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The presence of High-impact factor Open Access Journals in Science, Technology, Engineering and Medicine (STEM) disciplines

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Introduction

In the last few years the idea that the results of publicly funded scientific research should be available for public use with as few barriers as possible has begun to be widely accepted, and an increasing number of research funders, universities, and government agencies are starting to require that all the results of all the research that they fund must be made freely accessible. Among others, the National Institutes of Health (NIH), the Wellcome Trust, and the European Commission Framework Horizon 2020 all have requirements of this type. The ROARMAP (Registry of Open Access Repositories Mandatory Archiving Policies) database includes, as of August 2014, 90 such funder mandates worldwide.[1] According to SHERPA's JULIET database (August 2014),[2] which provides

[1] http://roarmap.eprints.org.
[2] http://www.sherpa.ac.uk/juliet

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summaries of funding agencies' grant conditions, out of 136 funders worldwide, 105 funders have a policy on open archiving (either required or encouraged) and 73 have a policy on open access publishing (either required or encouraged).

This has contributed to a rapid growth in the number of open access journals (see Figure 1).

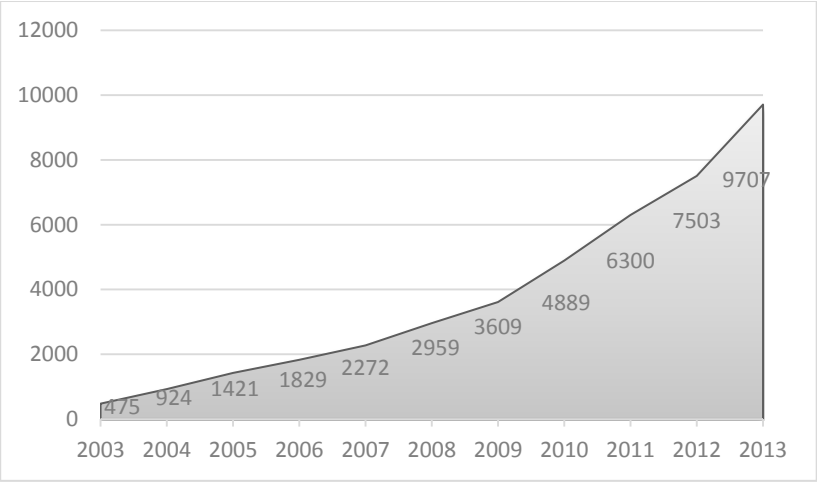

Figure 1: Number of open access journals by year, 2003-2013. Journals were associated to years according to the "Date added to DOAJ" field in the Directory of Open Access Journals (DOAJ)

Comparing the reports of the various authors who have collected statistics on the number of OA journals assigned an impact factor by the Thomson-Reuters Journal Citation Report (JCR) (Mcveigh 2004; Giglia 2010; Gerritsma 2011; Gumpenberger, Ovalle-Perandones, e Gorraiz 2012, 221–238; Vallez 2013); in the last ten years, we noticed that the increase in the overall number of open access titles was

matched by a steady growth in the number of such titles to have obtained this level of recognition (see Figure 2).[3]

