Script To Science 2.0 For Scholarly Communication

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Abstract

This article attempts to trace the evolution of scholarly communication from the days of publication of Journal-des-scavans to the era of web 2.0. Explains the Open Access (OA) movement in brief. The views of Harnad (7) on OA are highlighted. The emergence of Open Access 2.0 is put in context. The authors also explain science 2.0 as the emerging practice in scientific knowledge sharing and scholarly communication. The positives and drawbacks of science 2.0 are discussed. Some of the science 2.0 concepts like OpenWetware, PLoS and other science 2.0 systems used in scientific research for communication as put forth by Hooker and Surridge are cited to indicate that science 2.0 is the future for scholarly communication.

***K*eywords:** Scholarly Communication, Open Access, Web 2.0, Open Access, Science 2.0, OpenWetware, PLoS.

1. Origin of Scholarly Communication

The origin of scientific communication through a formal means such as, a journal dates back to 17th century, when a group of scientists described to move from scripting to printing research results. Firstly the socio - technological changes like the invention of printing and postal services in the western world combined with the change in the attitude of the scientists to move from script to print lead to the starting of the concept of knowledge sharing. Another significant shift was that the scholars were active in conducting experiments, observations and the knowledge ,thus produced was being shared through the ancient art of writing. Therefore prior to the origin of journals, knowledge sharing was based on writing communication among scientists. Scientists like Sir Isaac Newton and Hooke largely depended on extensive communication. Such correspondence would often be disrupted because of time, distance and geographic barriers, issues of maintaining secrecy among competitors etc. In the 16th and the 17th century the speed and periodicity in print increased and correspondence was more regular in the from of annual book catalogues, newsletters, almanacs and newspapers (1).

2. Genesis of The Scientific Publishing

'Scientific publishing dates back to 1665 when Henry Oldenburg launched Philosophical Transactions of the Royal Society of London and Denis de Sallo, in France, published the first volume of the first print journal called Journal des Scavens on January 5, 1665. Because of its convergence and periodicity (2), this journal was known as a scholarly serial. To maintain quality and higher standards, the system of 'peer review' was introduced, which indeed helped in building the body of scientific literature, scientific reputation, increases the status of the university and institute research. This was going on for nearly 300 years. That is the reason why libraries subscribed to core periodicals in several disciplines. This system of peer reviewing although valuable was not free from

flaws like time lag in publishing new ideas and delay in sharing knowledge.

Followed by this were the problems of escalating cost of production of periodicals, distribution, access, and marinating quality with the rigor of peer -reviewing. Libraries dropped subscription of journals due to lack of funds and price escalation. Naturally the users were deprived of many reputed print journals in their specific fields of interest as well as research and a loss to the library collection (2)

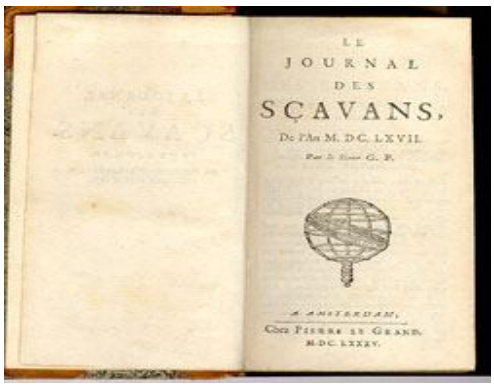
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Fig 1. Title page of the *Journal des scavans*, Volume 2, 1667. Amsterdam: Pierre LeGrand, 1685. Collection of the University of British Columbia.

source: http://www.slais.ubc.ca/COURSES/libr500/fall1999/WWW_presentations/K_MacDonell/origin.htm

♦ Apart from writing and using well researched and peer reviewed journal articles, scientists also use other patterns of communications. They are - short communications, Letters, Notes, supplements to the articles, reviews etc.

- Letters (also called communications, and not to be confused with letters to the editor) are short descriptions of important current research findings, which are usually written for sharing research ideas, experiments and methods etc.only to communicate science.
- Research notes are short descriptions of current research findings which are considered less urgent or important than Letters
- Articles are usually between five and twenty pages and are complete descriptions of current original research findings, but there are considerable variations between scientific journals for instance, 80 page articles are quite common in mathematics and theoretical computer science.
- Supplemental articles contain a large volume of tabular data that is the result of current research and may be run to a number of pages containing, mostly numerical data. Some journals now publish only this type of data on the Internet.
- Review articles are very lengthy and indicate current trend in research in a particular discipline and on a given topic. They are state-of-the-art type. Examples of reviews include the 'Nature Reviews' series of journals and the 'Trends in' series, which invite experts to write on their specialization and then have the article peer reviewed before accepting the article for publication. Other journals, such as the Current Opinion series, are less rigorous in peer reviewing each article and instead rely on the author to present an accurate and unbiased view. Review articles provide information about the topic, and also provide journal references to the original research (3).

