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SCIENCE MUSEUMS, SCIENCE CENTERS, AND NON-PARTICIPATION

Emily Dawson

"I couldn't think of anything worse than going there, to be honest"

Introduction

Despite decades of concern, patterns of participation in informal science learning remain skewed in favor of the more advantaged sections of the UK (United Kingdom) population. Research on those who do visit science museums, science centers, nature centers, aquaria and, the many other informal science learning environments, suggests that a large number of people in the UK, from minority ethnic backgrounds, socio-

economically disadvantaged backgrounds, and rural areas do not take part in informal science learning opportunities. Informal science learning environments can, therefore, be seen as resources for some people rather than others.

This observation is notable because while informal science learning institutions were becoming key environments for public engagement with science (or PES) in the UK, the then New Labour government was heavily invested in combating social exclusion. The durable nature of social exclusion and non-participation in informal science learning despite a national agenda for social inclusion in the cultural sector gives cause for concern. Ultimately, patterns of non-participation raise questions about the relevance and sustainability of informal science learning institutions in rapidly changing, multicultural societies.

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SCENARIOS: SCIENCE CENTERS ENGAGEMENT AND THE RIO SUMMIT – EXPERIENCES OF AN INTERNATIONAL PARTNERSHIP PROJECT

Annie Harris

At the Earth Summit in Rio de Janeiro in 1992, 12-year-old Severn Suzuki delivered a heartfelt message to the assembled world leaders, pleading with them to consider the future of children and young people when making decisions on the future of the Earth's environment. She became known as the 'girl who silenced the world for five minutes' and her message remains as powerful today as when it was first delivered.

Many of today's young people hold the same passion and concern for the environment. They



Students from Canberra, Australia reviewed data from a water audit completed at their school.

have the advantage of access to and affinity for a range of communication technologies that allow them to find and share information and opinions with their peers, and to be part of online communities to generate awareness and inspire action.

The Science Centers Engagement and the Rio Summit initiative, known as SCEnaRioS, was an international pilot coordinated by the Association of Science-Technology Centers (ASTC) in col-

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“Non-Participation,” continued from front cover

The observation above also suggests that the issues involved in social exclusion and non-participation in informal science learning are not well understood. As a result, attempts to develop inclusive informal science learning practices may have been limited and little able to address the many and complex issues involved in non-participation and social exclusion. This article is based on Ph.D. research about participation in PES that I carried out after working as a practitioner and a researcher in a variety of informal learning environments. While I would relish being able to offer a ‘to do’ list of suggestions for inclusive informal science learning practices, this article focuses instead on a brief summary of how the research was carried out and the findings and implications that are most relevant for the field of informal science learning.

Theoretical Framework and Methods

In this study informal science learning was explored from the perspective of those who did not usually participate in such activities: the ‘non-visitors’, the ‘excluded’, those for whom public engagement was not necessarily ‘public’. In order to do so, I used a theoretical framework that combined different areas of research that provided insights into the relationships between cultural participation, learning science, and social inequalities. Thus sociological theories about cultural participation and the reproduction of social inequalities from the work of Bourdieu, insights from informal learning research and social studies of science education were combined with intersectional theories about the influence of identity and social position, including the role of migration, on non-participation, social exclusion and the reproduction of disadvantages.

A qualitative, ethnographic approach was taken to exploring social exclusion and non-participation in informal science learning. In order to do so, this study explored these issues in terms of the contexts of people’s lives, their social positions, attitudes and experiences, and explored specific visits to informal science learning institutions with the research participants. The study also followed a

participatory approach in design, data collection, and analysis.

As sketched above, research has already shown how important ethnicity and socio-economic status are for participation in informal science learning. As a result, this study focused on exploring how these social positions affected social exclusion and non-participation by recruiting research participants who were socio-economically disadvantaged and from minority ethnic backgrounds. While living in rural areas has also be found to affect participation in informal science learning, it was important for this study that research participants lived somewhere with lots of informal science opportunities on their doorstep with which they were, nonetheless, not involved. London presented the ideal location for this study, which focused on one socio-economically disadvantaged, ethnically diverse neighborhood in central London — Southwark.

Following a snowball approach, where one community gatekeeper introduced me to another and so on, access to over 42 different grass-roots community groups was negotiated. Four of these groups ultimately took part in the project in 2010, a total of 60 people. A Sierra Leonean group (n=21), an Asian group (n=13), a Somali group (n=6), and a Latin American group (n=18) from Southwark took part in this study, generously sharing their views and experiences of informal science learning. Groups included people of different ages, different genders, and different lengths of time spent living in the UK.

Over a one-year period participants took part in focus groups, interviews, accompanied visits to informal science learning environments of their choice, and participant observation. The data collected with these groups amounted to four focus groups, 32 interviews, and four accompanied visits, alongside almost 65,000 words of field notes based on a year of participant observations from the community group events to which I was invited. Data were transcribed, anonymized, and analyzed using a range of techniques including constant comparative analysis, deviant case analysis, and participatory analysis to ensure the validity and reliability of the findings presented here.

Results

This study found informal science learning, as a field, involved complex processes of social exclusion that operated in different ways to create enduring and resilient patterns of non-participation. In particular, non-participation was affected by negative attitudes toward informal science learning, problematic experiences of informal science learning in practice and the structure of the field of informal science learning, described in more detail below.

Views and Attitudes Towards Informal Science Learning

Participants had limited experience of engagement with science and little or no direct experience of informal science learning. This is important because it suggests that their non-participation was not based simply on their experiences of informal science learning opportunities. Instead, participants drew on their experiences at school and elsewhere to develop views and attitudes towards science and informal science learning environments that resulted in their disassociation from both. In other words, a preference for not visiting museums or science centres came, at least in part, from experiences informal science learning practitioners have little influence over.

This study found attitudes towards science emerged from participants’ school experiences, as well as from their experiences of science in daily life. School was found to be a formative experience for participants, producing long lasting attitudes towards both science and learning science. Such associations were often negative. Participants described school as a place that put them off science as a subject, studying science beyond or outside school and scientific employment. Science was seen as an important and high status subject but too difficult to understand, too expensive to study, and as something for “other people”. As one participant from the Asian group put it “science is for people who want to be doctors...but it’s definitely not for me, I find it too much for my head”.

Engagement with science was associated with childhood and children by participants. In their eyes, science was a subject



for school students and informal science learning, especially visits to museums, was also seen as something for children and students. This can be seen clearly in the extract below from an interview with a participant from the Latin American group, who struggled to see museums except in terms of what they offered for children.

Jorge: The museum for the kids is quite good because the interaction with the things, I think for kids it's wonderful, they can learn by experimenting, I think to put things for them, like very accessible, is the right thing for a kid.

Emily: And what if you're not a kid?

Jorge: It's like, I don't know, it's like, I think, I see that like a playground for kids.

As a result, the association of both science and informal science learning with childhood highlighted a key way in which participants, as adults, disassociated from informal science learning. As Jorge ultimately concluded, he was not a child and was, as a result, unlikely to visit an informal science learning institution.

Despite the strong links seen between youth, science, and informal science learning, participants did not always see informal science learning as a positive part of childhood. Indeed, one Somali

participant described school trips to science museums as "punishments" from her teacher and had, as a result, developed a strong dislike of informal science learning institutions. As she put it, "I couldn't think of anything worse than going there to be honest". This finding is contrary to suggestions that school visits to informal science learning institutions encourage students from minority ethnic backgrounds and socio-economically disadvantaged backgrounds to visit such institutions and to learn science. Instead this finding suggests school visits to such places are not always positive and raises questions about how such visits are perceived by students from disadvantaged backgrounds.

Of the various informal science learning environments, museums emerged as the most recognised site for informal science learning, despite participants having little or no personal experience with museums. Participants perceived informal science learning opportunities to be not only child-oriented but Eurocentric and classed in ways that were off-putting. Overall, participants saw PES activities in museums and similar institutions as something for other people, but not for them. Participants did not see informal science learning as something that was relevant to themselves, to their communities, or as something that could be part

of their lives. This ingrained perspective was a key factor in how participants negotiated their non-participation in informal science learning opportunities. From this perspective, their non-participation resulted from their own active choices, rather than as a result of inaccessibility and exclusion.

Exclusive Elements of Practice

The data from the "accompanied visits" part of this study suggests participants were right in some ways to see informal science learning opportunities as 'not for them'. This study found that visits to informal science learning institutions resulted in both positive and negative experiences for participants.

Using Falk and Dierking's Contextual Model of Learning to analyze the visit data, this study found that informal science learning experiences did include enjoyable and learning experiences for participants, backing up considerable research on learning in informal contexts. These findings, however, caution against relying on research from museum visiting populations to make assumptions about the experiences of people from groups who do not typically take part in informal science learning. This study found that

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“Non-Participation,” continued from previous page

aspects of the visits involved in this study were sometimes neither enjoyable, nor learning opportunities for participants.

Inaccessible aspects of informal science learning resulted from language barriers, design issues, and staff facilitation styles. This finding resonates with research carried out in the US by Ash and her colleagues and by Garibay. Their research also suggests that mismatches between the language of informal science learning institutions and minority ethnic visitors creates significant problems in terms of their access to information, and thus their ability to learn or feel comfortable in such environments. The findings of this study suggest this is also the case in the UK. For example, participants felt confused by individual exhibits, exhibitions, and whole institutions because of a combination of language and design issues. Their confusion meant participants were unable to make sense of certain exhibits and felt uncomfortable as a result. Thus, the findings of this study show that the potential benefits of informal science learning activities were not equally accessible, even when participants were directly involved with a science centre or museum.

Furthermore, the analysis of the visit data and the follow-up interviews found that while the potential benefits of informal science learning opportunities were noted by participants, so too were broader inaccessibility issues. Participants noted that they were unlikely to repeat their visit or visit a different informal science learning environment given, among other things, their language skills, a broad disinterest in science, the cost of the visit (although not all visited institutions charge for entry), the lack of appealing food, and the competing, seemingly more relevant priorities for their time. Participants described feeling unconfident in terms of finding their way around institutions, understanding the content of galleries, or seeing other people like them, during their visit. This suggests that the negative perceptions participants had identified of informal science learning as “not for us” were reflected in their experiences of visiting informal science learning institutions.

Structural Exclusion from the Field of Informal Science Learning

In addition to a sense of personal detachment from informal science learning and inaccessible elements of informal science learning in practice, this study also identified structural issues that limited participants’ access to informal science learning opportunities. Thus while participants described their choices about non-participation as active, this analysis suggests their ability to make such choices was limited by the way informal science learning was structured as a field.

In particular, the social positions occupied by participants at the time of the research were identified as a key issue affecting their non-participation. Participants, having moved to London as linguistic and ethnic minorities from developing countries, fleeing war and civil unrest or as economic migrants, inhabited social positions that were disadvantaged in the UK. These disadvantages resulted, among other things, from limited employment opportunities, language skills, a lack of information and, in some cases, insecure legal status.

