Trends in Scholarly Communication: Challenges and Opportunities to Libraries

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Abstract

Scholarly communication is in turmoil. It is not clear how scholarly publishers will cope with change or if journals will even survive. That's why it is important to provide some insight into scholarly publishing now and in the future. The key issues confronting scholarly publishing include open access (OA), peer review, institutional re-positories, multiple versions of articles, increasing author awareness of copyright issues, archiving and preserving, and faster communication tools such as blogs, Web sites, RSS feeds, and podcasts. The newer communication tools speed up communication and bypass journals. In this environment, scholars may communicate in new ways and journals may have a different role from the past, but documents of record are still essential to the business.

Keywords: Open Access, Electronic Publishing, Institutional Repositories

1. The Current Situation

The current state of scholarly publishing is marked by confusion, uncertainty, and the lack of a clear path for the future. There is a lot of turmoil. People are focusing very much on open access and self-archiving in institutional repositories in parallel to publication in journals. However, people are looking in the wrong place. A potentially far more significant development is that scientists are beginning to work and to communicate in completely different ways made possible by the Web. What this means is that if publishers continue to focus entirely on what's happening to the article as we know it, the danger is that other people will make copies available for free, and therefore publishers won't make money selling articles. There are a number of competing trends interfering with each other like wave patterns interfere when you drop two stones in the water. What we are seeing is the first phase of the digital transition as far as publishers are concerned. Add in the political and economic trends, and the end result is, a very unpredictable mix.

Librarians, the primary buyers of schol-arly journals, have been faced with extraordinary inflation in journal prices for years, along with level or dwindling budgets that don't keep pace with increasing costs. At the same time, academic disciplines are also growing and changing. For the last few years, publishers have offered bundles of journals (called big deals) to consortia or to groups of libraries. These bundles reduce unit prices, mandate a certain level of expenditures, and preclude librarians from choosing titles. As a result, librarians may acquire access to titles they don't need and not to titles they actually do need to support research and academic programs. Librarians now want latitude in selecting what is in their bundles. And as librarians "pick and mix," the administrative costs increase, causing price increases that make it more difficult for librarians to buy what they want with limited budgets.

Between 1986 and 2004, journal expenditures of American research libraries increased by a staggering 273%, with the average journal unit cost

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increasing by 188%. During this same period, the U.S. Consumer Price Index rose by 73%, meaning that journal costs have outstripped inflation by a factor of almost 4. While many university libraries face severe budget cuts, large commercial publishers in the academic journal market have enjoyed increasing profits. In 2002, for instance, revenue rose 26% and operating profit increased to 25% for Elsevier, the largest journal publisher in the science, technology, and medical field. On average, libraries pay 4 to 6 times as much per page for journals owned by commercial publishers as they do for journals owned by non-profit societies.

Faced with ever-increasing journal prices and dwindling budgets, universities are being forced to take action. In 2003, Cornell cancelled its subscriptions to more than 200 Elsevier journals. The University of Wisconsin-Madison has withdrawn from the Big Deal. Scholars are also taking action. In 2003, researchers at the University of California-San Francisco called upon their colleagues throughout the world to boycott the journals published by the Cell Press (owned by Elsevier) after the publisher asked the University of California for $90,000 in annual fees for continued access to the six Cell Press titles—this in addition to the $8 million that the university already paid Elsevier annually for online journal subscriptions. As another example, in January 2004, the entire editorial board of Elsevier's Journal of Algorithms resigned in protest of the publishers' pricing policies, and went on to begin publishing a competing journal, ACM Transactions on Algorithms, in partnership with the Association for Computing Machinery.

2. The Importance of Peer Review

Peer review is clearly an issue for scholars, librarians, and readers. Referees who review articles give editors a way to distinguish between relevant, quality articles and those that may not meet specific standards. Readers and librarians rely on this vetting process to decide on value and whether to invest their time and money. Since peer review is far from a perfect process, it does not guarantee the absence of errors, plagiarism, or the falsification of research results. But despite its shortcomings, the current peer-review process works.

3. How Scholarship is being transformed

For most scholars, the ways research is conducted, conveyed, and shared are far different today than just a few years ago. Yet these changes only hint at the technology-driven transformation of scholarship that is on the horizon.

In science, journals have long been the glue that binds a multifaceted system of scholarly communication. In the humanities and social sciences, monographs often play a similar role. Today most scholarly journals (and a small but growing number of monographs) are distributed on the Internet. Shifting to digital distribution, while saving a lot of trips to the library, doesn't begin to capture the full potential of digital publications.

