The E-Resources Management Handbook – UKSG

Peer review

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This chapter outlines the methodology of peer review of scholarly publications, with some coverage of its history and purposes. To ensure the integrity of the research process, published work by any author is quality-controlled by being read and corrected by other scholars working in the same field. There is much evidence that the vast majority of scholars remain very supportive of the peer-review system and wish it to survive. It is now used in many countries as a measure of the quality of the work of individual researchers and of their depart-ments, with a substantial effect on the career development of the scholar and the funding of university departments. Changes in this quality-control system that might occur as publication moves towards electronic-only are covered, though it is noted that change is likely to be slow in view of the very conservative nature of scholarly opinion in this area.

Introduction

This chapter is based on the literature review section of a report produced early in 2009 for JISC[1], a version of which was also presented at the ElPub 2009 conference in Milan, Italy, in June 2009[2].

Ever since the publication of scholarly articles began in the 1660s, it has been recognized that this type of communication required quality control that went beyond simple considerations of marketability and grammatical correctness. It is acknowledged by a number of authorities (for example, John Ziman[3]) that scholarly publishing has four functions: current awareness, providing news of recent research work to the scholarly community; archiving, conserving the publications permanently so that future scholars may also access them; priority, ensuring that the true originators of ideas or research results obtain due credit for their achievement; and quality control, ensuring that the work reported is checked for its originality, correctness and validity. All of these functions need to be performed for the scholarly research enterprise to flourish.

The history of scholarly publishing is covered in detail by Michael Mabe in another chapter of this handbook[4]. For several centuries, the editors of scholarly journals, who were themselves active scholars and researchers within their own fields, provided quality control on their own. Henry Oldenburg, the Secretary of the Royal Society of London at the time of the launch of *Philosophical Transactions of the Royal Society*, felt able to do this unaided because the Fellows of the Society were known to be men of integrity and wisdom who would not attempt to foist faulty or erroneous material on their colleagues. As science grew and the number of active researchers grew with it, research and publications became more specialized, but editors could still maintain quality. Their names were the guarantee of quality, and journals like *Liebigs Annalen* and *Hoppe-Seylers Zeitschrift* perpetuated their founder-editors' names.

Editors took informal advice from other scholars known to them personally, if presented with manuscripts outside their own immediate field of expertise.

Editorial boards and referees

After the Second World War, however, the growth in the numbers of both scientists and scientific journals necessitated something more formal, and the practice of appointing an editorial board made up of members with varied subject specializations was widely adopted. (The full functions of editorial boards are covered by Mandy Hill in another chapter of this handbook[5].) If even this group was not able to assess a paper adequately, referees outside the board were called on for advice. This method has now become widespread and codified across scholarship, not just in science, and it is usual to demand 'peer-reviewed publications' as a measure of the quality of a scholar's work. It is conventional to use two referees (in addition to the editor), one or both of whom may be members of the editorial board if they have appropriate subject knowledge. If the two referees agree, their decision prevails; if they do not, a third referee is consulted. The editor, however, makes the final decision in the light of all the referees' reports[6,7]. Some journals require a larger number of referees' reports.

What do referees do?

However, referees do not just make a binary decision, publish or reject. Most commonly they recommend acceptance after amendments or improvements have been made. Thus their role is not the merely negative one of keeping poor work out, it has the more constructive aspect of improving what is published – which is one of the key roles of editors throughout publishing, not just scholarly publishing. There is some difference between disciplines concerning the amount of 'improvement' work that it is appropriate for a referee to do. Clarifying the language to avoid ambiguity – especially if the authors are not writing in their native language – is generally regarded as acceptable, but in some social science disciplines referees feel that the structure of the argument is as much part of the authors' original work as the raw data, and therefore referees should not seek to improve the quality of the argument. Furthermore, within most subjects there is a hierarchy of journals, from the one regarded as the best in the field, down through lesser ones, but all of them refereed. The same referee, knowledgeable about the field, might recommend rejection of a paper if reviewing for a top journal, but acceptance if reviewing for a lesser one. Again, then, the quality-control system provided by peer reviewing does not just provide a binary 'accept/reject' decision; rather, it provides a subtly graded indication of quality across a range of journals.

