The Peer Review Process: An Expanded Role for Repositories

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Abstract

Peer review has been regarded as a cornerstone of scientific research for a considerable time. Journals seeking to attract high quality scholarship rely on peer review to maintain their credentials in the publishing industry. However, over a period of time—and especially given the advent of the Internet—complaints have arisen from authors, reviewers and even editors as to the efficacy of the system. The authors outline a range of models which have evolved that either complement or replace evaluation processes which characterise traditional peer review. Research data is presented in the context of quality assessment. The authors introduce several approaches which are utilising repositories to support the process. Consideration is given as to how this might change the current institutional repository environment.

Keywords: Peer review, repositories, open reviewing, research data, data journals

1. INTRODUCTION

Formal peer review has been utilized in one format or another for scientific publishing since the eighteenth century [1], although it is considered by some to be a fairly recent innovation, not widespread until the twentieth century [2]. While most researchers agree with the principles of peer review, many feel there is room to improve how it is implemented. Along with citation impact, peer review has engendered quite vigorous discussion among its critics for failing to deliver on its objectives. Concern has been expressed regarding bias and inconsistency, ineffective filtering of error or even fraud, and the suppression of innovation.

In this paper the authors provide a brief overview of the conventional peer review process, focusing particularly on the perceived disparity between its objectives and actual utilisation. They proceed to discuss a number of review processes that either complement or replace peer review. Based on recent experience in working with new types of digital research content, the authors outline current approaches which utilise repositories to support the peer review process, as well as suggesting an expanded role, particularly for institutional repositories (IR).

2. TRADITIONAL PEER REVIEW

Traditionally the role of peer review is considered to touch on four main functions within scholarly literature: dissemination of current knowledge, archiving of the canonical knowledge base (KB), quality control of published information, and assignment of priority and credit for their work to authors [3]. Corollary attributes include ensuring the correctness of reported work by not allowing demonstrably false claims to be given credence, certifying authors' work as valid, maintaining the reputation of the publisher—especially if a learned society, and at the same time not stifling the introduction of valuable new ideas.

Notwithstanding the laudable objectives outlined above, the peer review process has been subjected to quite vigorous debate. Major complaints include:

- Unnecessarily lengthy review periods
- Papers rejected for trivial reasons
- Reviewers not reading work properly owing to time pressures
- Publication blocked because a reviewer is working on something similar
- Authors asked to recommend reviewers for their submission
- Reviewers reacting unprofessionally to criticism of their work
- Tendency for reviewers to be established authors, with subsequent bias against novel ideas and methodologies

A 2008 survey by Ware [4] corroborated the fact that while the majority of respondents (93%) supported peer review as a process and 64% supported the current system, they also concurred that improvements were needed. Ware highlights two areas in which peer review is deemed to have the most benefit as the ones clearly in need of improvement: improvement in the quality of published papers; filtering of the output of papers to the benefit of readers. While a clear majority of authors (ca. 90%) felt that peer review had "improved the published paper", concern was raised about the identification of statistical errors. The work by Garcia-Berthou and Alcaraz [5] was cited for having demonstrated that articles in high profile journals such as *Nature* and *BMJ* were full of such errors.

The "widely held" belief that almost any genuine piece of academic work—no matter how "weak"—could eventually find a peer reviewed journal in which to be published was used to undermine the concept of peer review acting as an effective filter. However recognition was given to the fact that the system does tend to lead to the "better papers" being published in the "better journals", where "better" is linked to attributes such as impact factor. The concept of content having met certain standards is implied in this process.

The role of the reviewer is critical to the success of the peer review system. The necessity for high-profile journals to select content for publishing from a large number of submissions

places pressure on both the editors and the reviewers. In an ALPSP (Association of Learned and Professional Society Publishers) survey [6], one in six reviewers indicated that they were overworked.

