy research published on the arXiv astro-ph preprint server. Astrobites was founded in 2011 and is run by a rotating group of graduate students with the specific goal of making astronomy research easier to learn about for undergraduates first starting out in the field. Astrobites is supported by the AAS since 2016.

Astrobites articles are published five times per week and often go into greater depth than an AAS

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Nova highlight; Astrobites posts typically are 1,000–1,500 words in length.

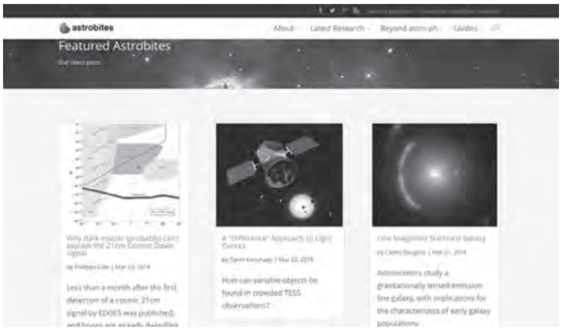

Fig. 2. The landing page from astrobites.org.

3. Communicating the Process of Science

Both AAS Nova and Astrobites place emphasis on not only communicating scientific results, but also communicating the process of science.

Highlights on AAS Nova show continuity as a consequence of being produced by one primary author. As a result, AAS Nova is able to emphasize the incremental nature of science, successively reporting on studies that build upon one another. As an example, AAS Nova might initially highlight theoretical work in planet formation as models are developed, later highlight results from observations of protoplanetary disks and discuss how they impact the models, and eventually highlight follow-up studies in which the theoretical models are refined. In this way, readers can see how science is done in real time.

Additionally, as a consequence of not being tied to the main headlines of the day, AAS Nova is able to highlight null-result studies that would otherwise not gain attention. This shows the practical reality of science: null results are as important as positive outcomes for the steady progression of a research field.

Astrobites shows the process of science by carefully describing the methodology of studies in addition to their main outcomes. In this way, readers can see how scientific conclusions are reached.

Astrobites also features “Personal Experience” posts, in which graduate-student authors describe their experiences as scientists. Past posts have included topics like a typical day in the life of an astronomy researcher, or what it’s like to go observe at the South Pole Telescope.

4. Challenges and Successes

Both AAS Nova and Astrobites have encountered challenges as they have developed. To meet the challenge of writing for a diverse audience, the sites often vary the level of their posts, include hyperlinks to clarify jargon, and provide extensive context, while also providing ready access to the source material for the more advanced reader.

To meet the challenge of balancing scientific accuracy and accessibility, the sites maintain close relationships both with their readers, and with the scientists whose research they are summarizing. AAS Nova and Astrobites are responsive to feedback and continually seek ways to improve their services.

Lastly, to meet the challenge of reaching readers, both sites have relied primarily on word-of-mouth advertisement. AAS Nova and Astrobites have both gradually built up sizable audiences around the world, but the sites are continually seeking new ways to expand their reach.

In tackling these challenges, AAS Nova and Astrobites have grown into robust resources that have been very well-received by a variety of audiences, including the public, press, educators, and scientific researchers. The sites have reached a point of stability that allows them to push for new collaborations and endeavors; as an example, Astrobites is currently working with educators to determine how best to integrate Astrobites content into undergraduate astronomy classes.

5. Conclusion

AAS Nova and Astrobites are two resources — with two slightly different models — available to astronomy communicators so they can more easily access and incorporate recent astronomy research studies into their communication efforts.

Both sites hope to continue to grow and collaborate, and they welcome feedback from the community. Please reach out to aasnova@aas.org or astrobites@gmail.com to contact the teams.

The COSMOS Collaboration: Engaging the Public in a Large, Multi-national, Multi-wavelength Astronomical Survey

Jacinta DELHAIZE[*1], Andreas FAISST[*2], Peter CAPAK[*3], Jeyhan KARTALTEPE[*4]

Abstract. The Cosmic Evolution Survey (COSMOS) is a large astronomical consortium with over 200 team members around the globe. The international nature of the team is one of its main strengths, but also presents challenges for public engagement with the survey. We describe the COSMOS communication and outreach strategies developed to overcome these challenges. Our efforts have largely concentrated on online and social media platforms since these can be widely accessed by astronomers and the public around the world.

1. Introduction

As telescope power has changed over the years, so too has the culture of astronomy research. Scientists and research groups are starting to work less in isolation and increasingly as part of large, international collaborations. This allows astronomers to pool their time, expertise and resources and thus to cope with the large volumes of astronomical data being produced.

However, this presents new challenges in astronomy outreach and communication. With collaboration members distributed around the globe, so too are the target audiences. Not only are the audiences separated by distance, but also by time zone, language, and culture. Furthermore, partner institutes can contribute differing amounts of financial and human resources towards communication endeavours and are subject to different rules. Within this context, it is important for astronomical collaborations to carefully consider how best to use their resources to communicate their science with the public.

Here we present the engagement strategy of the Cosmic Evolution Survey (COSMOS). COSMOS is a collaboration of over 200 astronomers from more than 12 countries and several continents. The collaboration collects and analyses high quality multi-wavelength data (from radio to X-ray) over the 2 deg^2 'COSMOS field' (see Reference [1]). This has resulted in hundreds of scientific publications focusing on galaxy formation and evolution studies. Much of the data is made publicly available, providing invaluable legacy resources for the international astronomical community.

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A priority of the COSMOS collaboration is to share information about the team, data and science results with a wide audience. We aim to communicate not only internally with other team members, but also with the wider astronomical community and international public.

The core COSMOS Outreach and Communications team consists of ~4 astronomers who each devote a fraction of their time to the project. We have chosen to focus our efforts on online platforms and social media, since they can be accessed from around the world. However, we also take advantage of the annual congregation of team members during team meetings to engage in other outreach initiatives.

2. COSMOS website

The primary platform for both internal and external communication is the COSMOS website: http://cosmos.astro.caltech.edu. The website back-end was custom built, allowing us to adapt the functionality to best suit our various intended audiences. This also gives us the freedom to introduce new functionality as our communication strategy changes.

Funding for website development and maintenance is provided by grants held by COSMOS leader Peter Capak at Caltech/IPAC. Dedicated funds for COSMOS outreach were explicitly listed in the grant budgets. In total, the website design, content migration, content management & paper tracking systems and other refinements cost an estimated USD 8.5k. However, the largest investment was the 2-4 months dedicated to content creation and maintenance by COSMOS astronomers. This is equivalent to roughly USD 15k–30k in salaries, removing overheads and including benefits.

Information for the public and for astronomers are separated into different sections on the website. The public section includes descriptions of the different telescopes and wavelengths used, explanations of cosmic structure and links to data explorers.

The home page contains a 'Spotlight' section, where recent COSMOS news stories are reported. These stories include new science results, approved or acquired observations, team member activities and new resources for the public. Team members can use the internal section of the website to submit spotlight stories for the outreach team to approve. Older stories are archived in a 'News' section.

The website can also be used to host English-language versions of press releases, allowing the original to be in the host country's language. For example, in 2017 the University of Zagreb distributed a COSMOS-related press release in Croatian. This was also released in German and Italian by co-authors in those countries. The English version was hosted on the COSMOS website, with links to the other language versions. This allowed for a larger and more diverse readership.

Website traffic is monitored using Google Analytics. This allows us to track, for example, the number, country and language of users, the most visited pages and the referrers to the website. We can therefore understand our audience better and adapt our communication strategy accordingly.

3. Social media

COSMOS has a Facebook page (http://www.facebook.com/cosmicevolutionsurvey) and a Twitter account (http://www.twitter.com/cosmosastro). These are ideal tools for quickly sharing news stories with a broad audience. However, the audience on these platforms is mixed between professional astronomers and the scientifically-engaged general public. The content of posts must therefore be carefully designed to be relevant to both audiences.

Each Facebook post links to the original article on the COSMOS website. As a consequence, Facebook is the main external referrer to the website and helps to increase the number of website users. Therefore, we find that these social media accounts are important supplements to the website and are particularly useful for disseminating new content.

4. Multimedia

COSMOS also has a YouTube channel (COSMOS Survey) where videos can be uploaded. These can then be embedded in the website and shared via social media channels. We have made a series of short ~3-minute videos of our team members introducing themselves and their research. We also produced a visual summary of a recent press release. These have had more than 2,000 views and we are considering the possibility of using Reddit posts to increase the viewership of new videos.

5. Artist-in-Residence

COSMOS has a long-standing collaboration with South African artist Karel Nel. Prof. Nel attends the annual COSMOS team meetings and gains inspiration for new artworks examining the connection between art and science. These pieces have been displayed in galleries around the world and in exhibitions such as 'Observe' and 'The Brilliance of Darkness.' Prof. Nel helps to deliver a unique perspective on COSMOS work to both astronomers and the public.

6. Live events

Alongside the 2016 team meeting, COSMOS collaborated with the Space Telescope Science Institute to run an Astronomy-on-Tap event at a local pub. Sixty attendees watched four short presentations on COSMOS-themed science delivered by team members. The annual meetings are perfect opportunities to engage in live outreach events and provide team members with public outreach experience. Based on the 2016 success, we hope to establish this as an annual tradition.

7. Summary

The COSMOS survey has developed communication and public engagement strategies to make the best use of our resources and reach a large audience of astronomers and the international public. Our primary platform for communication is the COSMOS website. Facebook and Twitter are important supplementary platforms for news dissemination and YouTube is used to host short videos. Alongside our annual team meetings we collaborate with an Artist-in-Residence and run live public outreach events. The strategies we have adopted may be of interest to other large, international astronomy collaborations facing similar challenges in communication and outreach.

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|Parallel Session|

The Ability of Indonesian Public to Determine Whether an Information About Astronomy is Valid or Hoax

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Abstract. The main factor that responsible to the expanding of interest in Astronomy in society is social media. Yet in other hand, social media also have responsibility to the spreading of hoax. This study aims to find how the public in Indonesia react to the news/information about astronomy and whether public can distinguish the validity of an information about astronomy. Involving 144 respondents and 15 survey questions, public profile, behavior and ability are analyzed statistically using cross-tabulation method and Chi Square Test significance level α: 0.05.

1. Introduction

Along with the growth of interest in astronomy, astronomy in Indonesia became one that being counted in South-East Asia. As we recognize, one main factor that responsible to the expanding of interest in Astronomy in society is the development of social media which makes people globally connected around the world so that can share and access the latest attractive information about astronomy. Meanwhile, in the other hand, not all the information is valid or hoax.

Although hoaxes can trigger the enhancement of interest in astronomy because they are easy to be shared and potentially viral, the negative impacts of hoaxes in astronomy still lead the way because it can lead misconception of basic science. There is no specific research dedicated for hoax in science especially astronomy this far in Indonesia. The research about hoax in general in Indonesia was conducted by National Population and Family Planning Board of Indonesia in February 2007. According to this survey, most of hoaxes (92.4%) are shared via social media (facebook, instagram, etc.) which means the target is internet literate people. Still from the same reference, hoaxes about science and technology, including astronomy reach 23.7% of total hoaxes which means almost 1 out of 4 hoaxes is about science and technology.

So, this study aims, firstly, to look how well public can distinguish whether an astronomy information valid or hoax which can reflect the literacy level of public and secondly to understand the public behavior in responding to news or information about astronomy.

2. Method

Survey was conducted with voluntary sampling method [1]. This survey was developed with free online survey service portal "surveyplanet.com", so in other words means that the respondents are internet literate. The questionnaire contains 3 parts of question, namely respondents profile (age, gender, education level, occupation, etc.), respondent behavior in responding to news/information about astronomy (tendency to validate, tendency to share, etc.) and last part contains of 4 example news/information about astronomy which respondent have to decide whether it was valid or not (the ability of respondent to determine whether an information is valid or hoax).

Next, the result of survey is analyzed statistically with cross-tabulation method (Chi Square Test with significance level α: 0.05) to understand the relation between two variables for example the education level to tendency to share the information, the education level to ability to determine the validity of information about astronomy, etc. This research will be beneficial for astronomy communicators as a consideration to look for the best method to communicate astronomy with public to certain audiences.

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3. Results

There are 144 respondents. Number of male and female respondents are balanced. Most of respondent (82.5%) live in Java island which is the most developed island in Indonesia. 60% of respondents is 24-50 y.o and most of them is high educated (39% hold Bachelor Degree and 33% hold Master Degree).

3.1 Astronomy Information Source

More than half (50.7%) public receive information through internet sites and other 24.3% from online media platform. Public dominantly get information through foreign sources (54.9%). It means that public can easily access astronomy information source from worldwide. Yet in other hand means that domestic sources have not been able to meet public need.

3.2 Public Behavior

Nearly half of public only receive information about astronomy 0-once/month. One third receives twice a month or once in a week. More than half of public do validation occasionally. One fifth never do validation at all. Most people who validate the news do it through search engine (80.4%). Nearly 70% use information only for personal consumption and have no tendency to share yet in fact the other 30% get significant effect in spread the fake news/information through social messenger and social media platform.

There are several consideration factors to validate the news. Two dominant consideration factors are source and rationality of information.

3.2 Public Ability

There are 4 questions in questionnaire which respondents must distinguish whether it is valid or not. I classify 4 correct answers as “good ability”, 3 correct answer as “moderate” and the other as “poor”. It is found 45.14% is good, 34% is moderate and only 20.83% is not able to distinguish the information. It is assumed this is because the people who participate in this survey is dominated by high educated people.

4. Analysis

Using cross-tabulation analysis, it is possible to see the contingency between two factors [2] such as public profile and their tendency to validate and share the information and their ability to distinguish the information. Table 1 provide several correlations between factors. If *p*-value is less than 0.05 means that there is a correlation between factors.

