



Open Science – For Whom?

ESSAY

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ABSTRACT

Who can participate in Open Science and whose interests are served? Open Science in principle holds the potential to reduce inequality, but this is not going to happen unless it operates within a consistent framework and environment that supports this goal. Unequal power and opportunities from institutional to global level constitutes a major obstacle to human development, while we need to appreciate diversity as a key asset. How can we build an equitable global research ecosystem in accordance with the United Nations 2030 Agenda for Sustainable Development that recognises science as a global common good and an integral part of the shared cultural heritage of humankind?

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“Everyone has the right freely to participate in the cultural life of the community, to enjoy the arts and to share in scientific advancement and its benefits.” This is the wording of **Article 27 (1) of the Universal Declaration of Human Rights (UDHR)**.¹ However, with regard to science, **how does the reality look like? What needs to change, and what is needed to make that change happen?**

The rights conveyed by Art 27 (1) UDHR regarding the pursuit of science cover two aspects: **active participation in the process**, and the **sharing of benefits**. Extending substantially beyond the accessibility of information, both of these require enabling measures and environments. They strongly resonate with the principles of Open Science, which the recently adopted **UNESCO Recommendation on Open Science**² defines as “practices aiming to make multilingual scientific knowledge openly available, accessible and reusable for everyone, to increase scientific collaborations and sharing of information for the benefits of science and society, and to open the processes of scientific knowledge creation, evaluation and communication to societal actors beyond the traditional scientific community.” Good Open Science 1) is a means, not an end in itself, 2) supports good research and innovation, 3) is a public good, 4) leaves no researcher behind, and 5) is imbedded in a supportive research culture.³ Moreover, as independent scrutiny is essential to the scientific process, transparency constitutes a key requirement.

While the UDHR does not constitute a legally-binding treaty, it nevertheless defines a generally accepted norm that holds an imperative for national states to guarantee respective rights for their citizens. The right of everyone “To enjoy the benefits of scientific progress and its applications” is furthermore explicitly protected by multilateral state treaty, namely **Article 15 (1) of the International Covenant on Economic, Social and Cultural Rights (ICESCR)**.⁴ Therefore, national states hold responsibility for making Open Science work and to provide means of access to required infrastructure.

But responsibility does not end at national level. The **2030 Agenda for Sustainable Development**,⁵ adopted by all United Nations Member States in 2015, sets out a shared blueprint for collaboration between and across countries towards peace and prosperity for people and the planet. It defines 17 Sustainable Development Goals (SDGs), which constitute a call for action in a global partnership.

In particular, SDG 10 is to “reduce inequality within and amongst countries”. A global Open Science ecosystem ultimately needs to support rather than contravene this goal. Creating a technical, legal, and cultural framework that makes it operate that way however appears to be challenging. Can Open Science bridge global divides or does it fail to deliver on its promises when confronted by the hard reality of disparities?

Science is also exemplarily mentioned in the context of culture and self-determination in Article 31 of the **UN Declaration on the Rights of Indigenous Peoples (UDRIP)**.⁶ “Indigenous peoples have the right to maintain, control, protect and develop their cultural heritage, traditional

1 United Nations, “A Universal Declaration of Human Rights”, Resolution adopted by the General Assembly on 10 December 1948 (A/RES/217(III)), [https://undocs.org/en/A/RES/217\(III\)](https://undocs.org/en/A/RES/217(III)).

2 United Nations Educational, Scientific and Cultural Organization: “UNESCO Recommendation on Open Science”, Adopted by the 41st session of the General Conference (9–24 Nov 2021), UNESDOC Digital Library, Document Code SC-PCB-SPP/2021/OS/UROS, <https://unesdoc.unesco.org/ark:/48223/pf0000379949.locale=en>.

3 c.f., K. Vermeir: “Good Open Science”, Presentation in plenary session “Opening Up Open Science: Innovations, Ideas and Possibilities”, Euroscience Open Forum (ESOF) 2018, Toulouse, France (11 Jul 2018), <https://www.youtube.com/watch?v=TYpFNRIEZW0>.

4 United Nations: “International Covenant on Economic, Social and Cultural Rights”. Adopted and opened for signature, ratification and accession by General Assembly resolution 2200A (XXI) of 16 December 1966; entry into force 3 January 1976. <https://www.ohchr.org/en/professionalinterest/pages/cescr.aspx>.

5 United Nations: “Transforming our world: the 2030 Agenda for Sustainable Development”, Resolution adopted by the General Assembly on 25 September 2015 (A/RES/70/1), <https://undocs.org/A/RES/70/1>.

6 United Nations: “United Nations Declaration on the Rights of Indigenous Peoples”, Resolution adopted by the General Assembly on 13 September 2007 (A/RES/61/295), <https://undocs.org/A/RES/61/295>.

knowledge and traditional cultural expressions, as well as the manifestations of their sciences, technologies and cultures, including human and genetic resources, seeds, medicines, knowledge of the properties of fauna and flora, oral traditions, literatures, designs, sports and traditional games and visual and performing arts. They also have the right to maintain, control, protect and develop their intellectual property over such cultural heritage, traditional knowledge, and traditional cultural expressions.”

