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# Open scientific journals: Emerging practices and approaches

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**Abstract.** This study aims to show how the concept of openness has been manifested and amplified in the universe of open access scholarly journals, pointing out emerging characteristics and practices linked to processes of submission, evaluation, revision, editing, publishing, editing, distribution, access and use of texts for publication. We proceeded to an overview and discussion of the pertinent literature and the identification and analysis of open access journals which have addressed the issue, and to the identification and analysis of cases of open access journals which have been adopting innovative practices, based on information on editorial policies available on their websites. Among the results, we have pointed out aspects of the publications examined, such as the types of licenses used, policies regarding access to research data, publishing formats, charges and alternative metrics of evaluation.

Keywords: Scholarly journals, scientific journals, open scholarly journals, open access, open science

## 1. Introduction

Traditional models of scientific journals, which constituted the dominant forms of scientific communication and publication since the emergence of what is known as "modern science", are being challenged by new values and practices disseminated by the Open Access movement and, more recently, by the Open Science movement. This has motivated the proposition and experimentation of significant changes in the formats of publication of research results. Thus, the significance of open journals has grown beyond the matter of access, while commercial publishers have been developing new business models in open access.

In demonstrating how the concept of openness was expanded in the universe of open access journals, this study[1] seeks to point out emergent characteristics and practices in the processes of publishing, such

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as the types of licenses used, policies regarding access to research data, publishing formats, submission, revision, distribution, and alternative metrics of evaluation, charges, access and use of texts for publication.

We thus proceeded to an overview and discussion of the pertinent literature as well as to the identification and analysis of cases of open access journals which have been adopting innovative practices, based on information on editorial policies available on their websites.

The article is structured around four main items. In the first one, we present a brief history of the genesis of movements for open access, pointing out emergent practices and approaches in this field. In the second item, we highlight some aspects of the political economy of scientific communication and publication which impact directly or indirectly the practices and approaches previously mentioned. In the third item, we present the results of research publications analysed, such as types of licenses, policies and rules for access to research data, publication formats, charges, and alternative evaluation metrics. In conclusion, we point out the main challenges to wider adoption and diffusion of emergent approaches and practices of open publications.

## 2. Emerging approaches regarding Open Access journals publication

The 1990s can be considered a landmark of the increasing reaction to the enclosures of scientific information and knowledge as well as of the proposition of alternative practices of scientific publication and diffusion. These movements may be framed in a broader perspective which benefits the understanding of knowledge and information – and all the infrastructure and means necessary for their creation, storage/conservation, and dissemination – as commonly shared entities. This approach involves circumventing the commercial for-profit exploitation of scientific knowledge and information infrastructures to create alternatives under the principle of the commons, driven by social norms or regulations [1,2].

From the beginning of the 2000s, several other movements were forming, in line with the original proposals of the Open Access movement, thus building a wider movement for Open Science. Its proposals reach beyond the universe of access to publications, addressing also other aspects such as research data, citizen science, alternative evaluation models, among others [3,4].

This is the context of the "scientific journals crisis". It expresses, on the one hand, a reaction to the high costs of updating scientific and university library collections resulting from the high prices practiced by commercial publishers, together with the high growth rate of this literature [5]. And, on the other, the development of new possibilities of production and circulation of scientific information in electronic media, particularly the Internet, and new interactive and collaborative digital platforms. In academic environments, the Internet has stimulated communication between researchers, favouring easy access, speed, visibility and exchange of information. This agility contrasts with the time required for production and distribution of printed journals with the instantaneity of electronic publication, although current publishing systems still make publication of research results extremely time-consuming [6].

Odlyzko [5] adds that new possibilities of electronic dissemination, especially in preprints available through FTP[2] servers have proven to be faster and less costly than traditional publication processes (typesetting, copy-editing, printing, and distribution). These media would be potentially operable by academics themselves since the necessary abilities were incorporated in pre-configured low-cost software and hardware.

[2]File Transfer Protocol, an Internet protocol for file transfers between terminals.