Table 1. Factor Contingency

	p-value	corellation
Location vs. Ability	0.709	x
Education vs. Ability	9.73E-09	v
Education vs. Tendency to validate	0.244	x
Education vs. Tendency to validate	0.059	x
Tendency to validate vs. Ability	0.508	x
Tendency to share vs. Ability	0.167	x

The study showed that the only contingency is level of education and the ability to distinguish the information/news. There is no correlation between location of the respondent and their ability. Although Java island is the most developed island in Indonesia, people with internet connection have same behavior wherever they are.

5. Conclusion

Hoax is mostly spread in internet [3]. Yet public is not hoax proof. To deal with hoax, astronomy communicators have to take preventive action such as multiply and provide easier access to reference sources. There are also several effective hoax mitigations that could be done, for example enhancing public literacy (in line with the result of the study), law enforcement, direct correction through social media, blocking, flagging, etc.

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|Parallel Session|

Astronomy Best Practices in Using Galileoscopes to Foster Science Interest

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and Robert T. SPARKS*4

Abstract. The Galileoscope team designed and produced a high-quality telescope kit ideal for use in schools and outside-of-school education programs; over 265,000 Galileoscopes are in circulation. This telescope has proven effective in exciting the interest of youth, and especially talented youth, in astronomy, optics, and the process of science. Since the International Year of Astronomy 2009, the Galileoscope has proven to be a robust component of numerous teacher professional development workshops, after-school astronomy clubs, formal education programs, astronomy engagement programs, and engineering and optics programs. These diverse programs worldwide have required the creation of many different public outreach and educational program models. Most of these programs were designed to excite students about astronomy, to encourage astronomy observations, and to facilitate an understanding of astronomical optics and image formation. We will describe best practices and programs for public outreach that are adaptable, localizable, and that can be evaluated to assess their effectiveness.

1. Introduction

The Galileoscope program was a volunteer-led program that resulted in the production of a very high-quality telescope kit. The program resulted from a need identified as we prepared for the International Year of Astronomy 2009 [1][2]. We could not identify a telescope of reasonable price that we could recommend to children and young adults. Our experience with the Project STAR cardboard telescopes in our national NSF-sponsored Hands-On Optics program convinced us that a kit approach would be valuable since children could then build their own telescope, feel a sense of ownership, and not imagine that the inside workings were some kind of magic. As we designed the telescope we gave considerable thought as to how to make it easy to use by children and others with little experience looking through telescopes. This led to a number of design decisions which have been described I detail elsewhere [3]. We also gave considerable thought as to how the telescope could be used in various educational settings [4], the topic of this paper.

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2. Perspective on Educational Programs

There are now over 270,000 Galileoscopes in many countries. There are many educational models for the use of the Galileoscopes. These include classroom settings (formal education) as well as museums, sci-ence centers, and afterschool programs (informal ed-ucation). The Galileoscopes are used in local, re-gional, national, and international programs. When we designed educational programs for the Galileo-scope, our goal was always to maximize the educa-tional value and ultimate utility of the telescopes for science education. We focused on what we call the educational etendue, which is the educational equiva-lent of the optical etendue. We also worked hard to connect with many other programs and organizations for donations and partnerships in order to amplify the program's effectiveness.

3. Telescopes4Teachers Program

Our initial program effort for distribution of telescopes to teachers was called the Telescope4Teachers program. During IYA 2009, 25,000 Galileoscopes were donated to educators. In the program 7,132 telescope kits were distributed for the cost of shipping only. These were claimed by 1,473 teachers in 6 weeks, in all 50 of the United States. We also saw that 100 kits were shipped by UNESCO to each of 20 countries in Africa, Asia, and South America. Thus our initial goal of distributing a high-quality telescope at the lowest possible price was realized.

4. Galileoscope Teaching Kit

Our next step was the creation of the NOAO Galileoscope Teaching Kit, a curriculum to go with it, and an Observing Guide. We also created an ongoing partnership, beginning in 2010, with the Raytheon company in Tucson, the University of Arizona and the Tucson Amateur Astronomy Association. With this partnership, we sponsored events held once a year where Galileoscope are built by 200-300 Tucson middle or high school students. The students build the telescopes with assistance from all of the partners and with particular assistance from about 60 Raytheon engineers, who are trained by NOAO education trainers. Although the program was successful, creating follow-up star parties with the students proved to be difficult, since many schools were represented.

5. School Participation Model

In Arizona, we created another model that allowed more connections with the students building Galileoscopes. We have brought this model to medium-sized communities in Arizona, including Yuma, Marana, Globe, Flagstaff, Payson, and Safford. We found a funding partner in Science Foundation Arizona who provided Galileoscopes and tripods to student "teams" in all grade 5 classes in these cities. Telescopes were typically built by teams of three students and teachers received our special teaching kits as part of their professional development. The teachers helped their students build telescopes in class and to test the telescopes on the playground. Then a district-wide star party was held at night for all 5th graders and their families. The star parties included raffles and treasure hunts. Student, their neighbors and families were all invited to the star party. The Galileoscopes and tripods remained as the property of schools, so they could be used with different 5th grade classes the next year.

6. Major Donation Programs

Two major donation programs aided our educational programs. The first program partnered the National Optical Astronomy Observatory (NOAO), the American Astronomical Society (AAS), the National Earth Science Teachers Association (NESTA), the Astronomical Society of the Pacific (ASP), and Galileoscope LLC in order to make 15,000 telescopes available to a large number of teachers. The program was sponsored by a generous donation from Edelman Financial Services. In this program 1,400 teachers received Galileoscopes, hands-on training, and pedagogical content knowledge. Another 1,500 or so teachers not connected with these astronomy education organizations (including home school teachers) paid only for shipping in order to receive Galileoscopes.

Recently, the Astronomical Society of the Pacific, with a grant from the Gordon and Betty Moore Foundation, has developed a series of workshops for educators utilizing the Galileoscope. In this program 6,000 Galileoscopes will be given to 250 educators, with each educator receiving a classroom set of 24 Galileoscopes. The educator participants had the opportunity to participate in either an in-person, or online workshop and also to receive activity toolkits.

7. Summary

The Galileoscope program has made the Galileoscope and its accompanying teaching kit available for as many teachers and students as possible. By building flexibility into the program, we have allowed the Galileoscope program to be adapted to many different environments, including many out-of-school programs, made possible by generous donations.

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|Parallel Session|

Wikipedia for Astronomy: Improving a Global Resource for Education and Outreach

Hannah E. HARRIS*1

Abstract. Wikipedia strives to be the "sum of all human knowledge." Increasing and improving astronomy-related content on Wikipedia not only contributes to this goal, but also aids in public understanding of astronomy, making it an important tool for education and outreach. Astronomy-related content on Wikipedia must be accurate, well-explained, and translated in many languages to combat the spread of false scientific information and ensure accessibility of astronomy information for all people.

1. Introduction

Wikipedia is a common reference for students, scientists, the public, and anyone interested in astronomy. Due to its ubiquity when searching for information online, it is often the first resource a curious reader will encounter. Its content is integrated into Google search results, and virtual assistants such as Apple's Siri and Amazon's Alexa pull information from the online encyclopedia. Journalists turn to Wikipedia for scientific definitions and basic astronomy facts, and when astronomy news makes headlines, the relevant Wikipedia pages often experience a spike in pageviews. In addition to its use by students, Wikipedia has been found to influence the writing in scientific publications. For astronomers, communicators, and educators, it matters what astronomical information is on Wikipedia, and whether or not that information is accurate and understandable.

2. Astronomy on Wikipedia

Astronomy-related Wikipedia articles range from entries on astronomical objects and telescopes, to astronomer biographies and chronologies of the history of astronomy. Table 1 lists a few common categories of astronomy-related topics with examples from the English Wikipedia.

Across all language Wikipedias, there are gaps in coverage of astronomy-related topics. Biographies of women and minority scientists are incomplete, and there is a lack of quality articles on contemporary and historical astronomical practices in non-Western countries. Sometimes this is due to the disinterest of current Wikipedia editors, other times, a lack of reliable sources per Wikipedia's verifiability guidelines may limit what articles can be created. Some scientific and mathematical articles are jargon- or equation-heavy, making them challenging for a layperson to understand. Additionally, the quality and scope of astronomy-related articles varies greatly by language.

As of April 2018, there are active versions of Wikipedia in 288 languages, with the English Wikipedia containing the most articles (5.6 million). The Japanese Wikipedia has 1.1 million articles [1].

It can be burdensome to seek information, especially on a scientific or technical subject, in a second or third language. Given that the quantity and quality of astronomy-related articles in non-English languages is often poor in comparison with the English Wikipedia, there is great need to improve the content in non-English languages, either through translation or the creation of original content. Knowledge of English should not be a prerequisite for accessing astronomy information on Wikipedia - all people should be able to learn and discover the wonders of the universe in their native language.

3. The Importance of Accurate Astronomy Information on Wikipedia

The near instantaneous nature of Wikipedia to integrate current events and new discoveries gives it an edge over traditional textbooks which fall out of date in their coverage of rapidly advancing subfields

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of astronomy and physics. This makes it an attractive resource not only for students but for science journalists.

Table 1. Types of Astronomy-related Articles on Wikipedia

Type	Examples
Astronomical Objects	“Stars”, “NGC 6357”
Scientific Concepts	“Gravity”, “Axiom”
People & Organizations	“Vera Rubin”, “IAU”
Telescopes & Instruments	“JWST”, “LIGO”
Observatories, Research Facilities & Institutions	“Whitin Observatory”, “JAXA”, “CERN”
Museums & Planetaria	“Science Museum”, “Adler Planetarium”
History & Heritage	“Historical comet observations in China”, “Australian Aboriginal astronomy”

False information on Wikipedia has made its way into “credible” news sites and even textbooks via a phenomena called *circular reporting*: when an error on Wikipedia is reprinted in a reliable source, that source is in turn cited on Wikipedia as validation of the error. Misinformation about exoplanets on Wikipedia has been cited by journalists without attribution, highlighting the need for rigorous vetting of astronomical information on Wikipedia.

Wikipedia additionally has been shown to influence the language in scientific publications, as was found in the case of chemistry journals published by Elsevier in 2017. One in every 300 words was influenced by Wikipedia, and this effect was even greater in lower-income countries, suggesting authors may be more reliant on Wikipedia when access to expensive journals is limited [2]. Further research is needed to determine whether Wikipedia influences astronomy publications.

Considering Wikipedia as a cultural artifact reveals insights into how the public views and consumes astronomy-related information online.

One study using Wikipedia as a proxy for public interest in academic research found that astronomy papers published before 2008 were less likely to be cited, shedding light on the rate at which research may be viewed as obsolete in the eyes of the public, or at least, those who edit Wikipedia [3].

Controversial topics in science and pseudoscience reveal themselves on Wikipedia. Articles on “Global Warming”, “Extraterrestrial Life”, “Astrology”, and “Flat Earth” – to cite a few examples – have been the subjects of vandalism and intense edit wars, often requiring intervention by experienced editors or Wikipedia administrators. Discourse on article Talk Pages illustrates the impact of conspiracy theories and public mistrust of scientific consensuses.

When astronomy makes the news, the corresponding Wikipedia pages often experience an upsurge in readership and edit activity. In the months before Stephen Hawking’s death, his page averaged approximately 20,000 pageviews per day, while on the day of his passing, over 7 million pageviews were logged [4]. Likewise, articles related to the Rosetta Spacecraft, JWST, Hubble, gravitational waves, and exoplanets, all experienced spikes in pageviews correlating with media coverage.

6. Conclusions

Accurate astronomy-related content on Wikipedia enriches public understanding of astronomy, supports factual science journalism, and provides quality astronomy information in languages besides English. Given the high impact of content on Wikipedia, its relevance for astronomy education and communication should not be underestimated, and translating and improving astronomy information on Wikipedia is critical to ensure all people may learn about astronomy and our universe.

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|Parallel Session|

Communicating Astronomy through Culture-based Programs

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Abstract. The Subaru Telescope is a Japanese telescope located on Maunakea, Hawaii. Part of the observatory's core mission is to share knowledge and experience of discoveries with the public, and to serve as a platform for education. Astronomy in Hawaii however, is now facing an extremely challenging situation. Efforts surrounding telescope construction and other major initiatives are entangled in a delicate web of local cultural tension, politics, and economics. Public outreach and effective communication are more important than ever. At the Subaru Telescope, the majority of staff are engaged in outreach activities and student internship programs. I will first present a summary of our outreach and educational programs for the local as well as Japanese communities. I will then discuss our ongoing efforts to understand, share, and enjoy the traditions of Hawaii's multi-cultural community through the examples of a culture-based astronomy outreach programs (e.g., Tanabata Star Festival), a continuing education program for staff (Subaru Makali'i Seminar), and novel outreach strategies (a kid-friendly Subaru mascot, "Subby"). I will also discuss our collaborative outreach programs with the 'Imiloa Astronomy Center using data visualization tools such as 4D2U, WorldWide Telescope, and CyberCANOE.

1. Introduction

Being home to twelve world-class observatories, the summit of Maunakea is widely recognized as one of the best astronomical observing sites in the world. Maunakea is also significant for Hawaiian culture as a spiritual landmark. Astronomy in Hawaii is now facing an extremely challenging situation in a delicate web of local cultural tension, politics, and economics. Public outreach and effective communication are thus more important than ever.

Operated by the National Astronomical Observatory of Japan (NAOJ), the Subaru Telescope has served astronomers from Japan and around the world since its completion on Maunakea in 1999. Among 100 staff members, about half are originally from Japan, while the rest are from Hawaii, the mainland United States, and other international locations. The Subaru Telescope is an international, multi-cultural workplace and a number of staff are engaged in local outreach and educational programs. In this paper, we emphasize (1) the importance of including a cultural component in both community outreach and staff education programs; (2) effective collaboration with local communities through schools, museums, planetariums, and business associations; (3) effective use of a telescope mascot to attract general public, in particular people who are not interested in science.