Peer review of a broadly similar nature is also applied to the quality control of potential conference contributions. Indeed, in some disciplines, especially in computer science and some fields of engineering, conferences represent a major type of scholarly communication, as important as journal articles. Conference organizers seek the assistance of referees in judging which papers will be granted an oral presentation at the conference's plenary sessions, which ones will only be included in parallel sessions, which ones will appear only in a poster session, and which papers will not be included at all: again, a graduated scale of quality applies. Most importantly, peer review is also used by research grant-giving bodies in making the critical decisions on which potential research projects will be funded – and will thus be undertaken – and which will not[8]. Sometimes the recommendation will be to revise and resubmit the grant application – another example of referees taking responsibility for improving a communication, rather than simply accepting or rejecting it. Peer review in the grant-giving process is a particularly sensitive area, since it is likely that the referees are in a broad sense competitors of the applicant for funding from the same body. This could lead to abuses in either direction – on the one hand, an 'I scratch your back and you scratch mine' approach, or, on the other hand, attempts to sabotage the research programme of competitors by unfairly turning down their proposals. It can also lead to a bias against less well-known or well-connected applicants. For this reason, grant-giving bodies usually use a larger number of referees per document than do journals – up to six may be consulted – and some allow applicants to suggest names of referees they would regard as suitable.

Refereeing and electronic publishing

From time to time questions have been raised about the efficacy of the peer-reviewing system, for example by the first chief executive of the Association of Learned and Professional Society Publishers (ALPSP), Professor Bernard Donovan[9]. In particular, with the appearance of electronic publication of scholarly journals on a large scale in the mid- to late 1990s, new possibilities emerged, were widely debated, and to some extent were adopted. Traditionally, referees knew the identity of authors but authors did not know the identity of referees. This seemed unbalanced, and both double-blind refereeing and open refereeing have been discussed[10]. The former, in which the authors' identities are hidden from the referees, has been adopted by some publishers, including the management science and information science publisher, Emerald. Double-blind refereeing has not, however, been adopted in the sciences. Open refereeing, where the author knows who the referees were, is less common. Another possibility that emerged was making electronic preprints available on a widespread basis, with the author perhaps obtaining comments from readers and only then submitting the paper for publication; this has become routine in physics, using the arXiv preprint server[11], but has not been adopted widely in other disciplines. A further opportunity in the electronic medium is post-publication peer commentary. Here, comments are appended to the paper after publication, and may in principle be used to produce an improved version at a later date. If post-publication commentary is applied to papers that have not been peer-reviewed initially, then the paper may not be fixed as the canonical version until some time after publication, to allow the author to take account of comments and improve the paper. In practice, this is not dissimilar to the arXiv model, except for the important question of when the formal 'publication date' is. Alternatively, papers may be peer-reviewed conventionally and then published, after which peer commentary is encouraged. This method is practised by a number of journals today. The journal *Atmospheric Chemistry and Physics* falls in between these last two models; a quick, light peer review is given first, open peer commentary proceeds for a while, the paper is revised, and full peer review is applied before final publication[12].

What do the scholars themselves think about peer review?

Over the past 30 years, many surveys of scholarly opinion have been made which have asked respondents for their views on the peer-review system – with this as the sole focus of the survey, or as part of a wider consultation about scholarly communication[13,14,15,16,17,18,19]. As a broad generalization, opinion is very conservative on this point. Respondents usually feel rather fervently that peer review should be retained, and although some of them predict that there will be some change in peer review in the future, few of them positively welcome any change. There is sometimes a recognition that peer review is open to abuses of various kinds – for example, a referee stealing ideas from an unpublished manuscript being reviewed, or deliberately delaying its publication – but these offences are felt to be rare, and in general the system as it stands is felt to be the 'least worst' option available for ensuring integrity in research work and maintaining the dependable quality of the canonical record of scholarship[20]. Hence, apart from the adoption of double-blind refereeing by some journals, innovation in this area has been discussed but largely not practised.

A number of UK organizations have conducted studies of various aspects of peer review recently. Research Councils UK looked at the costs, efficiency and effectiveness of peer review of research grant proposals, in an internal study of relevant reports supplemented by a number of interviews[21]. The Publishing Research Consortium, a publishers' co-operative body, commissioned a further large international questionnaire survey of scholars, which concluded – not unexpectedly – that 'Researchers want to improve, not change, peer review'[22]. The British Academy carried out a survey by interviews with prominent scholars in the humanities and social sciences, which identified many of the current difficulties with peer review that were also found in our own JISC study[23,24]. The British Academy concluded that, in its subject fields, a diversity of peer-review practice exists and is to be encouraged[25].