Despite the opportunity to put information in front of every potential user, access to most journals is still limited to subscribers — just as it was when journals were invented some 350 years ago. Monographs are still going out of print. Even though many older monographs and journals are being digitized, they are often only available to institutions that can afford brand new subscriptions to works that may already be in their print collections. In contrast, many informal aspects of scholarly exchange — taking place within the so-called "invisible college" — have been far more dynamic than the formal and deeply entrenched publishing process.

4. An Information-Rich Environment

The signs of change are apparent:

- Email efficiently and rapidly links researchers from around the globe. A growing range of other network-based technologies further enhances informal communication.
- In nearly every discipline, some scholarship is digital-only or can be fully understood only in digital form.
- Most scholarly literature is now created in digital form and online editions of journals are the norm. Back issues of an increasing number of journals and editions of older monographs are being digitized.
- Google offers a search for scholars and has cataloged more than eight billion web pages and a billion images, and now is undertaking to digitize books on a scale that previously seemed unthinkable.

Many of yesterday's limitations on research and learning are being swept away by the Internet. It presents an opportunity for unlimited dissemination of information at virtually no cost beyond that of providing it to the first reader.

As a result, the ways researchers study complex questions and share their data and findings are adapting. For example:

- In astronomy, observations from robotic telescopes are creating a virtual observatory that, unlike the powerful telescopes feeding the database, are available to all potential users.
- Data and text mining or exploratory data analysis techniques are being used in fields as diverse as literature and chemistry to look for unexpected patterns in large volumes of data.
- Some scientists base their work not on field observations or experiments, but instead draw on freely accessible data resources such as PubChem at the US National Institutes of Health or earth sciences data collected by the US National Aeronautics and Space Administration.
- Open digital archives such as arXiv.org, PubMed Central, and hundreds of institution-based repositories enable authors to ensure their works are available on the Internet to a universe of potential users.
- Social scientists are developing and sharing research databases such as the Atlas of Inequality using digital data that they and others have amassed.
- Humanities scholars are experimenting with reinventing the book, building digital collections, using digital analysis tools, and generating new kinds of intellectual products.

By seamlessly linking data, knowledge, and scholars, the emerging research environment promises to stimulate and accelerate discovery — and ultimately to fuel advances beyond the realm of scholarship.

The new digital scholarship gives scholars the potential to collaborate in dynamic new ways:

- It facilitates interdisciplinary approaches to complex questions by breaking down information silos.
- It enables researchers located across multiple time zones to easily share information and work effectively as teams.
- It allows the rapid development of new or ad hoc communities of scholars to respond to pressing questions and challenges.

Clearly, a new era of digital scholarship is upon us.

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6. Funders Support Sharing

Not surprisingly, governments and funding agencies around the world are recognizing that dissemination of research results is part of the research process itself. Many are implementing or exploring policies to facilitate the sharing of information and realize the benefits of digital scholarship. For example:

- The US National Institutes of Health (NIH) Public Access Policy requires that its funded investigators deposit their final peer-reviewed manuscripts in PubMed Central, NIH's online digital archive, for free public access within 12 months of journal publication. NIH also allows grant funds to be used to pay journal publication fees. (See the Association of Research Libraries' guide to the policy.)
- The Canadian Institutes of Health Research requires that all research papers from its funded projects are freely accessible online within six months of publication and that bioinformatics, atomic, and molecular coordinate data be deposited into a public database immediately upon publication of research results.
- Canada's Social Sciences and Humanities Research Council has endorsed the principle of open access and is moving to increase awareness, pursue discussions with major stakeholders, and gradually incorporate open access provisions in research support programs.
- Wellcome Trust, the UK's largest private biomedical research funder, requires grantees to submit an electronic copy of the final manuscripts of their research papers into PubMed Central. It also provides grantholders with additional funding to cover publication fees charged by open access journals.
- The Research Councils UK supports the principle that "knowledge derived from publicly funded research must be made available for public use." Several of its component funding councils have implemented policies asking or requiring their grantees to deposit journal articles and conference proceedings in open online archives when appropriate archives are available and copyright or licensing arrangements permit.
- A 2007 paper from the European Commission [PDF] takes the position that "wider access to and dissemination of scientific information are necessary, especially with regard to journal articles and research data produced on the

basis of public funding.

- The Deutsche Forschungsgemeinschaft (German Research Foundation, DFG) expects the research results it funds "to be published and to be made available, where possible, digitally and on the Internet via open access" — either in discipline-specific or institutional open online archives following conventional publication or in a recognized peer-reviewed open access journal.