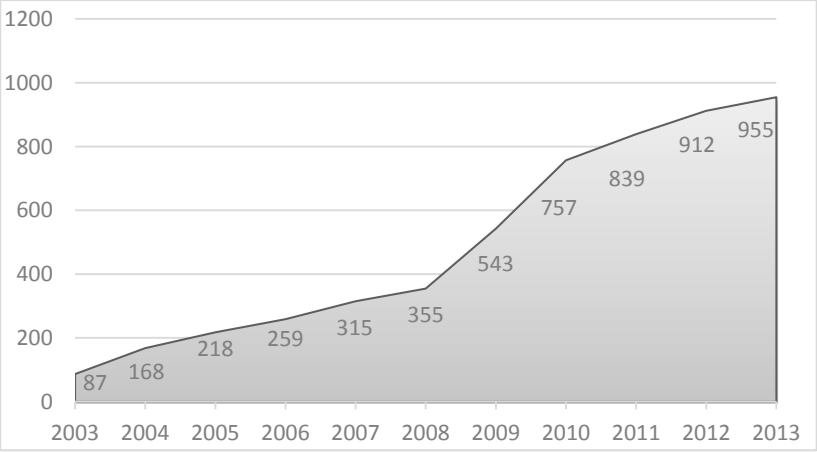

Figure 2: Open Access science journals with impact factor by year

Despite the commitment of the funding agencies, a number of factors have led to a reluctance on the part of some researchers to publish their work in open access (OA) journals. Several studies have been conducted about their opinions and attitudes on this new publishing model to analyze their hesitation (Nariani e Fernandez 2012, 182–195; Dallmeier-Tiessen et al. 2011). These studies suggest a conflicted attitude on the part of researchers: as readers, they would like to find all the information available for free, but as authors they tend to be tied to traditional editorial policies. There appear, ultimately, to be two main perceptions on the part of researchers which give rise to a preference to publish in traditional journals: that publishing in OA

[3] Figures for 2003-11 are adapted from (Mcveigh 2004; Giglia 2010; Gerritsma 2011; Gumpenberger, Ovalle-Perandones, e Gorraiz 2012; Vallez 2013), while those for 2012 and 2013 were obtained by counting the number of titles in JCR Science Edition for the appropriate year which also appeared in DOAJ

journals is expensive, and that subscription journals are more prestigious and of higher quality (Barquinero 2013, 253–257).

The perception of OA journals as expensive may stem from the "author pays" model which predominated in the early stages of the development of Open Access. Currently, it is much more common for Article Processing Charges (APCs) to be paid by institutions or by funding agencies: in a broad survey of authors conducted by the European Commission-funded SOAP (Study of Open Access Publishing) in 2011, the fees were most frequently paid by the authors' funder (59%) or employer (24%), but in some cases (12%) the authors paid the APC out of pocket (Dallmeier-Tiessen et al. 2011). Even researchers from underfunded or low-income countries, who benefit from waivers in many cases, still find themselves having to pay out of pocket in some cases (Solomon e Björk 2012, 98–107). Consequently, when examining the publication options available to researchers, it is important to take the presence or absence of an APC or other fees into account.

In discussing quality and prestige of scholarly journals, some sort of ranking or measurement is necessary. Impact Factor (IF) is currently the most widely used journal-level metric, but has been the subject of a certain level of controversy (Seglen 1997, 498–502; Alberts 2013, 787). Most of the controversy regards the very widespread misuse of Impact Factor as a proxy for the quality of individual articles for decisions regarding funding allocation and career advancement, as articulated for example in the San Francisco Declaration on Research Assessment (DORA, http://am.ascb.org/dora/) - which, at the time of writing, had been signed by 12,055 individuals and 547 organizations - and the Leiden Manifesto (Hicks et al. 2015), a set of ten proposed rules on the use of bibliometric indicators in research evaluation formulated by a group of experts during the 19th International Conference on Science and Technology Indicators held in September 2014 in Leiden. There are also concerns which are relevant to the use of IF in its original scope purely as an assessment

of journals, such as gaming or bias against niche articles (The PLoS Medicine Editors 2006; Rossner, Epps, e Hill 2007, 1091–1092).

A number of initiatives are now in progress to develop alternative metrics which are intended to address these shortcomings (Stuart 2014), but they are generally oriented towards the assessment of individual researchers or research products. Consequently, IF remains the only mature journal-level metric and is likely to continue to hold this position for some time. As a result, there is as yet no systematic alternative to the IF for a comparison of scientific journals.

The present study is intended to establish to what extent high-quality open access journals in different STEM disciplines are available as an outlet for publication, by examining their distribution and relative ranking by Impact Factor, where possible in relation to the presence or absence of Article Processing Charges (APCs). After a description of our methods, we present and discuss our findings in order to present an analysis of the state of the art of the open access publishing market, with the aim of providing some points of reference for the discussion about the quality or prominence of OA journals.

Methods

The present study is based on a systematic comparison between the journals included in the DOAJ (Directory of Open Access Journals, an online directory that indexes and provides access to open access, peer-reviewed journals), and the journals assigned an impact factor in the Journal Citation Reports (JCR) Science edition 2013, published by Thomson Reuters; all further mentions of the JCR refer to this version.