At the beginning of the 1990s Stevan Harnad, a Cognitive Scientist with a PhD in Psychology from Princeton University and founder of an early electronic open journal (Psycoloquy), argued for the need to take advantage of the new information and communication technologies (ICTs) to multiply the possibilities of scientists' interaction, until then restricted to face-to-face contacts. Harnad [7] called this new media "scholarly skywriting". According to the author, the process should be structured vertically, based on a pyramidal hierarchy of evaluation and judgment of scientific production by specialties, as well as horizontally, focusing on archiving of previously revised work validated by peer revision, in vertical format.

Harnad strongly promoted e-prints, which he called "esoteric scholarly publication" [8] referring to their non-commercial characteristic, favouring wider distribution, with no charges for royalties or access costs [6]. This designation

> [...] protects, however, the fair use of the work, in which the authors reserve the right to publish the electronic document wherever they wish, allowing the establishment of links indicating the URL where the text is found, yet not allowing the reproduction of the work in another server, nor its sale without author's consent [6].

Preprints may include: revised and accepted articles awaiting publication in a scientific journal; submitted articles not yet revised or accepted; and articles for which comments (from "invisible colleges") are expected before submission for publication. E-prints designate preprints in electronic format [9].

Another pioneering initiative in widening access to scientific information was the creation, at the beginning of the 1990s, of a repository, based on a preprint archive server, by Paul Ginsberg in the Laboratory of Los Alamos in the United States, for Physics and Computer Science, which later became known as arXiv.org.[3] Now hosted by Cornell University Library, this repository accommodates more than 1.3 million submissions accumulated along its 26 years of existence [10]. In recent years, mirroring the success of arXiv and the incentives to preprint publication [11,12], other areas have been creating their repositories, such as bioRxiv,[4] in Biological Sciences, and SocArXiv,[5] in Humanities and Social Sciences.

The Open Archives Initiative – OAI, was established at the Santa Fe Convention for the Open Archives Initiative in October 1999 in the city of Santa Fe in California, USA. A set of technical and organizational changes in existing processes of scientific communication was proposed in order to enable an open publication structure capable of establishing free layers as well as commercial ones [13]. The initiative was proposed taking advantage of the growing transposition of scientific publication to an electronic medium, specifically in open format and as e-prints.

Among its main actions was the establishment of norms which would allow for the creation of standards to promote the interoperability of data between repositories – already established or in constitution – such as arXiv.org, CogPints, NCSTRL, among others. The Initiative's guidelines established its main standards, including: (a) the definition of a simple set of metadata; (b) the agreement on the use of a common data syntax in XML;[6] and (c) the definition of a common protocol [13].

[3] https://arxiv.org/.

[4] https://www.biorxiv.org/.

[5] https://osf.io/preprints/socarxiv.

[6] The Extensible Markup Language (XML) is a simple text-based format for representing structured information: documents, data, configuration, books, transactions, invoices, and much more. It was derived from an older standard format called SGML (ISO 8879), in order to be more suitable for Web use [42].

In 2001, following the Public Knowledge Project[7] (PKP) initiative, the Open Journal Systems (OJS) software was developed in open source and has been freely distributed since then and translated to several languages with the scientific community's support. The software improves and allows for the systematization of processes such as editorial management and journal publishing on the Web, establishing and administrating the journal's workflow, from the submission of manuscripts and peer reviewing to publication and indexation. In 2017, OJS is used by approximately 35 percent of journals indexed in DOAJ [14] and has been an important tool for the development of scientific journals in Latin America and the African continent.

But it was the Budapest Open Access Initiative, in 2002, that became known as the official launching of the movement for Open Access to scientific publications. This declaration established the definition of what would become known as Open Access to scientific literature:

> "By "open access" to this literature, we mean its free availability on the public internet, permitting any users to read, download, copy, distribute, print, search, or link to the full texts of these articles, crawl them for indexing, pass them as data to software, or use them for any other lawful purpose, without financial, legal, or technical barriers other than those inseparable from gaining access to the internet itself. The only constraint on reproduction and distribution, and the only role for copyright in this domain, should be to give authors control over the integrity of their work and the right to be properly acknowledged and cited." [15]