As both a journal editor and a scientist who peer reviews articles, Leszczynski [7] attests to this fact: "Ultimately, too often reviewers are overworked and the reviews are done hastily, leading to publication of studies with poor science". According to Taylor [8], "In many cases the reviewer is only able to give a short and often cursory overview of the work in question. As a consequence the most able person capable of reviewing a new piece of work may be too busy or simply disinterested." Therefore while glaring problems are likely to be detected, subtle issues may escape unnoticed.

There is the well-publicised study [9] by the *British Medical Journal* in which the *BMJ* Editor and several colleagues deliberately introduced eight errors into a paper which was about to be published in the journal. The paper was sent for review to 420 people. Of the 221 respondents, the median number of errors detected was two. No one identified more than five, and 16% found no errors. It is this type of occurrence, along with high profile instances of actual fraud that has led some critics of the current peer review process to take the view that a single, experienced editor could judge the significance and quality of research as effectively as a group of external reviewers.

Certainly one of the most negative aspects of the peer review process has been encapsulated by Taylor [8], who describes it as "an excellent method for guarding the consensus view against attack". In some instances an editor may be unlikely to accept any new material which challenges a current viewpoint held within the research community. He cites the negative impact of what he labels as the 'gate keeping' activities of the system on "the timely publishing of the continental drift theory of Wegener and the *Helicobacter pylori* theory of ulcer formation, which eventually led to a Nobel Prize for Marshall and Warren".

In the final analysis, despite the "negative press", there are many who, like Harris [9], believe that peer review will remain a "cornerstone of the scientific process -- not because it's the best system, but because it's the best system we have".

3. OTHER REVIEW PROCESSES

Given the inherent dissatisfaction, however, a range of systems have evolved that either complement or replace evaluation processes which characterise traditional peer review. It has been recognized for several decades that the advent of the Internet offers opportunities to rethink the landscape of research publication and evaluation [10] [11] [12] [13]. Alternative approaches are being used to tackle some of the longstanding problems with traditional peer review. Birukou [13], for example, analyses three experimental approaches: asking reviewers to rank papers instead of reviewing them, bidding for reviewing a paper, and open evaluation of research works.

In addition there are new publishing models which are utilising alternative approaches for peer review. Articles published in the *EMBO Journal* (http://www.nature.com/emboj/index.html) have a supplementary Review Process File (RPF), which includes the timeline of the review process and all relevant communication, e.g. referees' comments and responses from authors. The *World Economic Journal* (WEJ) (http://world-economic.com/index.html) has recently launched an open reviewing process, entitled "Open Discussion Forum", which combines input from the membership with editorial decision making [14].

Philica (http://www.philica.com/) was created by two British psychologists, who were dissatisfied with traditional academic journal publishing because it "makes profits from researchers' efforts through strong copyright restrictions which greatly limit the free exchange of information, both between research groups and between researchers and the public". The journal publishes articles before full peer review process takes place. The whole review process is publicly available.

The *Journal of Scientific and Mathematical Research* (http://www.jscimath.org/) uses open peer review in part to overcome the issue of "overworked or competing referees":

> Manuscript submissions to the *Journal of Scientific and Mathematical Research* are posted immediately and peer-reviewed by the open scientific community, rather than by 2 or 3 people in a blind peer-review process. Reviews are therefore rigorous yet unbiased. The open (not anonymous) refereeing of manuscripts eliminates spurious or biased rejection of manuscripts by overworked or competing referees. Referees are required to post a clear justification of any rejections by openly citing errors relative to a list of errors.

Faculty of 1000, which has been in existence for nearly ten years, offers fours services that support the work of life scientists and clinicians [15]. Of particular interest in the context of the current discussion is *F1000Research*—a journal which is promoted on the basis of immediate publication and peer review:

> *F1000Research* is a completely original open access journal for life scientists; it offers immediate publication, transparent peer review (post publication) and full data deposition and sharing. F1000Research accepts all scientifically sound articles, ranging from single findings, case reports, protocols, replications, and null or negative results to more traditional articles.