For participants, this meant many of them worked several, badly paid jobs in order to make ends meet. Even participants with post-graduate degrees found their qualifications were undermined in the UK since they were awarded by a developing country. Overall therefore, participant’s disadvantaged socio-economic positions were related to their positions as members of minority ethnic communities.

Access to informal science learning opportunities was found to be limited by participants’ social positions since the preconditions for their participation, such as sufficient free time, money, good health, confidence, English language skills or information, were restricted or absent. Thus, as a field, access to informal science learning opportunities was structurally limited for participants. Issues of gender and age were also involved in ways that limited the extent to which participants were able to make choices about their involvement in informal science learning opportunities. What this meant is that non-participation was not

the result of just ethnicity, just socio-economic status, gender or age, but rather all these aspects of social position or identity, and more, were involved.

This is not to say, however, that research participants were not active in all forms of cultural engagement. On the contrary, this study found participants to be heavily involved in cultural activities that related to their communities, their heritage, and their personal interests. As outlined above, however, science was rarely considered a focus for their personal interests.

Applying these findings together demonstrates how informal science learning, as a cultural field or system, was structured in ways that made it inaccessible to those without the resources required to take part, whether those resources were information, language skills, money, free time or interest in science. As you might expect, you cannot visit a science centre if you work back to back shifts and have no free-time. Because taking part in informal science learning required these seemingly basic resources (time, money, information and so on), for the participants in this study it was hard, if not impossible to access, given their disadvantaged social positions.

Implications: Exclusion and Non-participation as a Complex System

Thus far, I have argued that participants were disinterested in science and informal science learning institutions and actively disassociated from informal science learning opportunities. In addition, I argued that tangible access problems arose when those same participants were directly involved with informal science learning practices in museums and science centers.

The final set of findings, described above, suggested that the field of informal science learning is organized in ways that make it structurally inaccessible for people in disadvantaged social positions. Thus, the first implication of this study for informal science learning is that, at present, informal science learning is an inequitable system in the UK, which does not provide resources to different groups within the population on an equitable basis.



Taken together, these findings suggest that non-participation and social exclusion involve active choices as well as structural issues about exhibit design, organizational features of informal science learning, and social disadvantages about which participants could do very little. In other words, non-participation was not as simple as whether people *do not want* to take part or *cannot* take part. Instead these factors contributed to one another, reinforcing their strength to create durable, long-term, and resilient patterns of non-participation and social exclusion.

Thus, a second key implication for informal science learning results from how the relationships between the three sets of findings presented here are understood. I suggest we can understand non-participation in informal science learning as a complex system that can maintain social disadvantages. These findings suggest a mutually reinforcing cycle exists between the structural limits of informal science learning as a field, exclusive elements of informal science learning practices and attitudes towards participation in informal science learning; see Figure 1. In other words, participants were unable to access informal science learning and, in turn, were not particularly willing to get involved. These attitudes were backed up by their problematic experiences of informal science learning in practice.

It is worth noting two key features of this. Firstly, the relationship between informal science learning as a field and participants' social positions plays a considerable role in this cycle. The constraints experienced by participants were such that exclusion from informal science learning was structured by the limitations of social position, even before informal science learning practice was experienced. This finding suggests that informal science learning as a system can be considered part of broader patterns of social disadvantage and marginalization that are in many ways outside the remit of those working in informal science learning. This point is important because researchers, practitioners, policy makers, and funders of informal science learning need to be able to understand their roles, limitations, and potential in this broader context.

Secondly, however, and in response to the first point, understanding how the different features of this cycle influence one another is a crucial step in seeing how non-participation, or exclusion, from informal science learning contributes to the reproduction of social disadvantage. In particular, how being excluded from reaping the potential benefits of informal science learning may uphold the view that informal science learning is not for everyone, and in turn, stop some people from getting involved. By understanding this proc-

ess, I argue we are better able to see how inclusive informal science learning practices may hold great potential for disrupting the reproduction of social disadvantage and contributing to social change.

While this study demonstrated some of the inaccessible elements of informal science learning, also present were moments where participants were able to connect with an exhibit in ways they found meaningful, creating learning opportunities. This suggests that informal science learning is not intrinsically unappealing or inaccessible to non-participants. Rather, that with considerable effort to acknowledge and understand inaccessibility and the development of increasingly inclusive practices, we may in the long term hope to shift this cycle towards a more equitable and inclusive pattern. Indeed, as Gurian has argued, this is a key responsibility of the informal learning sector.

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Notes

¹ Department for Culture Media and Sport. 2011. *Taking Part: The national survey of culture, leisure and sport*. London: Department for Culture Media and Sport.

² Ipsos MORI. 2011. *Public attitudes to science 2011*. London: Department for Business Innovation and Skills.

³ The Association for Science and Discovery Centres. 2010. *Assessing the impact of UK Science and Discovery Centres: Towards a set of common indicators*. Bristol: The Association for Science and Discovery Centres.

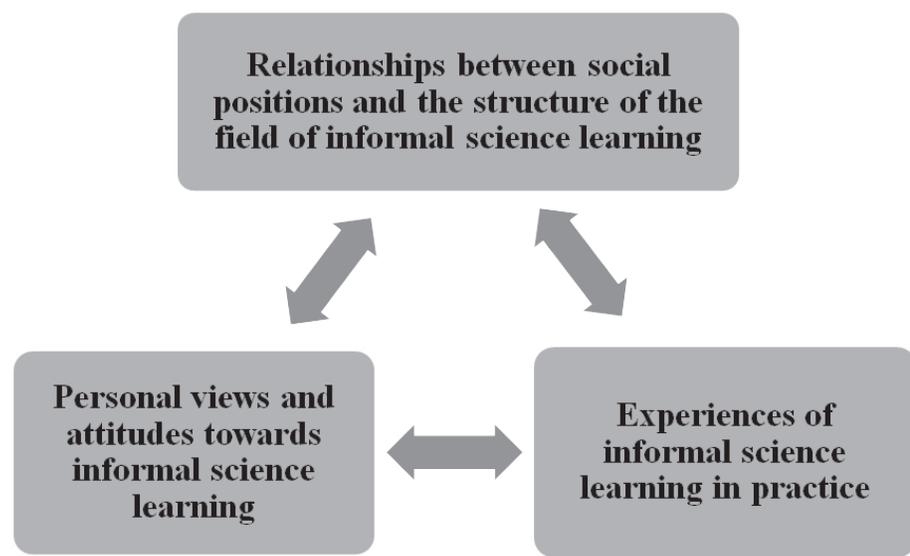


Figure 1: The cycle of non-participation/exclusion and informal science learning.

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Wellcome Trust. 2008. *Millennium science centres impact assessment report. Executive summary.* London: Wellcome Trust.

² Bourdieu, Pierre. 1984. *Distinction: A social critique of the judgement of taste.* Translated by Richard Nice. London: Routledge and Kegan Paul Ltd.

Bourdieu, Pierre, Alain Darbel, and Dominique Schnapper. 1990. *The love of art: European art museums and their public.* Stanford, CA.: Stanford University Press.

Bourdieu, Pierre, and Jean-Claude Passeron. 1990. *Reproduction in education, society and culture.* Translated by Richard Nice. Second ed. London, Newbury Park CA, New Delhi: Sage.

³ Collins, Patricia Hill. 2000. *Black feminist thought: Knowledge, consciousness, and the politics of empowerment.* New York and London: Routledge.

⁴ Hooper-Greenhill, E., Phillips, M., & Woodham, A. (2009). Museums, schools and geographies of cultural value. *Cultural Trends*, 18(2), 149 - 183.

⁵ Rennie, L. (2007). Learning science outside of school. In S. Abell, K. & N. Lederman, G (Eds.), *Handbook of research on science education* (pp. 125-167). Mahwah N.J.: Lawrence Erlbaum Associates.

⁶ Falk, J., & Dierking, L. D. (2000). *Learning from museums.* Walnut Creek, Lanham, New York and Oxford: AltaMira Press.

⁷ Falk, J., & Dierking, L. D. (1992). *The museum experience.* Washington D.C.: Whalesback Books.

Hein, G. (1998). *Learning in the museum.* New York: Routledge.

Hooper-Greenhill, E. (1992). *Museums and the shaping of knowledge.* London and New York: Routledge.

⁸ Ash, D. (2004). Reflective scientific sense-making dialogue in two language: The science in the dialogue and the dialogue in the science. *Science Education*, 88(6), 855-884.

Ash, D., & Lombana, J. (2011). *Reculturing museums: Scaffolding towards equitable mediation in informal settings.* Paper presented at the National Association for Research in Science Teaching, Orlando, Fl.

Rahm, J., & Ash, D. (2008). Learning environments at the margin: Case stud-

ies of disenfranchised youth doing science in an aquarium and an after-school program. *Learning Environments Research*, 11(1), 49-62.

⁹ Garibay, C. (2009). Latinos, leisure values, and decisions: Implications for informal science learning and engagement. *The Informal Learning Review*, 94, 10-13.

¹⁰ Gurian, E. (2006). *Civilizing the museum: The collected writings of Elaine Heumann Gurian.* Abingdon and New York: Routledge.

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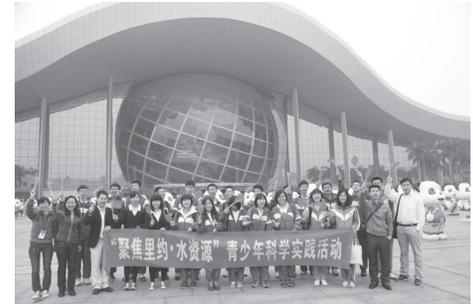
laboration with UNESCO and the Brazilian Foundation FIOCRUZ. Using current communication and information technologies, the project connected young people from 12 countries together for cross-cultural conversations around major topics central to the deliberations at the United Nations Conference on Sustainable Development in Rio de Janeiro (Rio+20) in June 2012. The project aimed to capture and represent the voice of youth through a range of events and video presentations held at both Rio+20 and the precursor conference, Planet Under Pressure, held in London in March 2012.

Scenarios highlighted the unique position of science centers as a powerful network for engaging the public, particularly young people, in discussion of critical global, science-based issues. The initiative was based around five partnership projects among 12 science centers worldwide, including in Florida, California, and Louisiana in the USA, Canada, Denmark, Brazil, Israel, Colombia, Australia, Singapore, China, and a secondary school in Mozambique. For each project, youth discussion was centered on one of three topics: energy and the green economy, access to clean water, and health issues related to environmental change. A key objective of discussions was to help the young people involved understand how global issues and local impacts are related, and to consider new solutions to shared problems.

SCEnaRioS: Water and Life

This article focuses on just one of the five SCEnaRioS projects. The SCEnaRioS: Water and Life project was delivered in a

partnership between three major science centers in the Asia-Pacific region: Questacon – The National Science Centre in Canberra, Australia, the Science Centre Singapore, and Guangdong Science Center in China. This project centered on the topic of supply and consumption of clean water. Each science center involved in the partnership had previously delivered programs and exhibitions around water issues, and had extensive experience in engaging young people with science and technology.