Open access

A topic that has seen much debate and dispute over the last decade has been open access (OA) – the principle that scholarly research reports, predominantly reporting work undertaken at the public expense, should be available free of charge to the general public. (OA has been covered by a chapter in this handbook by Jan Velterop[26].) In the print era, OA would have been impractical owing to the costs of paper, printing, binding and distribution, but electronic publications can be distributed at a minimal marginal cost per additional copy. Thus OA is feasible with electronic publications, but the question of covering 'first-copy costs' is unresolved. This issue underlies debate on what are 'the true costs of the essentials', since OA proponents wish to see costs minimized[27]. Two main roads to OA have been identified – the 'gold road', in which journals obtain funding from sources other than purchasers of the journals and thus publish their journals free of charge to the reader, and the 'green road', in which papers are published in conventional subscription-based peer-reviewed journals, but electronic copies of the final version of the text are placed in repositories that are accessible free of charge[28]. Opponents of OA tend to imply that peer review would be weakened or non-existent in an OA universe, but most OA proponents in fact advocate the retention of fairly traditional peer review. A radical minority have, however, sometimes suggested that the very low cost of computer storage allows all submitted papers to be published – this argument is usually associated with support for post-publication open peer commentary – and this minority view has been publicized by OA opponents as suggesting that OA (gold road) journals are not quality controlled.

   Current controversy also surrounds the green road. Many universities have recently established institutional repositories (IRs), though they tend to find difficulty in persuading their academics to input their publications to the IRs. Proponents of the green road approach, such as Professor Stevan Harnad, say that even if a large proportion of papers are available free of charge in repositories, the viability of the journals themselves will not be affected in the medium term; in the long term, transition to a gold road model could be carried out in an orderly manner. Publishers, understandably, are sceptical about this claim, since it is unlikely that libraries will continue indefinitely to purchase resources which they can obtain free of charge. Publishers suggest that their quality-control role, including the administration of peer review, could be jeopardised if their publications are unable to generate adequate revenue in the future[29].

Horseless carriages

There is also an unanswered question about the future nature of scholarly publications themselves. Thus far, there has usually been reference to 'e-journals' and 'e-books', and indeed the electronic publications generally made available have mostly been e-versions of previously existing, and usually still existing, printed journals and books. Even newly founded electronic journals without a print equivalent tend to perpetuate the usual journal article structure, though this may be supplemented by multimedia content and voluminous raw data not available in print. In essence, the concepts of a 'scholarly journal article', an 'academic monograph' and a 'textbook' have proved very resilient so far, despite the widely observed fact that modern students much prefer to access electronic rather than printed versions. Arguably, though, this puts the electronic scholarly literature in the position that cars were in at the end of the nineteenth century – 'horseless carriages', looking just like their horse-drawn predecessors but without the horse. E-journals and e-books look just like print journals or books, but without the paper. But just as the cars of today do not look remotely like horse-drawn carriages, we may expect the scholarly communication media of the future not to look like printed journals or books. The direction in which this venerable type of publication will evolve is not easy to predict.

Web 2.0

Changes in the telecommunications environment and in the situation of higher education in many countries make it likely that changes to the peer-review system will occur soon. The most recent surveys

of scholarly opinion on peer review[30,31,32] took into account the electronic availability of publications on the internet, but none seem to have taken place since the arrival of Web 2.0 and the rapid adoption of social networking. Earlier, there had been discussions of 'computer-supported collaborative work' (CSCW), for example by George McMurdo[33], and the term 'collaboratory' was coined by an organic chemist, Henry Rzepa[34], to describe research conducted by groups of scholars who might rarely if ever meet face-to-face but use the internet for their co-operation. Also, e-mail discussion groups and bulletin boards, fairly early internet functions in wide use since the late 1980s, have become potent media for informal discussions between specialists about current research. But now that Web 2.0 and social networking sites such as Second Life, Facebook, YouTube and many others have been adopted by millions of people, inevitably there has been discussion of their possible use by professional as well as social groups. In particular, some of these have come to be used by academic research groups, but the formal publication system still stands alongside these informal means of communication. Will they coalesce? Wikis, and especially *Wikipedia*[35], have had a large impact on both information-providing and information-seeking behaviour. The word 'prosumer' has been coined to describe people who both provide and use information in a wiki environment[36]. It may be noted that this concept closely resembles the classic collaborative–competitive nature of the scholarly research endeavour, and in that sense research scholars were the first prosumers! Wikipedia therefore offers an interesting challenge to scholarly communication: not only is it important that the quality of the information within it is dependable, but means also need to be found to allocate credit and priority to the originators of innovative ideas and research results within Wikipedia articles. Perhaps it is in this more collaborative environment that the future of scholarly communication may be found, rather than with those horseless carriages, e-journals and e-books.