2. Outreach/Education at the Subaru Telescope

The Subaru Telescope is committed to sharing the knowledge and experience of astronomical discoveries with the public, and to serve as a platform for education. We serve communities locally, in Japan, and around the world. Each year, we directly reach out to over 13,000 people through programs such as workshops/lectures at Subaru Hilo base facility, remote (Skype) lectures, public outreach events, visits to local schools (from pre-school to University), public talks, base and summit facility tours, and student internships. Among Maunakea observatories, Subaru is the only telescope that has been offering summit facility tours to the public since 2004.

2.1 Partnership with 'Imiloa Astronomy Center

'Imiloa Astronomy Center at University of Hawaii at Hilo is a unique astronomy cultural education center, where traditional Polynesian and Hawaiian knowledge is combined with astronomy's continued quest for a better understanding of the universe. 'Imiloa means "explorer" or "seeker of profound truth" in Hawaiian. The 'Imiloa Center's mission is to honor Maunakea by sharing Hawaiian culture and science to inspire exploration.

Subaru/NAOJ has strong ties with the Center since its establishment in 2006. Through grants from the Japan Foundation for Promotion of Astronomy, Subaru/NAOJ has helped fund school field trips to bring local children to 'Imiloa. In 2016, Subaru/NAOJ made several donations to 'Imiloa, including the updated 4D2U theater and WorldWide Telescope (WWT) with a motion sensor. These new exhibits have shown the power of data visualization in science communication. We also collaborate with 'Imiloa staff to create contents with cultural components such as Hawaiian star lines and legends.

It is essential for Subaru Telescope to share our findings and experience with the public. Subaru staff regularly conduct hands-on outreach activities and give talks at 'Imiloa. Data visualization exhibits such as 4D2U and WorldWide Telescope are excellent tools through which astronomy education can take place casually and interactively. Subaru also supports CyberCANOE (Collaborative, Analytics, Navigation

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and Observation Environment), a new immersive 3D exhibit space at ‘Imiloa, in collaboration with University of Hawaii at Manoa.

2.2 Partnership with Japanese Chamber of Commerce and Industry - Tanabata Star Festival

Because of its immigration history, Hawaii is one of the most racially diverse places in the world. Today, the Japanese in Hawaii are the second-largest ethnic group in Hawaii, and playing a very active role in the local community. The Japanese Chamber of Commerce and Industry of Hawaii (JCCIH) has been promoting the well-being of the community through business and personal relationships. Subaru’s directors have been members of this 70-year-old organization for over 20 years. To express our gratitude toward the local community for their support, the Subaru Telescope started an annual Tanabata star festival together with JCCIH five years ago. It is part of our ongoing effort to understand, share, and enjoy the traditions of Hawaii’s multicultural community.

Meaning “evening of the seventh,” Tanabata celebrates the annual time that legendary lovers Vega (“Orihime”), an accomplished weaver and princess, and Altair (“Hikoboshi”), a cow herd, can meet without the Milky Way separating them. Our Tanabata festival with JCCIH combines astronomy with culture. The program includes an astronomy talk, ice breaker game, observatory career information, kimono demonstration, Japanese dance/song performance, and Japanese food. It is a large event involving over 100 people with preparation spanning several months. The preparation process itself is where Subaru staff most effectively build their relationship with the local community.

2.3 Makali’i Seminar

As part of a continuing educational program for our staff, Subaru started a new seminar series called the “Subaru Makali’i Seminar,” to learn Hawaiian history, culture, language, and perspectives with lectures from experts in the field. The goal is to raise cultural sensitivity and respect for the host community. Seven seminars were held on topics including Hawaiian identity, culture, and language; and Polynesian navigation. We also invited a speaker who opposes and protests Maunakea development — including for astronomical sites — with the aim to understand different perspectives and find common ground.

3. Subaru Telescope Mascot “Subby”

Even though Hawaii is one of the world’s foremost astronomical sites, the number of students, particularly Native Hawaiians, who proceed to STEM careers is low. According to a survey conducted by ACT, Inc., the percent of students interested in STEM decreased by 6% in Hawaii between 2012 and 2016 (“The condition of STEM 2016, Hawaii”). It is crucial for the astronomy community to boost the public’s interest in science and technology and raise awareness and understanding of observatories.

In order to attract people, especially kids who are not necessarily interested in science, we started using a Subaru Telescope mascot, “Subby” (see Fig 1.) Subby turned out to be highly effective as a hook for astronomy. She also serves as an excellent educational tool to explain how a telescope works and why Subaru is unique (wide-field imaging capability thanks to a prime focus camera).

Over 40% of Subaru staff are locally-hired, and the majority of the observatory jobs are technicians and engineers. Contrary to popular belief in the local community, astronomers are the minority, only occupying 20% of observatory jobs. To raise awareness of observatory careers and encourage students to pursue STEM related careers, we made several Subby characters introducing various jobs.

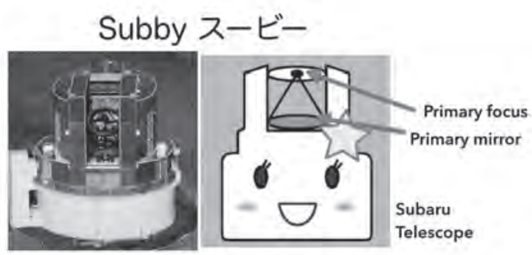

Fig. 1. Subaru Telescope mascot Subby is highly effective in attracting laypersons to astronomy, as well as serving as an educational tool to explain telescope characteristics.

4. Summary

Subaru Telescope has used several methods to bridge the gap between the astronomical and local communities in Hawaii, and environment in which astronomy outreach is particularly challenging. Paramount to this approach has been emphasizing the importance of local culture — both historical and current — in community outreach activities and educational programs for observatory employees, themselves. Further, Subaru has successfully partnered with local schools and business associations, also making full use of ‘Imiloa Astronomy Center and interactive technology. Finally, creating a telescope mascot, “Subby”, has facilitated a connection between the observatory and even the least-interested members of the public.

|Parallel Session|

Transnational Astronomy: Science Diplomacy on the Verge

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Abstract. This post-modern ideology reintroduces the so-called Track II 'Science Diplomacy', by questioning about its legitimacy towards scientific and diplomatic worlds. Globalization blurs colonial drawings of national boundaries and hence the effectiveness different approaches 'Science Diplomacy' has towards the global arena is being challenged, whether through 'Science in Diplomacy', 'Diplomacy for Science' and 'Science for Diplomacy'. The hypothesis is supported by modern theory of Benedict Anderson's Imagined Communities, which claims that existing nation states are indeed imaginary, and was drawn only for the sake of colonization. It also creates intangible barricades that separate humans into binary oppositions of ourselves vs. the other. With that being said, 'Science Diplomacy' is no longer working unless it is redesigned on different approaches, and 'Science Diplomacy' is thus encouraged to be perceived as an art form. By narrowing the scope to one particular field of astronomy, along with supporting evidences that art and science have never before been separated throughout recorded human and natural civilization. They are a proof of universal culture that dominates and itinerates through time and space. Ultimately, the art of astronomy should be implemented as the new 'Science Diplomacy' that is up-to-date, inclusive and accessible for all walks of life.

1. Introduction

In the 21st-Century Capitalism, the significance of national boundaries is being blurred from the emergence of globalization at a fast pace. It is therefore crucial for Nation States to establish and strengthen cooperation through the means that would serve best their mutual interests and the world at large. 'Science Diplomacy' has been introduced to the modern world as an effective tool to serve that purpose. The ideology of effective 'Science Diplomacy' is being elaborated through different approaches including 'Science in Diplomacy' in which science can provide advice to inform and support foreign policy objectives., 'Diplomacy for Science' where diplomacy can facilitate international scientific cooperation and 'Science for Diplomacy' when scientific cooperation can improve international relations. [1]

'Science Diplomacy' is also being redefined by narrowing the scope to Astronomy as one of the most arguably vibrant fields of science to foster such diplomatic ties. The argument is supported by providing solid examples and profes sional experiences from a career as a Foreign Affairs Officer at the International Training Centre in Astronomy under the auspices of UNESCO, hosted by National Astronomical Research Institute of Thailand (Public Organization).

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2. Redefinition

'Science Diplomacy' by definition is "Humanity's greatest challenges – and some of its most promising opportunities – are regional and global. Increasingly, the world requires effective partnerships between scientists, policymakers and diplomats" [2]. Having a background in Cultural Studies – which considerably non-scientific, the narrator perceives Astronomy as an art form that is truly universal which conquers international language that cuts across boundaries and language barriers. Meanwhile, he perceives Diplomacy as human natural behavior to connect with one another as social creatures. He therefore approaches "Astronomy Diplomacy" as social sciences, arguing that current major challenges in the global arena are more or less involve astronomy and related sciences in which requires diplomatic resolutions.

On the cultural approach, astronomy stands as one of the oldest of the natural sciences since early civilizations in recorded history. It is a performance of methodical observations of the night sky, and science is a systematic enterprise that builds and organizes knowledge in the form of testable explanations and predictions about the universe. Meanwhile, culture is a social behavior and norms found in human societies. A set of shared values and the characteristics features of everyday existence – as ways of life, including art and science.

Ultimately, diplomacy is an art and practice of conducting negotiations between representatives of states, the conduct of international relations through the intercession of professional diplomats with regard to a full range of topical issues. All in all, these four key words do share similarities towards the new approach of 'Science Diplomacy'.

This particular idea also tackles the main challenges which create intangible barricades between the scientific and non-scientific worlds. Those who face difficulties breaking through due to the mistaken stereotypes and cultural norms of binary opposition, be it the stereotypical discrimination within the scientific world and beyond, those without scientific backgrounds. It reminds that science and art emerged out of the very same roots and simply inseparable throughout recorded human history. See below of a supporting evidence elaborated through painting.

Fig.1. A celestial map from the 17th century, by the Dutch cartographer Frederik de Wit

3. Different Approaches

The key concept of this hypothesis revolves around approaching the original ideas through different means and thinking. The new 'Transnational Astronomy' is supported by the modernist ideology of Benedict Anderson's 'Imagined Communities'. Rather than enhancing multi-national collaborations in scientific areas, based on the concept of different nations states, it goes back to the origins that these states do not really exist in singular – without one there wouldn't be the other. They arguably coincide [3]. Although, the colonial line drawings of national boundaries are being claimed fake, but it doesn't necessarily attack the idea of nationalism, but rather national community is 'imagined' to some degrees.

The concept of a post-modern transnational collaboration is thus introduced for scientists, diplomats and policy makers to redesign the scope of strengthening their works in the field of science diplomacy. It is aimed to deconstruct the ideas that limit the work only between bilateral and multilateral to the more integrated, fluid and inter-connected world of science.

4. Summary

With the idea of the so-called 'Art of Astronomy', this method would foster the promotion of scientific astronomy from domestic to international. The implementation of 'Astronomy Diplomacy' is and should be executed widely across different sectors of those who are making efforts to promote science education and diplomacy. In Thailand, it is being executed as a part of the Thai National Agenda towards neighboring countries and beyond. By exploiting research and development of science, technology and innovation to maximize regional and international collaborations at different levels.

Ultimately, Astronomy stands as culture by itself. It exists in the daily lives. It defines human beings and differentiates us from other living organisms in the universe – or the world at least. "Astronomy Diplomacy" – as culture – thus pursues the urge from all walks of lives to familiarize themselves with, whether they are aware of it or not. It is in the very deed inclusive and accessible to everyone – just as art and culture.

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Evaluating Impact of Astronomy Outreach and Communication: A Pilot Randomized Controlled Trial

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Abstract. One of the most cited reasons for communicating astronomy to the public is that Astronomy is inspirational and exposure to such topics leads to the development of an interest in science and STEM. Astronomy communicators, educators and professionals frequently engage with children and the general public to teach, demonstrate, and talk about Astronomy. But very rarely is the impact of such communication evaluated scientifically. The results of public communication of Astronomy are generally based on surveys and feedback forms which may not be designed to reveal weaknesses. There is a need for more rigorous evaluation methods which would reveal the successes and failures of current methods of astronomy communication and whether they might lead to any inadvertent harm. In this presentation, we share the implementation of a pilot Randomized Controlled Trial carried out in Cape Town, South Africa to test whether exposure to an astronomy intervention affects empathy and altruism in children (that is, whether astronomy induces a perspective of 'One Global Humanity' as is oft quoted). The pilot demonstrated that it is possible to use such rigorous methods to evaluate impact of astronomy outreach in an inexpensive manner.

1. Introduction

The One World Experiment was carried out as a pilot effort in Cape Town, South Africa, to test whether exposure to an astronomy intervention affects empathy and altruism in children. The intervention focused on introducing children to knowledge around the Earth's position in the Universe and collecting data to assess the effect. This paper presents the project background as well as the methodology and results from the project's first phase, designed to understand the possible difference in empathetic response between a child and other "ingroup" and "outgroup" children; for any child, an 'ingroup' child is one belonging to their own social group (in this case, nationality), and an 'outgroup' child is one belonging to a social group other than their own. It is found that the students across the study have a strong cohesion to those of the same nationality but that there is no nationality bias in their feelings towards how other children share their joy with them. Full analysis of the data, which will compare the control group and experimental group results and focuses on the impact of astronomy intervention, is underway for future publication.