Six groups of secondary school students from Guangzhou, China who completed water-related research.



Five Australian students from Loreto College who researched water conservation awareness in their community.

Each of the three countries represented experience different challenges in supplying clean drinking water to its population. Australia, as one of the world's driest continents, faces multiple challenges of prolonged drought, increasing demand from growing populations—especially in major cities—and the uncertainty of the impact of climate change. For Singapore—a small island with a growing population and no natural freshwater lakes—water is an especially precious resource. In recent years significant investment has been made into water technologies that will increase Singapore's water self-sufficiency and reduce dependency on water imports from Malaysia. In the Guangdong Province of China, pollution of underground waterways and manmade water channels



is a considerable problem, along with pressures from increasing urbanisation of the population and inadequate access to clean drinking water in some areas. In each country, the students developed and conducted self-directed research projects investigating various aspects of the water issues in their localities.

A key aspect of the project was leveraging young peoples' confidence and interest in the use of new communication technologies. Drawing on Questacon's three years of experience in using high-definition videoconferencing technology to deliver educational events and programs, the science center partners decided that the project would revolve around a series of international video-conference sessions, where the students could engage in face-to-face, real-time discussions. This approach enabled a rich experience of 'conversations across borders' between peers in different countries. Due to access restrictions in China to some of the most popular social media sites, a bespoke social media site was also set up via a customisable, 'white label' platform. The aim of this site was to provide an avenue for students to interact outside of the videoconference sessions, and to upload the 'outputs' of their research projects—photos, videos, presentations and reports. Unfortunately, the site was not significantly used by students to interact with each other as was hoped, but it has become a significant repository of the students' work and an enduring record of the project.

Student Recruitment

Each country took a different approach to student recruitment. In China, Guangdong Science Center invited research proposals from small groups of students from 20 senior high schools. A panel of teachers and experts selected nine successful proposals, based on the innovation and feasibility of the research, the group's ability, and access to technical support. The successful groups then attended a consultation session with experts to provide them with professional guidance and technical support as they embarked on their projects. Approximately 30 students participated from China.

In Singapore, approximately 12 participants were recruited from the larger cohort of the Singapore Academy of Young Engineers & Scientists, a recently established science club based at the Science Centre Singapore. The students were high-achieving secondary and early tertiary students with an interest in science and technology.

In Australia, two smaller groups of six students each were recruited from two high schools in Canberra and Adelaide, representing opposite ends of the Murray-Darling Basin—Australia's largest natural river catchment. These two major Australian cities experience differing water challenges, relative to their position in the catchment and differences in rainfall patterns. The recruitment strategy taken by Questacon was to target secondary schools with established environmental sustainability groups and to promote the project through existing sustainability education programs and networks.

In each country the opportunity for students to be associated with the Rio+20 conference was a drawcard. However, as the students from both Singapore and Australia participated in the project as an extra-curricular activity, the project experienced some challenges with student retention and levels of participation. In China, the project was considered a valuable opportunity for the students to showcase their high levels of scientific and academic excellence, whereas in Singapore and Australia it was the opportunity to interact with international peers that proved to be of most interest to students.

Student Projects

The student research projects were conducted over approximately seven months, with videoconference sessions held in November 2011, and March and May 2012. Groups shared progress, findings, and experiences. Throughout the research period, the supporting science centers facilitated field trips, provided consultations with subject experts, and created resources, including digital media.

Project topics were varied between groups, but all focused on different aspects of drinking water quality and supply. In China, student projects focused on



Chinese students testing water quality in local water channel.

water issues in the city of Guangzhou and wider Guangdong province in southern China. Project topics included:

- investigation into the impacts of increasing urbanization on the sustainability of the water supply in Guangzhou.
- exploration of the economic and social impacts that recent remediation efforts in two of the area's major water channels have had on the local people and in raising public awareness of the importance of protecting the future health of the water channels.
- investigation of new options for water supply for households and schools in the area.
- investigation into ways to turn sewage sludge—a product of wastewater treatment and a major pollutant—into a substrate for growing turf.
- measurement of fluorine pollution levels in underground water supplies in nearby rural areas and devising filtering solutions.
- development of a drinking water pollution rating scale, driven by complex mathematical models.

In Singapore, the students researched Singapore's historical and current water supply, undertaking field trips to the Marina Barrage, which forms Singapore's newest water reservoir. They learned about Singapore's so-called 'Four National Taps' and investigated the sustainability of Singapore's main water supply sources. The group conducted a survey into Singaporeans' household water consumption habits and attitudes to water conservation. The group's major project

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was to conduct a study on the public acceptance of the recent introduction of a reclaimed water product, NEWater, into Singapore’s drinking water supply. To challenge negative public perceptions about NEWater, the students conducted blind tastings with the public visiting the Science Center and attending a World Water Day event. They tested NEWater against common brands of bottled mineral water and found that despite public perceptions to the contrary, most people could not identify NEWater by taste.

In Australia, the group from Adelaide looked into the long-term security of their city’s water supply, which faces a number of challenges including low rainfall, a hot climate and a small local catchment area to supply the city. The students concluded that, despite a number of public campaigns, community awareness among Adelaide residents about water conservation was still low. To try to increase water conservation behaviors within their school community, the students undertook a series of education and awareness-raising activities with the primary students at their school, creating a water awareness mascot called Danny the Drip.



Chinese students interviewing locals about the impact of water conservation efforts on lifestyle and business.

In Canberra, the students looked into water usage at their school; where water was being wasted and ways that water efficiency could be improved. They reviewed the results of a water audit that had been conducted at the school in 2007 as part of the Australian Sustainable Schools Initiative. The students found that some improvements had been made immediately after the audit, but many of these had fallen by the wayside and there were actions the students could take to make their school more water-wise. They

initiated a campaign of awareness activities and made plans to revive previous initiatives that had lagged.

Videoconference Technology

Questacon has a growing program of digital outreach and special events that provides students across Australia with opportunities to participate in interactive science workshops and experience presentations from leading Australian and international scientists from a variety of fields. Questacon is a major content provider for Australia’s growing educational videoconference networks, with videoconferencing becoming an expanding area of education delivery, facilitated by the development of the country’s high-speed National Broadband Network.



Videoconferences where students discussed water issues and shared ideas.

Through nearly four years of experience with the technology, Questacon has found that the stable, high-definition connection provided by H.323 protocol videoconferencing lends itself to interactive educational experiences. It enables effective content sharing of videos and PowerPoints, and avoids the internet access and stability problems encountered with some web-based applications.

Neither Science Centre Singapore nor Guangdong Science Center had used high-definition videoconferencing before, so this project introduced new technology to these centers. The funding provided by ASTC for the project enabled the purchase of H.323 systems. Project staff rapidly learned how to use the systems. The students from Adelaide joined the videoconference sessions at an external science organization, The Royal Institution of Australia, which has a compatible videoconferencing system. Each party connected via a bridge provided by the Australian Academic and Research Network

(AARNET), the organization that provides the high-speed fiber network between Australian universities. AARNET’s bridging services enabled simultaneous connection between the four endpoints in Canberra, Adelaide, Guangzhou, and Singapore.

The three student videoconferences held throughout the project allowed us to try different approaches to the videoconference structure to encourage maximum participation and interaction by the students. Seeing themselves on camera was a little daunting for the students so the first videoconferences were quite structured and formal, with little unscripted discussion taking place between the students. However, by the third videoconference the students felt more comfortable with videoconference communication and with each other, so discussions and questions between the three countries flowed more naturally. It was a pleasure to see this evolution take place!

As with any new technologies, the videoconferences did present some challenges. There was intermittent instability of the connection and difficulties in sharing video and PowerPoint content between China and Singapore. We worked around this by uploading student presentations to the SCEnaRioS social media site for local, offline viewing during the videoconference sessions.

Project Challenges

As with any pilot project and as the first international collaboration between science centers of this scale, the SCEnaRioS project presented some challenges. These included language barriers—the videoconference sessions were conducted in English only, which presented some difficulties for the Chinese students, especially during informal discussion as the students tended to speak more quickly. In general, however, all students managed to gain an understanding of the very interesting research being conducted in each location.

Another challenge was managing the sharing between varying numbers of student groups China (six groups), Australia (two groups) and Singapore (one group). While each student group was keen to share the finer detail of their project’s progress during the videoconfer-



ences, to keep sessions to a reasonable length, we restricted updates to summary points only.

Scheduling between the four endpoint locations was often tricky, with three different time zones, four different school term dates, and differences in whether students could attend videoconference sessions within school hours. A compromise was reached to hold the majority of sessions on Saturday afternoons. This required out-of-hours attendance for the two Australian teachers involved, to which they generously agreed.

The details of the main deliverables for the SCEnaRioS initiative evolved and changed over time as the ASTC negotiated the details of the involvement with the Planet Under Pressure and Rio+20 conference. This sometimes made it challenging to plan the project in advance and ensure both the students' expectations and project deliverables were met satisfactorily.

Project Outcomes and Legacy

The Water and Life project, as with all five SCEnaRioS projects, had three major deliverables as specified by ASTC:

- a short video representing the students' views on the issues they were investigating for showing at the Planet Under Pressure conference in March 2012.
- a presentation about each project and what the students had gained from their involvement for a Rio+20 side event held in Rio de Janeiro. This event was coordinated by ASTC and based around a live web link-up between each of the projects. Unfortunately, the time difference between the three Water and Life project countries and Brazil precluded a live link-up, so a video presentation about the project was instead created and broadcast at this event.
- a 'lasting repository' of the students' journals and work for further distribution by the ASTC, especially to science centers who were unable to participate in the pilot.

The videos for the Planet Under Pressure and the Rio+20 side event were created with the assistance of Questacon's Digital

Communications area. Both videos received significant exposure and excellent feedback from ASTC and event organizers, including praise from the Planet Under Pressure Co-Chair, who is based in Australia. These videos and events highlighted that the young people involved are concerned for the future of our planet and are actively involved in trying to increase awareness of these issues, within their spheres of influence. They have strong views and appreciate being given the opportunity for their views to be heard.

The students' work has been captured through PowerPoint presentations, videos, and animations, and will be made available to ASTC for their use in further promotion and possible extension of the project.

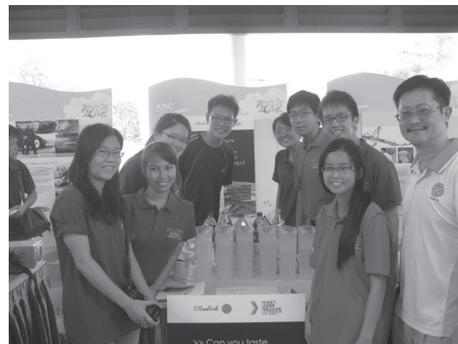
Through strategic exposure and publicity activities coordinated by ASTC at the two major global conferences, the SCEnaRioS project has served as a key platform to raise international awareness of the role of science centers in encouraging people, especially the younger generation, to explore, question, and discuss the science behind critical global issues.