As a comprehensive list of OA journals is not presently available and different databases give different numbers of OA journals , we consider only DOAJ, for three main reasons: it has strict rules

(http://doaj.org/publishers#standards) for journal inclusion, effectively barring predatory journals (Beall 2015); is the most complete listing in the STEM disciplines (Liljekvist et al. 2015) and it includes only fully OA journals, and not hybrid OA journals (Björk 2012, 1496–1504).

Both databases include an ISSN which uniquely identifies each journal, allowing us to identify matching entries corresponding to open access journals which have been assigned an impact factor. All data were retrieved in August 2014.

Since some of the further data examined in this study (discussed below) had to be collected manually from other sources, it was necessary to restrict the scope of the study to areas in which the authors had some familiarity with the publishing environment. Consequently, we did not include data from the JCR Social Science Edition.

JCR groups journals into one or more subject categories. Part of our analysis breaks the data down according to these categories in order to make comparisons between disciplines. It should be noted that many journals appear in more than one category, and we have taken care to identify all duplications.

The relevant sample for our study consists of the 8.470 unique titles in JCR. 955 of these titles appear in DOAJ.

Within each JCR subject category, the titles were ranked according their impact factor, so as to count the number of open access journals in the top quartile (that is, those among the 25% - rounded up - of journals in that category with the highest impact factor). Making this comparison on a category by category basis, as well as being interesting in its own right, avoids directly comparing publications in different disciplines where entirely different conditions can pertain.

At the moment, because the DOAJ is in a process of updating his database, current information related to the APCs is not available

from this source. Therefore we collected this information directly from the websites of the journals or their publishers. As a result of the large number of titles involved, we collected this data only for OA journals in the first quartile.

To provide an assessment of the relative quality of open access journals in general, we assigned a relative impact score[4] of

$$S_{jk} = \frac{N + 1/2 - R}{N}$$

to each journal for each category it appears in, where R is the rank of the journal by impact factor within the category, and N is the number of journals in that category. This is a number between 0 and 1 with a higher score corresponding to a higher impact factor. If there were no correlation between open access status and impact factor (our null hypothesis), the mean of S would be 0.5. As explained in Appendix 1, it is possible to estimate its standard deviation, making it possible to calculate a p-value.

The present study includes only the most up-to-date information available, and as a result impact factors are not averaged over a longer period. Some authors of related studies have used longer-term averages (in addition to the five-year period used in the calculation of the impact factor) in order to smooth out short-term fluctuations. This is not relevant for statistics involving large numbers of titles (such as S discussed above), since the average over a large population dramatically suppresses these fluctuations.

Results

Our findings show that, as of August 2014, there are 955 OA journals with an assigned IF, these journals represent 11.27% of the 8.470 titles listed in the JCR. On average, these titles have a relative score

[4] A detailed statistical analysis of the relative impact score is available as Appendix at http://leo.cineca.it/index.php/jlis/article/downloadSuppFile/11257/729.

(see above) of 0.404. The corresponding p-value is extremely small - smaller than 4.6×10^{-25} - so the difference from 0.5 is unambiguously statistically significant.

Out of the 176 subject categories used in the JCR, there are 85 categories in which open access journals are in the first quartile (Q1), 42 categories in which the highest ranked OA journal is in the second quartile (Q2), 21 categories where it is in the third (Q3) and 12 categories in the bottom quartile (Q4). 16 categories [5] have no open access titles with an impact factor.

The table collecting the list of all the open access titles appearing in Q1 in each subject category is in Appendix 2: there are a total of 193 entries, representing 152 unique titles, many of which appear in Q1 for multiple categories. For each title, we indicate whether or not it collects a publication fee. 32 of these titles (21%) do not require an article processing charge; these journals appear in Q1 in 27 of 85 categories. The categories with the largest number of OA journals in Q1 are *Biochemistry & Molecular Biology* and *Medicine, Research & Experimental* with 7 titles each.

Eight open access journals have the highest impact factor in their category. Two of these are funded by sponsoring institutions (in one case the Max Planck Institute for Solar System Research, in the other case a collection of professional associations), and do not charge authors for publication (Table 1).