Episciences.org (http://episciences.org/) is a project which has stemmed from the open access movement. It describes itself as a technical platform of peer reviewing. It is designed to host "epijournals", i.e. so-called "overlay journals". These journals do not actually produce their own content; instead they derive their content from sources such as pre-print servers, e.g. arXiv. The editorial boards of such epijournals organize peer reviewing and scientific discussion of selected or submitted preprints. The service is scheduled to launch in early 2014.

In his testimony to the UK Parliament, Taylor [8] has highlighted the fact that some scientists are beginning to post draft manuscripts on their own websites, requesting feedback, and subsequently producing a revised version for final submission.

In late 2013 PubMed, which is hosted by the National Center for Biotechnology Information, launched a pilot project, PubMed Commons (http://www.ncbi.nlm.nih.gov/pubmedcommons/). It

is a post-publication peer review system, in which users can comment directly on the 23+ million indexed research articles in the PubMed database; they can also rate the helpfulness of other users' comments. The decision was made to require all users to register, thereby avoiding anonymity. However ultimately user feedback will determine whether that requirement will remain in future. A feature of the system is a regularly updated listing of the top 100 papers that are trending, based on aggregated comments.

In a theoretical paper Martin [16] presents a model based on a "cooperatively built knowledge base" approach. Relationships are represented between elements (sentences, terms for concepts, relations). The fact that researchers would store and relate their knowledge in a "precise, organized and scalable way" into the shared KB of a community eliminates the need for a KB user to create / write a whole new article each time they make an advance in their research. For example, once a reference has been entered by a user, authors can draw on that shared information. In theory authors would have more opportunity to provide more technical information, without worrying about the presentation layer, e.g. space constraints. In fact it would allow for more flexibility in displaying aspects of their research. The reviewer is able to evaluate content using precise semantic relationships to compare, for example, a concept presented by one author with that of another. This would assist in identifying self- plagiarism, redundancy, and lack of precision in expression.

A number of systems have evolved to support these new publishing models. Managing content is a critical component of their review process. Given their genesis, repositories—particularly institutional repositories—have the potential to expand their current capabilities to meet the requirements of these new models.

4. ROLE OF REPOSITORIES

In several Commonwealth countries, accountability is measured among universities by means of a research assessment exercise. The United Kingdom has its Research Excellence Framework (http://www.ref.ac.uk/), while New Zealand universities are required to meet the requirements of the Performance-Based Research Fund (PBRF) (http://www.tec.govt.nz/Funding/Fund-finder/Performance-Based-Research-Fund-PBRF-/). In Australia, the Excellence in Research for Australia (ERA) (http://www.arc.gov.au/era/) initiative is designed to provide benchmarking data for Australian universities compared with international measures. In the latter case traditional publications have been evaluated in terms of citations. Research outputs which do not lend themselves to citation analysis have undergone peer review. The model has used either institutional or purpose-built repositories to store research content of all types which have been nominated to be peer reviewed by an Expert Committee.

As a logical consequence of focusing on research quality, governments and funding agencies are now turning their attention to the preservation and discoverability of the data which underpins research.

Research data is the new gold, or black, depending upon the perspective of the reader. Historically knowledge derived from research was disseminated through traditional publication formats while the very data which informed those publications was significantly undervalued. As Pryor [17] suggests,

> …data is the primary building block of all information, comprising the lowest level of abstraction in any field of knowledge, where it is identifiable as a collection of numbers, characters, images and other symbols that when contextualized in a certain way to represent facts, figures or ideas as communicable information.

Access to data expands the products of research to new communities and advances solutions to complex problems [18]. Major funding agencies have begun to recognise this, as evidenced by the move toward the requirement for a data management plan to be submitted as part of a grant proposal.

Given the high-level focus on research data, an important trend—from a publishing perspective—has been the emergence of data journals. While the definition of a "data journal" may vary, it is essentially a platform, primarily designed to formally publish datasets. GigaScience (http://www.gigasciencejournal.com/) publishes "big-data" studies from the entire spectrum of life and biomedical sciences. It links standard manuscript publication with an extensive database that hosts all associated data and provides data analysis tools and cloud-computing resources.