On a more local level, the Water and Life pilot project has had a number of outcomes. It has enabled the participating students to learn about the similarities and differences in water issues between the three countries and has allowed them to interact with their peers from different countries and cultures, broadening both their knowledge and horizons. It has also provided Questacon, Guangdong Science Center, and Science Centre Singapore with a valuable opportunity to collaborate and learn from each other and to forge relationships between center staff. These relationships have been further strengthened by meetings at the annual conference of the Asia Pacific Network of Science and Technology Centres (ASPAC) in Singapore in April 2012.

Since establishing our digital videoconferencing system in 2008, Questacon has participated in a number of videoconference linkups with science centers, educational institutions, and leading scientific facilities, such as CERN. This technology has allowed us to expand not only the reach of our own programs, but has also provided our visitors with oppor-



Chinese student measuring fluorine levels in a water sample.



Students from Singapore conducting water tastings of NEW water and bottled water.

tunities to interact with some of the world's leading scientific experts and hear first-hand about their work and their career paths in science and technology. We hope that the implementation of videoconference systems in these two additional, critically located science centers will provide them with the same benefits, and ultimately lead to a strong, vibrant Asia-Pacific science center videoconference network for conversations across borders.

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HOW TO DESIGN TRANSFORMATIONAL EXPERIENCES IN OUR SCIENCE CENTERS AND MUSEUMS?

Asger Hoeg

The priorities of the youth of today are not the same as they were fifty years ago. The immense growth in welfare during the last fifty years has changed the perspective of our children and grandchildren. I claim that today the young generation of the Western World is sitting on the top of the Maslow's Hierarchy of Needs. With only one mission in their lives: To realize themselves. Since the dawn of mankind, the mission of *Homo sapiens* has been to reproduce himself – bringing our precious genes further on to the next generation.

But now our mission seems to have changed: Now we strive to realize ourselves.

The experiences that we deliver to our visitors in the science centers must be designed in the way that our visitors feel that a visit is one step further on their road to realize themselves.

Pine and Gilmore ("The Experience Economy", 1999) describe the most progressed offering – a transformation – as an experience where the person that have the experience is transformed – in one way or another. This offering is characterized in the way that the customer is the product. Pine and Gilmore call the customer "an aspirant", a person that aspires to be changed. The offering must be designed in the way that it is completely tailor-made to the aspirant. This means that the experience that we deliver must be individualized for each customer.

Henry Ford understood the need for tailor-made individual offerings to his customers: "Any customer can have a car painted any color that he wants so long as it is black".

Because of the industrial mass-production system based on the assembly line system, Henry Ford could NOT deliver a tailor-made individual product to his customers.

But today we can design and deliver mass-produced tailor-made and individual offerings to our customers with the help of IT!

Pine and Gilmore describe three steps for how to guide a visitor through a transformation: assess the aspirant, guide him through the individual designed experience and make a follow-up after some time.

How can we design this three step tailor-made individually-designed offering to our numerous visitors?

Experimentarium in Copenhagen, Denmark, is continuously building up our future exhibition concept: The Individual Exhibition (TIE) that aims to establish a one-to-one relation between the visitor and the "Exhibition".

The first time a frequent visitor meets TIE, the Exhibition kindly asks the visitors to sign in with name, sex, age, phone number, email, address, and language. The "Exhibition" asks some additional questions about the visitor's habits and interests. In that way, the Exhibition can build up a profile of the visitor. All this information is saved on the visitor's password protected webpage (TIE-webpage).

Building up the profile of the visitors is the first of Pine and Gilmore's three step solution.

Based on this profile, the Exhibition can begin step two and guide the visitor through the exhibition. The Exhibition can suggest particular exhibits that the visitor might be interested to experiment with. And each time some data has occurred during the experiment, this data will be saved on the visitors TIE-webpage. As time goes by, the Exhibition gets more and more information about the visitor and can guide the visitor better

and better (and be more and more tailor-made and individual).

When the visitor gets home and go on-line, she can browse her TIE-webpage and re-live the visit. In that way, we fulfill Pine and Gilmore's third step, the follow up.

The next time the visitor visits Experimentarium the Exhibition can give the visitor a special welcome and inform the visitor about what is new in the exhibitions and recommend what exhibits the visitors should work with.

During the visit, the Exhibition can challenge the visitor with assignments. And if the visitor solves the assignment, she can go to the Gift Shop and pick up the "Niels Bohr Certificate", Level 1, Level 2, or Level 10 depending on the degree of difficulty of the assignment!

The Exhibition can supply the visitor with additional information about one exhibit based on the visitor's level of interest and language. In that way, we can supply our visitors with additional information about the scientific content of the exhibits tailor-made to the interests and knowledge of the visitor.

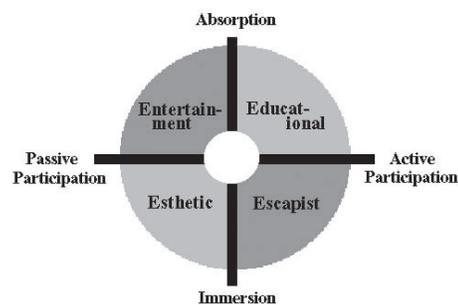
The communication between the visitor and the Exhibition is carried via the visitor's cell phone and the flow of information can be both via voice and written messages.

At the end of the day, the science center will have a very valuable file of data concerning its visitors: their interests, their preferences in the exhibitions, their email addresses, etc. The science center can inform its regular visitors with all relevant news - as long as the visitor accepts that she will receive emails from the science center. The science center also gets very useful information about how and how often the exhibits are used.

So, with the help of The Individual Exhibition, we at the Experimentarium hope to be able to guide the visitor through a tailor-made individual experience. And in that way, to build up a transformation in the visitor - as suggested by Pine and Gilmore.



Pine and Gilmore describe a coordinate system with the X-axis being whether the visitor is active or inactive participating in the experience and the Y-axis being whether the visitor absorbs or is immersed into the experience. This coordinate system shows four realms: Educational experiences, Entertaining experiences, Aesthetic experiences and Escapist experiences. Pine and Gilmore stress that to deliver a successful experience, it needs to involve all four realms.



I will claim that science centers have excellent abilities to design experiences that give the visitors educational and entertaining experiences. But I will also claim that we are less capable of designing experiences that immerse the visitors and bring them aesthetic and escapist experiences.

How do we design our experiences so that the visitor immerses himself in the activity??

Pine and Gilmore underline the need to obey the “**Four S’s**”:

First of all, we shall give our visitors **Satisfaction**. We shall deliver above expectation. If not, the visitor is far from being immersed in the experience.

We shall reduce the visitor’s **Sacrifice** as much as possible. When the visitor sacrifices (the exhibit is not working!), she is far from being immersed into the experience.

In our exhibition we shall **Surprise** our visitors (meeting the unknown giving rise to curiosity but also explaining the science behind the surprise).

And finally, we shall built up **Suspense**, so the visitor comes back, ready for a new Surprise.

Michael Kubovy describes in the paper “On the pleasures of the mind” (1999)

how we can give our visitors pleasurable experiences.

We must stimulate the visitor’s curiosity. And we must give the visitors the feeling of virtuosity.

Kubovy describes virtuosity as “the pleasure we have when we feel we are doing something well”. “Virtuosity is a pleasure that is present only in animals that play. It is a pleasure that is functional in altricial species that do not come into the world fully equipped to perform whatever tasks they need for survival”. “Curiosity is a far more primitive pleasure (although the human form of reflexive curiosity has no apparent evolutionary antecedent); it emerged out of foraging far earlier in evolutionary time than did play”.

Science centers shall guide the visitors through experiences where the curiosity is aroused and where the visitor can get the feeling of virtuosity. Then our visitors feel good!

Kubovy mentions two more objects of emotions that give pleasure of the mind: The pleasure of nurture (activities that for example involve child-rearing, nursing and teaching) and the pleasure of belonging to a social group (social activities like co-operating, discussing, competing, etc.).

Csikszentmihalyi (1990) describes a person’s feeling of flow. Flow can occur when the experience a person gets is neither too easy nor too hard; has clear goals; gives feedback and makes the person feel in control. The person is immersed in the experience so he forgets himself and his feeling of time slows down.

Apparently, Csikszentmihalyi suggests that when you create an experience that gives the visitor a feeling of virtuosity (not too difficult, clear goals and immediate response) you probably can bring your visitor into flow.

Reber, Schwarz and Winkielmann’s paper: “Processing fluency and aesthetic pleasure: Is beauty in the perceiver’s processing experience?” (2004), suggests that aesthetic pleasure is a function of the perceiver’s processing dynamics: The more fluently perceivers can process an object, the more positive their aesthetic response.



First, the authors describe how “objective” features of stimuli influence perceived beauty. They conclude that the higher figural goodness is perceived, the less information you have to extract from a stimulus. Therefore symmetrical figures are perceived as more beautiful than asymmetric figures simply because you only have to perceive 50% of the information! Vertical symmetry is easier to detect than horizontal symmetry, which in turn is easier to detect than diagonal symmetry. Vertical symmetry is perceived as more beautiful than horizontal and diagonal symmetry because vertical symmetry strongest support processing fluency.

Recognition speed – a standard measure of fluency – is faster for stimuli high in figure-ground contrast and visual clarity. Figure-ground contrasts and visual clarity are determinants of beauty because they influence processing fluency.

Secondly, Reber et al. were looking at factors underlying beauty depending on the history of the perceiver’s experience with the stimuli. They conclude that repeated exposure, implicit learning structure and prototypicality are factors underlying beauty. Again, the influence of these three variables can be traced to their influence on processing fluency.

So, in our science centers we shall try to design the experience for our visitors in a way that brings them into a processing fluency mode.

Flow and processing fluency are key words when we shall design our exhibitions!

How do we design our exhibitions so that we deliver educational, entertaining, aesthetic and escapist experiences, where we immerse our visitors, satisfy our visitors (beyond expectation), surprise our visi-

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tors, arouse their curiosity, let them feel virtuosity, let them nurture someone during the visit, bring them into social contact with our visitors, bring them in flow and give them experiences that influence processing fluency and in that way bring pleasures to their minds???

I suggest that we science centers make a paradigm shift and built our exhibition upon the Gesamt Concept.

In Copenhagen, we have witnessed a merger between the cultural institutions’ activities. By this, I mean that the cultural institutions have started to steal each other’s concepts! The Tivoli Gardens have built a very large aquarium. On the other hand, the new Danish Aquarium “The Blue Planet” will contain a whole science center exhibition on water. The Copenhagen Zoo is open on summer evenings (where most of the animals sleep) and invites the visitors to walk around in the garden like in Tivoli. And the National Museum and the Louisiana Museum for Modern Art long ago have established children’s departments where “Experimentarium-like” activities are conducted. And of course the Technical Museum of Denmark has science center exhibits.