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[5] Computer Science, Hardware; Crystallography; Engineering, Aerospace; Engineering, Geological; Engineering, Ocean; Materials Science, Characterization & Testing; Materials Science, Coatings & Films; Materials Science, Composites; Medicine, Legal; Microscopy; Neuroimaging; Physics, Atomic, Molecular & Chemical; Physics, Fluids & Plasmas; Spectroscopy; Transplantation; Transportation Science & Technology.

Journal with the highest impact factor	**Category**	**APC**
Genetic Selection Evolution	AGRICULTURE, DAIRY & ANIMAL SCIENCE	Y
PLoS Biology	BIOLOGY	Y
Journal of Medical Internet Research	MEDICAL INFORMATICS	Y
Studies in Mycology	MYCOLOGY	Y
Living Reviews in Relativity	PHYSICS, PARTICLES & FIELDS	N
Annals of Family Medicine	PRIMARY HEALTH CARE	N
PLoS Neglected Tropical Diseases	TROPICAL MEDICINE	Y
Veterinary Research	VETERINARY SCIENCES	Y

Table 1: Categories where the journal with the highest impact

Three OA-only publishers - Public Library of Science (PLoS), BioMed Central (BMC), and Copernicus - together publish 36% of all the OA journals in the first quartile, all of which require a publication fee. Out of the 152 OA titles in Q1, only 18% are published by a traditional publisher (Table 2).

Publisher	**# of journals**
BMC	40
Copernicus	8

Publisher	**# of journals**
PLoS	7
Springer	6
Frontiers	5
Oxford University Press	4
Wiley Blackwell	4
Elsevier	4
IoP	3
MDPI AG	3
Nature Publishing Group	3
Optical Society of America (OSA)	3
American Museum of Natural History	2
Co-Action Publishing	2
Hindawi	2
Ivy Spring International Publisher	2
Karger	2
Max Planck Institute for Solar System Research	2
WHO	2
Other (with only one OA title in Q1)	48

Table 2: List of publishers with the number of their open access journals in Q1

Discussion

On the whole, our results show that although the impact factors of open access journals tend to be slightly below average, in most scientific disciplines have at least one prominent, high-quality open access journal available. The 16 JCR subject categories with no OA titles appear to be largely niche subjects with a small number of titles (an average of 24 titles each, compared to an average of 75 overall). The difference in impact factors may be partly due to the fact that open access journals are, on the whole, relatively new, a question which deserves further study. Nonetheless, the large number of high-impact OA journals shows that the phenomenon as a whole is already quite mature.

This is particularly striking for OA-only publishers, which are by definition quite young (BMC published its first open access journal in 2000, Copernicus in 2001 and PLoS in 2003). In a short period of time they have gained a strong reputation in the STEM publishing market, as we see by the fact that these three publishers together publish the 36% of all the OA journals in the first quartile (Table 2).

It is noteworthy that two of the largest publishers in the STEM field, Elsevier (with 4 Q1 OA titles) and Wiley Blackwell (with 4), are not among the top publishers of high-profile open access journals. On the other hand, Springer has come to play an important role in the OA landscape due to their purchase of BMC in 2008 (Table 2).

The limited presence of traditional publishers in OA may be explained by their preference for a "hybrid" strategy, making articles published in their conventional journals openly available for a fee. Not surprisingly many authors prefer to follow this strategy because it includes the prestige of an established (and familiar) journal while, at the same time, making it possible to take advantage of the greater impact of an open access publication. OA advocates have criticized this approach, since it results in publishers receiving both subscription payments and APCs for the same article. This

phenomenon, called "double dipping", is potentially harmful for research institutions forced to pay for both subscription fees and APCs for their researchers. Moreover, "hybrid journals charge higher APCs than Gold Open Access publications"- as stated by a study conducted by Bjork and Solomon (Björk e Solomon 2014) commissioned by a consortium of funding agencies - despite the presence of an additional revenue stream.

While the vast majority of OA journals are not paid-publication journals (Suber 2012) we find that a substantial majority of high-impact-factor OA journals are paid-publication journals. This latter method seems to be popular among born OA large publishing houses such as BMC or PLoS, while journals without publication fees are usually related to smaller academic publishers or research funders such as the Max Planck Society (Table 3).