Launched in 2012, the *Geoscience Data Journal* (http://onlinelibrary.wiley.com/journal/10.1002/%28ISSN%2920 49-6060) is touted as a response to the ability of researchers "to create and collect often huge new data sets [which] has been growing rapidly in parallel with options for their storage and retrieval in a wide range of data repositories".

Another important trend is that of journals requesting data deposit to accompany journal article submission and, in some cases, to link the article with the underlying data. The Dryad Digital Repository (http://datadryad.org/) is a leading-edge example of the use of a repository structure to support the re-use of data. When an author submits an article for publication in one of the Dryad journal partners, they are encouraged to submit their data to the Dryad repository. While the article undergoes the peer-review process, the deposited data is issued with a Digital Object Identifier (DOI)--using DataCite through the California Digital Library)--which allows for the citation to be constructed.

These new publishing models which have evolved to support research data frequently have a repository structure that underpins them. The strength of this model is that whereas the repository handles the capture and management of the description of the data, the journal can focus on its interaction and interaction with the audience.

Because these new models now support research data, they have inevitably raised questions around peer review. If other parts of the scholarly information lifecycle are subject to peer review, than why not the underlying data? Lawrence et al [19] note that "A dataset which has been through peer review can be considered to have been through a process of scientific quality assurance." Callaghan et al [20] observe:

> There is significant interest in data journals at this time as they could provide a framework to allow the peer-review

> and citation of datasets, thereby encouraging data scientists to ensure their data and metadata are complete and valid, and granting them academic credit for this work.

While the aims are laudable, they raise the question as to how one avoids replicating the shortcomings associated with the peer review of traditional outputs. In future, one might expect that governments and funding agencies would require a quality assurance process for research data. Lawrence et al [19] elaborate on the data peer review procedure and provide a generic data review checklist. The authors acknowledge that data review will vary between disciplines and data types, and therefore while their checklist is not exhaustive, it is wide ranging and generic. The checklist includes aspects such as data quality, metadata quality and more general review measures.

A major JISC-funded project which targets the issue of peer reviewing of research data is Peer REview for Publication & Accreditation of Research Data in the Earth sciences (PREPARDE)(http://proj.badc.rl.ac.uk/preparde). It aims to:

> ... capture the processes and procedures required to publish a scientific dataset, ranging from ingestion into a data repository, through to formal publication in a data journal. It will also address key issues arising in the data publication paradigm, namely, how does one peer-review a dataset, what criteria are needed for a repository to be considered objectively trustworthy, and how can datasets and journal publications be effectively cross-linked for the benefit of the wider research community. PREPARDE brings together a wide range of experts in the research, academic publishing and data management fields both within and without Earth Sciences with the aim of producing general guidelines applicable to a wide range of scientific disciplines and data publication types.

An important part of the project's work—which uses *Geoscience Data Journal* as the test journal—is not only to develop procedures but also to develop policies for accepting data papers as submissions for publication. There will be a focus on "guidelines for scientific reviewers who will review the datasets".

The involvement of a wide range of stakeholders from the research lifecycle, the exploration of current technologies, and the emphasis on policies and procedures offer promise as a model which combines both traditional and new elements to build a peer review system. It remains to be seen how "open" the process will ultimately be.

Akerman [12] suggests that institutional repositories could take on some of the intermediation roles in the scholarly workflow. A major function could be providing links and unique identifiers such as Digital Object Identifiers (DOIs) for the article and the data as well as unique identifiers for authors. Some of his ideas are now manifest in the evolution of data journals and data deposit.

In questioning whether peer review has maintained pace with the evolution of the Internet, Akerman has proposed that:

> ...the article itself could live an independent life on web pages or in institutional repositories without ever being published in a journal. Since a blog is fundamentally a publishing technology, might a scientist's blog be the authoritative source for his or her academic output? An article or blog entry submitted to, and passed by, a stand-alone peer review service might be recorded in a public registry, or be digitally signed as part of the certification process.