Today with the emergence of open access and web 2.0 tools, the communication of science is instant and quick. For example: www.3quarksdaily.com. Thus a modern tool like blogging is as good as short communications.

3. Scholarly Communication Studies Today

Some of the well known authors such as Garvey (4), Nagami (7), Peset (8), Zaya and Metamski (11) discuss that communication is the essence of scientific knowledge and research. Sandstrom (9), Barjak (1), Smith (10), Fernandez (3) have examined science communication in a sociological system, the role of Internet and electronic communication. Crawford, Hurd and weller (2) have studied the transformation of print to electronic scientific communication. Kaser (6) has studied the evolution of scientific communication. Garwey and gottfredson (5) presents scientific communication as a social process. Therefore, in this context the current methods of communication such as open access, web 2.0 to science 2.0 are also the obvious scientific social communication processes.

4. Open Access (OA) Reality

Waldrop (1) interalia states that according to Surridge, "Science happens not just because of people doing experiments but because they are discussing those experiments," Critiquing, suggesting, sharing ideas and data - this communication is the heart of science, the most powerful tool ever invented for correcting errors, building on colleagues' work and fashioning new knowledge. Although the classic peer-reviewed paper is important, "they're effectively just snapshots of what the authors have done. They are not collaborative beyond that, except for rudimentary mechanisms such as citations and letters to the editor."

According to Bill Hooker (1), a postdoctoral cancer researcher at the Shriners Hospital for Children in Portland, Ore., and author of a three-part survey on open-science efforts that appeared at 3 Quarks Daily (www.3quarksdaily.com), where a group of bogglers write about science and culture. Web 2.0 technologies open up a much richer dialogue, he says "To me, opening up my lab notebook means giving people a window into what I am doing every day". He continues by saying "That's an immense leap forward in clarity. In a research paper, one can see what the authors'/ researchers' have done. But one doesn't know how many things the authors/ researchers tried that didn't work. It's those little details that become clear with an open (online) notebook but are obscured by every other communication mechanism we have. It makes science more efficient." That jump in efficiency, in turn, could greatly benefit society, for example, in everything from faster drug development to greater national competitiveness.

In principle, Surridge says, scientists should find a transition to Web 2.0 perfectly natural. After all, since the time of Galileo and Newton, scientists have built up their knowledge about the world by "crowd-sourcing" the contributions of many researchers and then refining that knowledge through open debate. "Web 2.0 fits so perfectly with the way science works. It's not whether the transition will happen but how fast," he adds.

Open access is free, quick, instant, and hassle free online access to full text of research articles web wide for anyone-anywhere. According to Harnad (4) there are two popular paths to OA- (i) THE GOLDEN ROAD AND (ii) THE GREEN ROAD.

(i) THE GOLDEN ROAD - of OA journal publishing is that the journals themselves provide articles.

(ii) THE GREEN ROAD - of self-archiving, where authors provide OA to their own published articles, putting their articles in e-prints free for all.

Both the paths of access are good and complimentary to each other but the green path is faster and will reach 100 percent OA. He is also of the view that, there are two kinds of Open Access - 'Gratis and Libre'. "Gratis" means free online access and "Libre" means free online access plus certain re-use rights.

Benefits of OA are many, which include –

- Scientists benefit from speedy results;
- Research can advance faster;
- Researchers can have immediate access to all that they need for their work;
- OA enables visibility;
- Usage and impact of researchers own findings increases;
- Universities also co-benefit from their researchers' increased impact. This also results in increase in return on investment of the funding agencies and the tax paying public. For the teaching community OA means no restrictions on usage of research papers for teaching;
- Like-wise publishers also benefit, as the dissemination is faster, wider, allowing greater visibility and higher journal impact factor and citation of research articles.

5. WEB 1.0 TO WEB 2.0

Web 1.0 is marked with the emergence of Internet, which is undergoing a major change - from an original environment where individuals posted static information that was hard to navigate to a new environment where people are dynamically posting information and collaborating. But, new search and aggregation tools are making it easier to find and contribute to the information that an individual is interested in. This shift has been described as the switch from Web 1.0 to Web 2.0, which is propounded by O'Reilly. The landscape of web 2.0 for example encompasses a whole lot of tools, which are shown in Britannica Online – Wikipedia, Directories (taxonomy) - tagging ("folksonomy") and Mp3.com – Napster.