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2. Background

The Pale Blue Dot is a famous image of Earth taken by the Voyager 1 spacecraft on 14 February 1990, when it was around 6 billion kilometers from us. In this picture, taken at the suggestion of the astronomer and science communicator Carl Sagan, Earth appears as a pale blue dot, a tiny point of light, less than a pixel in size. As Sagan later wrote in his book, the image 'underscores our responsibility to deal more kindly and compassionately with one another and to preserve and cherish that pale blue dot, the only home we've ever known'[1]. The image and the philosophy behind the Pale Blue Dot have inspired awe and excitement in many people around the world. It is assumed that knowing one's place in the Universe alters perception and induces more empathy towards fellow humans. But there is little evidence supporting the claim. Empathy, altruism and pro-sociality are critical foundations for a stable human society. Research shows a tendency for individuals to feel more empathy and engage in more prosocial behaviour towards individuals categorized as belonging to their own social group relative to other groups.

3. Pilot Study

From October to November 2015, the astronomy outreach project 'One World Experiment' was carried out among 938 secondary school students in Cape Town, South Africa. The IAU Office of Astronomy for Development and Hosei University together with the South African Astronomical Observatory conducted a Randomized Controlled Trial (RCT). The main objectives of the study were a) to test whether exposure to an astronomy intervention affects empathy and altruism in children b) prove feasibility of evaluating an astronomy intervention in a low-cost manner.

Participants were randomly assigned (as a class group) into experimental and control groups. The experimental group received an astronomy intervention where a qualified Physics teacher taught the students about their place on Earth and in the solar system. The students were taken on a tour of the solar system (using a combination of Google Street View, Mitaka software and Google Mars) to foster the idea of 'One Common Humanity'.

The intervention was followed by two measurements:

1) a voting process intended to test the helping behaviour of the children toward children from other groups. Each student had a card with envelopes affixed under a gender-neutral picture of a child from their country (ingroup) and a child from a chosen foreign country (outgroup). Students were given 3 tokens each and told that each token represents 1 unit of currency. They were told that whichever envelope they put the token in, a real donation of that amount would be made to the child whose envelope they chose.

2) questionnaire to test their feelings towards children from ingroup and outgroup. There were two sets of five questions, one for the home country and the other for the chosen foreign country.

4. Auxillary Analysis

This paper describes the auxiliary analysis of possible differences in response among ingroup and outgroup children to the parts of assessment measures with no reference to the astronomy intervention by collectively dealing with experimental and control groups. Correlation analysis was performed to examine the strength and direction of the linear relationship among the answers to the questions.

In this paper, two questions q3SA and q3K are focused on. The q3 means the Question 3.

Question 3. If something good happened to you, how do you think this child would feel?

A. The child doesn't care at all
B. The child feels neutral, okay with it
C. The child feels happy
D. The child feels very happy
E. The child feels very, very happy

For data analyses, the answer options (A, B, C, D and E) were converted into ordinal variables (1, 2, 3, 4 and 5) and SA is used to denote the set of questions relating to the fictional South African child and K to denote the set of questions about the fictional Kenyan child.

5. Results

Figure 1 shows a bubble chart for q3SA and q3K of [vote_K]. ([vote_K]: Students who gave more tokens to the Kenyan child than the South African child)

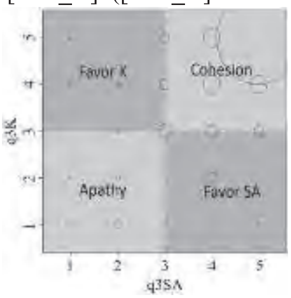

Figure 1. Bubble chart for q3SA and q3K [vote_K]. The size of the represents the frequency of the answer set to questions. The X-axis and Y-axis show the answer options (from 1 to 5) of q3SA and q3K, respectively.

6. Summary

The majority of answer results particularly concentrate on the upper right corner (q2SA = 5, q3SA = 5) of Figure 1. Additionally, it has been observed that the partial correlation coefficient between q3SA and q3K for [vote_K] is 0.40. This value is higher than the medium effect size of Cohen's index, that is, 0.30 [2], indicating a remarkable positive correlation in this question combination. These results lead to the conclusion that [vote_K] have no bias about their impression of how others share joy with them regardless of whether the other is an ingroup member or outgroup member.

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TUIMP: The Universe In My Pocket.
Free Astronomy Booklets in All Languages.

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Abstract. TUIMP is an international project to produce small astronomy booklets. These booklets, folded from just one sheet of paper, can be used in classrooms, at open public conferences, or during visits of observatories and planetariums. They are free to download, and the only thing needed is a color printer (in absence of a printer, the booklets can also be directly consulted online, even with just a smartphone). The booklets are intended for children from nine years old and for anyone curious about astronomy. They are written in a simple language, amply illustrated, revised and translated by professional astronomers. So far, they are being published in six languages, with other languages on the making. Everyone is welcome to download the booklets and use them in their outreach activities.

1. Introduction

TUIMP [1], in English, stands for "The Universe in My Pocket". The characteristics of this outreach project are threefold. First, it does not require any funding and provides its products for free. Second, it allows anyone with an Internet connection to download the PDF files that can be printed and folded into small astronomy booklets. Third, it is open to all languages, in the hopes of reaching communities that do not have much contact with astronomy.

2. Free

Even in the richest countries, outreach activities can reach their goals much better if they are made available free of charge. In less developed countries this is a necessity.

With TUIMP, all that is needed is a computer with an Internet connection (and a printer).

3. Astronomy booklets

There are lots of sites for astronomy outreach on the Internet. But people often like to have something to keep after a conference, a planetarium show or a school activity, so that they can remember or share their experience with their families.

TUIMP provides small 16-page booklets folded from one sheet of paper, free to download from the Internet.

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Fig. 1. How to fold a booklet.

4. In all languages

In countries with a large number of professional astronomers many people are available to devote part of their time to astronomy outreach. In countries where astronomy is not much developed, the few professional astronomers are facing a large number of challenges and responsibilities, and developing original outreach activities is difficult for them.

Ready-made outreach Internet sites are numerous in English but are likely scarce in the majority of languages, except a few in which an active astronomical community is working.

TUIMP provides material written by professional astronomers that can be translated and used for free in any region of the World.

5. The target audience

The booklets are written with a wide audience in mind: children from nine years old but also any person curious about astronomy irrespective of their background. The language is simple, and numerous illustrations support the the texts.

6. What makes TUIMP a quality resource

The authors are professional astronomers. All the information and illustrations are from verified sources. There is an effort, in spite of very limited space, to put the astronomical material in a broader context and to address historical or sociological aspects. The scientific content is revised by external referees. To insure an accurate translation, the texts are translated by professional astronomers or astronomy students.


Left: a photo of the Pleiades constellation, that can be seen with the naked eye. For the aboriginal people of northern Australia, the Pleiades are a group of kangaroos that are chased by a pack of dingoes.

Galileo Galilei explains to the Doge of Venice how to use his telescope (Fresco by Giuseppe Bertini).

Galileo's drawing of the Pleiades as seen through his telescope. The small asterisks represent stars not seen without the telescope.

The first photograph of the Orion Nebula made by Henry Draper in 1880 with a 50 min. exposure using a telescope 28 cm in diameter.

2

The dawn of astronomy

In ancient times, knowledge of the Universe was limited to what the un-aided human eye could see. Myths and legends completed this view of the Universe.

At the beginning of the 17th century, the first telescopes allowed astronomers to detect objects several times weaker than the weakest ones seen with the naked eye. Hundreds of stars were discovered and a lot of nebulae were detected.

By the end of the 19th century, astronomical photography allowed a deeper exploration of space. One could follow an object with a telescope and record its light on a photographic plate during several hours. In this way, one could detect fine details on the planets and many nebular objects.

3

Fig 2. Two pages from the booklet "The invisible Universe".

7. The languages of TUIMP

Booklets are presently available in Albanian, English, French, Polish, Portuguese, and Spanish. Translations are being prepared into Armenian, Greek, Italian, Nahuatl, Persian and Russian. Many other languages are desired, especially from African and Asian countries.

8. Where can the booklets be used?

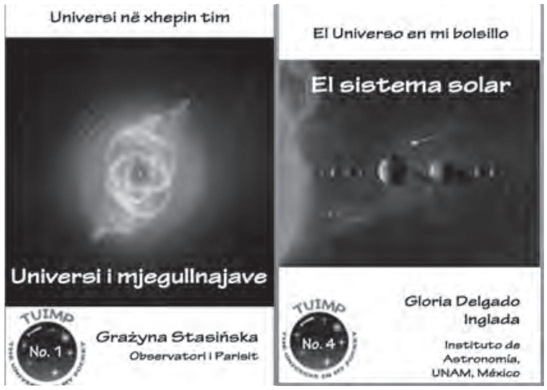

Fig. 3. The covers of two booklets, one in Albanese and the other in Spanish.

They are perfect for activities in the classroom. They have much success when distributed after open public conferences on a related topic. They can be made available to visitors in planetariums and observatories. They also make creative gifts for friends and family.

9. The TUIMP team

Initially, the team was composed of just a few persons from different parts of the world: Fabricio Chiquio Boppré (Brazil), Gloria Delgado Inglada (Mexico), Mimoza Hafizi (Albania), Dorota Kozieł-Wierzbowska (Poland), Stan Kurtz (USA), Grażyna Stasińska (France), Natalia Vale Asari (Brazil). The team is now growing, with astronomers from Greece, Italy, Iran, Armenia joining in. All the participants – including the webmaster – give their time for free, on a volunteer basis.

New authors and translators are welcome to join us [2]. For this they can write to us using the contact form to be found on our site at http://www.tuimp.org/pages/about.

10. Conclusions

The TUIMP project has started off well. It needs now to find its public. It is crucial to introduce it to potentially interested people all over the world, i.e. educators, children and teenagers, students, scientific journalists, astronomy aficionados and anyone interested in science. For this, the international astronomical community can be of great help.

References

[1] www.tuimp.org
[2] http://www.tuimp.org/pages/about.

How an MPV Gains Traction for a National Observatory of Indonesia?

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Abstract. Planetarium shows always attracts attention, and always plays important role in educating general public about the awe and wonder of space. We implemented that idea with the development of a system that can be easily transported to various locations in Indonesia to educate, communicate and disseminate space science. Briefly, we describe our system which consist of a multi-purpose vehicle (MPV) that had been modified for transporting the planetarium and also can be used as an observing station, and how it played important role to promote various information. Currently, with the plan for the development of national observatory of Indonesia, the mobile planetarium and observatory system carry more challenging task on promoting this national plan to general public, whose majority still lack of understanding about what is astronomy, what is observatory, why is it important for a nation, etc. In this talk, we discuss the innovation of the content, how to reach different audiences, with different education background, age, ethnicity etc., on how communicate the knowledge and at the same time deliver the issue about the new observatory.

1. Introduction

Indonesia had already acknowledged the importance of space for human interest, this became the impetus for the government to establish National Law No 21/2013 about Space Activity for Indonesia, which the legal basis for space activities in Indonesia. For instance, article 11 of the law that space science activities include the astrophysics, as well as the requirement for ground-based observatory. Further on, Presidential Decree no 45/2017 clearly states that Indonesian should establish a national observatory that can contribute to the global science by 2040. This ground clearly help to accelerate the space activity of Indonesia.

The new astronomical observation facility will be established in the south-eastern part of Indonesia. However, as much as the effort from astronomy community to build the new facility, there is big gap with the general people, as well as the policy maker; so it is not an easy task simply to build a new facility and in the same time convincing them that it is needed by the nation. There is the need to develop strategy to disseminate what astronomy and space science are, why they are important, and how they can help development of Indonesia.

One method in disseminating the science is by employing planetarium~~,~~ which attracts general public through playing movies and other interesting features related to the theme. Space Science Center of LAPAN adopt this method in developing the system of mobile system , based on modified MPV (Multi-Purpose-Vehicle), which hopefully can answer challenges on disseminating the science.

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2. The Challenge of Astronomy in Indonesia

Despite that Indonesia already on the long history embracing astrophysics [1], recent time shows that Indonesian is left behind on science productivity. Other challenges that need to be answered is not only science productivity, but at the same time how science, in particular astronomy, can help the development of the country.

The gap of development between different regions of Indonesia is very wide, so one method for teaching science applied to one region cannot immediately applied to others. In such the case Space science and astronomy well developed only in Java & Sumatra.

Fig. 1. The location of the proposed new national astronomy observatory in Indonesia, on Timor Island, Mount Timau in Kupang regency (grayed box).

The new proposed observatory, which selected in eastern part of Indonesia (Figure 1), is expected, not only for nurturing modern astrophysics in Indonesia, but also becoming the leverage for closing the gap between eastern and western part of Indonesia.

The selected area is very remote, with limited modern infrastructures, so there is the gap between supporting facilities with requirement of a modern observatory. Moreover, there are a lot of effort to build the facility as a ‘national need’, since in the current time it is only supported by merely small numbers of institutions in Indonesia.

The curiosity of general public related to space related event tend to grows with the growing information using more diverse medium, e.g. social media, televisions, or like in 2016 the Solar Eclipse that passed Indonesia. However not everyone can have direct access to observe the particular phenomenon. This become also one challenge that need to be answered, also that different background, education and need require different approach on disseminating space knowledge to general public.

Fig. 2. The Planetarium dan Observatorium Mobile’ (POM) and The EKUATOR

3. Mobile Planetarium System

To answer several of those challenges, Space Science Center of LAPAN since 2014 developed a mobile system, called ‘Planetarium dan Observatorium Mobile’ (POM) [2] (Figure 2-left), which can proactively reach the general public on bringing the science.

The POM is a simple system based on modified MPV that consists of Mobile Support System, planetarium system (inflatable dome and digital planetarium system), and the observing equipments attachable on top of the car.

Our first generation POM has already set on a couple of places: Sumedang (2015) for observing Lovejoy comet, Jakarta (2015) for national-scale exhibition on Climate Change, Palembang (2016) during Total Solar Eclipse, Cirebon (2017) and Pasuruan (2017) during National Jamboree of amateur astronomer communities. During its tours, the planetarium is not only displaying full-dome movies, but also another space-related knowledge and information contents.

