

Open Science and Research Communications

Sarah Currier, June 2011

What are the strategic issues involved in supporting open science in HE institutions and beyond?

The fifth in our series of occasional discussion papers on developments in academic communications focuses on open science as a continuum of research practices. This continuum has two facets: (1) open access to research data, processes, materials and results; and (2) openness of participation, including citizen science. What needs to be considered in deciding which level of openness to support in science, and how can it be supported?

Why Open Science?

For centuries scientists have tested, confirmed, challenged, and built on the work of others. Now, the technological possibilities for communications and for generation, storage and analysis of massive amounts of data could provide more openness of access and participation than ever before, with potential for exponential increases in human knowledge.

There is also an emerging sense amongst the general public, spurred by recent events such as 'climategate,' that publicly funded data should be available to the public.

However, the tensions and constraints brought to bear by traditional academic rewards systems, career structures, publishing and intellectual property rights are holding much of this potential at bay.

What is Open Science?

Open science allows anyone beyond a research team to access, contribute to and collaborate with the research effort, with data, results and protocols made freely available at different points along a continuum of openness.

The open access (OA) movement, attempting to ensure the availability to all of peer-reviewed research papers, is at one end of the open science continuum. Closely allied to this is an emerging requirement for the scientific data underlying research papers to be made openly available at the time of publication.

The open science continuum goes further than this, however, encompassing a range of approaches to making protocols, materials, laboratory notebooks and results available more or less openly at different stages of the research process. This continuum is represented at its most radical by open notebook science, whereby researchers' thoughts, ideas, methods and results are shared with the world simultaneously with writing them up for themselves.

Citizen science is about open public participation and engagement with research, and brings its own challenges, as well as rewards undreamt of by past generations of scientists. Citizen science involves using non-professional volunteers to perform research-related tasks such as observation, measurement, and data analysis.

Open Science: A Strategic Challenge

The challenge for universities, policy-makers and funding bodies is to make sense of how open science will benefit them and their stakeholders, through maximising return on investment in science. Of key importance is identifying how best to navigate the tensions inherent in this time of social and technological change with a clear strategic vision. That these tensions will be different across different scientific disciplines (as well as in the humanities and social sciences) increases the complexity of the task.

Understanding the Benefits of Open Science

The benefits of open science include:

- improving the efficiency of research;
- promoting scholarly rigour;
- improving the quality and scope of scientific results;
- increasing the pace of discovery;
- improving scientific engagement and literacy for the public;
- increasing the economic and social impact of research, including providing new opportunities for innovation.

Benefits of citizen science include:

- the ability to more fully utilise extremely large data sets;
- the ability to gather multiple independent interactions with the data;
- provision of large, powerful training sets for machine learning;
- serendipitous discovery from exposing data to large numbers of users.

A secondary, but still important benefit is that citizen science is a powerful tool for public education about specific sciences, and about the scientific method itself: scientific literacy.

Barriers, Risks and Constraints on Open Science

Most barriers to wider uptake of open science lie in the current rewards culture within academia. University funding, research grants and individuals' careers are ultimately tied to publication and citation, which are themselves tied to the publishing industry and its constraints on open sharing. Open and citizen science are still niche activities found in a few areas of science. Lack of openness means that vast swathes of knowledge are inadequately exploited.

There are other constraints which prevent moving forward. A wider constituency could potentially be convinced to take more risks with openness if these issues were addressed, even without solving the core problem noted above. These concerns include:

- fears around misinterpretation of data, wrong data being released too early, or being scooped;
- the lack of usable tools to ease data sharing and curation costs;
- the need for new skills, roles and career structures in scientific informatics, scientific data curation, and Web and database design and development;
- more broadly, the lack of a sustainable technical infrastructure not reliant on short-term project-based funding.

Problematic areas for citizen science include:

- concerns about the quality of science produced;
- assumptions that, due to technological developments, humans aren't, or very soon won't be needed for any task;
- concerns about exploitation of volunteers;
- the need for extremely careful expert design of protocols, user interfaces and software, including scalability;
- and the failures of some projects due to misunderstanding what citizen science is for, i.e. if the focus is on PR and not science then the project will fail, which is bad for the participants, and for public perception of citizen science and science generally.

Strategic Issues for Supporting Open Science

Issues that government, funding bodies, universities and other organisations with a stake in science need to consider are:

- Firstly, developing a policy on open science, and developing and enforcing a strategy in support of that policy. At this stage, requiring open access publication of research papers, and open publication of supporting datasets, are the most important steps.
- For those funding bodies and other organisations who already require open publication of datasets alongside research papers, ensuring these requirements are enforced is essential.
- If funding bodies and other organisations are requiring open publication of scientific data, appropriate technical infrastructure must also be funded. Most universities don't have the economies of scale to meet requirements for skills and infrastructure.
- Support for and provision of open source tools for use in laboratories, and within and across research teams. Usability, integration into existing software ecosystems, and support services are essential for uptake.
- Building on current efforts to examine alternative academic reward structures, including rewarding open sharing and reuse of data, methods etc. alongside citation of formally published papers. Once people's careers are no longer dependent on citations of published papers in a few high-status journals, open sharing will become more attractive.

- For citizen science in particular, but also for more developed areas of open science, provision, at national, regional or discipline level, of advocacy and support services for project development will save on time, resource and expensive mistakes.
- Developing strategic funding provision in support of appropriate roles and career structures for scientific informaticians, scientific data curation professionals, and Web and software developers with open and citizen science specific interests and skills.