- A 2004 Organization for Economic Cooperation and Development (OECD) "Declaration on Access To Research Data From Public Funding," adopted by the US, Canada, and 32 other nations, pledges to work towards the establishment of access regimes for digital research data from public funding in accordance with the objective of openness.

7. Open Access Expands Sharing

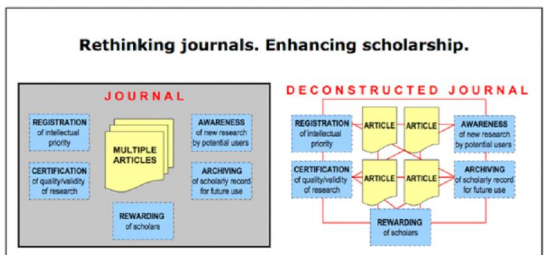
Instead of making content valuable by making it scarce, open access makes new knowledge valuable by making it widely available to scholars and researchers. For example:

- Open-access journals — whose costs are covered through publication fees, sponsorships, in-kind contributions, or other sources of support — are emerging as an alternative to the traditional subscription model. More than 2200 open-access journals in wide-ranging fields are listed in the Directory of Open Access Journals.

- Online open archives hosted by universities ("institutional repositories") and governments provide free access to articles, supplementary materials, supporting data, working papers, pre-prints, images, and more. They extend the options for disseminating scholarly work, serving as complements to traditional journals and monographs. So, for example, physics papers often will first appear in preliminary form for community feedback in the arXiv.org physics repository. Subsequently, they appear in final form in a peer-reviewed journal and in arXiv.org. Despite the free availability on arXiv.org, physics journals have continued to flourish.

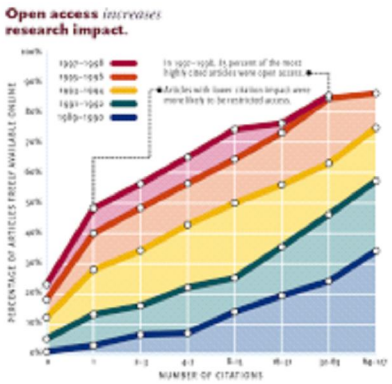
- New kinds of works - wikis, open textbooks, annotated digitized primary source materials - are providing researchers and scholars with new options for sharing knowledge.

Breaking down or lowering access barriers do not mean giving up peer review. Open-access and economically priced journals recognize and preserve the important role of peer review in scholarly communication. E-book series are being developed by reputable presses using traditional editorial practices.



Open access utilizes new technology, sustainability strategies, and legal mechanisms to facilitate the sharing of information that is so vital to the progress of scholarship.

Researchers benefit from sharing



Data source: Steve Lawrence, "Free online availability substantially increases a paper's impact" Nature 411, p. 521.

Scholars can gain tremendous professional benefits from expanded dissemination of their work. Beyond the convenience and speed of more open scholarly exchange, a growing body of evidence indicates that articles that are freely available on the Internet have greater impact. For example:

- Gunthur Eysenbach of the University of Toronto compared the citation rates over time of both open-access and non-open-access articles published in Proceedings of the National Academy of Sciences. His findings indicate that the open-access articles are cited earlier and more often.
- Steve Lawrence, a scientist at NEC Research Institute, analyzed nearly 120,000 computer science articles cited in a standard disciplinary bibliography. When he looked at articles with successively higher levels of impact or citations, he found successively higher percentages of open-access articles, and vice versa. The strength of this correlation steadily increased over a decade, Lawrence reported.

The large audience for information made available free on the web is apparent from just one example: the National Library of Medicine's experience. NLM transformed its fee-based index and abstracts of biomedical journal articles to free availability on the web as PubMed. Use of the database increased a hundredfold once it became freely available. The potential scope of this usage could never have been anticipated by looking solely at use of the controlled-access version.

Similarly, in the Humanities, projects like Roman de la Rose and Project Perseus have attracted far larger communities of scholars than were able to use their corresponding artifacts.

Who are these new readers? Certainly they include scholars around the globe at institutions that may not be able to afford the monographs you write or the journals in which you publish. They also may be users in unexpected fields who didn't previously realize they'd be interested in your work. And they may be professionals who apply your research, patients, hobbyists, or others from the general public —taxpayers who indirectly fund much research — with an interest in your field.