Why do the cultural institutions start to blend concepts? Because they want to immerse the visitors into the experiences!

This blending of concepts has given me the idea that Experimentarium should learn as much as possible from the way our colleagues design their exhibitions and create a mix in our exhibitions that contains elements from art museums, natural history museums, technical museums, children’s museums, history museums, aquariums etc.

I call this the Gesamt Concept inspired by Richard Wagner. He built his Festspielhaus in Bayreuth with architecture and acoustic elements that optimally supported his music and the libretto of his operas. In the same way, we science centers should built up our exhibitions with elements from exhibits, natural history artifacts, pictures, film footage, pieces of

art, living animals (including fish), models, historical artifacts, computer games and amusement elements known from Tivoli Garden and Children’s Museum.

With such a mix of elements, the visitor gets a much richer experience: for example, she experiments with some exhibits on the brain’s ability to observe changes in our surroundings, then she is confronted with living animals (also fish!) extremely capable of camouflaging themselves, then she see pieces of art where the artist teases the visitor’s brain, then she is confronted with the most modern technique which can make things invisible (at least on a radar), then she tries exhibits where she learns about the 3D technique, then she is confronted with some assignments: Guess the animal (detailed pictures of strange animals) etc.

The mix of elements shall deliver an experience that challenge all the visitor’s senses, bring pleasures to their minds, lead them in flow and let them process the experience fluently so that they are immersed in the experience.

And a transformation occurs!

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References:

Pine, B. J. and Gilmore (1999): *The Experience Economy*, Harvard Business School Press.

Kubovy M. (1999): *On the pleasures of the mind*, University of Virginia.

Reber R., Schwarz N., Winkielman P.: *Processing fluency and aesthetic pleasure: Is beauty in the perceiver’s processing experience?* Personality and Social Psychology Review, 2004, Vol. 8, No. 4, 364 – 382.

Csikszentmihalyi, M. (1990). *Flow: The Psychology of Optimal Experience*. New York: Harper and Row.

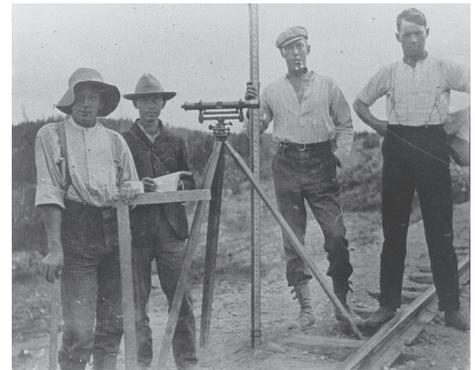
**CREATIVE USES OF HERITAGE SITES
DYNAMIC EARTH
A SCIENCE NORTH
ATTRACTION**

Guy Labine

The Sudbury Story

1.8 billion years ago, a meteorite created the Sudbury Basin, one of the world’s richest nickel deposits. For the past 115 years, the community of Sudbury has been home to one of the largest integrated nickel mining and processing facilities and today thousands of people are employed by this industry.

Dynamic Earth, the Home of the Big Nickel is a Science North attraction and presents the history and heritage of this industry through creative and innovative visitor experiences.



It’s a great example of a historical site being transformed into a significant science center focused on the geology and history of the community.

Science North History and Mandate

Science North is Northern Ontario’s most popular tourist destination and an important educational resource for the North. It includes four major attractions: the science centre, Dynamic Earth, an Imax Theatre, and a digital planetarium. Average annual attendance to Science North is about 400,000 visitors, including well over 35,000 young schoolchildren who visit the facility each school year in organized school visits. Science North is a major centre of informal science learning for school students and the general



population. The science centre is recognized worldwide as a leader in interactive science education.

Science North has educated, entertained and impressed visitors, school groups and others since 1984. It was developed with a pioneering style of science communication that engages its visitors. Through its evolution it has developed a pioneering style of "object theatres" which conveys various subject matters in a unique style and delivery.



The Big Nickel Mine

The Big Nickel, a national icon and the largest in the world, was the brain-child of a Sudbury fireman, Ted Szilva, and artist/sign maker, Bruno Cavallo. Their idea was to develop the coin to celebrate Canada's 1967 centennial. However, the centennial committee rejected their submission.

Undaunted, Szilva and Cavallo formed the Nickel Monument Development Corporation Ltd. (NMDC) and Szilva coined the phrase "The Big Nickel". The NMDC chose the 1951 Canadian five-cent piece as the model for the giant coin. The 1951 coin was designed by Canadian artist Steven Trenka and was issued to commemorate the 200th anniversary of the isolation of nickel as an element by Swedish chemist Baron Axel Frederick Cronstedt in 1751. The coin featured King George VI on one side and a nickel refinery on the other side. As Sudbury was the second largest producer of nickel in the world, it was the perfect place to locate The Big Nickel.

The construction project was undertaken in Cavallo's sign manufacturing workshop in Sudbury. Two vertical columns and several angle iron pieces made up the framework. The inside layer was a sheet of metal skin. Plywood was used for

the middle layer and the outer layer was stainless steel sheet metal. Upon completion, The Big Nickel weighed close to 13,000 kilograms (approximately 13 tons), stood nine metres (30 feet) high and was 61 centimetres (24 inches) thick. It is about 64,607,747 times the size of a real Canadian nickel.



The Big Nickel Then

In May, 1964, the nickel was erected and the Canadian Centennial Numismatic Park began operations. The nickel was unveiled at the official opening on July 22, 1964 in front of 2,500 Sudbury residents and dignitaries.

In 1965, an "underground experience" was added to complement the "numismatic park" theme. Szilva contracted the excavation of a vertical shaft and about 50 metres (164 feet) of underground drifts, as well as the construction of a simple headframe. Visitors descended in an elevator to follow a self-guided tour underground. Over the years, Cambrian College students worked at the Big Nickel Mine to extend the underground drifts, while meeting the practical requirements of their mining courses.

In 1981, Ted Szilva sold the Big Nickel and the Canadian Centennial Numismatic Park to Science North (Northern Ontario's future science centre). During the week of January 22, 2001, the Big Nickel was removed from its original base. Dismantled for refurbishing, this was the first time in almost 40 years that the nickel was absent from Sudbury's skyline. In April, 2001, the Big Nickel was temporarily relocated to Science North to accommodate construction on a brand new earth sciences centre on the Big Nickel Mine site and to allow visitors to have access to this important landmark during construction. It was moved

back to its traditional site on Big Nickel Road at the newly constructed Science North attraction, Dynamic Earth, on May 10, 2003.

Dynamic Earth – The Visitor Experience

The Dynamic Earth visitor experience is as diverse as the minerals it celebrates. It features two exhibit galleries, two object theatres, a digital HD theatre, and the 21-metre (70 feet) deep Inco Chasm and the Maclean Engineering Gallery for temporary exhibits. More than 550 metres (1,800 feet) of underground drifts enable visitors to see how the mining industry has evolved over the past 100 years.

The Earth Gallery

The Earth Gallery features our planet and the geological process that shape it. Its central icon is a large hand-painted globe that takes visitors on a tour of some of the most impressive geographic features of our planet. Interactive exhibits on plate tectonics, volcanoes, and earthquakes are set around Planet Earth to help visitors understand the ever-changing nature of our environment.

While visitors gain a better understanding of the Earth as a whole, Sudbury's rich geological history is also explored. The formation of the Sudbury Basin, its discovery and its development are highlighted through a number of exhibits. Visitors can create an impact crater, manipulate Sudbury Breccia and shattercones, study Sudbury thin sections, and view how a 10km wide meteorite created the riches of the region nearly two billion years ago.

The MacLeod Rock Gallery

The MacLeod Rock Gallery enables visitors of all ages to role-play and experience what geologists and/or miners do on a daily basis. Explora Mine is a three-level model mine for young children with equipment and tools adapted to their size. Wearing their hardhats and mining vests, the budding miners learn what the mining process entails by blasting rock,

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operating a skip, sending ore down a chute and moving the ore to the mill.

Budding geologists of all ages can identify a wide collection of rocks and minerals in the Rockhounds Lab while modern miners can learn about mining's technological advances and control underground equipment from surface in the Command Centre.

Nickel City Stories

Nickel City Stories is a Science North object theatre. Set in the Generations Barbershop, the 25-minute presentation uses a number of special effects to captivate the audience. Louie the barber, through the magic of pepper's ghost, comes to life to share with the audience the many stories he has heard in his shop about the establishment and evolution of the community. From the establishment of the CPR line in 1883 to today's mining and research innovations, visitors gain a better appreciation for the community's rich history.



The Inco Chasm Show

The Inco Chasm Show leads to the underground experience. To access the underground drifts, visitors board a glass elevator that takes them seven stories deep into the earth. Their voyage becomes the stage for a powerful multimedia experience in which the cavernous opening becomes alive with sound and light. Using moving screens and intelligent lights, visitors are taken to one of four different locations on Earth where the geology has had a profound impact on the culture of the local population. Visitors explore Tibet, the Andes, Hawaii, or Japan, and are immersed in the environment through the use of local artwork and music. Local narrators also add to the authenticity of the experience.



Going Underground!

At the bottom of the Inco Chasm, visitors don hardhats and embark on their underground tour. The guided 45-minute experience takes them through more than 550 metres (1,800 feet) of drifts that have been transformed to represent a mine of the 1900's, one of the 1950's and a modern mine. Throughout the mine, visitors meet and interact with

'miners' (staff and volunteers) from the past and present that invite them to participate at various stations and tell them some of the human stories associated with mining. Visitors can see first-hand how the Sudbury mining industry has evolved over the past 100 years and how mining has moved from dependence on strength to that of knowledge. The early mines required large numbers of men to break apart the rock. Today, men and women mine deep underground from the comfort and safety of a control room on the surface.



Exploring the Site

Outdoors, visitors can visit our Ghost Mine to look at mining relics or stand under the Big Nickel. This replica of a 1951 Canadian nickel was built in 1964 and symbolizes the wealth that Sudbury has contributed to the Canadian economy through nickel production. When the Big Nickel returned to Dynamic Earth on May 10, 2003 for the official opening, it was lit for the first time in history. The new base provides barrier-free access to this Canadian icon.

A mining playground and picnic areas are a place for families to relax. Interpretive trails provide a commanding view of the surrounding landscape and help visitors understand the rich geology of the rocks underfoot, the story of the Copper Cliff Smelting and Refining Complex, the re-greening of the nearby hills, and





the social history of Sudbury's west end community.