The growth of self-archiving practices, the expansion of institutional and thematic repositories, and the increasing number of open access journals or journals that did not impose restrictions to the authors to archive the preprint or post-print versions of their published articles in institutional repositories inspired Harnad et al. [16,17] to create two terms to differentiate these practices. The denomination Green Open Access (Green OA) refers to publication, by means of self-archiving in a repository or institutional website[8] of a preprint or post-print version of the article. The Gold OA denomination refers to publication in a scientific journal whose articles are freely accessible online. One of the essential factors of the differentiation between the two is that while Gold journals use peer review by default, authors who make their preprints available in repositories must find alternative means of evaluation [18]. These two terms have been widely disseminated and used in the literature on open access.

There are then new issues which widen the scope of open access, such as: maximizing the reproducibility of scientific experiments whose results are described in the publications; going beyond the publication of research results in closed or exclusively textual formats, opening up space for sharing research results and different materials produced along the research process; and incorporating new, more transparent approaches to evaluation and review permitting greater agility, such as open post-publication review.

One of the main challenges to the establishment of open publications relates to finding a suitable business model that allows for long-term and sustainable funding beyond commercial and monopolistic exploitation. Cope and Kalantzis [19] raise concerns about the unsustainable costs and inefficiencies of traditional commercial scientific publishing, which lead to the expensive costs of journals subscription. It is also important to emphasize that commercial publishers have a focus on high profits and the

[7] https://pkp.sfu.ca/.

[8] With the diffusion of academic social networks, such as ResearchGate and Academia.edu, authors began to use these venues to deposit preprint and post-print versions of their articles. Yet this practice has been controversial, since these venues perform active harvesting of publications, associating them to authors' profiles and encouraging the deposit of the full texts. In many cases, these texts are submitted to copyrights, thus creating new conflicts with commercial editors.

subscription fee or cost per article does not necessarily reflect the production costs but also the journal influence (its "symbolic capital") [20]. Those high costs prevent that a large proportion of society (researchers and the general public) have access to the published research and thus to science results [21]. The rise of open access (OA) journals is challenging the business models of scientific journals [19] and is also demanding the development of more sustainable publishing models. Open access journals need financial sustainability, just as commercial journals need to adapt if they are to continue making a profit in the open access paradigm.

Some OA journals charge the authors a publication fee, also known as Article Processing Charge (APC), pioneered by BioMed Central and Public Library of Science Journals (PLOS) since 2002 [22]. Others, known as hybrid journals, still published under a subscription model, charge those authors who prefer to publish their article in OA. According to Björk [23] although the idea of allowing individual authors the opportunity to pay to make their articles in subscription journals openly available is on schedule since 1996, this practice has failed as a way of significantly adding to the volumes of OA articles, and will remain a very marginal phenomenon in the scholarly publishing landscape.

Another challenge is the need for sharing research data along with the published article. Considering the growing amount of shared data, Brown [24] argues that due to limited page space in an article to present data, it became necessary for scientists to organize, disseminate, and archive their research-related data digitally, and then link that data to the article. This practice is reinforced by Tenopir and King [25] who highlight that citation linking within and between articles and links from the article to external datasets represent some of the future trends of journals and article publication. Data sharing has been increasingly valued to enhance scientific knowledge credibility and certification without the intervention of discursive rhetoric of the authors when the research results presentation is limited to the article text [19]. As with data, many findings are currently not published, such as small studies and software papers [21]. The open publication of diverse results throughout the research cycle may enhance collaboration besides enabling other researchers to replicate studies or to find new results without the need to recollect data. Finally, open access publishing does not necessarily reduce the closure in scholarly knowledge production and communication. It still "by and large perpetuate[s] the print analogue workflow of PDF, with all its intrinsic deficiencies as an open knowledge system" [19].