8. Bringing Down the Barriers

With all the benefits of more open sharing of research, why hasn't change proceeded more rapidly? There are a number of factors holding things back:

- Economies extrinsic to scholarship have grown up around the sale (and now lease, in the digital context) of journals and monographs. Change has sometimes been hampered by efforts to

protect publishing revenues and profits.

- Related to this is the need perceived by many publishers to rigorously defend their intellectual property (the texts provided to them by scholarly authors, together with their editing and formatting) in the digital environment through licensing restrictions. And new technical protection schemes on the horizon could make matters worse yet for information users.

- The culture of academe, with its "prestige economy", also has been a damper on change. Career advancement depends on publishing in leading, well-established venues whose publishers that may fear they have little to gain from change. Some promotion and tenure committees may not yet recognize the value of new forms of digital scholarship and many scholars are fearful that non-traditional publications "won't count".

As a result, and despite the potential of the Internet for broad and economical information dissemination, the readership of journals and monographs today is little changed from in the past — or may have actually declined as a result of library funding constraints.

For scholars and students at institutions that can afford subscriptions to the digital editions of journals, the problem may not be obvious. But many potential users don't have access. And despite the tremendous growth in library purchases of electronic resources, researchers are more often than ever requesting copies of materials their library doesn't own. The research process is too often slowed or degraded by use restrictions that are a relic of another time. But promising changes are starting to emerge.

9. Institutional Repositories and Author Archiving

More libraries and other organizations are creating institutional repositories to preserve, archive, and provide access to the works of faculty, researchers, and scholarly communities. The institutional repositories and author self-archiving, are viewed as a threat to scholarly publishers. The Institutional repositories are actually much scarier for publishers than the open access publishing model. While self-archiving may coexist with the subscription model, it has the potential to parasitize it to the point that it actually kills it. Institutional repositories may influence librarians to cancel subscriptions and could bring about the demise of a lot of journals very quickly.

Librarians view institutional repositories as a way of aggregating, archiving, preserving the institution's output and giving those outputs visibility. The repositories include preprints or postprints of articles, papers, technical reports, dissertations and theses, data sets, teaching materials, digitized special collections, and other materials related to the institution's work. The unique materials in special collections were previously hidden from scholars and researchers before being digitized and available through repositories. Universities and institutions that are establishing repositories must bear the upfront costs and ongoing fees for maintenance and expansion. This distributed system of archives provides the base for a rich, interoperable resource for scholars, students, and research-funding agencies.

Institutional repositories pose no threat when they are used as a store for gray literature and access to them was confined to intranets. The more they are public Web sites rather than closed intranets, the

more risk they run of essentially duplicating the scholarly literature in a no-pay environment. Without pay models, publishers cannot recoup their investments. The increasing use, in some quarters, of repositories as an alternative to scholarly dissemination will potentially create great damage in terms of the ability for journals to remain viable. Further, a publisher's embargo periods of 6 to 12 months may not be economically safe for journals.

Since peer review and multiple versions of articles are related to institutional repositories, we need to talk about the sociological function of journals, which are more than an information vehicle. This community function of the journal might be quite difficult without re-establishing something that looks exactly like a journal with all the costs and implications that flow from that. It would be quite difficult to replicate that in free form with roving peer-review panels looking after materials in a repository. Multiple versions of journals from self-archiving and those deposited in institutional repositories pose problems for journals, librarians, and readers. When a paper or an article is cited, which version is being cited? Many publishers permit authors to deposit preprints that have not been peer reviewed. Others permit an article to be deposited after peer review and prior to copy editing. Most publishers prohibit the published version from being deposited from 6 to 24 months to forever. For example, the National Institutes of Health (NIH) requires deposit of the published version in 12 months. Librarians are quite concerned that the preprint version that has not gone through peer review is not an adequate substitute for journals. On the other hand, if you look at areas like physics and mathematics, all or most of a journal's content is deposited in some form by authors in the arXiv repository. Those in the physics and mathematics disciplines are happy to get preprints from arXiv rather than the final published version.

10. The Changing Face of OA

OA, institutional repositories, and Internet opportunities are making publishers look at new business models. OA is still a hot-button issue for authors, funding authorities, librarians, and publishers. The Directory of Open Access Journals lists **3803** journals with **243080** articles as of Dec. 19, 2008. The major costs of scholarly publishing, including salaries paid to authors by their universities or research institutions for writing articles and peer review (as well as library acquisition, processing, and storage costs), are not borne by publishers. This investment is often overlooked when journal costs are discussed.