To improve and innovate the contents, collaboration between researchers, educators, and even multi-media industry seems to be more than compulsory. The bold example of such innovation was the story telling in the *Festival Keraton Nusantara* (Royal Palaces Festival) by employing materials from the Asian Stars Project[3].

The second generation of POM was developed by Space Science Center and Institut Teknologi Bandung in 2016, called EKUATOR (Edukasi Ilmu Astronomi dan Antariksa untuk Timor/Space and Astronomi Education for Timor), (Figure 2-right) tougher MPV-POM, designed to explore Timor area. Intensively operated by team from Nusa Cendana University, it increases the awareness of people in Timor about the observatory project and the broader view of science, technology, engineering, and mathematics. More opportunities to explore Timor enabled us to dive deeper to astronomy-related local wisdom. One example, people in Mutis (close to Timau) traditionally use Maklafu (Pleiades) in heliacal setting as the time sign to harvest honey from wild honey bee (Apis dorsata sp.), based on interview with local dwellers.

The MPV which at first only to bring education to public turns into small laboratory for space education to general public.

4. Summary

Mobility can help to proactively attract the audience, in particular, by bringing planetarium to the general public, proved can attract audience to gain first-hand experience on space.

Regardless all the limitation, the mobile planetarium system can plays role as incubator for space education in remote region of Kupang. Even a small MPV can gain traction to drive a national program, and it shed light on space curiosity to the general public, particularly young children, on preparing next generation to be ready for the new observatory.

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When Social Effort Overcomes Funding Constraints

João RETRÊ[*1], José AFONSO[*2], Sérgio PEREIRA[*3] and Ana ALVES[*4]

Abstract. The necessary funds to commission services for science communication activities are often inexistent. This work addresses a comprehensive science communication programme which allows to do outreach in a scale that would not be possible with the commonly available budgets for such kind of activities. Some results of the strategy followed in this programme are shown, including an artistic residence resulting in an art exhibition, music concerts within astronomy events, content production with designers, and a national tour.

1. Introduction

The development of science communication activities requires professionals in various areas of knowledge and expertise (e.g. journalists, designers, musical artists or movie producers). The necessary funds to commission these services can be a serious limiting factor for most institutions doing science communication. However, it is possible to create an efficient outreach programme without having access to a large budget.

This work addresses a comprehensive science communication programme, developed at the Instituto de Astrofísica e Ciências do Espaço (IA), which makes use of social synergies and innovative collaborations to co-create outreach contents and activities.

2. Strategy

The strategy followed within this programme focus on two main lines of action. One of them is the fostering of a close bond between the institution/scientists and the public, and the creation of synergies with a diversity of professionals.

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Providing a shared environment which foster connections and dialog, and placing the public and researchers in equal standing, one can raise the awareness of the institution in society and nurture empathy for it [1]. One way of doing this is to provide public activities which are very informal, and always try to support and promote a close and frequent interaction between the public and the researchers.

On this ground, it is possible to create a close, reciprocal and beneficial link between society, the scientists and the institution itself. At the same time, this interaction can result in researchers becoming more encouraged and motivated to do outreach, and in many cases, they are the ones who look for or propose new ideas to implement and in which they collaborate.

In addition, many people from the public come up with new ideas for outreach (see section 3), either as individuals, companies, or institutions, and propose mutually beneficial collaborations that lead to projects with minor costs to the institution. Moreover, it becomes much easier for the institution to establish contacts with members of the public, companies or other institutions in order to negotiate partnerships.

3. Synergies

The synergies created with the public are the main key of this programme. They provide a way to diversify the style of communication that is done, and by doing so, to attract and captivate a larger and more diversified public at a very low cost.

In what follows, a few real success examples of low budget outreach initiatives, which are part of this comprehensive programme, are addressed.

3.1 Art Exhibition

One of these synergies was an art exhibition of a group of five visual artists. They organised an art exhibition at the Astronomical Observatory of Lisbon, which is one of the host institutions of IA, and created unique pieces of art related to astronomy and the history of the Observatory.

The artists were able to have a space where they could work for 6 months, mount their exhibition and sell their artistic work. We had the advantage of having a unique exhibition related to astronomy in our own space that brought several hundreds of people to the Observatory.

3.2 Live musical concerts

In some special occasions, we have live music concerts in our activities. Usually, the music bands or choirs (professional and amateur) are the ones that initiate contact, interested in performing for a large audience (300+ in one of our monthly activities), or simply for free publicity. These concerts allow the creation of a diversified activity programme which attracts new audiences.

3.3 Designers

We have created partnerships with two visual arts faculties, giving their students the opportunity to do training in visual science communication, and producing educational material to be freely distributed by our institute. The students involved are bachelor students in Animation Arts and master students in Communication Design and New Media.
From these partnerships, an astronomy related exhibition and a series of astronomy related short video animations have already been produced.

Another example of a synergy with designers, was created with the objective of having a visual branding for a specific monthly outreach activity. We opened a contest on our social networks, inviting everyone to create this visual identity. The prize established for the winner was a private observation session, with a guided tour to the night sky. Besides this, we also provided the opportunity for the winner to present publicly its work in our events and networks. This initiative led to the submission of more than 30 logos, many created by professional designers or by professional design companies.

3.4 Ignite IAstro Tour

Since 2016 we have been touring across Portugal, visiting cities or towns distant from metropolitan areas and promoting astronomy within the local cultural scene. Although we have a specific budget allocated to this activity, its cost would be “astronomical” if there wasn’t the support of the municipalities. These provided, for example, outdoor advertising and the venues (which renting value per hour can reach several hundreds of euros). In some cases, we also received free advertising in the local news media through media partnerships.

4. Summary

The lack of funding for the dissemination of science is, unfortunately, a reality for many institutions doing science communication. This fact makes, in most cases, the creation of an efficient outreach programme a very difficult task due to several factors, one of the most crucial being the lack of human resources. In our experience, it is possible to create an efficient outreach programme without having access to a large budget. This can be done by fostering a close bond between the institution/scientists and the public, and by creating synergies with a diversity of professionals. These synergies provide a way of diversifying the style of communication that is done, and to do outreach activities in a scale that would not be possible with the commonly available budget for science communication.

References

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Acknowledgements

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The Promotion of Star Observation with the Private Sector in Japan

Fumiki ONOMA[*1] and Keiko YOSHIKAWA[*2]

Abstract. Star Observation can raise awareness of sustainable development and contribute to regional development. In Japan, the Ministry of the Environment (MOEJ) conducted "Continuous Star Observation Project" from 1998 to 2012. MOEJ called for participation in this project through local governments and rounded up the results of those activities. After the suspension of the project, Hoshizora Kodan provided voluntary efforts to maintain the observations. In 2017, an advisory panel to the Director-general of the Environment Management Bureau discussed how to promote star observation activities. MOEJ will relaunch promotion of these activities with the goal of building a sustainable society.

1. Introduction

In Japan the Ministry of the Environment (MOEJ conducted "the Continuous Star Observation Project" from 1988 to 2012. In this project, local parties, such as regional astronomy clubs, schools and local observatories, measured the night sky brightness, and the MOEJ announced the results and ranking the observed places. However, in 2010, the government revitalization unit recommended to cut the project and the project was suspended. This year, the MOEJ and supporters including the National Astronomical Observatory of Japan (NAOJ), academics, NGOs, called for independent efforts to maintain continuous star observation. Even so, it became more and more difficult to centralize the data and report the results and the MOEJ suspended the project in 2013.

2. Continuous Star Observation Project

The MOEJ conducted the project from 1988 to 2012. MOEJ had called for participation in the star observation activities through local governments and collected the results of those activities. The purpose of the project was to create awareness regarding air quality and light pollution. More than 16 thousand parties had participated in the project. Main activities were;

- Milky Way observation with the naked eye;
- Observation with binoculars;
- And measurement of night sky brightness.

Every summer and winter, participating parties conducted these activities.

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Figure 1 shows the result of the milky way observation in 2012. In Japan, almost 50% of population lives in mega cities or large cities. The Milky Way was seen by less than 20% of the people in those areas with the naked eye.

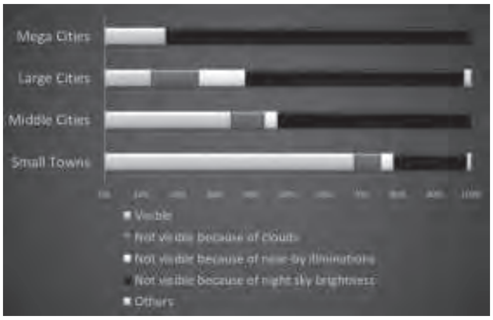

Fig. 1. Visibility of the Milky Way (Winter, FY2012)

In this project, there were 21 fixed observation sites. Figure 2 is the historical data of night sky brightness measured at several continuous observation sites.

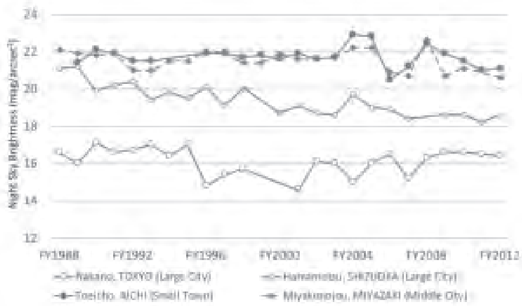

Fig. 2. Night Sky Brightness at fixed sites
(Winter, FY1988 – FY2012)

Many of star watching parties conducted educational activities on Sustainable Development. For example, major topic of educational activities in star observation events is light pollution which is caused by the inappropriate or excessive use of artificial lights. Light pollution is a kind of issues about energy conservation and climate change, sustainable cities, and natural conservation. That links to the UN sustainable development goals. We think star observation can provide a good opportunity to collaborate astronomers and environmentalists.

4. Committee to Promote Star Observation

Last June, the MOEJ set up a committee to promote star observation. Some local governments became more and more popular using the ranking shown in the continuous star observation project. Achi village in Nagano prefecture, with population under 7000 was listed as the best of night sky darkness in 2006. They have used the record to attract tourists. In 5 years, the number of tourists rise 17-fold. It presents an opportunity to promote star observation again.

There is another momentum. Internationally, CIE150, the Guide on the Limitation of the Effects of Obtrusive Light, which MOEJ's guideline to prevent light pollution referred to, was amended last year. In addition, Tottori prefecture issued the new ordinance to prevent light pollution in December 2017. Thanks to those, light pollution has mentioned in the press frequently.

The committee discussed methods to promote cost-effective star observation that is easy to participate in. MOEJ will promote the Milky Way observation by naked eyes and to participate in the global activity, "Globe at Night" by International Dark-Sky Association, as well as measurement of night sky brightness using digital cameras. After 3 years of continuous measurement, the data will be evaluated and classified. Each classification will be considered based upon the results, which can contribute to regional development such as "Astro-Tourism".

5. Activities by Hoshizora Kodan

Hoshizora Kodan are voluntary individuals who wants to protect the quality of our night sky. There are over hundred members, consisting of academics, students, staff of museums, and office workers. We evaluate night sky brightness in Japan using digital cameras. Figure 3 shows the result of measurement of night sky brightness using digital cameras in FY2009 – FY2017. Anyone can submit the image data taken by digital camera for night sky measurement to our Web-site.

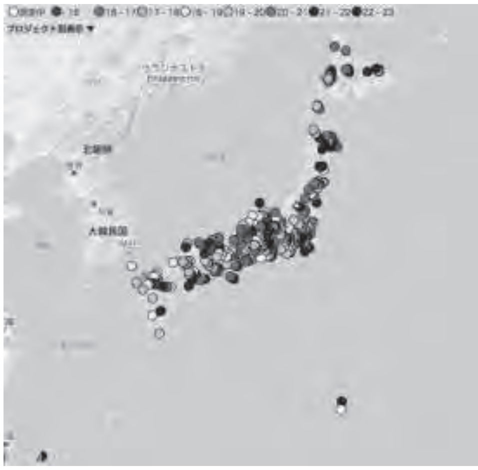

Fig. 3. Measurement of night sky brightness using digital cameras (FY2009 – FY2017)

During MOEJ's suspension of the observation project, we called the parties which had a long history of continuous observation. More than half of them replied to our call and made independent effort to submit their results of observation to us. Figure 4 shows the historical data of night sky brightness measured at several continuous observation sites including the data during MOEJ's suspension. We believe this data is very valuable and necessary.

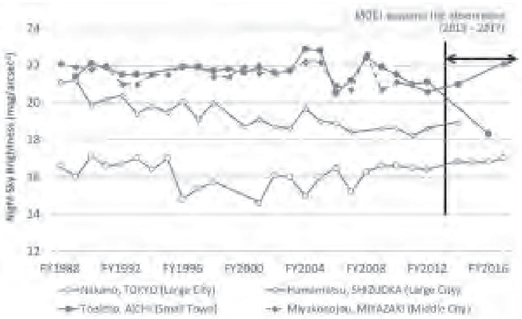

Fig. 4. Night Sky Brightness at fixed sites (Winter, FY1988 – FY2017)

6. Summary

Star observation can raise awareness of the need for sustainable development and contribute to regional development. And public-private partnership is also key for sustainable activities. We are sure that star observation has a lot of good aspects to contribute to Sustainable Development Goals. This recognition is key for public participation in both the central government level as well as at the local level, including private participation.

|Workshop|

Organizing Frameworks for Communicating Science in Large, International Science Collaborations

Gordon K. SQUIRES[*1], Janesse BREWER[*2] and Tracy ROBERTS[*3]

Abstract. While many large scientific projects of the past were approached on national levels, science projects of the future are more and more requiring intellectual and financial contributions from multiple countries. Factors such as the pace of communication, distrust of science, the high price tag of astronomy, and the difficulty in demonstrating public benefit all contribute to a challenging context. In this session we explore these WEPOC challenges, borrow from the engineering design process to articulate an iterative model for approaching WEPOC, and provide diagnostic questions that should guide various stages of developing a communications and outreach plan for a large international science project.