The standard peer review system is also being affected by new approaches to meet the demands for more open, transparent and rapid review processes and to increase the possibility of granting credit to all those involved in the process. Tracz and Lawrence [21] argue that the lapse of time since the article is submitted until the time it is published and the lack of transparency in the anonymous review process are some of the problems of the current system. Another problem highlighted by the authors is the waste of time involved in finding a journal that accepts the article, caused by inefficient reviewing processes. As an alternative, with the implementation of an open peer review system, articles are readily published if they meet the editorial standards and guidelines required by the journal and then become available for the referees to make public comments, as an example of transparent review or the post-publication review described by Ford [26]. This process should increase both the credit and accountability for peer reviewing [27] especially if the comments and reviews are published along with referees' Open Researcher and Contributor IDs[9] (ORCID).

Journals dedicated to openness in the publication of research may also engage with alternative forms to assess articles' relevance and impact after publication. Regarding post-publication evaluation, Cope

[9]It corresponds to unique alphanumeric identifiers associated with an individual and the different representations of his/her name when involved in academic, research and innovation activities. They are generated and administered by the non-profit organization ORCID (https://orcid.org/).

& Kalantzis [19] raise questions and concerns about the fact that this evaluation is centered primarily on citation or impact analysis, while many researchers advocate for the adoption of alternative metrics ("altmetrics") and article level metrics, such as article download counts or those collected from reference management tools and social media as a complement to assess article impact and how it is being discussed, shared and used [28–30].

## 3. Political-economic aspects of science publishing

For many years the commercial publishing industry has been keeping a monopoly of scholarly journals publishing considering the high level of investments in technologies necessary for their printed versions. With the rise of new techniques for publication and dissemination of research outcomes, derived mainly from the advent and popularization of personal computing and the Web, these barriers to entry should no longer make sense, since most researchers are now able to publish their findings by themselves.

By the beginning of the 21st century, with the spread of electronic publishing, Houghton accounted for an increase in competition in the publishing market, with a possible reduction of the monopolies, and a transfer of scholarly communication from the hands of commercial publishers into those of the creators [31]. Nonetheless, almost twenty years after this assertion, we keep facing the resilience of the traditional journal format and the prevalence of journals maintained by commercial publishers. According to Larivière et al. [32], only a few publishers, namely Reed-Elsevier, Wiley-Blackwell, Springer, Taylor & Francis, and Wolters Kluwer are responsible for the publication of almost 50 percent of all papers.

Such resilience also tends to reproduce some flaws in the publication system of the print era. As stated before, papers' text and results are enclosed in PDF format, which represents a barrier to the processes of sharing and reuse of previous studies and data within the paper. Aligned with this, the transference of copyrights to publishers by authors also prevents the reuse of this paper in processes like Text and Data Mining (TDM) for knowledge-generation, automated screening for errors and automated literature searches that renew scientific discovery [33].

The transference of copyrights also led to the continuity of value exploitation by publishers over research-derived knowledge and information. Throughout the print paradigm, publishers have invested in the commodification of scientific knowledge and information with their commercialization as marketable and tangible objects. Electronic publishing led to dissipation of the exchange value of journals or papers as saleable goods, since "the publisher does not have to upload or produce an additional copy each time a paper is accessed on the server as it can be duplicated *ad infinitum*, which in turn reduces the marginal cost of additional subscriptions to 0" [32], leaving no parameters for the definition of subscription fees. Commercial publishers thus have been operating towards a pure rentier capitalism, by monopolizing a public resource then charging exorbitant fees to access it [34], taking advantage of the rights granted by authors. It is the lifeline of a regime of artificial scarcity in which access to knowledge and information is controlled and limited, mainly by price, technical barriers and/or legal (copyright) constraints [1], in the context of the consolidation of a paradigm of knowledge and information abundance.

Some other persistent flaws are related to the artificial barriers imposed on authors to manage or at least actively participate in the reviewing, editing and publication processes, which are still by and large controlled by commercial publishers. Scientists face the alienation from their creative work by giving up control and decisions regarding this process to publishers. This mediation is also achieved with the intensive exploitation of other scientists' labour for free, performing tasks such as peer reviewing, editing and editorial duties. Based on five studies addressing the economics of the scholarly journal

system, King and Tenopir [35] concluded that researchers' time dominates the overall cost of scholarly journal communication, accounting for 79.5 percent. Those costs are not covered by publishers, the main profiteers of the system. They are paid by public investment, that is, by society.

