

Web Casts as Informal E-Learning for Scientific Centers

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INTRODUCTION

The advent of global digital networking, chiefly the Internet, broadened access to cultural portals with various remote online education resources, providing a unique behind-the-scenes view of knowledge, and therefore re-established the visitor's own ability of self-learning. Science centers capitalized on that development, as they expanded their mission beyond lab assessments and hands-on interactive exhibits using Web casting with explainers; the most recent innovative technology for real-time demonstrations involve real and virtual scientific institutions. Hence, adopting a multidisciplinary perspective covering both the humanities and natural sciences such as biology, heritage, physics, civilization, informatics, theology, medicine, anthropology, and even law for visitors have become involved in topical debates. Web casting allows individuals to form their viewpoints on contemporary concerns ranging from genetic engineering and sustainability to space exploration.

This article is a revised version of a book article on the usage of Web casts covering two scientific institutions: La Cité des Sciences et de l'Industrie of Paris, France and the Exploratorium of San Francisco, California, United States. We examined creative approaches, in particular fields, to address innovative pedagogy within virtual scientific centers (Bernier, 2005).

SCIENTIFIC KNOWLEDGE AND THE PUBLIC UNDERSTANDING OF SCIENCE

Numerous ideologies from scientists, explainers, and other related-professions concerning the notion of science are presently confronted, especially how to approach innovation, phenomenon, and concepts through live demonstrations. Indeed, what constitutes promising ideas on a scientific basis? (Khun, 1977). Some may argue that scientific knowledge is more extensive than science itself, and thus should encompass what is happening nowadays to improve our lives (Barrow & Silk, 1994; de Rosnay, 1995), while others outline that the fundamental role of science is as much knowing humanistic problems and societal issues as developing our critical judgment on philosophical materialism, ecological deterioration, cultural segregation, medical failures, or democratic peace

(Barr, 2006; Brin, 2005; Diamond, 2005; Murphy & Margolis, 1995; Singer, 1994).

Science education generally fails because of inadequate communication and limited views, creating disinterest of the general public; thus, according to a study on several academics of the US Philosophy of Science Association, we found they held 11 different fundamental philosophical positions on scientific matters (Osborne, 2002). A common error is identifying current science with its public understanding, as science is defined by history and its contents, but also through its negative and positive impacts on society. These issues can be appreciated by familiarizing people with various existing philosophies as well as explaining the known, the unknown, and the unknowable.

Thus, the implementation of Web casts within discovery centers falls in line with the Public Understanding of Science—PUS (Bono, 2001; Durant, 1992; Hilgartner, 1990; Miller, 2000; Wynne, 1995), and more recently the Public Understanding of Research—PUR (Davis, 2004; Lewenstein & Allison-Bunnell, 2000; Ucko, 2004). Several important organizations contribute toward the popularization of science; to name a few, the Association of Science-Technology Centers (founded in 1973 and including over 400 science museums in 43 countries—www.astc.org), the American Association for the Advancement of Science (established in 1993, the world's largest nonprofit society dedicated to technological excellence—www.aaas.org), the UK Network of Science Centres and Museums (created in 2001 and affiliated with the European Collaborative for Science, Industry, and Technology Exhibitions, representing over 80 discovery centers—www.ecsite-uk.net/index.php), the established Committee on the Public Understanding of Science (set up in 1987 for promoting science activities in UK—www.copus.org.uk), and the International Network on Public Communication of Science and Technology (launched in 2001 and encouraging conceptual frameworks with practitioners—www.pcstnetwork.org).

The main accepted fact is that science is reliable knowledge about our world and needs to be redefined, because scientific paradigms evolve or are called into question. But how can these perspectives be transmitted and used by informal e-learning environments? What lessons can we draw from history at all levels? And which government representatives are willing to cope with major societal changes? The basic public understanding of research requires three elements:

the discovery process, actual research, and potential implications to convey the excitement of science (Ucko, 2004) with the help of private partnerships. All the previous views characterize today's Web casting in science centers.

THE EXPLORATORIUM

Live@Exploratorium: Creative Web Casts

The Exploratorium of San Francisco, occupying 110,000 sq. ft. as part of the city's 1915 Panama Pacific Exposition, was founded in 1969 by the physicist Frank Oppenheimer. It is regarded as the earliest science center and a pioneer of hands-on displays. In 2006, the budget was \$29,000,000 with 530,000 visitors yearly; its overall collection encompasses 650 interactive exhibits and contributed to partnerships with more than 35 science centers worldwide (Exploratorium, 2006). In May 2006, Dr. Dennis M. Bartels, a national science education expert and AAAS Fellow, became the Executive Director (ED). From 1991 until 2005, Dr. Goéry Delacôte was the ED and previously served as a chair of the French Research Scientific Council at La Cité in the 1980s.