As these new technologies develop, science can use these new tools directly and also apply similar concepts by analogy. A key example of how Web 2.0 technologies can advance in biological research is OpenWetWare (OWW). OpenWetWare is a wiki on which researchers can share expertise, information and ideas in biological science and engineering. Inspired both by Wikipedia and MIT OpenCourseWare, OWW seeks to create a useful resource that relies on a community of users to keep the content accurate and up-to-date. It is hoped to be the OWW will foster enhanced collaboration among community members as well as provide a useful reference source for researchers around the world. The expectation is that these new technologies will change how scientists communicate their work and the way in which research is done. Such changes should accelerate the pace of scientific discovery and technology development, thus leading to a better scientific communication (5) and collaboration tools.

6. So How To Put Open Access Into Practice?

Now-a-days researchers, funding agencies and institutions and universities are, aware of the benefits of OA. If not they must be made aware of how quickly it can be done for scientific communication. The immediate requirement is to

create Institutional Open Access Repositories and register, so that others also follow suite. In-fact Institutional Repositories (IR) is the best way to provide access to scientific research output. IR software such as Eprints provide web based OAI – compliant IR for free, which is currently being used at one of the premier research Institutes in India, The Indian Institute of Science (IISc), Bangalore, India.

There is usually a delay of several months after an article is written before it is published in a journal therefore today it not the only ideal form for announcing the latest research. Many journals now publish the final papers in their electronic version as soon as they are ready, without waiting for the assembly of a complete issue, as is necessary with paper. In many fields where even greater speed is wanted, such as physics, the role of the journal in disseminating the latest research has largely been replaced by preprint databases such as arXiv.org. Almost all such articles are eventually published in traditional journals, which still adhere to quality control, archiving papers, and establishing scientific credit (3).

7. Open Access 2.0

Scientific communication is a multi-faceted subject area, which is undergoing a profound transformation. In this article we tried to correlate public discussion of scientific communication, as most of the attention is focused on journals, especially on the "serial crisis," in which libraries cannot afford to pay for the rapidly increasing subscription rates (according to an estimation it's more than the rate of inflation), or say with shrinking library budgets in the ever growing specializations of the nature of the disciplines which makes the librarians or library administrators all the more difficult to cater to the ever growing demands for the scholarly literature published in the form of journals. Electronic publishing, using the Internet, is often seen as a possible way to relieve the pressure on cost. This view is too limited, though, as it concentrates on a small portion of scientific communication, and it does not provide a full picture of the revolution that is taking place.

Many scientists and librarians have long been protesting the ever-growing cost of the journals, especially as they see these payments going to profit making publishing houses. To provide the researchers, online access to journals, universities generally purchase site licenses, permitting access from anywhere in the university using the IP based access – and, with appropriate authorization, university-affiliated users can access the journals on campus. This arrangement may be quite expensive, sometimes much more than the cost for a print subscription – although this reflects the number of people who will be using the license; a print subscription is the cost for one person to receive the journal, while a site-license can let thousands of people access it. But, cost may be increased at the users level, as to how many printouts users would be printing for reading at their leisure.

Publications by scholarly societies (such as ACS, ASME and so on) also known as not-for-profit-publishers, usually costs less than commercial publishers, but the prices of their scientific journals are still very expensive comparatively. However, this extra money is generally used to fund the activities of the scientific societies that run such journals, or is invested in providing further scholarly resources for scientists, and thus the money remains in and benefits the scientific sphere. Despite the transition of print-to-electronic publishing, the journal crisis persists.

Concerns about cost and open access have led to the creation of free-access journals such as the Public Library of Science (PLoS) and partly open or reduced-cost journals such as the Journal of High Energy Physics. However, professional editors still have to be paid and some free-access journals (such as PLoS) still rely heavily on donations from foundations to cover most of the operating costs; smaller journals unfortunately, do not always have access to such resources. (3).

Some of the positives and the Negatives relating to Open Access are:

7.1. Positives of Open Access

a) No peer reviewing: but to publish to reach reader with no cost or almost no cost in a very less time: There are numerous deficiencies of the traditional editorial and peer review system,(6) they are a legacy of the print technology, which was all that we have had for the last few centuries. Many of those deficiencies can be overcome through more flexible systems that electronic publishing is making possible of. However, change has started which is quite visible in today's electronic journals, but it's a lengthy process to get full-fledged. Although the classic peer-reviewed paper is important, says Surridge, "they're effectively just snapshots of what the authors have done and thought at this moment in time. They are not collaborative beyond that, except for rudimentary mechanisms such as citations and letters to the editor."This also helps in eliminating free/ cheap labour for the process of peer reviewing, from the peer reviews point of view; they no need to donate their labour for reviewing the literature for free / less fees.