In the next section, we propose to examine, based on experiments in progress, whether objective, technical, practical changes in ways of producing and distributing knowledge are being – or can be – combined efficiently into a changing culture of openness along the entire process of production while leaving behind the economic gridlocks of for-profit centered economic models.

## 4. Emerging practices and policies in selected OA journals

In this section, we describe the results of a study on ten open access scientific journals[10] selected due to mentions in social networks, blogs related to Open Access and mailing lists, for proposing and adopting innovative open access editorial policies and practices: Distill (DIS), F1000Research (F1R), Gates Open Research (GOR), PeerJ (PRJ), PLOS Journals (PLO), RIO Journal (RIO), ScienceOpen Research (SOR), Self-Journals of Science (SJS), The Winnower (TWN), Wellcome Open Research (WOR). Our objective was to point out how the concept of openness has been resignified and amplified in new directions and experimentation. Our selection contemplates a purposive sample, with no intention of working with an exhaustive list of journals, but instead to identify experiences demonstrating new possibilities and tendencies in the field of scientific communication and publication.

The main aspects under consideration were: type of license; research data access; publication formats; APCs and evaluation metrics. Tables 1, 2, and 3 summarize the journals' policies regarding publication, access, and submission, which we discuss later based on the topics addressed in the literature review.

Most of the journals analysed here are relatively recent, having been launched less than five years ago, except for those published by the Public Library of Science which, together with BioMed Central, are notable as pioneering experiences in the publication of open access articles, initially propagating the APC [22] financial model discussed farther down.

Most of the selected journals act in the *Gold* mode of open access, charging for article publication or processing. Only Distill declares charging no fees, while The Winnower offers the possibility of one publication per month and charges for additional articles. In the case of Self-Journals of Science, no information was found relative to APCs. Table 2 presents a synthesis of the amounts charged by the journals. Charges vary according to the size and type of the documents or according to the subject matter, such as in PLOS which aggregates several journals, PLOS One (multidisciplinary) having the lowest price and PLOS Medicine and PLOS Biology the highest. Some journals also offer membership plans or "packages" for multiple publications.

Average prices for articles in open access journals were calculated by Solomon and Björk [22] at USD $906, in a span from USD $8 to USD $3,900, with lower prices charged for journals from developing countries and higher ones for journals with greater impact factors and publishers with greater international presence. Morrison et al. [36], based on data from DOAJ for 2014, identified an average of USD $964. In 2017, according to DOAJ data [14], these prices were higher for journals with high impact factors: USD $5,000 (Cell Reports), USD $4,750 (The Lancet), USD $4,500 (Advanced Science) e USD $4,000 (Nature Journals).

In the case of Gates Open Research and Wellcome Open Research, built and distributed on the platform developed by F1000, which also publishes F1000Research, it is important to point out that both

[10]The acronyms do not necessarily correspond to the official ones and are intended as a guide in the article.

Table 1
Emerging characteristics and practices of OA journals

| Journals | Launch year | Licenses | Research data required | Article formats | Peer-review | APCs | Alternative metrics |
|---|---|---|---|---|---|---|---|
| Distill https://distill.pub/journal | 2015 | CC BY | Yes | Software, HTML | Open | NA | NA |
| F1000Research https://f1000research.com | 2013 | CC BY | Yes | PDF, XML, HTML | Open | Yes | Yes/Altmetric |
| Gates Open Research https://gatesopenresearch.org | 2017 | CC BY | Yes | PDF, XML, HTML | Open | Yes | Yes/Altmetric |
| PeerJ https://peerj.com | 2013 | CC BY | Yes | PDF, XML, HTML | Closed | Yes | Yes/Altmetric |
| PLOS Journals http://journals.plos.org | 2006 | CC BY | Yes | PDF, XML, HTML | Closed | Yes | Yes/Altmetric |
| RIO Journal https://riojournal.com | 2015 | CC BY or CC 0 | Yes | PDF, XML, HTML | Open | Yes | Yes/Altmetric |
| ScienceOpen Research https://www.scienceopen.com | 2013 | CC BY | NA | PDF, XML, HTML | Open | Yes | Yes/Altmetric |
| Self-Journals of Science http://www.sjscience.org | 2015 | CC BY | NA | PDF, HTML | Open | No | Yes/Altmetric |
| The Winnower https://thewinnower.com | 2014 | CC BY | NA | PDF, HTML | Open | Yes | Yes/Altmetric |
| Wellcome Open Research https://wellcomeopenresearch.org | 2016 | CC BY | Yes | PDF, XML, HTML | Open | Yes | Yes/Altmetric |