Journal title	**Publisher**
Acta Orthopaedica	Informa Healthcare
Annals of Family Medicine	Annals of Family Medicine
Banach Journal of Mathematical Analysis	Tusi Mathematical Research Group
Beilstein Journal of Nanotechnology	Beilstein Institute
Biochemia Medica	Medicinska Naklada, Zagreb
Bulletin of the American Mathematical Society	AMS
Bulletin of the World Health Organization	WHO
CBE: Life Sciences Education	American Society for Cell Biology

Journal title	**Publisher**
Chinese Medicine - UK	BMC
Chinese Science Bulletin	Springer
Cleveland Clinic Journal of Medicine	Cleveland Clinical Educational Foundation
Current Zoology	Current Zoology
Deutsches Arzteblatt International	Deutscher Artze-Verlag
Dynamics of Partial Differential Equations (DPDE)	International Press of Boston
Earth System Dynamics	Copernicus
Elife	eLife Sciences Publications
Emerging Infectious Diseases	Center for Disease Control and Prevention
Environmental Health perspectives	National Institute of Environmental Health Sciences
Eurosurveillance	WHO
eXPRESS Polymer Letters	Budapest University of Technology
Health Reports	Statistics Canada
Hematology - American Society of Hematology	American Society of Hematology
HYLE: International Journal of Philosophy of Chemistry	HYLE Publications
Journal of Machine Learning Research	Microtome Publishing

Journal title	**Publisher**
Journal of Statistical Software	UCLA
Journal of the American Board of Family Medicine	American Board of Family Medicine
Living Reviews in Relativity	Max Planck Institute for Solar System Research
Living Reviews in Solar Physics	Max Planck Institute for Solar System Research
Nano-Micro Letters	Nano-Micro Letters
Oil & Gas Science and Technology	Institute Francaise de Petrole
Pain Physician	American Society of Interventional Pain Physicians
Proceedings of the Japan Academy, Series B Physical and Biological Sciences	Japan Academy

Table 3: Open Access titles in Q1 not requesting an Article Processing Charge

This provides further evidence that APCs are the most sustainable funding model available to open access publishers in the present environment, which among other features has included a rapid growth in their scale of operations. This is a matter of considerable importance for funding agencies, who must take this into account in decisions on allocation and levels of funding to ensure that researchers are able to meet these fees without compromising other aspects of their activity. In the longer term, this can be complemented by other policy interventions meant to shape the publishing marketplace, such as minimum standards that must be

met before APCs are paid, establishing price caps, and encouraging price competition in the APCs market (Björk e Solomon 2014).

Finally, it is striking that the category Tropical Medicine has two open access titles ranking respectively first and second: *PLoS Neglected Tropical Disease* and *Malaria Journal*. This may be indicative of a particular commitment on the part of researchers, funders, and/or other actors involved in that field to make research results available to practitioners in developing countries.

Although OA journals are on average less prominent than conventional journals, high-quality open access options for publication are available in nearly half of the Journal Citation Reports (JCR) Science edition 2013 categories. A large proportion of them require article processing charges, and funding agencies must take this into account in designing policies to promote open access publishing.

References

Alberts, Bruce. 2013. «Impact Factor Distortions». *Science* 340 (6134): 787–787. doi:10.1126/science.1240319.

Barquinero, Jordi. 2013. «Next-generation scholarly communication: A researcher's perspective». *Int Microbiol* 16 (4): 253–57. doi:10.2436/20.1501.01.201.

Beall, Jeffrey. 2015. «Potential, possible, or probable predatory scholarly open-access journals.» *Scholarly Open Access*. Consultato agosto 25. http://scholarlyoa.com/individual-journals/.

Björk, Bo-Christer. 2012. «The hybrid model for open access publication of scholarly articles: A failed experiment?». *Journal of the Association for Information Science & Technology* 63 (8): 1496–1504.

Björk, Bo-Christer, e David Solomon. 2014. *Developing an effective market for open access article processing charges | Wellcome Trust*. http://www.wellcome.ac.uk/stellent/groups/corporatesite/@policy_communications/documents/web_document/wtp055910.pdf.