Created in winter 1993, its Web site is among the first of the online science centers (www.exploratorium.edu) and gets about 20 million visits annually. It contains over 18,000 pages exploring hundreds of topics, produces 50 original Web casts and nearly 500 experiments for partner programs (e.g., *ExNET* in 1999) for over 4,000 schools (Exploratorium, 2006). The Exploratorium offers five main sections: Explore, Educate, Visit, Partner, and Shop. Among them, a great variety of *Online Exhibitions* in "Hands-on Activities" provide a certain consistency across the Web site (e.g., Planet Earth, Sport Science, Society, and Culture); subjects range from the Nagasaki bombing and skateboarding to stem cells, and more recently *What's Hot*, an online forum on cutting-edge science (e.g., nanotechnology). The Exploratorium aims at creating a culture of learning about science and technology through innovative material and tools, while focusing on cognition and laboratory apparatus, carefully designed to challenge the visitors' mind and senses (Delacôte, 1999).

In spring 1993, the Exploratorium extended its role in public educational programs with the Phyllis C. Wattis Web cast Studio, which has won the 2000 ASTC Award for Innovation, allowing up to a hundred individuals to attend networked events with international researchers remotely "whether working with NASA to broadcast a total solar eclipse from Africa, or visiting a penguin ranch near the South Pole" (Exploratorium: About Us, 2004). The concept *Live@Exploratorium* (www.exploratorium.edu/webcasts) was initiated with the "Hubble Space Telescope Servicing Mission" launch in February 1997. Between April 2001 and March 2002, the Exploratorium revisited Hubble, from which 13 Web casts were derived covering its tops achievements,

and later marked its 15th anniversary on April 26, 2005 with images of Eagle Nebula and Whirlpool Galaxy (www.exploratorium.com/origins/hubble/live/webcasts.html). Almost a thousand people interacted with scientists and explainers over 10 days, while 20,000 online visitors were invited to e-mail questions. "Hubble: A View to the Edge of Space" gained the largest audience, mostly men aged 50 to 70, with live transmission of the first Horsehead Nebula; the "Archive Web casts" of Hubble still attract 80 viewers each week (M. Alexander, personal communication, July 2004).

One year later, on February 26, 1998, there was "Eclipse: Stories from the Path of Totality" designed in collaboration with the NASA's Education Forum and Discovery Channel Online for showing a total solar eclipse during February, only visible from the Caribbean, Galapagos, and South America. NASA provided a high-bandwidth datalink for Aruba Island, while the Exploratorium organized a video feed for schools. There were more than half a million users and over 10,000 onsite visitors, compared to millions on television. *Solar Eclipse* gave birth to a series of six live Web casts (e.g., Greece in June 2004, USA in June 2002, Zambia in June 2001) (www.exploratorium.edu/eclipse/index.html). The most recent was Turkey on March 29, 2006, when another total solar eclipse occurred; several photos are available as the moon's shadow felt on Brazil and moving across the Mediterranean. (see Figure 1).

The 2004-05 season was particularly prolific, with over 10 demonstrations on the solar system: Saturn from Lick Observatory, A New Look at Phoebe and Titan: Up Close. In this respect, the feature *Saturn: Jewel of the Solar System*, tackling the "Cassini-Huygens Mission" investigating the Saturn's rings and the composition of its surrounding moons, has received the Scientific American Award in astronomy www.exploratorium.com/saturn/webcasts.html. The more recent Web cast found on the Exploratorium's homepage introduces us to "Watch Ancient Texts Revealed" (August 4, 2006) providing an interpretation of Archimede's original texts with an intensive X-ray, one the world's greatest mathematicians www.exploratorium.edu/archimedes/index.html. See Figure 2.

Other examples include the *Chain Reaction*, considered a very creative Web cast (April 11, 2001) designed by Arthur Ganson's MIT artist, who showed a theatrical play of physical mechanisms (e.g., roll, burn, grind) for passing energy from one object to another. At the very beginning of Web casting, the *Memory Lecture Series* (June-December, 1998) examined how memory affect your imagination, stress and aging, or the *Science of Wine* (November 17, 1999), an initiation of the basic components such as acid, sugar, and tannin along with its aromas. However, the three favorite Web casts are *The Accidental Scientist* for preparing everyday meals (e.g., roasting a turkey) and *IronScience Teachers*, where one creates a 10-minute lesson www.exploratorium.edu/iron_science/index.html. Both features were built for

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