Notes: NA: Not available (We were unable to find information regarding this practice on journal websites).

Table 2
APCs in place on the studied journals

| Journals | APCs |
|---|---|
| Distill | NA |
| F1000Research | USD $150–US $1,000* |
| Gates Open Research | USD $150–US $1,000* |
| PeerJ | USD $895–US $1,095† |
| PLOS Journals | USD $1,495–$2,900 |
| RIO Journal | EUR €50–550 (for single publications) |
| | EUR €430–4,250 (for "research cycle packages") |
| ScienceOpen Research | USD $800 |
| Self-Journals of Science | No charges |
| The Winnower | No charges/USD $50 per article with DOI‡ |
| Wellcome Open Research | GBP £135 – GBP £900* |

Sources: Journals' websites; Directory of Open Access Journals (DOAJ).
Notes: NA: Not available (We were unable to find information regarding this practice on journals' websites).
*The prices for publication in these venues vary according to the number of words in the article/document. The prices are similar because all three are based on F1000 publication platform.
†Journal also offers a payment model called "Lifetime memberships", which allows for one, two, or five peer-reviewed publications per 12-month period respectively, counting from your last publication to your next first-decision due to payment of USD $399, $449 and $499 annual fee, respectively.
‡Journal also offers membership options which allow for two publications per month (USD $25) and unlimited publications (USD $200).

Table 3
Guidelines and policies regarding underlying data in the articles published in the analysed journals

| Main guidelines | DIS | F1R | GOR | PRJ | PLO | RIO | SOR | SJS | TWN | WOR |
|---|---|---|---|---|---|---|---|---|---|---|
| Journal clearly states that data underlying the findings described in the article should be made available without restrictions | Y | Y | Y | Y | Y | Y | NA | NA | NA | Y |
| It presents a dedicated topic for data guidelines and policies within the guidelines for authors | N | Y | Y | Y | Y | Y | NA | NA | NA | Y |
| It allows data stored with the articles as supplementary materials | N | Y | Y | N | Y | Y | NA | NA | NA | Y |
| It defines/recommends a specific license for data published as supplementary materials in the articles. Which one? | N | CC0 | CC0 | N | CC BY | CC0 | NA | NA | NA | CC0 |
| It encourages data deposit in dedicated repositories | Y | Y | Y | Y | Y | Y | NA | NA | NA | Y |
| It presents a list of domain-specific recommended repositories | N | Y | Y | Y | Y | Y | NA | NA | NA | Y |
| It presents a list of generic recommended repositories | Y | Y | Y | Y | Y | Y | NA | NA | NA | Y |
| It presents recommendations on how to provide links to data deposited in repositories* | Y | Y | Y | Y | Y | Y | NA | NA | NA | Y |
| It mentions the FAIR Principles† | N | Y | N | N | Y | Y | NA | NA | NA | N |

Source: Journals' websites.
Notes: Y: Yes; N: No; NA: Not available (We were unable to find information regarding this practice on journals' websites).
*This includes guidelines on which metadata related to deposited datasets should be mentioned in the article in order to make it fully accessible, such as persistent identifiers (Digital Object Identifiers – DOI, Uniform Resource Locator – URL, dataset ID etc.), titles, description etc.
†According to the FAIR Principles, research data must be Findable, Accessible, Interoperable, and Re-usable.

result from initiatives by research funding foundations – the Bill and Melissa Gates Foundation and Wellcome Trust respectively, which establish mandatory policies of open access to publication resulting from research funded by them [37,38]. Prestigious journals which do not follow the rules of the Foundation, such as Nature, Science, the New England Journal of Medicine (NEJM) and the Proceedings of the National Academy of Sciences (PNAS), are impeded from publishing their research funded by the foundation since January 2017, when the policy was adopted [39].