Research assessment and impact

The growth of higher education, too, has led to requirements from governments that universities and the individual academics within them should actively demonstrate the quality of their research work. In many subjects, the Thomson Reuters Journal Impact Factor (IF)[37] is used for this purpose; it is assumed that if a scholar has many publications in high-ranking journals in the field, then this guarantees the quality of the work, and as a consequence university administrations sometimes try to insist that all their academics attempt to publish in these top journals. (IFs have been fully covered in the chapter by Jo Cross in this handbook[38].) Strong resistance to this simplistic approach has arisen lately in various disciplines, especially in the humanities, where an attempt at classifying journals into grades A, B and C has been abandoned[39,40]. The practice of judging the quality of work by means of the IF has been widely criticized, and it has often been pointed out that many papers in high-IF journals are uncited, where some papers in generally low-IF journals may be individually highly cited. Since individual researchers and scholars need to build their careers, and the institutions within which they work need to protect and enhance their reputations, a reliable measure of research quality is needed. Many countries now use the body of published research as a means to measure the research quality of institutions and of individuals, and thus to determine their future research funding. In the UK until now, peer review was used as the main methodology of the Research Assessment Exercise (RAE)[41]; although the submitted work had already been peer-reviewed before its publication, the RAE panels of subject experts effectively peer-reviewed it again. To an extent which varied between disciplines, they also leant on the IFs of the journals in which the submitted papers appeared. IFs are based on the average rate of citation of papers published in the journal, but citation rates can also be used at the level of the individual paper or of the individual author as a measure of quality. This, of course, is a retrospective measure, since the work cannot be cited until it has been published, but in the longer term citation is a reasonable parameter to measure quality. It is planned that the next RAE (renamed the Research Excellence Framework, REF) will depend to a greater extent on metrics, including citation rates, and less on human-based, and thus labour-intensive, peer review[42]. This has proved controversial, and many scholars have fought against the change. In the humanities a less metric-based approach is likely to prevail.

Publications about peer review

Peer review has itself been the subject of many scholarly publications, notably an entire book on the subject published by Ann Weller in 2001[43], which is strongly recommended to anyone who wishes to cover the peer-review field very fully. I published a much shorter review study of peer review, up to date to 2002[44]. Much of the investigation covered in these reviews has been undertaken by medical editors[45], especially the staffs of the *British Medical Journal* and the *Journal of the American Medical Association*. This reflects the particular importance of quality control within the biomedical area, where critical decisions by clinicians on appropriate therapy for individual patients may be based on recently published research papers. The issues covered in this extensive body of research include the reproducibility of refereeing decisions, the incidence of errors by referees, referees' ability to detect fraudulent research, and possible bias in refereeing.

A major report entitled *Current Models of Digital Scholarly Communication*[46] was recently published by the Association of Research Libraries (ARL) in the USA, reporting a project undertaken by the Ithaka consultancy firm for ARL. It concluded that peer review was still almost universally respected, but that Web 2.0 tools were increasingly blurring the boundaries between traditional categories of scholarly publication.

Refereeing administration systems

Another area that has been reported on extensively is the development of automated systems for the selection of referees and the administration of peer review by journal editors, conference organizers and research grant-giving bodies, often as part of an overall document-processing system for electronic prepress[47]. Several different proprietary systems compete for the business of scholarly publishers in this area. Adoption of such systems has undoubtedly made the peer-review process quicker and more efficient, but it has not altered the fundamental nature of the quality-control process. This remains in the hands of the author's peers – themselves being authors on other occasions.

Scholars' reluctance to referee – and is refereeing needed in the electronic era?