b) Instant publishing/ or live publishing: Journals are just one part of scientific communication. Personal contacts, correspondence, talks, and conferences have always been important. The Internet has made it possible for a variety of new, much more flexible forms of communications. What we can increasingly observe (6) is vigorous growth in novel forms of scientific communication that take full advantage of the online medium. Growth rates are high, and if they continue for just a few years (as they show every sign of getting in there), these new forms will dominate.

c) Immediate reach to audience: Ease of access and use are paramount. For example, mostly all of us turn to Amazon.com for bibliographic help, as Amazon not only gives the summary, it also provides the related title for further navigation in the same area one would be looking for. The main feature of Amazon searching makes it a pleasure because, it provides the catalog of the item you would be looking for and user review for the customer to review/ rate the item he/ she just accessed. The database is not as complete or scholarly as that of a major library, but it is more convenient to use and the user would get more avenues to find more info then what he came-in looking for. However, it does lead to more efficient use of time, eliminating all the monotonous trips to the library. Easy access from one's desktop (or increasingly from one's mobile device as part of communication 2.0) is leading to usage of serious scholarly material by a much wider audience, both of other scholars and the general population (6).

d) Paradigm change in approach and openness: Bradley Laboratory (7) of the UsefulChem states that, more the open scientists are the better. When

Broadley started UsefulChem, his lab was investigating the synthesis of drugs to fight diseases such as malaria. Since, search engines could index what his team was doing without needing a bunch of passwords, "they suddenly found people discovering the team on Google and wanting to work together. The National Cancer Institute contacted Bradley, wanting to test his compounds as anti-tumor agents. A scientist at Indiana University offered to help do calculations about docking-figuring out which molecules will be reactive". Now Broadley Lab is not just one lab doing research but they are a network of labs collaborating with each other.

e) A huge save in the Libraries budget: In this article, our attention is focused on journals, especially on the "serial crisis," in which libraries cannot afford the rapidly increasing subscription rates and the growing ranks of journals. Electronic publishing, using OA platform on the Internet, is often seen as a possible way to relieve the cost pressure. However, this view is too limited, though, as it may not concentrates on all parts of scientific communication, and hence may not provide a full picture of the evolution full fledged OA that is taking place (6) for scientific communication thus leads to science 2.0.

f) Reduces the unauthorised publishing: Easy electronic access and publishing of scientific information using OA is also changing the patterns of publish and use. Much of what we have been used to was the artefact of print technology. Once the limitations of that technology are eliminated, it leads to behavioural changes. With easy and lower costs of access, a greater fraction of reading is of the superficial browsing variety. However, that does not mean that there is less deep study, since there is general growth and speed in information processing, as older material is accessed much more frequently than before (6).

g) Helps to reduce the distance between an Author and the reader: The first generation of World-Wide-Web capabilities rapidly transformed information search and retrieval mechanisms. More recent attributes such as wiki, blogging, tagging, chatting and social networking, dubbed Web 2.0, have just as quickly expanded people's ability not just to consume online information but to publish it, edit it and collaborate about it-forcing such old-line institutions as journalism, marketing and even politicking to adopt whole new ways of thinking and operating.

h) Improves collaboration among authors and readers: As stated earlier, "Science happens not just because of people doing experiments but because they're discussing those experiments". Also, it appears that critiquing, suggesting, sharing ideas and data - is the heart of science, the most powerful tool ever invented for correcting errors, building on colleagues work and fashioning new knowledge. To advocate this, an atmosphere of openness makes science more productive. "When you do your work online, out in the open, you quickly find that you're not competing with other scientists anymore but cooperating with them" (1).

i) Improves collaboration activity for publishing/sharing: Web 2.0 technologies open up a much richer dialogue, says Hooker (1), where a group of bloggers write about science and culture. He says "To me, opening up my lab notebook means giving people a window into what I'm doing every day," He adds "That's an immense

leap forward in clarity. In a paper, I can see what you've done. But I don't know how many things you tried that didn't work. It's those little details that become clear with an open /online notebook but are obscured by every other communication mechanism we have. It makes science more efficient." That jump in efficiency, in turn, could greatly benefit society, in everything from faster drug development to greater national competitiveness.

j) Authors can announce, obtain comments, Ratings and still hold Copyrights: Authors could still go ahead and publish in the peer-reviewed journals without bothering much about copyright issues. (E.g. PLoS ONE and Harward's college of Arts and Sciences). Hence contributing papers in OA for scholarly communication is a dream come true for many scholars.

