

Citizen Science: A Roadmap for Science Centres and Museums

SAKET SINGH KAURAV

Curator, Nehru Science Centre, Mumbai, Maharashtra, India

Email: saket.kaurav@gmail.com

ABSTRACT

The modern era of fundamental sciences is demanding involvement of the general public in scientific research. Over the past decade, there has been a rapid increase in the diversity and scale of citizen science. Initiatives range from crowd sourcing activities, in which the time and effort of large numbers of people are used to solve a problem or analyse a large dataset, to small groups of volunteers, who are experts in their own right, collecting and analysing environmental data and sharing their findings. Now, using the power of the Internet and local platform of science centres, non-specialists/scientists can participate in world-class scientific projects for effective and useful production of scientific results in time. The emerging field of citizen science has potential to become one of the strongest pillars for science communication through science centres. This article discusses how citizen science can be benefitted with the involvement of science centres & museums. It also brings the subject in front of the professional science communicators for detailed discussions about its feasibility and appropriateness for science centres & museums in the years to come.

KEYWORDS: Citizen Science, Science Museums/Centres, Public Participation, Scientific Research

Introduction

‘Citizen Science’ is a fairly new term but an old practice. Prior to the 20th Century, science was often the pursuit of gentleman scientists, amateur or self-funded researchers such as Isaac Newton, Benjamin Franklin, and Charles Darwin. By the mid-20th Century, however, science was dominated by researchers employed by universities and government research laboratories. By the 1970s, this transformation was being called into question.

Philosopher Paul Feyerabend called for ‘democratization of science’. Biochemist Erwin Chargaff advocated a return to science by nature-loving amateurs in the tradition of Descartes, Newton, Leibniz, Buffon, and Darwin — science dominated by ‘amateurship instead of money-biased technical bureaucrats’. Rick Bonney is credited with coining the term ‘citizen science’ in the 1990s. Citizen science has evolved over the past two decades (Rosner, 2013). Recent projects place more emphasis on scientifically sound practices and measurable goals for public education.

Why Citizen Science is Important

Modern Citizen Science differs from its historical forms primarily in the access for, and subsequent scale of, public participation; technology is credited as one of the main drivers of the recent explosion of Citizen Science activity. Science centres possess an immense potential to accelerate the objectives of citizen science using the existing infrastructure and global network.

Research often involves teams of scientists collaborating across continents. Now, using the power of the Internet, non-specialists are participating, too. Citizen Science falls into many categories. A pioneering project was SETI@Home, which has harnessed the idle computing time of millions of participants in the search for extraterrestrial life. Citizen scientists also act as volunteer classifiers of heavenly objects, such as in Galaxy Zoo (Hand, 2010).

The Zooniverse is home to the Internet’s largest, most popular and most successful citizen science projects. Many current projects are already running but plenty more are on the way, where science centres can play an important role. Science centres can also devise their own projects to cater to the need of educational programmes. But there are limitations for network-based citizen science projects:

- They all depend on the Internet and its users
- Promotions and awareness about such projects beyond the Internet users is limited.

This is the area, where science centres can contribute a lot using their already globally established network.

Conducting research by using Citizen Science has several advantages, including:

- The ability to cope with extremely large data sets — we can provide many person-years' worth of classifications.
- Unlike work by a small number of experts, our ability to gather multiple independent interactions with the data provides quantitative estimates of error.
- Citizen science data sets naturally large and powerful training sets for machine learning approaches to classification problems.
- Serendipitous discovery is a natural consequence of exposing data to large numbers of users, and is something that is very difficult to program into automatic routines.
- While the primary goal of such projects is to produce academic research, by their very nature they are also outreach projects. As it involves volunteers directly in the process of research, citizen science is a powerful tool for both formal and informal education.

From this perspective, the involvement of Science Centres in Citizen Science Projects will make a larger impact on accessibility of scientific datasets. At the same time, it will be immensely helpful in creating interest in the field of basic sciences among the general public, and students in particular. Citizen Science may become an important pillar for Science Centres to develop new educational programmes and activities for public participation and engagement in scientific research. It needs new initiatives from the science centre community from scratch to design and develop facilities for Citizen Science across the globe.

Citizen Science: A Gateway of Innovation through Science Centres

Innovation today is increasingly going beyond the confines of formal R&D to redefine everything. Today innovation can mean new and unique applications of old technologies, using design to

develop new products and services, new processes and structures to improve performance in diverse areas, organisational creativity, and public sector initiatives to enhance delivery of services. Innovation is being seen as a means of creating sustainable and cost-effective solutions for people at the bottom of the pyramid, and is being viewed as an important strategy for inclusive growth in developing economies. In combination with Science Centres, it can trigger the pace of innovation in a fruitful manner.

Notwithstanding the need for more Science Centres to cater to the current billion plus and future Indian population, the National Innovation Council (NInC), Govt. of India in partnership with the National Council of Science Museums (NCSM), National Museum of Natural History (NMNH) and others, seeks to showcase models of promoting innovative spirit and enhancing the impact of Science Centres (NInC, 2012).

NInC proposes the following to strengthen the existing Science Centres in the country:

- 1. Enhance Interactivity:** Populate Science Centres with more interactive exhibits, while leveraging locally available resources to showcase science in a hands-on manner.
- 2. Showcase Innovation:** It is proposed that all Science Centres should focus on showcasing innovations on a regular basis. The section should house successful application of scientific discoveries, effectively relaying stories of stalwarts and innovators among others to portray application and benefits derived from science in day-to-day life.
- 3. Improve Outreach:** Examples of innovative ways of taking science to remote areas using buses, science train and others exist. Yet, there needs to be a renewed focus on interacting with the local communities better and attracting them to leverage the facilities at the Science Centre.