In recent years, it has sometimes been reported that there may be growing reluctance on the part of many academics to undertake refereeing work. Several reasons have been suggested for this. One is that the number of papers submitted to peer-reviewed journals, conferences and grant-giving bodies continues to increase. This in turn is due both to the growth in the number of people engaged in research work, and to the growing insistence by universities and governments that academics must show evidence of peer-reviewed publications. At the same time, pressure of work on academics has increased, not only in respect of the need to seek more research grants and to write more papers, but also because of increased student numbers as the proportion of young adults engaged in higher education increases. The willingness of scholars to undertake work that is neither paid nor publicly recognized is said to be falling. At the same time, as mentioned earlier, a minority of the academic community feels that electronic-only scholarly publication – seen to be a likely development in the near future – will remove the need to ration publication space by peer review, since, unlike print products, electronic publications have a virtually zero 'run-on cost'. Although it is true that computer storage for voluminous data has continually fallen in price over many years, the readers' time remains a scarce resource, and most academics feel that peer review performs a valuable filtering function, saving them time, as readers, by providing an indication of the gradations of quality among publications. It does seem likely, though, that in the electronic era scholarly articles will include more of the voluminous original data obtained by the author but not published in the print version of papers.

Data collections and databanks

Another route to the provision of full research data lies in the provision of databanks and data collections of various kinds. In some subject fields, these have existed for some time. For example, the UK Data Archive run by the Economic and Social Research Council conserves social-science data collections that have been created in research projects in the UK[48]; and the enormous quantities of DNA sequence data collected by the Human Genome Project (HGP) and by projects to sequence the DNA of other species have been collected in large-scale international databanks[49]. It may be that other projects in the future might follow the method that the HGP did, placing data directly into databanks rather than passing it through scholarly publications en route to databanks. In either case, there is clearly a need for data to be quality controlled before it is permitted to enter an authoritative databank. This is a rather different challenge from refereeing papers, a much newer one, and potentially a much larger one. Projects of the future – such as the Large Hadron Collider – will generate data in enormous quantities, which numerous groups around the world will wish to use in their research. Ensuring the quality of these collections will be essential for maintaining the integrity of the research enterprise for the future.

The Higher Education Funding Council for England (HEFCE) has funded a feasibility study for the proposed UK Research Data Service being carried out by Serco; the interim report of this feasibility study helpfully lists many of the current data initiatives[50]. In the USA, the National Research Council has a Board on Research Data and Information whose mission is to improve the management and use of digital data[51]. Its website says:

> The *mission* of the Board on Research Data and Information (BRDI) is to improve the management, policy, and use of digital data and information for science and the broader society. The BRDI maintains surveillance of the field and proposes initiatives that might be undertaken at the National Research Council (NRC). Acting through the NRC, the Board engages in planning, program development, and administrative oversight of projects launched under its auspices.

Conclusions

The term 'peer-reviewed' has entered common parlance, especially as regards clinical trials of new pharmaceutical products, but few outside the academic and research worlds understand fully what it means. It is a self-regulating quality-control system for scholarly and academic research publications, which serves to avoid 'the bad driving out the good' in research work. It keeps scholars honest by making sure that their career advancement depends on their producing work that fellow-scholars within their discipline judge to be valid, accurate, well-argued and original. The system has existed for a very long time, and has changed very little. When biologists find that a certain characteristic is 'conserved during evolution', they conclude that the feature must be essential for the survival of the organism. Any mutation there would be lethal. It is not entirely fanciful to suggest that peer review is essential for the survival of the scholarly research community, as shown by the fact that it has been strongly conserved during the evolution of this system.

Continuing with the biological analogy, a new environmental pressure has affected the evolution of the research system over the last decade: electronic publishing. More recently a further variant on this environmental pressure has arrived: Web 2.0 and social networking. In spite of this, the evidence to date – scanty evidence so far in the case of Web 2.0, admittedly – suggests that the strong conservation of the peer-review system continues. Despite its well-known drawbacks and problems, in all surveys of scholarly opinion it retains its primacy as the most important feature of the scholarly communication system that must be retained at all costs.

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Fytton Rowland was originally a biochemist, and entered information work in 1967 as an editorial assistant at the Biochemical Society. He moved on to research work on chemical information retrieval, first at Oxford University and then with the Royal Society of Chemistry (RSC). Later he served as Scientific Information Officer at The Royal Society of London for three years, before returning to the RSC in managerial positions. His final post there was Publications Production Manager, in which role he performed some of the RSC's early experiments in electronic publishing. In 1989 he joined Loughborough University, and was successively Research Fellow, Lecturer and Senior Lecturer in the Department of Information Science. There, he developed and led the department's undergraduate degree programmes in publishing, and most of his teaching was delivered to students on these courses. He retired early in 2008. Fytton Rowland has authored over 100 publications on information topics, mostly on human and economic aspects of electronic publication of scholarly journals, which has been his main research interest throughout his career.

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