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Effectively Coordinating Museums and Planetariums Worldwide

Mark U. SubbaRao[1]

[1]Adler Planetarium,
1300 S, Lake Shore Drive, Chicago IL, USA
email: msubbarao@adlerplanetarium.org

Abstract. Informal science educators at museums and planetariums face the challenging task of engaging a diverse public audience in contemporary science. To do this they need a solid background in the science itself, educational pedagogy, and modern practices in science communication. The task has gotten even more challenging in the era of big data. Interpreting and visualizing these datasets in planetarium shows and museum exhibits requires specialized technical skills. Furthermore, the increasing pace of discovery means that informal science educators have less time to accomplish these tasks. This presentation will summarize a variety of museum and planetarium community efforts to address these challenges through worldwide collaboration and coordination among museums and planetariums. Solutions include content sharing and distribution mechanisms as well as networking museums and planetariums together to create global worldwide events.

Keywords. Keyword1, keyword2, keyword3, etc.

1. Introduction

Museums and planetariums have a tremendous potential for communicating astronomy with the public. These free-choice learning environments are unbound by the content restrictions inherent in formal education. The nature of the museum and planetarium experience allows for more in depth exploration than is often possible in other informal education formats (e.g. traditional media and social media). The presence of trained facilitators and presenters allows for the creation of an experience that is both exploratory and explanatory. This facilitated exploration has been termed "Exploranation" (Ynnerman *et al.* 2018). As the pace of scientific discovery accelerates, and as the flow of new data increases the role of science museums and planetariums needs to change. They should transform themselves from presenters of well established scientific truths, to places where the community can come together with experts in a facilitated 'exploranation' of the latest discoveries.

Museums and planetariums reach a large worldwide audience. There are approximately 3,000 science centers in the world serving an audience of roughly 310 million people each year (Mechelen Decleration 2014). A rough estimate gives 4,000 planetariums in the world, with an annual attendance of 150 million (Petersen, M., 2018). These institutions are scattered all over the world. (Fig. 1) Progress is being made in establishing new institutions in the under represented areas of the world. At the 2018 International Planetarium Society Biennial Congress the first meeting of the African Planetarium Association took place (Padavatan 2018). This group will help nurture and grow the African planetarium community.

Informal science institutions generally benefit from a high level of public trust. This is especially important in an era when trust in the traditional sources of information such

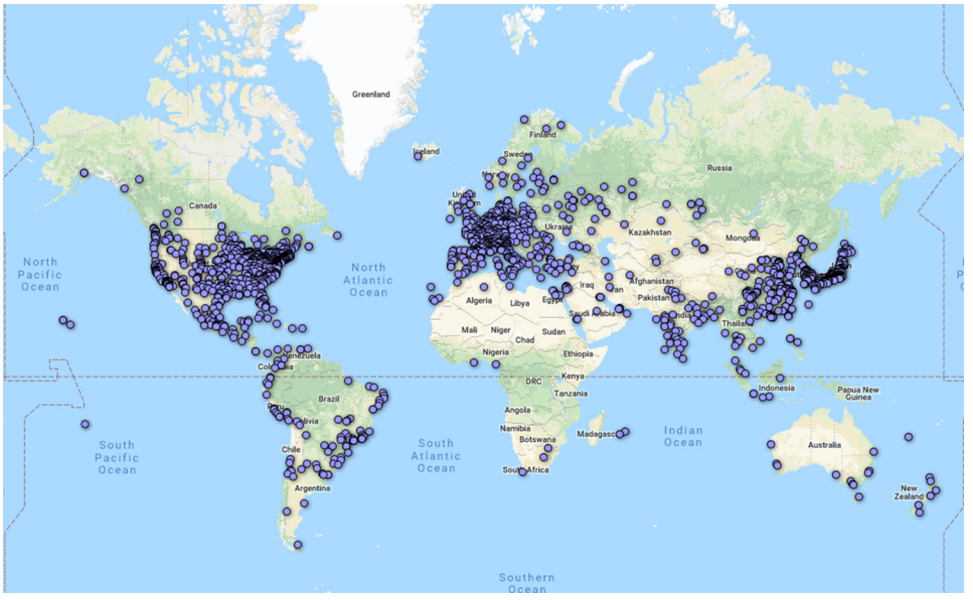

Figure 1. A map of the worlds planetariums.

news media and politicians are low (Leiserowitz *et al.* 2010). This high level of public trust is especially important when dealing with potentially controversial topics such as the Big Bang, evolution, or climate change.