Ackerman is not proposing that the "wisdom of the crowds" replaces peer review by "experts". Instead he is advocating that, because of the sheer volume and pace of information enabled by the Internet and web-based publishing tools, peer review should not be conceptualised only in terms of "slowly circulating, static documents".

New communication formats create new ideas. Echoing some of Akerman's thinking, Dineen [21], a professor of music, has proposed a new category of content which should be considered for peer review: digital ephemera, i.e. forms of scholarly communication that respond to changing circumstances only to be replaced by new ephemera. As vehicles of new scholarly ideas, entities such as blogs, webinars, wikis, webcasts, tweets, Facebook comments and even email should be captured.

Dineen goes on to outline how the peer review might work:

> First, allow a scholar to assemble digital ephemera for peer evaluation for the purposes of tenure, promotion and scholarly funding. In lieu of a published book or article, a scholar seeking tenure might create a blog comprising dated copies or records of emails, webcasts or other digital- media publications that have contributed to the formation and dissemination of their research. Preface the blog with a description of the research developed through these ephemera, how, for example, an email exchange led to the emergence of a new scholarly idea. Let the blog and its contents then become the object of peer review.
>
> Second, open up the process of peer review by allowing the author to respond to reviewer comments (and the reviewer to respond in turn), under the auspices of an editor or moderator. Retain the judgment of the reviewer as ultimate, for peer review is the cornerstone of evaluation in academia. But make the process a true exchange between peers.

We would propose that the use of a repository solution instead would provide a more fully featured environment to: store the content; publish the content; capture reviewers' comments and authors' replies which are then preserved with the content; link data to any publications; build discipline-specific interfaces; and provide underlying functions / processes need to achieve this, e.g. DOIs and blogs.

This proposed model offers the potential to increase the participation among potential reviewers. Ware [4] makes the point that:

> Some have shown that peer review can be unreliable. For instance one study showed that the chances of two reviewers agreeing about a particular paper were only slightly better than chance; in order to produce a reliable result, editors would need to use six reviewers for each paper. (In practice, they typically use two or three – the average reported in this survey was 2.3.)

Repository solutions which enable easy access to content in theory would help address the challenge of identifying a

majority viewpoint about a piece of research rather than the feedback from as few as two reviewers as seen in the current traditional system.

5. DISCUSSION

Institutional repositories evolved from a need to archive and preserve scholarly materials, specifically research publications. However, in this new research publishing environment, a new type of repository system will be required.

Recent developments worldwide have seen the emerging trends of enhanced discovery and data sharing services along with more focus on the content lifecycle - from data capture through to publication and preservation. One outstanding issue is ensuring quality assurance processes are in place throughout the lifecycle, especially for the final published data set.

If peer review is used, services will need to be provided that capture feedback from the reviewers as well as publish the results of qualitative and quantitative measures. These services will allow readers to assess the quality of the content and to have some assurance that the data has been through an assessment and review exercise.

Emerging methods such as altmetrics (alternative metrics) may provide possible solutions for qualitative measures to show the level of discussion and review around individual published data. While outside the scope of this paper, altmetrics are a key element in the current discussion about the impact of social media / systems on "soft peer review" [22].

6. CONCLUSION

There is no single, one-size-fits-all approach. Instead models should be developed which incorporate several processes to evaluate authors' submissions. Consideration should be given to the specific needs of individual disciplines, given the variance in the practice and goals of peer review. As the landscape of publishing is changing, the processes for the evaluation of research outputs are also changing.

To meet these challenges institutional repositories will need to evolve from an archive of preserved research publications to a rich ecosystem of data stores, content management functions, discovery, and collaboration services as well as offer publication services to capture open peer review of content. The interfaces developed for peer review will need to be tailored to specific disciplines.

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