1. Introduction

The next generation of scientific discoveries are likely to emerge from large-scale infrastructure projects which provide an increased capacity to advance the collective understanding of our world and our universe. While many extensive undertakings in the past were approached on a national level, science projects of the future are increasingly global, requiring intellectual and financial contributions from multiple sources. These projects are highly collaborative and involve scientific and engineering talent from multiple institutes and countries to design, finance, build and operate. An important element of these large projects is inviting both stakeholders and the general public to share in the journey and the findings. Authentic engagement, when effective, helps to shore up public support so that projects benefit from support and adequate funding.

2. The Challenges

This work is enormously important, and the complexity cannot be overestimated. In addition to the science and engineering challenges inherent in every program, managers of international science projects must juggle multiple teams, time zones, languages, budget cycles, cultures, public perspectives on science, governance structures, project management methodologies and specific issues distinct to each mission. In addition, the public demand for knowledge and information about our work drives the need to include teams of specifically trained and dedicated staff in the areas of Workforce development, Education, Public Outreach, and Communication (WEPOC) strategic planning and programming. Furthermore, the environment in which international science projects are being developed has changed and thus elevates or exposes certain challenges:

- The world is global and networked and this brings unprecedented real-time communications risks.
- Science is under threat in many parts of the world. It isn't enough to say "we are about science" and expect this will be well-received.
- Large projects are expensive, and this comes with a responsibility – especially when public funds are used.
- Astronomy facilities often are located on mountains. Mountains are important, and even considered sacred, to many cultures.
- The field of astronomy often touts that "astronomy is relevant to everyone and so are the results." Is this true, and if it is how do we demonstrate this every day?

3. Grounding WEPOC in Project Values

How often are WEPOC programs initiated in an ad hoc fashion, at the whim of the organization Director, or direction of the Board? While most WEPOC ideas are good ones, not all are feasible, nor advisable, in a limited resource environment.

In order to find a compass to guide WEPOC strategic planning and programs, WEPOC efforts need to be aligned with, and support, the Vision/Mission/Values of the organization. In large international science projects, this is complicated by the fact that these may vary from partner to partner and even have tension with the central project itself.

In this environment, WEPOC teams must develop their own mission statement as a subset of

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the overall project. This mission statement should clearly elucidate how WEPOC will advance the project. It should also be aware of the obligation to attend to the needs of all international partners. WEPOC programs will be aligned with both the enduring and short-term goals of the project and the partners.

5. Special Considerations for Strategic Planning

Large international science projects require answers to questions which vary from plans developed for local or even national facilities. The questions below are not intended to be an exhaustive list but rather serve as a starting place for key questions to be addressed through the life cycle of a large international science project.

5.1 Concept Stage Questions

- What is the vision and mission of the project?
- What is the *WEPOC* vision/mission in support of the project?
- Are WEPOC decisions and activities centralized or across the project?
- When do you start WEPOC programming? At first-light? At the concept phase?
- What is the process for determining which programs/products to prioritize and approve?
- Across the partnership, what are the strengths, weaknesses, and level of interest in WEPOC? Where does each partner have capacity? Where is each partner interested in building capacity?
- What roles can WEPOC fulfill to support the near-term and enduring goals of the project?
- What are the potential WEPOC goals/actions/strategies that would advance the project vision/mission/near-term and enduring goals?
- Do your key audiences change for each phase of the science project (planning, construction, science onset, “routine” science operations, close-out)?
- Do you equally value WEPOC components (workforce development, education, public outreach and communication)? If not, how are these various aspects regarded within your program?
- What are the best practices, evidence-based approaches, and innovations that might be applicable for your science project?
- Where have other WEPOC leaders had successes or failures?

5.2 Development Stage Questions

- What are the most important activities that would make the most difference to the project, and/or the partners?
- What are the anticipated long-term impacts, and do they contribute toward the vision/mission?
- Who are the most critical/important audience(s)?
- What resources will you use or leverage from the project, the partners and their communities?
- How will you ensure accuracy, and sensitivities each partner may have?
- Who needs to be involved from the project and the partners in each activity? How is each activity led?
- How can you use this project to further enhance partner capacity/capability for WEPOC?

5.3 Evaluation Stage Questions

- Did the partners engage / participate in the expected way? How did the partnership work?
- Did the project(s) address fundamental needs of the partners and/or the project?
- Does additional infrastructure need to be built?
- Where are the inefficiencies in the project?
- Did you create a report / record of the process, for posterity, reporting, etc.?

6. Summary

Modern-day astronomy projects have many challenges and also an obligation to deliver scientific results. But upcoming projects also have an obligation to address promises about workforce development, public education, and building global communities. Large, international science projects inherently have new and unique challenges in developing a strategic WEPOC plan and program . Robust WEPOC planning and implementation is essential to a successful approach. Critical elements of this are asking the right questions and designing the WEPOC architecture to allow for a nimble and iterative approach to strategy, problem-solving, and resourcing.

Science Under Threat: Communicating Astronomy in the Age of Misinformation

Chris IMPEY*1

Abstract. Astronomy is an excellent vehicle for communicating science to the public. The research is fast-paced, the images are spectacular, and the subject addresses profound questions about our place in the universe. But in the wider area of science communication, there are serious challenges posed by the degradation of the public discourse and attacks on science in some quarters. The general public in the United States and elsewhere has a high opinion of the scientific enterprise and trust in scientists is high, but science literacy is low and pseudoscience is widespread in the popular culture and in the Internet. Science communication by transmission is not uniformly effective. It is better to engage in a dialog that acknowledges the social and cultural context of the audience.

1. Science Literacy

Astronomy is an excellent vehicle for increasing public awareness and literacy in science, because of its visual appeal and many newsworthy discoveries. However, conveying astronomy takes place within the larger context of public science literacy.

There are pressing global challenges that can only be addressed through science and technology. Yet in most industrialized or OECD countries, surveys of science literacy show that the general public has large gaps in their knowledge, and sometime are unsure or disagree on topics where scientists are in near-unanimous agreement (Figure 1).

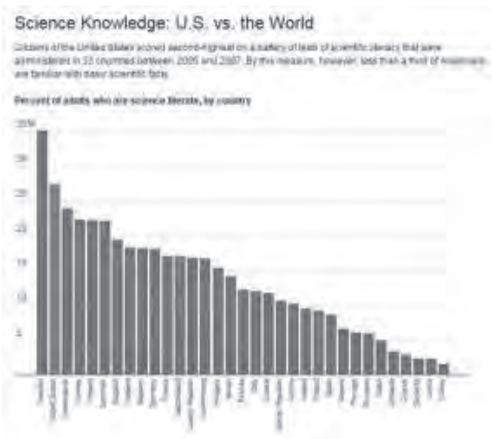

Fig 1. Science literacy in industrialized or OECD countries, measured between 2005 and 2007 [1].

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The PISA surveys show large variations in the science knowledge of 15 year olds around the world [2], and surveys by the NSF show similar variations among adults worldwide [1]. Only 15% of Americans are scientifically literate, meaning they can correctly answer 2/3 of a set of basic questions about science and can explain what it means to study something scientifically. Compared to the other OECD countries, the American public has higher knowledge levels in basic physics and chemistry, but lower levels of belief in human-induced climate change, the origin of the universe in the big bang, and the evolution of humans from earlier species [1].

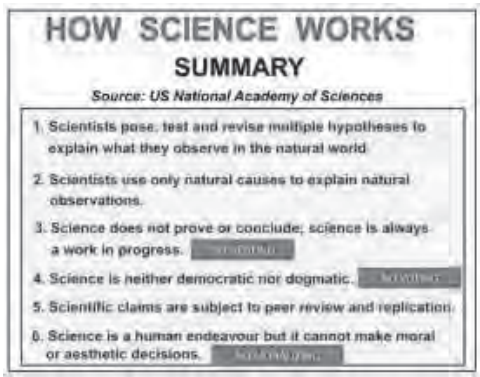

Fig. 2. Overview of the scientific method, from the U.S. National Academy of Sciences [3].

Some of the public's confusion stems from a lack of awareness of how science actually works. The U.S. National Academy of Sciences has summarized core attributes of science (Figure 2). Contrary to simplistic stereotypes, science doesn't generally lead to certainty or proof and it doesn't entail voting on positions. Also, science is mute on decisions that are rooted in morals or ethics. These nuances are often lost in the popular level of discourse carried by the mass media.

2. Knowledge and Belief

Scientists view the world through a rational prism, but non-scientists tend to judge new information in a way that depends on context and their prior history. In a study of American undergraduate students, science literacy was not strongly correlated with their level of belief in UFOs, or the strength of their religious belief, or their susceptibility to pseudoscience (Figure 3). In the figure, mean science literacy scores and sample sizes are given for those with the strongest beliefs (2nd column) and the weakest beliefs (3rd column).

Factors	Agree ≥ 4 (across factor)	Disagree 2 ≤ (across factor)
Belief in UFOs or Aliens	Mean = 11.33 (2.27) n = 1519	Mean = 11.11 (2.36) n = 701
Faith-based Beliefs	Mean = 10.84 (2.30) n = 1156	Mean = 11.89 (2.22) n = 762
Unscientific Beliefs	Mean = 10.92 (2.32) n = 1301	Mean = 11.62 (2.32) n = 1330

Fig. 3. Undergraduate non-science majors with a similar levels of science literacy can have divergent belief systems involving non-scientific ideas [4].

3. Science Communication

A new area of scholarship, called the “science” of science communication, shows why many of the attempts to communicate with the public are not very successful. Most people get their information online, and the Internet is awash with misinformation, false facts, and conspiracy theories. Part of the problem is a failure of the deficit model of science communication. In this model, non-scientists are uninformed or confused on what science has to say about a particular topic. The role of scientists is, therefore, to address the deficit by providing facts and data, and explaining the topic as clearly as possible to the public.

Uniquely in the United States, but to some degree in all other countries, the public is polarized along cultural, political, and religious fault lines on issues like climate change and evolution by natural selection. Social science researcher Dan Kahan puts it this way [5]: “Never before have human societies known so much about mitigating the dangers they face, but agreed so little about what they collectively know.”

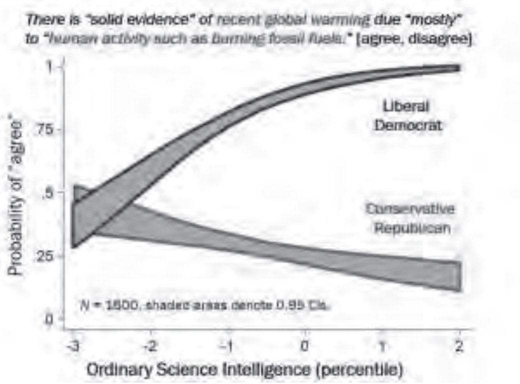

Fig 5. In work by Dan Kahan at Yale, polarization by politics on an issue like global warming increases as the level of science knowledge increases [5].

In what is called the cultural cognition thesis, when scientific facts become associated with social groups with opposing values, social norms, or political beliefs, individuals selectively assess evidence in patterns that reflect their group identity. Traditional modes of science communication all fail. What is required is modes of communication that can disentangle the acquisition of knowledge from a person’s identity in their cultural group. Mistrust of science can be addressed by smarter communication strategies, and astronomy can be a prime example in this important effort.

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|Poster|

Astronomy Communication as Conversation

Pecier Paul C. DECIERDO*1

Abstract. New models of science communication incorporate the necessity of engaging the public to be active participants in the process. Such models of science communication highlight the fact that effective communication involves dialogue and is therefore two-way instead of one-way. In the interest of promoting a culture of such dialogues, The Mind Museum serves as home to the Philippines' Cafe Scientifique movement. Cafe Scientifique is a global grassroots pubic science initiative that aims to engage the public in conversations about science. The Mind Museum has served as host to Cafe Sci events in various locations in Metro Manila since 2009 (before the physical museum opened). Joining the sessions in Manila is free of charge. Because of the open nature of such discussions, attendees of all ages and educational and professional backgrounds were engaged in the conversation. Attendees were able to ask other attendees who were lawyers, engineers, and teachers. Both the lay people and scientists in attendance have expressed appreciation over the two-way exchange of information.

1. Introduction

The deficit model of science communication is an important model that will probably not go away. For there to be a healthy relationship between the public and science, the public should meet a certain minimum requirement with regard to scientific literacy. This minimum requirement can be set and raised by connecting the public with scientists and experts. This connection will allow information to flow from the experts to the public.

However, the deficit model must be supplemented by other models of science communication. One important part of science communication should be the building of trust between the scientists, science communicators, and members of the public. One way to strengthen this trust might be to connect the scientists and the public in a way that allows for greater conversation in which information flows not only one-way but two-way.

To achieve this end, we at The Mind Museum in the Philippines host events called Cafe Scientifique.

2. Cafe Scientifique

Cafe Scientifique is a program of the museum wherein we invite scientists and other subject matter experts to engage in a casual conversation with the public in a non-academic space.

Cafe Scientifque is inspired by similar activities such as Science Cafe, Cafe Philosophique, Astronomy on Tap, and others.

Topics of sessions range from the physics of black holes to the science of taking care of a dog. Based on our experience, the most attended sessions of Cafe Scientifique are the ones where the invited scientists charismatic and have a good rapport with the public.

Another set of topics that have a lot of signups are topics where science meets policy and public opinion. One example of this is the topic of an indigenous space program in the country like the Philippines.

3. Summary

Attendees, including the invited scientists, have given us positive feedback about the events. The scientists appreciated the chance to engage in a casual conversation with members of the public. Another form of positive feedback comes from the frequency of repeat attendees. Some scientists have even volunteered to facilitate several conversations.