2. Challenges

This article lays out an optimistic vision of the potential for sciences museums and planetariums to radically change the public's understanding, appreciation, and interest in science. There are some serious challenges in reaching that vision. Chief among them are the burdens placed on museum and planetarium staff. These positions require a combination of skills, a solid background in the science itself, educational pedagogy, and modern practices in science communication. In addition 'data science' skills are increasingly important as we shift towards communicating more immediate and more data intensive scientific results.

Professional development is critical to combating this challenge. Since 2002, JPLs Informal Education group has run NASAs Museum Alliance (Sohus 2006), providing museums and other informal education institutions with access to NASA staff, resources, and professional development. More than 700 organizations around the world are Museum Alliance members. The Museum Alliance's primary product is professional development teleconferences with NASA scientists and other experts.

While certain trends, like an increasing pace of scientific discovery, are making the job of the Informal Science Educator more difficult, there are others making it easier. In particular there has been development in our understanding of how effective certain science communication strategies are.

Figure 3 shows the relationship between the traditional 'deficit model' of science communication, the 'engagement model' and the 'participatory model'. These should not be thought of as a hierarchy, and in general an institution should employ all three models. However when possible museums should try and move from the one way flow of information in the 'deficit model' to the two–way flow of information in the 'engagement model'. The 'participatory model' is enabled by citizen science projects such as the Zooniverse

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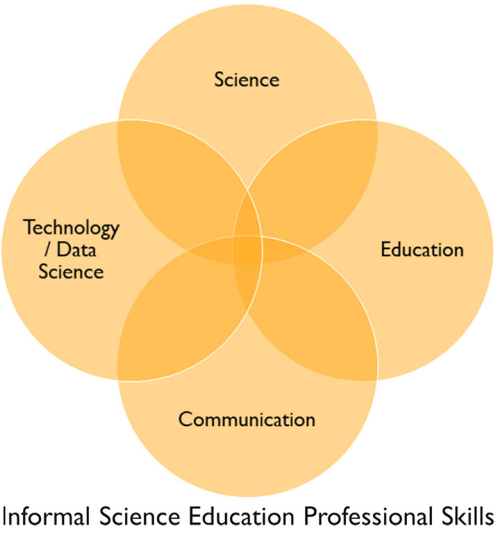

Figure 2. Informal science education requires a rare combination of skills.

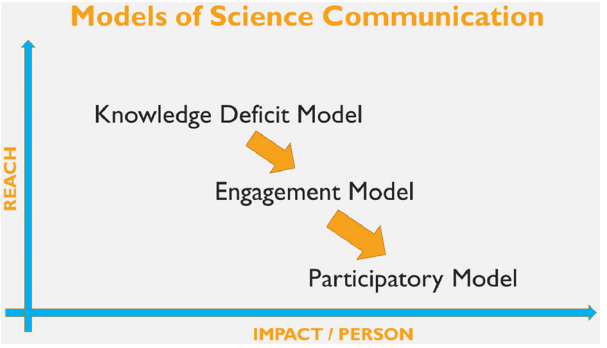

Figure 3. Science communication models

(Smith *et al.* 2013). These projects provide opportunities for museum and planetarium visitors to contribute to scientific projects.

3. Technology

Modern museum exhibits have been transformed by technology. Traditional optomechanical planetariums have largely been replaced by digital projection systems. No longer limited to the night sky, the modern digital planetarium is capable of presenting any astrophysical phenomenon. The open data revolution means that more and more of this astronomical data is publicly available, much of it streamed almost instantaneously. As the LSST comes on line and ushers in an era of time domain astronomy. Planetariums and museum exhibits will be capable of pulling in, processing, and visualizing these data streams. Figure 4 illustrates a planetarium (the Grainger Sky Theater at the Adler Planetarium) being used for big data visualization. At the core of realizing the potential of this data rich future is a philosophical shift in the role of the planetarian or museum facilitator. From that of a curator of astronomical data to that of an 'astronomical weatherperson' - an interpreter of the continuous flow of information coming from telescopes, space missions, and computer simulations. Hopefully this will also inspire a shift in how the public views a planetarium or science center from a place to be visited

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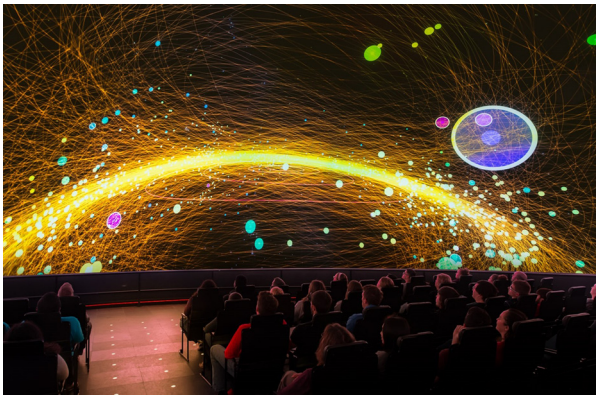

Figure 4. The modern digital planetarium has become a world class immersive data visualization facility. (Photo Nick Ulivieri)

once in a lifetime, to a place that one should visit frequently to keep abreast of our growing understanding of our place in the universe.