Xstrata Mining Gallery

The Xstrata Mining Gallery focuses on the latest innovations in mining technologies and looks not only at the extraction of ore but also at its processing and refining. Displays and activities portray modern mining in the Sudbury region as a high-tech, high-tonnage operation, and illustrate how today's technological innovations are allowing for deeper and "smarter" mining through the increasing use of computers, remote control, robotics, and improved communication systems. But the story of mining extends far beyond machines and technology; the economic, social, and environmental impacts are significant. Visitors discover how they too, are personally connected to the mining story, because almost everything we do and use in everyday life depends on the products of mining.



The Atlas Copco Theatre

This digital HD Theatre seats 125 people and offers video and live presentation programming. The theatre is equipped with several media technologies and provides high quality films dealing with the Earth. These films and videos provide continuous program change.

The theatre is also equipped with presentation technology for live demonstrations and lectures. It has high-powered slide projectors, video cameras to enlarge micro-experiments, and appropriate sound and lighting systems.

The theatre is also an outstanding facility for seminars and symposia and is used on a regular basis.



Conclusion

What started with a vision to create a site where visitors can see, hear and learn about Sudbury's close connection with geology and mining, and an attraction to draw visitors to the community, is continuing almost 50 years after it was first developed.

Science North has invested nearly \$25 million dollars in the past 10 years to transform what used to be the Big Nickel Mine into Dynamic Earth, a science center that connects visitors with mining, geology, and the environment. Using history and heritage to underpin the story, Dynamic Earth educates people of all ages on a key part of the fabric of the community of the City of Greater Sudbury.

We think it's a fitting and appropriate use of a heritage site to advance the science learning and engagement of our visitors.

Guy Labine is CEO of Science North, Sudbury, Ontario. He may be reached at labine@sciencenorth.ca.

NEW CLIMATE CHANGE INITIATIVES

Robert Mac West

Over the past decade, climate change/global warming and its causes, implications, and validity have become increasingly part of educational programs in both informal and formal educational arenas. There is voluminous and growing literature (online and on paper) on the subject, examining it from scientific, non-scientific, political, social and economic aspects. A substantial number of museums and science centers have exhibitions and/or programs that deal with the subject, and it is the focus of numerous presentations at national and international conferences. These include ECSITE – European Network of Science Centres and Museums; ASPAC - Asia-Pacific Network of Science & Technology Centers; ASTC – Association of Science-Technology Centers; AAM – American Alliance (formerly Association) of Museums; as well as others that are more geographically focused.

We have been tracking this in the ILR for the last five years, observing several trends. These include, in no particular order, concerns about and occasional reactions to political responses to the institutions' approaching/presenting the topic; introduction of multiple science disciplines into presentations of the topic; development of climate change programming across the world, with museums/centers on all six populated continents engaged; introductions of more interactivity and direct engagement with the audiences; and, very importantly, efforts to "personalize" climate change/global warming and make it more germane to the individual visitors and the specific location of the center.

The US National Science Foundation (NSF) has recently initiated a program, housed primarily in the Division of Undergraduate Education but drawing support from several other programs, that is providing substantial funding for these interpretive efforts. This is the Climate Change Education (CCE): Climate

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Change Education Partnership (CCEP) Program.

A recent set of six awards from the CCEP is moving the development of public presentation and discussion of climate change and its relevance to everyday life forward in some very interesting ways. Informal learning organizations are deeply involved in two of these initiatives; the full listing is at the end of this article.

Climate and Urban Systems Partnership (CUSP)

The CUSP is led by the Franklin Institute of Philadelphia, Steven Snyder, Principal Investigator. The description of the program includes materials quoted directly from the award abstract. As the name indicates, this program is aimed at "engaging urban residents in community-based learning about climate, climate-change science, and the prospects for enhancing urban quality of life through informed responses to a changing Earth. With over 50% of the world population and 76% of Americans living in urban areas, the urban climate is becoming the climate and environment experienced by the majority of the world's population.



The urban systems upon which these populations rely, including energy, transportation, water, and public health, face unique vulnerabilities to climate change." CUSP intends to develop a replicable model for providing climate education in urban environments. To that end, it includes partners in four metropolitan areas. It is taking advantage of the existing

community-based organizations (Urban Learning Networks – ULN) in Philadelphia, New York City, Washington, DC, and Pittsburgh. "CIUSP is coordinating programs and messages through three interlinked community platforms that reach residents in neighborhoods, online, and at city festivals.....These four, integrated community platforms comprise the CUSP model, connecting the interests and concerns of city residents to the urban systems on which city life depends, systems that are vulnerable to climate hazards and climate change."

PI Steven Snyder observes that the clear intent of CUSP is to highlight and understand the immediate issues of the urban environment as it is affected and modified by the changing climate. Everyday issues to be analyzed and addressed include transportation systems/how to get to work, water systems and quality, intense heat waves (such as those experienced this summer), numerous health issues, etc. These are immediate and relevant issues, not abstract and/or distant. The goal is to develop means of understanding them and then taking some action that will benefit urban residents in the near future, thus giving new meaning to the "green city" concept.

The early documentation of the project does not predict any specific educational and communications strategies. This implies that, while there may be some formal exhibition or museum floor programming development, they are not required strategies. I rather see that as yet another indication of the intentional broadening of the definition and community expectations of museums and science centers.

The partners in the CUSP initiative include the Franklin Institute, Philadelphia; the Columbia University Center for Climate Systems Research, New York; The University of Pittsburgh Learning Research and Development Center, and the Carnegie Museum of Natural History, Pittsburgh; the New York Hall of Science, New York City; and the Marian Koshland Science Museum of the National Academy of Sciences, Washington, DC. It is an interesting combination of informal learning organizations and climate change and global warming researchers,

with a strong focus on local implications of climate change for the broad public.

National Network for Ocean and Climate Change Interpretation (NNOCCI)

NNOCCI is led by the New England Aquarium Corporation, William Spitzer, Principal Investigator. As with CUSP above, the description of the program includes materials quoted directly from the award abstract. The network "strengthens the capacity of informal science education institutions (ISEIs) to increase public understanding of climate change and its impacts on coastal zones and marine life. Building on ISEIs' large audiences, interpretive capacity, and public trust, NNOCCI has a transformative impact on public science communication. The project's goals are to: (1) Expand interpretive techniques based on sound social science research; (2) Expand the emerging community of practice developed through the CCEP-Phase I planning grant; (3) Deepen content knowledge and communication skills of scientists and interpreters; and (4) Develop a resilient and replicable national infrastructure for reaching ISEIs and their public audiences."



This project includes The Association of Zoos and Aquariums (AZA), Silver Spring, MD; Frameworks Institute, Washington, DC; and the Woods Hole Oceanographic Institution, Woods Hole, MA. They will develop 14 Study Circles to provide professional development for interpretive staff working with climate scientists and cognitive/social scientists. Frameworks Institute brings substantial research into public perception of global warming, especially with regard to the marine environment: <http://www.frameworksinstitute.org/oceansclimate.html>. AZA's 224 member institutions provide the potential to reach large numbers of people through these improved interpretive skills.

"NNOCCI will ultimately engage millions of visitors to aquariums and other ISEIs in learning about the scientific processes



linking climate change and the ocean. The project's strategic impact is its potential to transform how these organizations present this topic and, ultimately, how they communicate other complex environmental or scientific topics that involve policy implications."

NNOCCI differs from VUSP in that it is explicitly oriented toward better and more comprehensive interpretation of existing and future exhibitions. This will allow aquariums and zoos to more directly address the complex issues of climate change and consequent environmental stresses on natural populations in ways that will encourage and stimulate visitors and not depress or alienate them.

Appendix I: Climate Change in The Informal Learning Review

Trautman, Charlie, 2007. Global Warming at European Museums, ILR 87, 1-7

West, Robert Mac, 2009. Challenging Climate Change Traveling Exhibition from the American Museum of Natural History, ILR 95, 10-12

West, Robert Mac, 2009. Examples of Climate Change Exhibitions, ILR 95, 11-15

Russell, Robert L., 2010. Climate Change Education: What's the Problem?, ILR 102, 22-24

Phipps, Molly, 2011. Global Warming's Six Americas, ILR 106, 15-17

Appendix II: Climate Change Education (CCE): Climate Change Education Partnership (CCEP) Program, Phase II (CCEP-II)

Climate and Urban Systems Partnership (CUSP), Franklin Institute Science Museum, Philadelphia, PA

CCEP-II: Polar Learning and Responding: PoLAR Climate Change Education Partnership, Columbia University, New York, NY

Making Global Climate Science Local: Implementing an Effective Model to Educate Key Influentials and Community Leaders, University of San Diego, San Diego, CA

MADE-CLEAR - Maryland-Delaware Climate Change Education, Assessment, and Research, University System of Maryland, Adelphi, MD

Pacific Islands Climate Change Education Partnership, Pacific Resources for Education and Learning, Honolulu, HI

National Network for Ocean and Climate Change Interpretation, New England Aquarium Corporation, Boston, MA

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LIVING THINGS

When you breathe, you inspire. When you do not breathe, you expire.

The body consists of three parts - the brainium, the borax and the abominable cavity. The brainium contains the brain, the borax contains the heart and lungs, and the abominable cavity contains the bowels, of which there are five - a, e, i, o and u.

Artificial insemination is when the farmer does it to the cow instead of the bull.

Blood flows down one leg and up the other.

Liter: A nest of young puppies.

Before giving a blood transfusion, find out if the blood is affirmative or negative.

There are 26 vitamins in all, but some of the letters are yet to be discovered. Finding them all means living forever.

The spinal column is a long bunch of bones. The head sits on the top and you sit on the bottom.

In spring, the salmon swim upstream to spoon.

The inhabitants of Moscow are called Mosquitoes.

A census taker is man who goes from house to house increasing the population.

INFORMAL LEARNING EXPERIENCES IS NOW IN DENVER, COLORADO

Effective August 22, the Informal Learning Experiences office is located at 1776 Krameria Street, Denver, Colorado, 80220.

While phone and fax have new numbers, our email and website addresses remain the same: ileinc@informallearning.com and www.informallearning.com. The new office telephone number is 720.612.7476 and the fax number is 303.321.0645. Please make these changes in your records as necessary.

Associate Alison Dineen stayed in suburban Washington, and will be working with ILE through the upcoming ASTC conference in Columbus, OH. She will be focusing on the Traveling Exhibits Database and the Traveling Exhibits Forum on Monday morning, October 15. She is managing the speaker list for that session.

We are joined in the Denver office by Associate Justine Gregory Dodson. Justine has degrees in History/English from the University of Tennessee-Knoxville and in Museum Education from George Washington University. Prior to joining ILE, Justine directed the Education program at the Country Music Hall of Fame and Museum in Nashville, TN, and also has served at the U.S. Holocaust Memorial Museum in Washington, DC



“Viruses,” continued from back cover

narrative and storytelling in education. He discussed two ways in which we as humans understand our experience. One he describes as *paradigmatic* – understanding something through a logical and scientific ordering of information. The other is *narrative* or stories. Journalists know that the best way to engage most readers is to tell a story. From the beginning of history and the myths of creation to fables to the novels, movies, and television dramas and reality shows, we are experiencing stories that have a subject and, in most cases, a beginning, middle, and end. Avaamidou and Osborne (2009) argue for the use of narrative in “...communicating science as a way of making it meaningful to and accessible by the public.”

