Final Thoughts

Scientific Scholarly Communication: The March Forward

Science is a distributed system in which scientists individually or collaboratively conduct research following the scientific process, exploring new theories, or reexamining existing theories. In recent years, science has become more collaborative and interdisciplinary in nature, and the somewhat closed scientific practices that once existed are evolving into a more open and inclusive system. Open and unrestricted access to scientific knowledge facilitates free exchange of ideas, faster sharing, as well as public scrutiny of research findings, which together instigate the self-correction of science and accelerate its advancement.

Scholarly communication is an integral part of the science enterprise. The formal scientific scholarly communication system that originated in the 17th century has evolved through the centuries, creating an authority structure in the form of journal publications that still remain as the preferred venues for sharing scientific research findings. Society places a great deal of trust in the authority represented by the pantheon of revered publications that form the foundation of scientific knowledge. Although the scholarly publishing structure evolved for nearly three centuries with relatively little change, the unprecedented transformation of the scientific infrastructure and culture accelerated by technological advances has challenged these traditions. Along with these changes came the demand for a strong but flexible and efficient system that can handle the unprecedented accumulation of knowledge coming at varying speeds, in diverse and complex formats, from dispersed geographical locations.

One of the most prominent revolutionary changes that has emerged over the past three decades was the "opening up" of the scientific scholarly communication system; as a result, the open access (OA) publishing movement was born. OA publishing challenges the restrictions imposed on information sharing by the continuously increasing subscription rates of scholarly journals. Although the OA concept agrees with the norms of openness in scientific inquiry, it was initially met with skepticism and even resistance in some sectors of the scientific community. However, the support for OA publishing has been steadily increasing among many

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stakeholders, and many innovative and bold experimentations have led OA publishing to become a significant part of the scientific scholarly communication system. OA publishing extends the reach of information sharing to a broader audience, allowing researchers in geographic areas outside of the established research centers to join the scientific global forum. This expansion has allowed collaborations within the worldwide scientific community, increasing the speed of progress. Nonetheless, there are many challenges to overcome. Unfortunately, trust in OA publishing has eroded under the cloud of predatory publishers who exploit the author-paid publishing model. Of course, these unethical publishers are the exceptions, and many OA journals maintain high standards that include rigorous peer review, exemplifying the practices that establish trust. The fact that the traditional subscription journals are moving toward offering a hybrid system, i.e., publishing OA articles in their subscription-based journals, highlights the increased acceptance of the OA publishing concept. There is no question that OA scholarly publishing is pushing the boundaries of journal publishing toward a more open scientific scholarly communication system.

Critical evaluation of scientific claims by other experts in the field is considered as an essential facet of the scientific process. The peer-review system evolved parallel with the formal scholarly communication to fulfill this need and has gained the trust of the scientific community and society as a way to determine the credibility of publications of research findings. However, the conventional peer-review system is drawing criticism for its deficiencies, and the scientific community agrees that it needs to be improved. The closed and secretive nature of the conventional system contradicts the norms of openness in science, and the arguments for opening up the peer-review system, making it more transparent, have gained momentum. Enabled by technological advances, the open peer-review (OPR) model is being tested with and even implemented with varying levels of success by some scholarly journals. Moreover, peer review is now evolving in many different directions as new reviewing models are created, ranging from OPR models with pre- and post-review to hybrid models of closed pre-publication review with open post-publication review, and even to publishing with no review. The traditional closed peer-review system concentrates on pre-publication review, but the post-publication evaluation of journal articles is a novel and inventive concept that has been tried by some journals. Community engagement in reviewing is probably one of the most important aspects of OPR and can be constructive, especially in some scientific fields, if used effectively. Some journals with closed peer-review traditions now allow public discussions about published articles, thus encouraging public engagement. Probably, the most intriguing aspect of all these new approaches is the freedom journals enjoy in adopting peer-review systems by combining features of different models that works best for the journals themselves and the scientific community they serve. There may be failures and glitches on the way, but OPR is surely going to be a permanent fixture in the scientific scholarly communication system.

Assessing the scientific quality and the impact of scientific research is a necessity but is unquestionably challenging. There are quantitative measures, mainly relying on citation data, that are being developed to assess the influence of journal articles as proxies for the scientific impact of the research they describe. Although there are concerns regarding the effectiveness of these metrics and implications arising from incorrectly using them, still citation metrics can be considered the best tools yet implemented to assess the influence of scientific research; however, it is important to stress that their strengths, limitations, and implications need to be well understood when using them. Use of alternative metrics systems (altmetrics), mainly based on social media interactions to assess the societal impact of scientific research, is a fascinating but logical concept. It is important to understand and correctly interpret these social interactions beyond just counting the numbers. Both the scientific community and society need to be mindful about the possibilities of selective dissemination of research and misinterpretation of findings, in addition to the potential for manipulation of interaction counts.

Traditionally, scientists have shared research data as tables, graphs, and summaries in support of their scientific claims when publishing their work. With advances in computer and communication technologies, collection, storing and archiving, dissemination, retrieving, and analyzing data are becoming easier and faster. As data are considered the foundation of science, data sharing is gaining momentum. Compared with sharing scientific information as journal articles, a system that has evolved over 350 years, sharing research data is still a relatively new experience for researchers. Although data sharing has already become a regular practice in data-driven scientific fields, it poses many challenges as it is a complex, costly, and time-consuming endeavor, especially in disciplines with small-scale research projects. The practice of making supporting research data available along with each article is being promoted, especially by research funders. The concept of formal data publication is being introduced to provide a means of rewarding researchers for their useful and well-documented research data. Following this trend, the emergence of data journals is a new development in scientific publishing.

Along with OA publishing and OPR, there is a move toward “open data,” another development that embraces openness in science. The “open data” paradigm expedites scientific collaborations and leads to scientific discoveries and innovations that otherwise would not have been possible, or at least would take much longer to achieve. However, it is important to recognize that there are boundaries to opening up scientific data that need to be recognized and respected. The privacy of individual research subjects, their families, and their communities needs to be respected when sharing scientific data. Safety, national security, and economic interests are other areas that need careful attention and caution when openly sharing data. These critically important aspects highlight the need to promote not just openness but intelligent openness in scientific data sharing.

Has active public engagement and participation always being positive? Some public engagements have turned against scientists, and there have sometimes been well-organized and well-financed harassment campaigns against scientists and calls for retraction of research articles on sensitive and controversial topics. Scientific communities and society as a whole need to be aware of these practices, and journals should publicize these threats and litigations to expose these incidents.

Despite these negative incidents, opening up of the scientific scholarly communication system enabled by technological advances is moving ahead, empowering scientific innovations through the open exchange of ideas, evidence, and collaborations. As illustrated in different chapters in this book, invigorating academic discussions and conscientious deliberations of stakeholders of science have been integral to the evolution and improvement of the scientific communication system, thus promoting scientific advances that support and enrich the well-being of all human life.

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