Finally, we have observed our attendees change their minds about or at least grapple with certain topics in a way that might not be possible in an event designed with the deficit model in mind. One example of this would be the reversal of the majority opinion during the session where the topic was a possible Philippine space program. Before the start of the session, a majority thought that such a program would be a waste of tax payer's money. After the session, this opinion was reversed.

This method of science communication should be seen as an excellent supplement to events that seek to remedy the public's deficit in scientific literacy.

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Transit of Mercury in India - a Crowd-sourced, Large-scale Observational Outreach Campaign

Samir DHURDE[*1] and Niruj M. RAMANUJAM[*2]

Abstract. The poster describes an extensive, crowd-sourced, outreach campaign across India, by the Public Outreach and Education Committee of the Astronomical Society of India for people to view the Transit of Mercury (ToM) in 2016. The objectives, design and implementation of this nationwide campaign are noted and the use of internet tools is highlighted. We also draw the attention of the outreach community in the regions of Africa and Latin America, which are set to experience the next transit of Mercury on 11 November, 2019**.**

1. Introduction

On 9th May, 2016 a Transit of Mercury was visible from various parts of India. The Public Outreach and Education Committee (POEC of the Astronomical Society of India (ASI organised an extensive crowd-sourced outreach campaign around this transit.

2. Process

The network of Indian amateur astronomers and diverse outreach stakeholders was first mobilised with a call to plan and register their own events in their vicinity. Internet based tools were used to register, connect and coordinate efforts of people who were thousands of kilometres apart. Webcasts were encouraged to counter disappointments.

An internet-based portal [1] was created to host resources made by the POEC. These included an information handbook containing history, scientific cause, observing details, safety precautions, multisite predictions for timings etc. A live online map (Fig.1) was also created with the list of events marked at the geographic locations provided.

Exclusive information was shared with journalists who helped more members of the public find observing events close by.

There were concerns of it being a "telescopic event", but early preparations paid off. A great success – the event reached more than 75,000 people who could understand and view it safely via telescopes provided by amateur astronomers.

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Salient numbers post event: 262 registered public observing locations, 300+ telescopes, 7 webcasts, 75,000+ people reached.

Fig. 1. Reach of the ToM2016 campaign in India.

3. Conclusion & Future

This was the first time such an ICT supported crowd-sourced campaign was carried out in India. It is easy to replicate successfully for similar events. The best practices and lessons learnt from this may be of particular interest to the outreach community in Africa and Latin America, which will experience the next Transit of Mercury on 11 November, 2019. These are being reported to the CAP journal.

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|Poster|

The TENPLA Project: Communicating Astronomy to the Public in Japan

Naohiro TAKANASHI*1 and Masaaki HIRAMATSU*2

Abstract. The TENPLA Project is one of the most active volunteer groups for communicating astronomy with the public in Japan. We started the project in 2003. These activities are operated under a conceptual framework called the "circulation model of knowledge," which we developed for the purpose of designing a better relationship between Astronomy and the people of Japan. We introduce some of our activities related to our vision and conceptual framework.

1. Introduction

The TENPLA Project (www.tenpla.net) was launched in 2003 by the two authors of this paper and graduate students majoring in astronomy. We organize 100-150 events per year with our collaborators. Our activities include not only practical activities such as star gazing parties, lectures, seminars, developing astronomical materials but also theoretical studies which support the practical activities.

Our main purpose is to design and achieve a better relationship between astronomy and people in Japan. Because both astronomy and the people in Japan are changing, the relationship between them must be changed. In order to design a new relationship, we must recognize various values which astronomy holds for the modern Japanese people. In order to understand these values, we must communicate astronomy with people who have various views of the world, not only with the astronomy fans. This is the reason why we engage in communicating astronomy with the wider public.

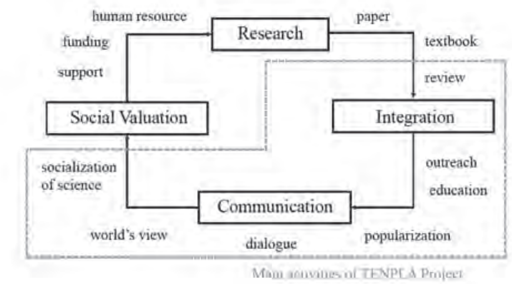

Fig.1. Our conceptual framework named the circulation model of knowledge

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2. Conceptual Frameworks

Figure 1 is a schematic view of our conceptual framework called the "circulation model of knowledge". There are four main components. Researchers produce scientific papers in each sub-field of astronomy (i). The papers are reviewed and digested from higher point of views and integrated as books, TV programs, and so on (ii). The integrated knowledge is absorbed by people in various ways through communication (iii) and interweaved with people's views of the world. As a result, people find their own views of astronomy and the aggregate of those values become the social valuation of astronomy (iv). This valuation encourages the next step of research and the circulation will develop astronomy and fertilize the society in Japan.

All our activities are designed under the concept. The science poster "the Diagram of Our Universe" [1] is an example of integration of knowledge. Roppongi Tenmon Club [2] is a typical activity for communication. We think that these activities will give us many clues to design a desirable relationship.

3. Summary

The TENPLA Project is still developing. Based on the frameworks, we design new activities that promote communication between astronomy and the public. Further information and story will be presented in a submitted paper to CAPJ [3].

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Toward an Establishment of a Global Curriculum of Astronomy as a Comprehensive Science

Shigeyuki KARINO*1, Hidehiko AGATA*2 and Lina CANAS*3

Abstract. For the academic international exchange, mismatching of the intentions/levels between the institutions and the candidate students sometimes become a big obstacle especially when students study abroad. To solve this problem, it would be useful to formulate a global standard curriculum of astronomy as a unified indicator of educations in each institution. Here, we propose a way to formulate a standard curriculum of astronomy.

1. Introduction

It is necessary to support higher education for young people in developing countries, to train up researchers and educators who can play leading roles in their own countries. The importance has been emphasized in “strategic plan 2010-2020” by IAU [1]. To relocate knowledge to developing countries, international education exchanges are required. At present, however, a required level of education has not been defined. This could lead to significant obstacles, especially when students study abroad. That is, for students, it is difficult to understand the entrance skills required, and the skills achieved after training in a certain institution. This situation might cause a serious mismatch between students' intentions/levels and the curricula offered by institutions.

It is possible to avoid such a mismatching by having a set of "standardized skills” and "standard curricula” of astronomy based on the improving scheme of those skills. Toward this goal, we need to

1) Investigate the current curriculum to grasp the current situation of astronomy in higher educations.

2) Formalize an IAU endorsement for the creation of the IAU Astronomy Education Guidelines.

2. Problems of the current curriculum

We have checked astronomy syllabi in 195 Japanese universities (25% of all universities in Japan). As the result, we found only 25% of universities offer astronomy courses. About half of them are for general education, while others are in departments of sciences and a few are in teacher training courses. Furthermore, only 40% of astronomy courses in general education level are conducted non-member of the Astronomical Society in Japan. Most of courses are contaminated by geo-science, meteorology and so on. From this survey, in fact, it is difficult to take proper course of astronomy in Japan.

Though this is the typical problem in Japan, other type of problems could be found if we make syllabus survey in other countries.

3. Proposal of standard curriculum in astronomy

By sharing the skills and levels which will be mastered at the end of the training course, it is expected that the level of education at the training course in different countries / institutions can be standardized. Educational institutions can show the required skills and levels that students wishing to enroll should master before the start of training. Additionally, institutions can show the expected skills and levels that students can master when they finish the training. After completion, students can describe these skills and levels in their CV. We show a set of examples of “standard skills” in Fig.1.

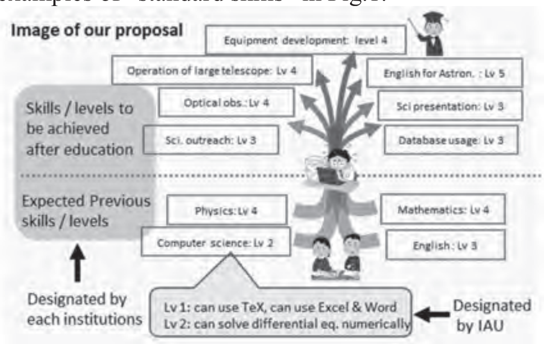

Fig. 1. Schematic figure of our proposed standard curriculum in astronomy.

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|Poster|

Practical Tools for "Making the Case" for Workforce, Education, Public Outreach and Communications (WEPOC)

Tracy ROBERTS[*1], Janesse BREWER[*2] and Gordon K. SQUIRES[*3]

Abstract. Following an April 2017 workshop at Caltech, a group of 20+ astronomy and high-energy physics leaders have been compiling a body of knowledge to "make the case" for the importance of WEPOC in large international science projects. We summarize the outcomes of this work, including a list of eight principles and practices that world-class science projects should (and do) implement. Additional leaders in astronomy and high-energy physics have been invited to endorse these maxims based on their own experience of how science projects most effectively advance their WEPOC goals.

1. Introduction

While many large scientific projects of the past were approached on national levels, future projects require contributions from multiple countries.

The complexity of this cannot be overestimated: international projects involve multiple teams, time zones, languages, budget cycles, cultural perspectives, governance, and project management styles. Failing to include all stakeholders increases the risk that a lack of public support could result in de-funding or under-funding of these projects. Here we coalesce the operating principles and rationales which compel the need for WEPOC to be included as an integral part of large scientific projects.

2. Evidence Based Rationales

The 2017 workshop participants elucidated eight rationales for robust WEPOC programming.

R1: Our project is mandated to carry out WEPOC.
R2: Positive impact on science, tech & society.
R3: World-class science projects carry out WEPOC.
R4: Not doing WEPOC can be risky and expensive.
R5: Projects that receive public funds have an obligation to inform, inspire, and involve the public.
R6: Provides a model of global collaboration.
R7: Assures the long-term sustainability of science.
R8: Helps recruit the best young staff.

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3. Principles and Practices

- A phased WEPOC plan should be initiated in the conceptual stage, adequately resourced, and be aligned with the project.
- The project has a responsibility to consider the WEPOC requirements of its partners and the wider community.
- WEPOC enables the project to fulfill an obligation to be respectful, responsive and an integral part of the site community.
- WEPOC leaders should be integrated into the leadership structure with access to the decision-making bodies.
- WEPOC staff should hold relevant professional WEPOC qualifications and/or experience and undertake continuous professional development.
- Holding to a similar standard as the other elements of the science project, WEPOC programs should be reviewed by peers.
- WEPOC should include evaluations appropriate to the individual WEPOC activities.
- Successful WEPOC activities are inclusive and promote diversity.

4. Summary and Next Steps

Join the movement in "making the case" for WEPOC in large international science projects.

- Endorse the Proclamation.
- Help build the evidence base for the rationales.

Visit:
https://www.surveymonkey.com/r/JoinUs-MakingTheCase

http://conference.ipac.caltech.edu/wepoc2017

Astronomical Communication Activities through Business

Shoichi ITOH*1*2 and Tomoya NAGAI*1*3

Abstract. To contribute to the sustainable development of scientific research and regional revitalization through scientific culture by effectively utilizing the results of scientific research and returning it to society, we conduct the following projects:
1. Consulting, processing, and providing of astronomical contents (such as planetarium program production etc.)
2. Utilization and dissemination of astronomical research results (Mitaka 3D Portable System Sales, etc.)
3. Training of human resources to disseminate science (publication of textbooks, etc.)
In this article we introduce our astronomy communication activities through business.

1. Introduction

Founded in June 15, 2010, our company [1] seeks to put to public use the fruits of natural science research, in particular astronomy, thereby contributing to the development of science studies through popularizing science culture, and forming "Science Culture" in civil lives as a result.

Our Goals are:
1. To popularize science results through our business activities.
2. To bring up talents for the popularization of results in science research.
3. To rise general people's interest in science studies, thus contributing to the development of a "science culture" in our society.

2. Business Contents

1. Consulting about astronomical contents
・We process image or movie contents, then provide them on demand.
2. Utilization and popularization of the results of astronomical studies.
・Production and support of planetarium shows.
・Producing and selling astronomical goods.
・Planning the astronomical events.
・Dispatching astronomy lecturers.
・Organizing astronomy trip events.
・Assembling Mitaka Projection System and selling, renting or delivering. ("Mitaka" is a software for visualizing the known Universe with up-to-date observational data and theoretical models, developed by the Four-Dimensional Digital Universe (4D2U), a project of the National Astronomical Observatory of Japan (NAOJ)) (Fig. 1.)

Fig. 1. Mitaka Projection System

3. Bringing up talents for popularizing science, contributing for a "Science Culture".
・Training talents, such as science producers and image creators.
4. Other work concerning astronomical education and events.

3. Summary

We would like to contribute to the sustainable development of scientific research and regional revitalization through scientific culture by effectively utilizing the results of scientific research and returning it to society. Please contact us if you are interested in our contents.

References
[1] Website: http://www.nao.jpn.com/

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SPECIAL SESSION :

IAU 100 Years Celebrations

Communicating Astronomy
with the Public Conference 2018

|Plenary Talk|

IAU 100 Years: Under One Sky[1]

Jorge Rivero González
IAU100 International Coordinator

In 2019, the International Astronomical Union will celebrate its 100th anniversary. To commemorate this milestone, the IAU will organise a year-long celebration to increase awareness of a century of astronomical discoveries, as well as to support and improve the use of astronomy as a tool for education, development, and diplomacy under the central theme "Under One Sky". Here I present an overview of the initial plans.

The year 2019 will be a great and unique opportunity for our community, not only because it's the anniversary of the International Astronomical Union, but because two important milestones will attract the attention of and inspire people worldwide. These are the 100th anniversary of the 1919 Solar Eclipse that for the first time proved Einstein's Theory of General Relativity, and the 50th Anniversary of the Moon Landing. Our aim is to use these important milestones to celebrate astronomy.