7.2 The Setbacks Of the Open Access

a) Credit Problem: Critics of OA are of the view that scientists who put preliminary findings online, risk having others copy or exploit the work to gain credit or even patents.

b) Research Secrets: Many scientists remain wary of such openness especially in the hypercompetitive discipline of biomedical Research, where patents, promotion and tenure of the product can hinder to publish a new discovery. For the practitioners in Biomedicine, Science 2.0 seems dangerous as putting their serious work out on blogs and social networks is like an open invitation to have their lab notebooks vandalized. Sometimes, the best ideas may get stolen and published by a rival.

c) Reduces citations: Journal articles made freely available online are accessed more than articles with a subscription cost. It seems paid OA articles are less frequently cited than freely available online papers. This is the controversial early finding of what will be a four-year study at Cornell University. The open access (OA) lobby has slammed the publication of the preliminary report as premature. Further, past studies have shown that OA literature is cited more than non-OA literature but it has not been clear whether this is due to its free availability or factors such as more popular papers or authors being made OA (8).

d) Decrease in Revenue: Open Access approach is a departure from the industry's traditional subscription-based approach, where access to scholarly journals is expensive, partly because of the costs of printing, mailing and publishers owned copyrights to the research papers. This has resulted in a serious dip in revenues.

Sometimes fee paid by the researcher, to retain the copyright, covers the lower cost of putting the research online. For instance, at PLoS, the fee ranges from $1,300 to $2,850, which is met from the research grants.

e) Plagiarism: There is a fear of the online research results getting completely copied and claiming as their own.

f) Usage Metrics: In case of free online journals measuring of usage is completely based on the viewing of the full text. There is no organised method of measuring the citations and impact factor.

8. Copyright

Traditionally, the author of journal article is required to transfer the copyright to publishers. Publishers claim that it is necessary in order to protect author's rights, and to coordinate permission for reprints or other usage. However, many authors, especially those active in the open access movement,

found this unsatisfactory, and have used their influence to initiate gradual move towards license to publish instead. Under such a system, the publisher has permission to edit, print and distribute the article commercially, but the author(s) retain the other rights themselves.

Even if the publishers retain the copyright for an article, most journals allow certain rights to their authors. These rights usually include the ability to reuse parts of the paper in the author's future work, and allow him to distribute a

limited number of copies. In the print format, such copies are called reprints and in the electronic format they are called post prints. Some publishers, for example the American Physical Society, also grant the author the right to post and update the article on the author's or employer's website and on free e-print servers, to grant permission to others to use or reuse figures, and even to reprint the article as long as no fee is charged (). The rise of open access journals, in which the author retains the copyright but must pay a publication charge, such as the Public Library of Science family of journals is another recent response to copyright concerns (3).

9. Conclusion

Scientific communication has always aimed at making research known to the peers for reasons of dissemination, priority, prestige, recognition and visibility. The concept of peer review though protects the quality and standard of a journal, still continues to cause delay resulting in time lag in publishing. But now with the use of science 2.0 there is ample opportunity for all the enthusiastic authors to discuss research online without meeting on site in a formal meeting, conference or a seminar. Issues like visibility, prestige, recognition, and priority are not taboo any more. The obvious out come is in favour of researchers and the scientists. Because of this, time taken for the completion of research projects and publishing is reduced considerably. Feedback is immediate, leading to furthering of knowledge and science. Open access 2.0 and science 2.0 is the future of science communication along with electronic journals and print journals.

In the name of quality, it would not help the real researchers who are keen in published work to always depend on peer-reviewed journals for publishing their work. Some kind of hidden bias and favoritism did exist in the western world for a long time and publishing was the prerogative of the elite. Further, there is a lot of time lag in publishing research output in print journal due to peer-reviewing. Now the emergence of the Internet, web and open access has provided ample opportunities to the scientists to publish on going research and illicit quick response and discuss research on line.

Further OA is more suitable and economically viable. The authors foresee more vigorous OA initiatives than ever before in the web 2.0 environment. Ninety nine percent of the ideas, which use to remain as ideas, with science 2.0 will be a reality. Just like the axiom "publish or perish "now it will be "publish and flourish". Scientific communication patterns shall be more and more effective and highly informal and personalised. Writing shall be more collaborative and it is going to be writing 2.0 modes. It is the meeting of the great minds and the think alike in science 2.0 plat form. Along with quantity and per capita authoring

of papers the quality of research will be of very high order. As the axiom goes:

"If you have an apple and I have an apple and we exchange these apples then you and I will still each have one apple. But if you have an idea and I have an idea and we exchange these ideas, then each of us will have two ideas."

- George Bernard Shaw

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