In recent summative evaluations, I found that Soundprint’s storytelling was effective in helping listeners not only gain a deeper understanding of science research on climate change, but also to understand the human experience and meaning of the science. At the simplest level, these stories of the research scientists portrayed them as dedicated, hard-working, and curious. The focus of their research was understood within the context of a research question. In short, narrative can be an effective strategy for engaging interest in and understanding of science.

Approach to Evaluating Radio Documentaries

The same general approach was used in the evaluation of the radio documentaries of the three projects described earlier, including the documentaries produced for World of Viruses (Russell, 2010). The programs were designed to engage adults in developing a greater interest in the science topics presented and to enable them to gain a better understanding of the science research processes and concepts underlying the research. Adult participants were recruited who are listeners to informational public radio programs and who were reasonably representative of the demographics of the National Public Radio audience. Participants listened to radio documentaries prior to reporting to evaluation sessions. At the session, par-

ticipants filled out surveys where they were asked to describe “what the program was about” and to describe new concepts or ideas they learned from the program. After they filled out the surveys, participants took part in qualitative focus group discussions of the clarity, appeal, and impact of the programs.

Evaluation results for the Pole to Pole showed that when their survey responses were analyzed, 75% or more of participants were able to accurately describe new ideas or concepts they learned and specific research topics and techniques that were introduced in each of the programs. The focus group discussions revealed that the programs were effective in introducing the “nitty gritty” nature of the research and the scientists’ approach to research-that it is a process of inquiry and not just seeking data that supports prior views. Participants in the Out of This World evaluation were able to accurately describe the stories and social issues presented in each of the programs. (Table 1 summarizes the methods and results for these two evaluation studies.)

In both of the Pole to Pole and Out of This World programs, participants stated that they found the storytelling approach used in the programs very engaging and effec-

tive in helping them develop an interest in topics and concepts with which they were unfamiliar. In brief, the Soundprint programs resulted in significant cognitive impacts and were successful in deepening the interest and understanding than participants had of science research processes and concepts (Pole to Pole) and of social issues (Out of This World).

Methodology

For the World of Virus radio documentaries, 40 evaluation participants were recruited, using notices on neighborhood listserves and craigslist.com. The notice indicated that participants had to listen to five or more hours of news or informational programming each week. Those responding were asked questions to screen their background so that an appropriate mix of age levels and gender could be achieved. The recruited participants, as a group, paralleled NPR listener demographics, with higher education and income levels than national averages. Seventeen of the participants were male and 23 female. Ten participants were African-American; two were Asian; and two were Latino. Their ages ranged from 23 to 69 years old, with an average age of 44 years. Four evaluation sessions were conducted in 2012

PROJECT	EVALUATION METHODS	SAMPLE	RESULTS
<u>Pole to Pole</u> : Radio documentaries on polar and climate change research scientists (funded by NSF)	Written survey with open-ended questions followed by focus group discussion after participants listened to documentary segments	20 adults: radio listeners with NPR demographic profile	1. Over 70% accurately recalled science concepts & methods 2. Over 2/3 reported increased interest in polar research & climate change
<u>Out of This World</u> : Radio documentaries on the stories of the first African Americans and women in the space program (funded by NSF)	Written survey with open-ended questions followed by focus group discussion after participants listened to documentary segments	20 adults: radio listeners with NPR demographic profile	1. All participants identified one or more major social or historic themes in the programs Participants reported 2. Participants discussed their unfamiliarity with the civil rights issues in the programs and inspiration after hearing individual stories

Table 1: Summary of Evaluations of Radio Documentaries on Polar Research and the Social History of African American and Women Pioneers in Space.



with participants, including a written survey and a focus group discussion that followed. Each evaluation session lasted approximately 60 minutes.

Four evaluation sessions were held. Participants were asked to listen to two documentary programs one to three days prior to the session; each documentary lasted approximately 25 minutes. Two groups listened to segments entitled “Mosquitoes in Iquitos” (research on dengue fever) and “The Clinic” (HIV/AIDS research in South Africa). The other two groups listened to segments entitled “HPV: The Shy Virus” and “Flu Pandemic.” Participants had been informed that they would receive an incentive of \$50 for their participation, which they received at the conclusion of the session.

The documentary segments are briefly described below:

HPV, The Shy Virus: The Human Papillomavirus - or HPV - is a common virus that touches billions of human beings in one way or another - from a tiny wart on the hand to invasive cancer. HPV is a major health threat worldwide, yet mostly harmless. The virus can “hide” for years from a person’s immune system - with no apparent ill effects - then awaken and create deadly disease. The documentary tells the story of a virus that often doesn’t act as scientists expect it to - a puzzling, paradoxical virus. The program features research scientists as well as individuals directly affected by the disease.

Flu Pandemic: From pig to farm worker and back to pig – that’s the path of the perfect swine flu virus. Likewise, chickens and turkeys, not to mention geese and birds, are hot zones for pandemic flu viruses. In the past, when governments grew concerned about a particular flu, often they would isolate, quarantine or even kill animals that carried a suspect virus. Now, animal health and public health authorities are beginning to collaborate on more extensive bio-security. The documentary visits farms, fairs, and clinics to find out how surveillance is preparing for the next pandemic.

The Clinic: South Africa’s approach to HIV/AIDS has dramatically changed in recent years. For more than two decades,

a combination of government inaction, socio-political conflict, and controversial public health policies led to the situation that South Africa finds itself in today: home to the largest number of people living with HIV/AIDS. Now the country is trying to make up for lost time, both in prevention and in treatment. The government has launched an ambitious HIV/AIDS counseling and testing campaign that included 15 million people by 2011, with the goal of reducing the HIV/AIDS incidence rate by half. At public health clinics across the country, addressing the science of HIV/AIDS means addressing a litany of social problems, too. The documentary presents scientists, researchers, field workers, and patients as South Africa fights to slow the march of the virulent disease. Our program today is called The Clinic.

Mosquitoes in Iquitos: Iquitos, Peru, home to more than 400,000 people, is a living laboratory. Researchers there are tracing the spread of lethal dengue fever by going door to door in neighborhoods throughout the city. They’re mapping the spread of the virus, as well as the mosquitoes that carry it. The documentary producer follows researchers as they try to figure out what people can do to stop it.

(The full documentaries are available for streaming or download at: www.soundprint.org.)

At the beginning of the evaluation session, participants filled out a written survey in which they were asked for demographic data (age, race, education level), information on their radio listening habits, and their recall of the contents of the programs. They were also asked to respond to two questions for each program: “What was the program about?” and “Describe research topics or techniques presented in the program.” They were also asked to describe up to three new concepts or ideas they had learned from the programs about viruses. After filling out the surveys, participants took part in a focus group discussion, where they discussed the clarity, appeal, and impact of the programs.

Limitations of the Methodology

Since participants listened to the programs online and knew they would be participating in an evaluation study, their

listening experiences were clearly different from typical radio listeners who tune in and listen casually while driving or participating in some other activity. However, social science has a long tradition of using artificial contexts to test concepts, so this evaluation follows in this tradition, but the findings must be interpreted against this background.

Several specific limitations of this evaluation approach should be noted. First, no comparison groups were used, so the participants were used, in effect, as controls. They were asked to describe information that they were unlikely to have read or heard before and they were also asked to identify “new” ideas or concepts that they had learned from the programs. In short, the analysis assumes that the information was novel and that the participants truly reported new ideas or concepts they had learned, rather than merely supplying answers to satisfy the evaluator. Second, the listening experience was artificial; participants were probably more attentive to the documentary content, since they knew they would be participating in the evaluation session. However, participants were instructed to listen to the session only once and they were not informed about what specific topics they would be asked to respond to or discuss. Third, because no control or comparison group was used and no pre/post measures taken, the results that are reported are descriptive statistics; there were no appropriate tests of statistical significance that could be applied to the data.

Results

The results will first be presented for the written survey, followed by the analysis of the focus group discussions.

Written Survey Results: The survey asked participants to provide written responses to two questions for each of the two documentaries, followed by two questions about the two documentaries considered together. The evaluator categorized the responses. The results are summarized in Table 2. (page 20)

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On the first question, participants were asked, “Can you briefly summarize what the program was about?” Two-thirds (70%) or more of participants were able to describe what the program was about in a way that indicated they had understood one of the “big ideas” underlying the program. More than two-thirds (70%) were also able to list at least one correct response to the second question, “Please list any research topics, questions, or techniques discussed in the program that you can recall.”

Participants were then asked two questions about the two programs together. For the first question, participants were asked, “Please list up to three new concepts or ideas you have learned about viruses as a result of listening to the programs.” The 15 (out of 20) respondents who listed new concepts identified a mean of 1.9 concepts. For the second general question, participants were asked, “What more would you like to know about viruses, after hearing the programs?” Slightly over half (55%) of

the participants in the two groups that listened to “Mosquitoes” and “The Clinic” indicated they would like to know more by responding yes and/or listing one more items related to the programs or viruses. Three-fourths (75%) of the participants in the other two groups that listened to “HPV: The Shy Virus” and “Flu Pandemic” indicated “what more” they wanted to know by listing one or more items related to the programs or to viruses.

Focus Group Results: The dialogue from the focus group sessions analyzed here is combined, since the programs all addressed a common subject – viruses – and addressed the same broad topics. The four focus group discussions addressed several broad topics:

- Use of storytelling;
- Science learning;
- Motivation to learn more;
- Science research processes; and
- How to improve the programs.

The key themes that emerged within each of topics are presented below:

PROGRAM (N=20 for all items)	FOCUS GROUPS 1 & 2		FOCUS GROUPS 3&4	
	Mosquitoes in Iquitos (Dengue Fever)	The Clinic (HIV-AIDS)	HPV: The Shy Virus	Flu Pandemic
What was the program about?	75%	80%	80%	70%
List research questions, topics or techniques.	90%	70%	75%	70%

Table 2: Percent of Participants Providing Correct Written Responses to Open-Ended Questions

PROGRAM (N=20 for all items)	Mosquitoes in Iquitos & TheClinic	HPV: The Shy Virus & Flu Pandemic
List up to 3 new concepts	75% (listed at least one)	75% (listed at least one)
What more would you like to know?	55% (listed at least one more thing they would like to know about the topics)	75% (listed at least one more thing they would like to know about the topics)

Table 3: Percent of Participants Listing at Least One New Concept and Research Questions, Topics, or Techniques

Use of Storytelling: Overall, most participants were engaged by the storytelling approach. Typical comments were, “Great stories, enjoyable to listen to,” “I liked the stories with examples,” and there was a general consensus of participants that the storytelling approach was central to engaging their interest in the programs. They discussed several aspects of this approach that contributed to its success. First, the stories engendered an “emotional connection” with the persons portrayed in the documentaries; another commented that the programs were “Very sincere, very credible, very moving.” As one participant put it, “...basically it was a human interest story for us...” Another participant said, “But you have to create a human interest, you will lose the interest of the audience.”