Another interesting characteristic in all these journals is the adoption of the Creative Commons Attribution (CC BY) license for article publication, one of the least restrictive, allowing other authors and users the commercial use, sharing, creation of derivative work, etc., as long as the authorship and the original source of publication of the work are duly cited. Other modalities of license include: Creative Commons ShareAlike (CC SA), which requires the sharing under the same license originally used; Creative Commons NonCommercial (CC NC), which limits commercial use; Creative Commons NoDerivatives (CC ND), which limits the creation of derived or remixed work; and Creative Commons Zero (CC0) or public domain, which imposes no restrictions.

Most of the journals analysed require the availability of data supporting the study that generated the article. Some of the journals present extensive documentation on the best ways of making such data available and on how to present data in the articles, as well as suggesting repositories for the deposit of

the data, according to the field of study. Table 3 presents a synthesis of the main directives and policies of the journals as to the availability of research data.

Most of these journals also encourage depositing data in dedicated repositories, presenting lists of recommended ones according to research fields, besides generic or multidisciplinary repositories. They also present recommendations as to how to link the data in repositories to the respective articles. These recommendations usually indicate that data must be machine-readable and be satisfactorily described and represented by metadata in the repository, such as: title, persistent identifiers (DOIs); ethical and confidentiality protocols, as well as those of data treatment and use; registry of funding, etc. Part of these metadata must be mentioned in the article, generally in a specific section, to facilitate the link between the data and the article. What is not mentioned, however, is that deposit in external repositories can generate other unforeseen costs which may not be covered by the APCs paid to the journal. One must also consider deposit policies in each repository and their compatibility with deposit policies in each repository and their compatibility with the rules expressed by each journal.

The journals PeerJ and RIO Journal explicitly discourage data publication directly in the articles, recommending deposit in data repositories. In the case of Distill, data and article codes are deposited initially in the authors' own repositories in GitHub, during article composition, and then transferred to the journal's repository,[11] also in GitHub, after publication. The layout and presentation of data and experiments are done in HTML in direct integration with repositories in GitHub. Cases which limit open publication of data for ethical or confidentiality reasons can be treated directly with the editorial team of some journals (F1R, RIO, GOR, WOR). In only three journals (SOR, SJS, TWN) it was not possible to find a dedicated topic or specific guidelines about data in publication norms in the public section of their websites.

Regarding article formats for publication, all journals publish articles in HTML and seven of them also publish in XML, which is acknowledged as open and interchangeable. Distill presents as a differential the possibility of publishing in software format, since it publishes studies in the field of "machine learning", which is best represented by the demonstration of computational programs execution, and less the purely textual.

RIO Journal stands out for the possibility of publishing different types of results along the research cycle, including research projects and funding proposals, data, methods, doctoral theses, traditional research articles, etc. in "Research Cycle Packages", preserving the context and the organicity of research results. Other journals, such as Winnower and Distill, also present varied items of typologies already published, besides the traditional format of scientific articles, and present no limitations (in the public part of the site) on publication types. ScienceOpen Research and Self-Journals of Science allow the creation of article collections by readers and authors. These collections favour articles retrieval in specific areas of interest, besides the storage of specialized and recommended (curated) lists. These modalities represent advances with respect to conventional formats of publication of scientific journals, be it for the greater possibility of interaction between authors, peers and the general public along the research cycle, be it for the possibility of counting on aggregation tools and curatorship exempting them from paying for third-party services and tools.

Excepting Peerj and PLOS Journals, all others count on open post-publication peer review, that is: all submitted articles are immediately published after editorial checking and become available for peers and reviewers to publish their evaluations equally in open form. The journals F1000Research, RIO Journal, Wellcome Open Research, Gates Open Research and Self-Journals of Science also offer the possibility

[11] https://github.com/distillpub.

of versioning articles according to evaluation outcomes. This means that, after the published article has had one or more reviews, the authors can implement suggested changes and generate a new version. All versions, however, remain published with different persistent identifiers and with the indication of the version in the title and the description of the article. In the specific case of Distill, the author can improve or refine the experiments and their visualization after peer review, but the article will not be versioned.