Focusing on these will also accrue benefits to the Science Centre in becoming more receptive to the audience and also moving towards self-sustenance, which will further help to boost

the field of Citizen Science. Such initiatives could thus creating a favourable atmosphere for innovations.

Public Involvement in Scientific Research

Public participation in scientific research is not new. Light-house keepers began collecting data about bird strikes as long ago as 1880; the National Weather Service Cooperative Observer Program began in 1890; and the National Audubon Society started its annual Christmas Bird Count in 1900 (CAISE, 2009). Throughout the 20th century, thousands of public volunteers participated in projects to monitor water quality, document the distribution of breeding birds, and scour the night skies for new stars and galaxies. The current concept of Citizen Science, however, with its integration of explicit and tested protocols for collecting data, vetting of data by professionals and inclusion of specific and measurable goals for public education, has evolved primarily over the past two decades (Bonney, 2009).

Science Centres and Museums across the globe are already providing interactive, engaging and immersive experiences for their visitors. Citizen Science project corners in Science Centres could be appropriate platforms for the public for getting early involvement in scientific research. A facility like the Nano Lab in Science City, Kolkata, is an example of early involvement of students in scientific research. Another example is the new add-on facility 'Innovation Hub' set-up by the National Council of Science Museums initially at Birla Industrial Technology Museums, Kolkata, Visvesvaraya Industrial & Technological Museum, Bangalore, Regional Science Centre, Guwahati, National Science Centre, New Delhi & Nehru Science Centre, Mumbai, which is going to play a pivotal role in developing scientific temperament among school students, a primary requirement for learning the method of scientific research (Islam, 2014).

Mode of Participation

For public participation in scientific research, some challenges would have to be met. For one, how do we knit together the vastly different goals and project types? Researchers have tried

to catalogue projects, but at a fundamental level Citizen Science projects fall into two categories: those where the public directly serves the scientists and those where the scientists directly serve the public.

Galaxy Zoo, home to some of the world's best astronomical information, began with a group of postdoctoral researchers drowning in downloads from the Sloan Digital Sky Survey. Galaxy Zoo now includes images from the Hubble Space Telescope and has spawned a family of online citizen science projects called Zooniverse, in which volunteers help to make sense of data. Zooniverse's nearly 720,000 participants transcribe weather observations from World War I warships, identify species in photographs from the seafloor and categorize whale calls. The scientists benefit from all these projects (Rosner, 2013).

Science Centres can play crucial role in developing citizen projects with the help of the scientific community but there is a need for intensive brainstorming sessions among science centre professionals and scientists to chalk out appropriate and efficient methods to bring about fruitful participation. The mode of participation depends on the nature of the Citizen Science project — if a project needs access to the Internet then there should be a dedicated and tailored educational programme as per the project requirement, but if the project is open then mode of participation will be different.

Framing new projects needs collaborative exchange between the scientific community and Science Museum/Centre professionals so that transformative approach for the projects may be devised and a corresponding model for developing a Citizen Science project can be applied.

Future of Scientific Research through Science Centres

Citizen science is simply a different way of producing scientific knowledge. One of the most important contributions of Citizen Science may ultimately be to spread scientific literacy by exposing people to the process of science through the platform of Science Centres. Science Centres' endeavour of increasing an understanding of the scientific method, involving people in the

nitty-gritty of science through Citizen Science projects may become one of the major milestones for their informal science educational programmes. Whether it is learning the difference between elliptical and spiral galaxies, discovering how a protein's structure determines its function, helping to count wildlife or deciphering the chemical composition of a local stream, the act of directly engaging with science can be a transformative approach for science centres as well as the scientific community. The concept of Citizen Science is totally new for the Science Centres, which therefore require dedicated intensive brainstorming and idea exchange platforms among science centre professionals, science communicators and scientists.

Acknowledgement

The author is extremely thankful to Shri Shivaprasad M. Khened, Director, Nehru Science Centre, Mumbai for giving his invaluable guidance and suggestions time to time to encapsulate a nuanced understanding of the subject and his motivational encouragement for doing curatorial research. The author is also thankful to Shri S.P. Pathak, Curator, Nehru Science Centre, Mumbai for his creative inputs and using analytical reasoning in the work, whenever addressing the subject of larger interest, especially from the point of view of science museums and centres.

References

- A CAISE Inquiry Group Report (2009) Public Participation in Scientific Research: Defining the Field and Assessing Its Potential for Informal Science Education edited by Bonney R, Ballard H, Jordan R, McCallie E, Phillips T, Shirk J and Wilderman C, *Center for Advancement of Informal Science Education*, (CAISE):15.
- Bonney R, Cooper C B, Dickinson J, Kelling S, Phillips T, Rosenberg K V and Shirk J (2009) Citizen Science: A Developing Tool for Expanding Science Knowledge and Scientific Literacy, *BioScience*, 59(11): 03.
- Hand E (2010) People Power: networks of human minds are taking citizen science to a new level, *Nature*, 466(5): 03.
- Islam E (2014) Innovation Labs in Indian Science Centers, Exhibit Case Studies, Dimension (ASTC) at www.astc.org/blog/2014/01/06/exhibit-case-studies/

National Innovation Council (2012) Inspiring India's Scientific Temper for Innovation, National Innovation Council, Government of India, *Report to the People*: 40.

Rosner H (2013) Citizen Science: Data on Wings — A modest effort to enlist amateur bird-watchers in the cause of ornithology wound up producing a fire hose of data and helping rewrite the rules of science, *Scientific American*: 06.