

Evolution of scientific publishing over the last 30 years

Evolução da publicação científica nos últimos 30 anos

Evolución de la publicación científica en los últimos 30 años

Hooman Momen ¹

¹ *Bulletin of the World Health Organization, Geneva, Switzerland.*

Correspondence

H. Momen
Bulletin of the World Health Organization, WHO Press, World Health Organization. 1211 Geneva 27, Switzerland. momenh@who.int

Since the launching of *Cadernos de Saúde Pública* (CSP) in 1985, the revolution in information and communication technologies (ICTs) has transformed all aspects of scientific publishing: content generation, publication management, workflow and production formats, accessibility, dissemination, and archiving. These changes have, in turn, radically altered the scientific publishing landscape and the relationships among the major players, including scientific publishers, libraries and academic institutions, authors, and readers. In this short perspective I will review examples from each category and reflect on some current and future trends that are driving the scientific publishing enterprise.

Content generation

Thirty years ago, when CSP was first published, word processors and related elementary software programs were already available. Nonetheless, most authors typed their manuscripts using a typewriter, often an electric one; manually searched their research and laboratory notebooks; physically consulted periodicals in the library; prepared images and tables for publication by hand; and laboriously formatted their own reference lists according to each journal's specifications. Today, a personal computer, lap-

top, smartphone, or tablet is considered an essential instrument for researchers, and software exists to facilitate and automate all of these tasks and many more, allowing most authors to produce, to journal requirements, professional-looking manuscripts with relative ease. This has freed up considerable time to allow authors to increase their productivity and creativity.

Publication management

In 1984, authors would post their manuscripts (in multiple copies) to the journal's editorial office. The work of most editorial offices centered on the morning mail, incoming new manuscripts, comments from peer reviewers, revised manuscripts from authors, decisions and suggestions from editors and board members, proofs from printers, etc. Such activity would be followed by preparation of equivalent outgoing mail to similar classes of contributors. Modern manuscript and production management software platforms have transformed the editorial offices of publications by placing all communication on line and efficiently recording all editorial processes so that "lost" manuscripts are a relic of past times. Editorial offices now run with much higher workloads, fewer permanent staff, and often in decentralized working environments, and they

can produce multiple scientific publications simultaneously.

Workflow and production formats

In 1984, simple graphic software was available, but many journal workflows were still based on the production of marked-up typewritten manuscripts by in-house editors. These manuscripts were composed by printers and eventually printed following several rounds of checking of proofs by proof-readers, authors, and editors. The printed version was king, and any other production formats were an afterthought. Today modern journal workflows require very little information to be retyped. Information is captured from the manuscript management system. All comments are incorporated on line. An XML or other single-source workflow is used, allowing all corrections to be stored centrally and multiple formats to be produced simultaneously for print, web, CD-ROM, and mobile devices. Content can be reused and repurposed for new or multilingual editions without needing to restart the workflow.

Accessibility, dissemination, and archiving

The printed journal of 1984 was mainly distributed to libraries and personal subscribers. The printing and distribution of copies comprised a large fraction of the cost of scientific publishing. Updated mailing lists were kept as the principal tool in the promotion and marketing of journals. Libraries, as the depositories of scientific information, were responsible for the preservation and archiving of content.

The advent of the internet has completely changed the dissemination of scientific publications. These no longer need to be “pushed out” to customers, but are placed instead on attractive websites where interested readers can discover their contents through search and social media facilities. The cost of giving access to additional readers is insignificant, allowing for the real possibility of making these publications freely accessible to readers. With all information being increasingly available on line and often only on line, the web has itself become the chief depository of the world’s scientific information.

Changes in the scientific publishing landscape

As scientific publishing has become more sophisticated, with publications rich in features that allow information to be more easily discovered, searched, linked, and reused, so has the requirement for increased resources to provide the ICT platforms for hosting these publications. This has benefitted large publishing organizations, which can now house many publications on a single platform and thereby harvest, most effectively, the large efficiency gains that the advent of ICTs has enabled. Scientific publishing has therefore become concentrated in the hands of fewer and fewer publishers, with the largest ones responsible for the production of thousands of journals each. These publishers are now among the most profitable commercial companies in the world.

Libraries have responded to these changes by forming consortia to purchase access to the greatest amount of information. They increasingly see their role as providers of access to scientific information rather than repositories of scientific publications. Academic institutions, seeing the multiple purposes to which the scientific information that they produce can be used, have grown more attentive to the management of the intellectual output of their staff and use of copyright. These institutions, together with libraries, are increasingly promoting the concept of open access to allow free access to and reuse of scientific information. This new environment has provided unprecedented opportunities for both authors and readers by increasing the diversity and accessibility of scientific publications for their use.

Interestingly, despite the revolution in scientific publishing that has completely changed the publishing ecosystem over the last thirty years, the papers published in the current issue of CSP and other journals are not much different in style and format from those published in 1984. This is in spite of the fact that with the move to online publishing, the restrictions on space and cost that historically determined the conventions governing the format and appearance of a scientific article are no longer relevant. Today articles could be longer, references more numerous, graphs multicolored, and figures three-dimensional. Images could be produced in video, commentaries could be available in audio, and all significant names and facts in the article could be linked to online encyclopedias and databases containing complementary information. However, very few journals have implemented these possibilities. Innate conservatism among researchers and a continuing desire among edi-

tors to maintain congruence between the print and online versions of the publication as well as the extra costs involved are possible reasons for such reluctance.

Future trends

The revolution in ICTs that has so profoundly affected scientific publishing is continuing and continues to impact scientific publications. The advent of cloud computing has significantly reduced the entry costs for starting a publishing enterprise and has resulted in many new entrepreneurs appearing on the publishing scene. These new publishers will certainly be testing many new publishing ideas and may reverse the historic concentration of the sector. They are certainly challenging the traditional quality assurance mechanisms used in scientific journals.

The concentration of journals among publishers is being mirrored by the concentration of articles within journals. The lack of restriction on space has given rise to mega journals that publish thousands of articles per year, with the most successful of these now representing about 3% of all articles appearing in MEDLINE. New models of open access and peer review are also being introduced.

The social media not only provide increased opportunities for promoting existing scientific publications; they also represent new conduits for the dissemination of scientific communication that threaten the established role of academic journals. Editors, editorial offices, and production workflows are often separated geographically. Peer review and other quality assurance mechanisms can be outsourced, along with production and publication. Content is often searched via article depositories rather than by browsing journals. These developments could

eventually leave the journal with little more than a virtual editor and a brand.

In addition to the changes introduced by technology, other changes in the scientific publishing landscape are being caused by social and economic change. China, Brazil, India, and other emerging economies have invested massively in higher education in recent years. As a result, hundreds of thousands of new researchers have appeared on the international scene and the number of articles submitted for publication has risen dramatically. Such trends are severely testing the established publication infrastructure and driving some of the changes already mentioned, and they are certainly favoring radical change in the future of scientific publishing.

As CSP reflects on its thirtieth anniversary, it can congratulate itself on surviving the most tempestuous times in scientific publishing and can look forward to new changes, challenges, and victories in the decades to come.

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Submitted on 17/Feb/2014

Approved on 18/Feb/2014