The goals of the IAU 100th anniversary celebrations are:

1. Increase awareness of progress and excitement in astronomy over the past century, in particular:
   - The importance of collaborative enterprise of astronomy as a whole,
   - The importance of technology development for astronomical progress,
   - The coordinating role of the IAU in fostering communication and exchange of ideas for the global astronomical community.
2. Promote widespread access to astronomy knowledge and observing experiences.
3. Support and improve the use of astronomy as a tool for education, development and diplomacy.
4. Support and improve an inclusive, equalitarian and diverse astronomy community.
5. Facilitate the preservation and protection of the world's cultural and natural heritage of dark and quiet skies.
6. Raise awareness and discuss prospective new exciting developments in the next 100 years of astronomy.

To achieve these goals, the IAU have set up a taskforce and a secretariat that is preparing an exciting plan for global programs organised around nine themes that will help us to achieve those goals. The idea is that under each flagship theme, there will be different projects. The projects will be implemented using the extensive outreach networks that IAU have developed over the past 10 years, with the help of the National Outreach Contact points and also the National Astronomical Societies.

The 9 Flagship themes are:

- **IAU 100 Celebrations**
  - This will mainly comprise celebration activities aimed at the astronomical community and also activities related to the IAU 100 Anniversary.
- **Astronomy and Sustainable Development Goals**
  - The second of these flagship themes will comprise projects showing that astronomy is key for helping us to achieve many sustainable development goals.
- **IAU100 Exhibition**
  - We are preparing an exhibition that will highlight the main discoveries of the past century and also important milestones from IAU. The goal of the exhibition is that it could be replicated in many places. It will open during the IAU General Assembly in Vienna, Austria, in August 2018, and will travel to selected locations during 2019.
- **New Worlds, Are We Alone?**
  - We want to foster a sense of global citizenship and critical thinking by encouraging people to reflect on their place in the world, in the Universe, by using activities related to exoplanets or astrobiology.

[1] For the latest updates on the initiative visit the IAU100 website at www.iau.org/iau100

- **100 Years of General Relativity: Eclipse**
  - During this celebration we will commemorate the 100th anniversary of the solar eclipse observations that served as the first successful test of Einstein's Theory of General Relativity. We aim to raise awareness about the importance of gravity and the Theory of General Relativity.
- **Astronomy Natural and Cultural Heritage**
  - We will also highlight both our natural and cultural astronomical heritage, which is something that needs to be preserved and passed on to future generations.
- **Inclusive Astronomy**
  - We will work towards a more inclusive egalitarian and diverse community. Under this theme, the IAU Working Group of Women in Astronomy will organise a framework for everyone to organise activities during the UN International Girls and Women in Science Day in February.
- **Astronomy for Education**
  - Astronomy education is really important, and we want to help inspire young minds to become interested in astronomy, and also to train teachers.
- **Star Parties**
  - We will have various large-scale outreach star-gazing events. We want to enable as many people as possible, especially children, to look through the telescope for the first time. Among the main activities will be once again organizing 100 Hours of Astronomy, and setting up a worldwide star-gazing event around the 50th anniversary of the Moon landing.

Your involvement is critical for the success of the initiative

Whether you're a professional working in astronomy, an amateur astronomer, or just someone interested in astronomy, we'd love everyone to get involved in the celebrations. You can participate in a variety of ways—by, for example, implementing one of the activities of the flagship themes locally, assisting the different IAU100 National Committees, or by developing your own activity. These are just a few of the examples of how people can get involved, but the most important thing is that the community is involved as a whole.

As the experience of the International Year of Astronomy showed back in 2009, the community's involvement is vital for such initiatives. Large-scale events such as the International Year of Astronomy challenged every one of us to become better professionals. But what's more important is that these events give us the opportunity to collaborate together, to go beyond borders and to really inspire people. Let's not waste the opportunity to work together to make this celebration a great way of engaging citizens of the world with the wonders of the universe.

100 Years of General Relativity: Eclipse

Stephen Pompea
100 Years of General Relativity: Eclipse Coordinator

In 2009, we had a tremendous opportunity that we took advantage of—the 400th Anniversary of Galileo first looking through the telescope. It was a great opportunity to take the brakes off, to be experimental, to reach new audiences, to develop new programs such as the Galileoscope. And we're going to have the same great opportunity in 2019—the 100th anniversary of a mind-changing experiment, a mind-changing observation, a game-changing moment in science: the 1919 Eclipse where Einstein's predictions came true, catapulting Einstein into the public eye, and the words "general relativity" into the general vernacular. We can take advantage of this tremendous opportunity to launch something we call the "Einstein Schools."

First of all, we're building on previous collaborations, on previous projects, best practices, lots of things that you've done and that we've done in the U.S. and we want to take advantage of what we have learned in terms of program models and dissemination models to reach these goals. The Einstein School Program is a chance to get a whole lot of schools to look at the science theme, to think about Einstein, gravity, general relativity, compact objects, LIGO, etc.

Now, we're going to have to work together to figure out what those resources are that can support these schools. This might mean websites, demonstrations, or tangible experiments with rubber sheets to demonstrate gravitational reflection of starlight—it can be an awful lot of things that are developed all around the world that we can put together for these schools to support them.

We also have the ability to create an educational activity around the 1919 eclipse because not everybody will be at the 2019 eclipse. We can use the resources in Portugal where the original plates are stored. We can talk about the measurements that were made in Brazil and on the small island off the coast of Africa that confirmed the deflection. So we plan to develop a formal education activity that can be used worldwide in these Einstein Schools. We'll have to think about what these Einstein Schools are going to really mean, how we are going to badge them, what the requirements would be, what we're going to do for the different levels of schools, the primary schools, the high schools, the universities.

So just in conclusion, this is your project. We are here as experimentalists, we are here to start the experiment to get as many of these Einstein Schools established around the world to get them as productive as possible to excite as many students as possible about gravity and future research that will be done on compact objects and gravitational wave events.

Dark Skies for All

Sze-Leung Cheung and Constance E. Walker
Dark Skies for All Coordinators

We all know about the problem of light pollution, but in recent years, it's been getting more serious—so serious that we have to take action.

Satellite images show us that, from 2012 to 2016, Earth brightened by 9%. One big reason it's so bright (and brightening so fast) is because of the modern-day use of LED technologies. People thought LED technology would reduce light pollution and improve energy consumption, but in hindsight and in general, it does not.

There are three objectives for our "Dark Skies for All" project. The first one is that we want to have more educational programs available to more people. By bringing the programs together on a website portal, we can make them more readily and easily accessible to people. The second objective is to provide the latest information on the current understanding of light pollution issues, allowing communicators to talk with local communities and especially with the government, with the objective that some action be taken. We want the world to make light pollution a familiar household term, just as air pollution, water pollution, and noise pollution are familiar terms.

What will the deliverables be? We have a particular project in mind that already exists called the Quality Lighting Teaching Kit. 100 kits have already been disseminated to 32 countries worldwide. We want to use this as a prototype for what we could do with IAU's 100th anniversary. We aim to make online training available for this project and others. The website would have a number of different constituents. For instance, other light pollution activities and resources, brochures, posters, a toolkit for lobbying governments, a press kit for communicating with the media and a Dark Skies declaration signup form in which everybody, all over the world, can participate as Dark Skies Ambassadors. These are just some of the ideas, but we're open to more.

How will this project be disseminated? There are a lot of ways to disseminate this project. We intend to partner with different groups. Of course, in the IAU, there is C.B7, the Commission of "Protection of Existing and Potential Observatory Sites", whose president will be Constance Walker. There is also the Commission of Astronomy Education and Development, the Office for Astronomy Outreach, the Office of Astronomy for Development, and the Commission for World Heritage and Astronomy. In addition, there are the National Outreach Contacts, astronomical observatories, light-pollution advocacy groups and the International Dark-sky Association. Of course, in individual countries, a lot of advocacy groups exist with whom we could partner. We want to reach schools, astronomical communities, science centers, libraries, parks, media groups, and governments—to name a few—along with the general public.

Inspiring Stars

Lina Canas
Inspiring Stars Task Force

Inspiring Stars is a joint venture between IAU Central Administration, the Office of Astronomy for Development, and the Office for Astronomy Outreach. I'm standing before you today, but the people who actually set this project in motion are Rosaria D'Antonio, and Wanda Diaz Merced. This was in direct response to the challenge set by Piero Benvenuti to try to move the IAU actions on inclusion forward. The Inspiring Stars project aims to promote egalitarian participation in science, especially in astronomy. How? Through itinerant exhibitions that will showcase the best practices around the world.

There are so many good resources and activities around the world. Our aim is to put these in the spotlight: to share with everyone what's being done. We've framed the program around inclusion and with it, we're seeking to advance human development through outreach, education, and scientific research. But exactly what is the project in terms of deliverables?

We started by issuing a global call to the community to show us your best practices, your research, education, and outreach activities. The community's very active. We were amazed at how incredible projects are being implemented around the world, and by the creativity of the different teams. But when we look at the resources that reached us, the activities, we were able to identify some issues. First, we had many resources focused only on outreach and especially for the blind. Another one was that very few replies focused on accessibility research-wise. When we look at these results we can see that we're sending a message to children and to students that they can study astronomy, that astronomy is an accessible science. But once they enter university at a research level, we lack the tools to make them feel welcome and active. So this is something that we need to address.

This exhibition or this showcase of best practices will have two instances in the community it serves. One is what we call the inception event. There are so many practices, the best practices that are being done locally, that we never hear of. So we want to go to the community and identify what's being done and incorporate it into our showcase, in our exhibition. Then, after this first contact with the community, we'll have the final exhibition.

We hope that with future editions, this exhibition will organically evolve. Every time there's a new exhibition, it will be in a different community and that will absorb and incorporate local activities or best practices. So we look forward to changing and evolving with each new edition.

Open Astronomy Schools

Rosa Doran
Open Astronomy Schools Coordinator

Empowering teachers and educators in general is Open Astronomy Schools' main vision (Astronomy Education during IAU100 flagship). We want to enrich educators' roles as facilitators of science learning and promoters of science literacy for the future leaders of this planet.

In teacher training programs, we discovered a rich diversity of school settings, from a cultural, social and environmental point of view. Diverse opportunities and challenges. These are also associated with different levels of infrastructure, training, and openness to local communities. Schools in general and teachers in particular need support, inspiration, and motivation to move towards a new paradigm for education. Schools need to become knowledge hubs for their communities with educators functioning as travel companions in knowledge and competence acquisition. Learning has to be contextualized, inter/multidisciplinary and student centered. To prepare students for future challenges, we aim to encourage them to handle unpredictable situations and the unknown creatively, be fearless of failure, and resilient in the pursuit of their goals. International collaboration, tolerance, resilience and solidarity are keywords in any educational setting. Astronomy is a domain that gracefully integrates many of these characteristics. Astronomical research demands collaboration, multicultural understanding, critical thinking and creativity, and problem-solving competencies among so many other key skills. The astronomy community is in a privileged position to embrace the mission of changing the educational paradigm. So, for this flagship it's crucial to have our community's support, to embrace this renewed opportunity to make a difference in the world. Nowadays, education is driven by huge investments related to promotion of 21st-century skills and the production of cutting-edge tools and resources. The problem is how to foster and assess such skills, find the appropriate resources, handle these resources, and integrate them into curricula. This is what we foresee to integrate within this new trend of teacher-training events and astronomy for education efforts, empowering teachers to embrace this vision with confidence.

Our vision integrates several activities among which are 100 countries training teachers following innovative criteria, a selection of 100 tools that can effectively support the flagship's vision, reproduction of ancient experiments, use of robotic telescopes, and other interesting projects. Under the Open Schooling Flag (Open Astronomy Schools) we will work with students to help them apply the design-thinking model to target local misconceptions and promote astronomy awareness within their communities. We need your help to fulfill this vision. Please start thinking big and put 100 in front of any project that you carry out.

100 Hours of Astronomy 2.0

Thilina Heenatigala
100 Hours of Astronomy Project Coordinator

Whenever someone says “let’s party,” I’m ready to go. Star Parties is one of the themes of IAU 100. With Star Parties, we aim to promote three projects, one at the beginning, one in the middle, and one near the end of 2019. Star Parties are big public outreach events, like sidewalk astronomy. One of the really successful or maybe the most successful event during IYA in 2009 was the 100 Hours of Astronomy. This event reached an incredible number of people around the world and so we want to do that again. But now, ten years later, we have even more resources. We have better offices. We have the Office of Astronomy for Development, the Office for Astronomy Outreach, and stronger Astronomers without Borders networks. We have more networks in general as well as more channels. We’re aiming to set this in motion in the beginning of January.

And ten years ago, these outreach events mostly took place on streets and sidewalks, from shopping malls to camel carts traveling to a village. Now, we want to offer those experiences, of course, but we want to go the extra mile. At IAU we have an inclusive astronomy working group, so we want to make sure that we include everyone, reach the community, and different communities. We aim to make the Star Parties accessible and make all the resources available to help increase people’s awareness of astronomy. Inclusiveness and accessibility means asking, “How do you help someone in a wheelchair if they come to your telescope?” and “How can you help someone in a hospital bed to view the night sky?”

So we’re aiming to make it inclusive and reach different communities and not just do sidewalk astronomy. We want to do online efforts, we want to make a big push on social media… Our project is about people—it's about you—and so any ideas you have, anything you want to do, let us know. We’re more than willing to collaborate, and because it's a people-project we really want to get everyone involved.

This is probably going to be the first major event in 2019, and we really want to work together to make a big push for the rest of the year and get people excited and inspired. Because in 2019, the 100 years isn’t just about celebrating IAU. It’s an opportunity to educate people and do outreach and inspire people.

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