Dallmeier-Tiessen, Suenje, Robert Darby, Bettina Goerner, Jenni Hyppoelae, Peter Igo-Kemenes, Deborah Kahn, Simon Lambert, et al. 2011. «Highlights from the SOAP project survey. What Scientists Think about Open Access Publishing». *arXiv:1101.5260 [cs]*, gennaio. http://arxiv.org/abs/1101.5260.

Gerritsma, Wouter. 2011. «The Impact Factor of Open Access journals». *WoW! Wouter on the Web*. http://wowter.net/2011/01/06/the-impact-factor-of-open-access-journals/.

Giglia, Elena. 2010. «The Impact Factor of Open Access journals: data and trends». Presentation. giugno 17. http://eprints.rclis.org/14666/.

Gumpenberger, Christian, María-Antonia Ovalle-Perandones, e Juan Gorraiz. 2012. «On the Impact of Gold Open Access Journals». *Scientometrics* 96 (1): 221–38. doi:10.1007/s11192-012-0902-7.

Hicks, Diana, Paul Wouters, Ludo Waltman, Sarah de Rijcke, e Ismael Rafols. 2015. «Bibliometrics: The Leiden Manifesto for research metrics». *Nature* 520 (7548): 429–31. doi:10.1038/520429a.

Liljekvist, Mads Svane, Kristoffer Andresen, Hans-Christian Pommergaard, e Jacob Rosenberg. 2015. «The Directory of Open Access Journals Covers More Biomedical Open Access Journals than Other Databases». *PeerJ* 3 (maggio): e972. doi:http://dx.doi.org/10.7287/peerj.preprints.717v1.

Mcveigh, M. E. 2004. «Open Access Journals in the ISI Citation Databases: Analysis of Impact Factors and Citation Patterns». http://ip-science.thomsonreuters.com/m/pdfs/openaccesscitations2.pdf.

Nariani, Rajiv, e Leila Fernandez. 2012. «Open Access Publishing: What Authors Want». *College & Research Libraries* 73 (2): 182–95. doi:10.5860/crl-203.

Rossner, Mike, Heather Van Epps, e Emma Hill. 2007. «Show Me the Data». *The Journal of Cell Biology* 179 (6): 1091–92. doi:10.1083/jcb.200711140.

Seglen, Per O. 1997. «Why the Impact Factor of Journals Should Not Be Used for Evaluating Research». *BMJ* 314 (7079): 497. doi:10.1136/bmj.314.7079.497.

Solomon, David J., e Bo-Christer Björk. 2012. «Publication Fees in Open Access Publishing: Sources of Funding and Factors Influencing Choice of Journal». *Journal of the American Society for Information Science and Technology* 63 (1): 98–107. doi:10.1002/asi.21660.

Stuart, David. 2014. Web Metrics for Library and Information Professionals.

Suber, Peter. 2012. *Open Access*. MIT Press. https://mitpress.mit.edu/sites/default/files/9780262517638_Open_Access_PDF_Version.pdf.

The PLoS Medicine Editors. 2006. «The Impact Factor Game». *PLoS Med* 3 (6): e291. doi:10.1371/journal.pmed.0030291.

Vallez, Mari. 2013. «High-impact open-access journals : #LibTechNotes». http://labs.biblioteca.uoc.edu/blog/?p=3827.

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ABSTRACT: The present study means to establish to what extent high-quality open access journals are available as an outlet for publication, by examining their distribution in different scientific disciplines, including the distribution of those journals without article processing charges. The study is based on a systematic comparison between the journals included in the DOAJ, and the journals indexed in the Journal Citation Reports (JCR) Science edition 2013, released by Thomson Reuters. The impact factor of Open Access (OA) journals was lower than those of other journals by a small but statistically significant amount. Open access journals are present in the upper quartile (by impact factor) of 85 out of 176 (48.8%) categories examined. There were no OA journals with an Impact Factor in only 16 categories (9%).

KEYWORDS: DOAJ; E-journals; Impact analysis; Impact factor; JCR; Open Access.

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