Second, by engaging participants in the stories, the programs motivated learning. As one participant stated, “What I liked most about it, they gave you the facts at the beginning, then they gave you the testimonies about how it affected personal lives – this can be appreciated by someone listening to the radio.... they might not have learned the same information from Web MD or a source like that.”

An important aspect of the successful storytelling was timing. One participant said, “The narrative timing was good – presenting aspects of the musician’s (who was suffering from cervical cancer) life at the right times (supported engagement).”

The storytelling approach was more successful in some programs than in others. On “The Clinic,” one participant commented, the program was “more interview than storytelling.” A few participants stated they were more interested in hearing information than stories, but most participants agreed, “Stories encouraged people’s attention to the topic.”

Science Learning: In the written surveys, where participants were asked to identify up to three new ideas or concepts they had learned from the programs, three-fourths described at least one new concept they had learned and described a mean of 1.9 specific concepts. In the focus group discussions, participants discussed a rich variety of new ideas or con-



cepts they had learned as a result of listening to the programs. One example of a comment by a participant illustrates the richness of the learning: “(I) thought it was really well done, described what it was and how serious it is, that it takes years and years and years and then it takes off, that there are a hundred different kinds, that one woman had five different kinds...”

Participants not only identified specific examples of learning in the written surveys and discussions; some also characterized what they had learned as surprising: “(I) was really surprised by HPV’s ability to replicate...,” and “(I) was surprised by how in hog lots, chicken farms, how that is a spreader of the (H1N1) disease.” Another commented, “...was surprised by the fact that most viruses don’t cause illnesses...”

The storyline also provided a structure or scaffolding that supported learning. As one participant stated, “What I thought worked they are able to break down complex issues, doesn’t make me feel like I am in a class...” The stories were effective in “...combining facts and testimonies...” Another participant said, “Very informational and it gives very good background on HPV and why it is important....(I) knew something about HPV but it made me think about how it affects me...”

Motivation to Learn More: Participants were motivated to learn more about the topics presented in the surveys. In the written surveys, 65% of participants described at least one more topic or area they wanted to know more about. A majority of examples focused on learning more about the science underlying viruses or related diseases. Some typical comments were, “I’d be interested to know how this research of serious viruses may be applied to research on common ones like warts, colds, etc.,” “More about the transfer of the viruses via mosquitoes,” “are there any benefits to these viruses?,” and “do viruses constitute life?”

Some participants also wanted to know more about the political or social contexts of related research, as these comments illustrate: “I would still be inter-

ested in how some religions can still claim that a human being can be protected through prayer.” and “What policies are countries preparing to prevent deadly viruses from spreading.” and there was also interest in learning more about the level of public support for virology research.

Many participants were motivated by the impact of viral illnesses on their lives, as these comments illustrate: “The HPV program really scared me, like I need to learn more about it,” and “I would like to learn more about dengue fever and its prevalence where I work. I loved this program.”

Science Research Processes: Reinforcing the findings from the written surveys, participants described numerous research techniques and procedures they learned about from the programs. The storytelling approach was effective in engaging participants in learning about how scientists in the programs were conducting their research and about their dedication to research. As one reviewer commented, “Following researchers was a good technique.” The participants were particularly impressed by the story of Harald zur Hausen, who shared the 2008 Nobel Prize for medicine for his discovery of the link between HPV and cervical cancer. As one participant commented, “I liked the story of the scientist who everyone ignored, he was persistent – an inspirational science story – another reinforcing science story.” Another was amazed by his “obsession” with the research against all odds. They were also impressed by the passion of researchers and volunteers in Iquitos, Peru who were doing field research and prevention related to dengue fever.

Suggestions: Participants who listened to the sets of two groups clearly favored one of the programs they listened to when compared to the other. One group favored “HPV: The Shy Virus” over “Flu Pandemic.” The second group favored “Mosquitoes in Iquitos” over “The Clinic.” The focus group member comments indicated that the effectiveness of the storytelling was the primary reason they were more engaged by one of the programs in comparison to the other.

The specific elements of storytelling they referred to were:

- Engaging characters (e.g., the “passion” and “dedication” of scientists, the emotional story of a female musician with cervical cancer),
- Character development (e.g., “the story of the 4 year old boy was introduced and then dropped”),
- A coherent storyline (e.g., “didn’t see a consistent theme,” “the program wasn’t well organized”), and
- An emphasis on narrative vs. “telling” or a reciting facts and information (e.g., the program was “like reading a report in class.”).

In short, participants appreciated good storytelling and recommended that “Flu Pandemic” and “The Clinic” would have been even more engaging programs if they had used the elements of storytelling more effectively.

Many participants also wanted to know more about what personal actions they could take to address their own personal health or to prevent viral diseases from spreading. A typical comment was, “I was fascinated by the hundred kinds, how could you be checked for all those types? This was kind of alarming, what can I do about it?”

Several themes emerged from the qualitative analysis of the Virology focus group discussions. First, participants clearly favored two of the four segments that had a clearer storyline through a focus on one or two main “characters.” Overall, however, participants reported they were very engaged in the subject matter as a result of the storytelling approach. Second, participants recommended that more information about viruses be presented in the segments, but they also indicated they wanted the information presented within the storytelling or narrative framework. Third, for the segments that had immediate relevance for their personal lives, they would have liked more information about what actions they could take, such as when to get the vaccination for HPV. In brief, participants reported that they were generally engaged by the radio documenta-

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ries through the storytelling approach. They wanted to learn more and find out more about what they can do, but they wanted this information presented in a storytelling or narrative context.

Summary

Storytelling is an effective approach in engaging radio listeners. In the focus group discussions, participants stated that telling the stories of researchers and others affected by the science topics featured in the programs engaged and held their attention. They identified several aspects of storytelling that contributed to the format of engaging programs: engaging characters, character development, a coherent storyline, and an emphasis on narrative (as opposed to “telling”).

Radio listeners can learn new science from radio documentaries. In written responses to open-ended items and in focus group discussions, participants were able to accurately describe research techniques presented in the programs and to describe new concepts or ideas they had learned from the programs. In the written survey, more than 70% were able to describe a main theme or idea from the program and to describe research questions or techniques presented in the programs. Nearly two-thirds (65%) of the participants identified new concepts they had learned from the programs, naming a mean of 1.9 new concepts.

Radio listeners wanted to know more. In focus group discussions, participants often discussed wanting to know more about the topics and to know more about what personal actions they could take regarding their personal health or preventing the spread of the diseases discussed. In brief, listeners would have liked a “call to action” in the programs.

Science research processes are interesting. Participants discussed learning about research processes and techniques and found portrayals of research

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scientists to be "inspirational" and found the research scientists in the programs dedicated to their work. In brief, participants learned more from the programs than new concepts about virology. They gained insight into the motivations of scientists and insights into the specific research questions and techniques they used in their work.

In summary, Soundprint's radio documentaries helped participants learn new concepts about virology and gain insights into the scientists and how they went about their research on viruses. The programs motivated participants to want to know more; they were particularly interested in personal actions they could take related to the health practices and issues presented in the programs. Participants identified storytelling as key to engaging their interest in the programs and providing a context for learning new concepts and ideas.

References

Avraamidou, Lucy and Osborne, Jonathan. (2009) 'The Role of Narrative in Communicating Science', *International Journal of Science Education*, 31: 12, 1683 — 1707.

Bruner, Jerome (1991). "The Narrative Construction of Reality." *Critical Inquiry* 18, 1–21.

Russell, R. L., *Summative Evaluation of Soundprint's Pole to Pole: An Exploratory Study of the Impact of Radio Documentaries on Listener Understanding of Science Research on Climate Change*, *The Informal Learning Review*, 2010.

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AN EVALUATION STUDY OF RADIO PROGRAMS FOR WORLD OF VIRUSES

Robert L. Russell

This report presents the findings and analysis of an impact evaluation study conducted of a series of radio documentary programs produced by Soundprint Media Center to educate adult radio listeners about virology. The programs were supported as part of a National Institutes of Health, Science Education Partnership grant award (R25RR024267) to the University of Nebraska, Lincoln, for *World of Viruses*, a project led by Dr. Judy Diamond and featuring an entire suite of educational resources for students, teachers, and adults on virology (Figure 1). I designed and conducted the evaluation of the programs described in this report.

This report is organized in several sections: background information on the radio documentaries, the approach to the evaluation, a summary of the methodology used in the study, results, and summary.

Background

Soundprint is a seasoned producer of a weekly one-hour radio program, consist-

ing of two 30-minute documentaries.

The Soundprint program, now in its 25th season, is aired on 40 radio stations nationwide, reaching an estimated 350,000 listeners each program, based on ratings information provided by stations. Radio programs are distributed through public radio stations and national satellite radio. Soundprint has produced over 150 documentaries on science topics.

In the past four years, Soundprint has produced radio documentaries for three projects focusing on science. Like most of Soundprint's productions, these programs have used a storytelling approach to present science. In the NSF-funded Pole to Pole, the programs featured polar research scientists on site in polar regions. The NSF-funded Out of This World documentaries told the stories of the first women and African-Americans who served as scientists and engineers in the 1960's when the United States started its space program. In the NIH-SEPA funded World of Viruses, the focus of this report, the radio documentaries highlight biomedical researchers who are investigating virus-related issues such as the flu pandemic, HIV-AIDS, and dengue fever. The virology programs weave interviews with the scientists highlighting

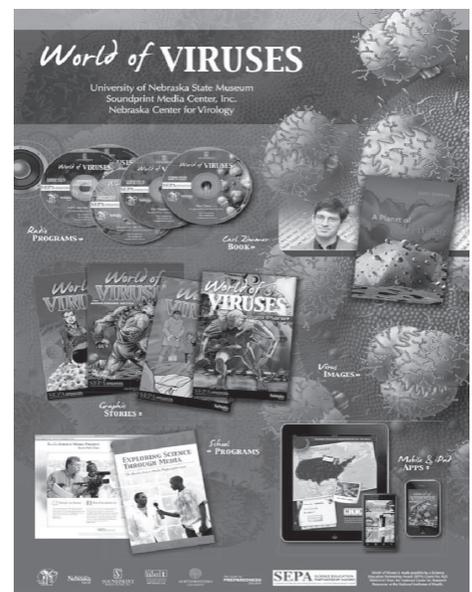


Figure 1. The SEPA-funded World of Viruses project created informal learning materials that include Soundprint radio programs, comics, a book by Carl Zimmer, iPad apps, and teacher professional development.

their research questions and activities together with stories of the lives of people affected by the research.

The psychologist Jerome Bruner (1991) has long argued for the importance of

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