The OA question is complex. Assuming journals survive, the real issue is who should pay to publish scholarly articles. More and more publishers are adopting a hybrid model where subscri-bers pay or the authors pay. If open access repositories become the norm, then many journals would disappear. Access to older journal material has become a big concern for publishers. Converting predigital articles is a significant investment for publishers. How will they recoup the investment, and are people willing to pay for the value added by publishers?

10.1 Author Rights

The Internet and OA are influencing authors' and institutions' views concerning copyright and author rights. Many publishers let authors deposit preprints in repositories and reproduce authored materials for classroom use, but then they insist on having copyrights to publish the work. Authors and the institutions that employ them are beginning to resist the transfer of copyrights to publishers.

The days of publishers' exclusive rights to publish material may be coming to an end. Awareness is growing by authors and their employers and funders that assigning copyrights to publishers may not be in their best interests. Universities, governments, and other organizations are suggesting that authors now retain their copyrights and license to publishers; suggestions are in authors' addenda to publishing agreements.

10.2 Why retain rights?

- Many publishers create significant barriers for authors who want to reuse or share their work, and for access to that work by others. Negotiating changes to standard publisher agreements can help authors avoid these obstacles, thus increasing options for authors as well as readership, citation, and impact of the work itself. (Openly available articles have been shown to be more heavily cited. (http://opcit.eprints.org/oacitation-biblio.html))
- Publishers routinely change the agreements they ask authors to sign. If authors have not secured rights they want as an author, the publisher may alter its practices over time.
- Making research and scholarship as widely available as possible supports the mission of "generating, disseminating, and preserving knowledge, and to working with others to bring this knowledge to bear on the world's great challenges."
- Some research funders request or require that work created with their funds be made available openly on the web. Their policies can be reviewed at the "Juliet" site (http://www.sherpa.ac.uk/juliet/index.php).

10.3 Which Rights to Retain?

Authors are often most interested in retaining rights to:

- Reuse their work in teaching, future publications, and in all scholarly and professional activities.
- Post their work on the web (sometimes referred to as "self-archiving") e.g. in Institutional Repository; in a discipline archive (such as PubMed Central or arXiv ; or on a web page.

10.4 How to Retain Rights?

- Authors should specify the rights they want to retain, as most publishers do not extend these rights to authors in their standard agreements.
- Authors can demand rights to continue using their publications in their academic work; to deposit them into their Institutional Repository; and to deposit them into any discipline-based research repository (including PubMed Central, the National Library of Medicine's database for NIH-funded manuscripts).

10.5 Which publishers are likely to be flexible about these rights?

- Publisher policies and agreements vary considerably. The "Romeo" database offers a convenient summary of many publisher copyright policies & self-archiving.
- Publisher policies and agreements are usually linked from the author information or article submission section of a journal's website.
- Publisher policies change over time, and the terms stated on their websites often vary from the terms of their actual agreements, so it is important to read the agreement itself.

11. Trends and Challenges for the Future

The future of the scholarly publishing field is murky. Uncertainty is a key trend, along with its accompanying anxiety, experimentation, tension, and change. The industry has transformed itself with success in the past. Publishers depending on subscriptions for their livelihood may have a tough time of it unless the journal has an astronomically

high reputation. Some publishers will see this coming and will start to create completely new kinds of products and services to help research-ers and others to do their jobs more easily. But new players may emerge.

With the industry dating from the 17th century when The Royal Society of London began publishing its Philosophical Transactions, some publishers perceive clear threats—from institutional and disciplinary repositories, OA, Google, Microsoft, and communication facilitated by the Internet—while others see opportunities. The crystal ball is cloudy; the turmoil and the turbulence are likely to increase before the storm abates.

But the key questions remain: Will journals survive, or will they be replaced by new forms of communication? Who should pay to publish scholarly work? How should peer review be conducted? Who will pay start-up costs for new titles if the journals survive? And will people find value in copy editing, formatting, and other services supplied by publishers and editors? Chances are that we won't have clear answers for some years to come.

In the age of the Internet, the ways the Researcher share and use academic research results are changing — rapidly, fundamentally, irreversibly. There's great potential in change. After all, faster and wider sharing of journal articles, research data, simulations, syntheses, analyses, and other findings certainly fuels the advance of knowledge. It's a two-way street — sharing research benefits between you and others. But will the promise of digital scholarship be fully realized? How will yesterday's norms adapt to tomorrow's possibilities? A scholarly revolution is underway. It enables you to get a greater return from your research. All you have to do is share it.

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