4. Data to Dome

In the planetarium community it has been recognized that the field needs to evolve to thrive in the big data era. This evolution requires both the development of technical infrastructure as well as the professional development of planetarium staff. To accomplish this the International Planetarium Society established the Science and Data Visualization Task Force. The mission of the Science and Data Visualization Task Force is to streamline the process of going from data to dome, increasing the potential for scientific communication and storytelling in the planetarium.

The task force has undertaken initiatives aimed at:

- Preparing planetaria for the big data streams that will come from next generation telescopes, satellites, experiments and computational simulations.
- Creating professional development opportunities aimed at developing more 'data savvy' planetarians.
- Developing and promoting best practices for data visualization in the dome.
- Connecting data suppliers with vendors and planetarium end-users by setting, and recommending, standards for real-time scientific content distribution.
- Encouraging the visualization of a wide range of scientific data in the dome (moving beyond astronomy).
- Advocating for the inclusion of dome visualization tools in standard scientific analysis and visualization packages.
- Encouraging planetaria to make their facilities available to researchers from their communities to use as a visualization tool.

As a result of these initiatives a new data streaming standard was developed (data2dome). Spearheaded by the European Southern Observatory, this standard provides a mechanism for content providers to deliver content directly to planetariums. On the same day as the press release of a major discovery, planetarium operators will find planetarium content related to that discovery on their console. This includes not only the visual assets to display on the dome, but also the contextual information necessary to interpret them effectively.

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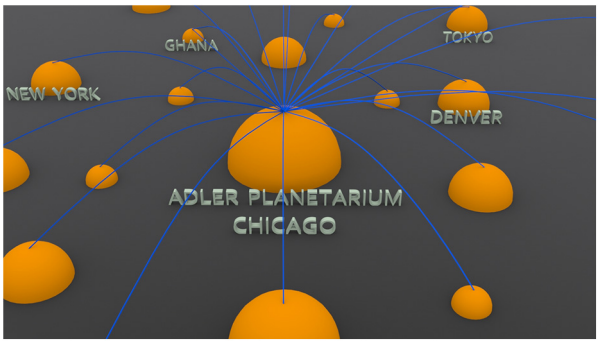

Figure 5. Domecasting synchronizes planetariums around the world, enabling the creation of global science communication events.

5. Domecasting

This article has outlined how museums and planetariums can coordinate through the sharing of resources and professional development opportunities. However a more direct form of coordination involves linking museums and planetariums together through networked events.

Domecasting is the synchronizing of planetariums around the world. This technology was first demonstrated at the 2008 International Planetarium Society conference by the planetarium company SCISS, where they connected a portable planetarium in Chicago with the Ghana Planetarium in Accra. One decade later the technology is now quite mature.

The largest domecasting event is the Kavli Fulldome Lecture Series. This lecture happens twice a year featuring a prominent astronomer. They are produced by the Adler Planetarium and simulcast to a network of approximately 30 planetariums around the world.

One challenge of a worldwide presentation are timezones. Currently the Kavli Fulldome Lectures are performed twice to accommodate North and South America, Europe and Africa. Language is also a challenge, the Adler is experimenting with crowdsourcing the simultaneous translations among different museums.

Simulcasting allows the presentation to reach far more people than it would in a single planetarium. This justifies more developmental effort in the lecture, which leads to a higher quality experience. Domecasting also provides an opportunity for people to participate in the lecture in rural areas, or parts of the world that are infrequently visited by top scientists. Perhaps most important is the sense of global community that is created by these live connections.

6. Conclusions

Because of the number of people they reach and the public trust they hold, museums and planetariums are in a unique position to elevate the public's understanding and interest in science globally. To accomplish this it is imperative that museums and planetariums develop both their technical infrastructure to display and visualize scientific data streams, and the scientific communication skills of the staff that help the public interpret these data. To accomplish this we need to effectively coordinate our resources and expertise across the global museum and planetarium community.

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Discussion

W. Waller: How could the IAU best partner with the IPS for optimal outreach?

M. SubbaRao: We are actively looking for ways to strengthen the relationship between the IAU and the IPS. My invitation to give this invited talk at this focus meeting is a reflection of that. This involves working with the OAO and IAU Comission C3 to include planetarium content at the CAP meetings. Increasingly I hope to work with the OAD to better support planetariums in emerging communities around the world.

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