These practices of immediate publication and post-publication review can sometimes be a superposition with preprint practices. Some articles, once published, can take years or even never be evaluated, although this does not invalidate the statement that these journals are peer reviewed. Many of these journals encourage active participation of authors in indicating reviewers to evaluate these articles. Furthermore, as already mentioned, the practice of open evaluation implies the possibility of credit and registry of work done by the reviewers.

To evaluate impact, reach and audience of published articles, all journals, excepting Distill, present metrics for each article individually (article level metrics), such as access counts, downloads, etc., easily accessible to readers. Some present integration with the Altmetric[12] platform to use alternative metrics of impact and attention based on platforms for article sharing and on social networks.

## 5. Final remarks

The widening agenda of issues imposed on scientific journals aligned with the open science movement in all its breadth brings into discussion the actual meaning of openness in processes of scientific communication and publication. This openness impacts more and more and affects, in turn, several stages of the research cycle. Cope and Kalantzis [19] point to an epistemic disruption in the scientific knowledge communication system with repercussions on academic journals. It has been driven by technological, cultural, economic and (geo)political factors, favouring the adoption of platforms and practices for more distributed knowledge production and circulation.

And yet, if several issues and directives to guide new policies and practices of openness in editorial processes of scientific journals and, more widely, in processes of science communication and publication, are being pointed out and discussed in the pertinent literature, their implementation and dissemination face barriers of many types – technical, sociocultural, political-institutional, and economic.

From the technical point of view, we underline the importance of development and use of management platforms adequate for composition and evaluation of articles in open formats, allowing for greater interaction between authors, editors, reviewers, and readers in the process of publication. This interaction can attenuate, in some measure, the alienation of these actors' work along the editorial process. But the guarantee and efficacy of openness of the published material – in access levels as well as in format and creation – depends on the more balanced distribution of rights and responsibilities among these different actors.

The flexibilization of means of publication, beyond the conventional format of the scientific journal, also contributes to the flexibilization of evaluation and peer review, permitting an approximation to the original proposals of subversion of scientific communication/ publication, based on self-archiving. It also permits a break with the rigidity and linearity of the printing paradigm, in which the control of the processes and events of disclosure of new discoveries depended on much more on mediating agents than on the researchers themselves.

[12] https://www.altmetric.com/.

However, it is imperative to point out the persistence of technical, cultural and socio-regional barriers to openness, participation, and design in publication processes. Although open access platforms and journals facilitate greater control of authors over their publications, they must develop new skills and familiarity with technologies they are not accustomed to use, which may result in contradiction with the spirit of open science. This also implies evaluating the effects (positive and negative) of this multiplicity of new technologies and associated practices linked to Open Science on institutional, political and geographic barriers which interfere in scientific work. Particularly, it is necessary to examine its influence on the growth or reduction of visibility and influence of scientists from developing countries – the Global South – on world scientific production [40].

Along the same line, economic barriers, which had an impact particularly on users and readers, now affect authors and the institutions they are linked to or which fund them. The open access business model based on APCs is funded by grants or individual research projects funds. In many countries, this type of financing is not yet an established practice. In other cases, only a scientific elite is benefitted with funding, which means they get publication priority in a paradigm based on the APC model. Alternative proposals have been discussed, such as the formation of a pool of resources for financing publication on institutional or national levels, among others [41], aiming to attend to a greater and more diverse number of authors.

Finally, it should be said that possibly the most complex element of these changes resides in the institutional dimension, particularly concerning systems of evaluation of science and scientists. They are still by and large guided by indexing services based on proprietary tools and controlled by private institutions, with direct implications for research financing policies and progression in an academic career. It becomes evident that innovations in processes of opening science communication and publication involve a wide-ranging complex of issues, regarding formulating new approaches and policies and forging the necessary apparatus to implement the changes.

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