OBSTACLES TO PARTICIPATION

While major obstacles to participation are related to economic power, there are also significant cultural and sometimes political hurdles to overcome. Such exist not only between countries, but are also an issue for collaboration across regions, institutions, communities, and individuals.

Open Science emerged as a bottom-up or ‘grassroots’ phenomenon driven by researchers and the research community,⁷ but these are now confronted with a wide range of policies that differ across various countries, which does not ease constructive engagement or collaboration, in particular if such policies add burden rather than aid scientific progress.

Publishers of scholarly communication have essentially become IT service providers. Global reach and access are far more a question of ownership and management than a technical issue. Much of the publishing landscape however is still entrenched in models that reflect the printing press.^{8,9} Gatekeeping procedures that are subject to the risk of promoting exclusivity are of serious concern. Acceptance or rejection of manuscripts informed by pre-publication review (or without it) appears to be biased by brand perception of institutional affiliation rather than being strictly guided by criteria of scientific quality.¹⁰ Rather than supporting the free flow of information, legal instruments such as copyright remain in place, factually protecting the rights of publishers (rather than the rights of authors or the general public), some of which continue to flourish on a business model that sells meaningless prestige in a false economy.¹¹

So-called “Open-Access journals” lift the economic barrier to reading scholarly articles, but flipping the paywall from the reader to the author is not a viable solution and inhibits global participation in the scientific process. While article processing charges as well as read-and-publish deals currently on offer appear to be unaffordable to many institutions or individuals (not only in low- and middle-income countries), already the requirement of somebody else having to sign off for getting research published collides with the principles of academic freedom. It is striking that universities in the United Kingdom are championing the “green” route to Open Access via institutional repositories,^{12,13} with some explicitly stating their preference for this model over paying publishers for “gold” Open Access, thereby opposing the government position. Moreover, rather than just gradually being provided with read access to future scholarly work, our global society requires universal free access to the entire past record of science.

7 e.g., European Commission: “*Validation of the results of the public consultation on Science 2.0: Science in Transition*”. DOI: [10.13140/RG.2.1.4549.0726](https://doi.org/10.13140/RG.2.1.4549.0726) (2015).

8 e.g., International Science Council: “*Opening the record of science: making scholarly publishing work for science in the digital era*”. DOI: [10.24948/2021.01](https://doi.org/10.24948/2021.01) (2021).

9 For a historic perspective, see Aileen Fyfe et al.: “*Untangling Academic Publishing – A history of the relationship between commercial interests, academic prestige and the circulation of research*”. DOI: [10.5281/zenodo.546100](https://doi.org/10.5281/zenodo.546100) (2017).

10 e.g., D. Peters & S. Ceci: “*Peer-review practices of psychological journals: The fate of published articles, submitted again*”. *Behavioral and Brain Sciences*, 5(2), 187. DOI: [10.1017/S0140525X00011183](https://doi.org/10.1017/S0140525X00011183) (2010).

11 e.g., M. Binswanger: “*Excellence by Nonsense: The Competition for Publications in Modern Science*”. In: S. Bartling & S. Frieseke (eds.): “*Opening Science*”, ISBN: 978-3-319-34257-3. DOI: [10.1007/978-3-319-00026-8_3](https://doi.org/10.1007/978-3-319-00026-8_3) (2014).

12 N. Robinson-Garcia, R. Costas, T. N. van Leeuwen: “*Open Access uptake by universities worldwide*”. *PeerJ* 8:e9410. DOI: [10.7717/peerj.9410](https://doi.org/10.7717/peerj.9410) (2020).

13 C. Huang et al.: “*Evaluating the impact of open access policies on research institutions*”. *eLife* 9:e57067. DOI: [10.7554/elife.57067](https://doi.org/10.7554/elife.57067) (2020).

Internet bandwidth remains an issue in many countries and especially in rural areas. Moreover, increasingly large data sets pose a challenge for providing sufficient infrastructure in economically weaker regions. However, infrastructure is of little use without people who possess the relevant skills for making good use of it. Investment in education remains a central measure for overcoming inequalities.

The principles of Open Science require orientating communication towards serving the needs of various audiences, both with regard to natural language and technical background. Research data should comply with the FAIR principles¹⁴ (findable, accessible, interoperable, reusable), and similarly, Open Access of research findings itself is useless unless outputs are provided in forms that make them usable for others. However, the vast majority of publications in “Open-Access journals” fail these criteria when it comes to the tax-paying public (which is frequently referred to in arguing for Open Access), starting with the fact that $\frac{2}{3}$ of the world’s population does not understand English.

The anglophonic dominance¹⁵ is also reflected in global science networks, notably when comparing English-speaking and French-speaking countries in Africa, as well as with respect to the iberophonic South and Central America. Researchers are facing the dilemma of either being recognised globally or connecting with their region and local communities. Epistemologies from the Global South as well as the richness of Indigenous knowledge are particularly underestimated and little known. Not too surprisingly, hardly anyone makes extensive efforts to consider hard-to-find or hard-to-access material, while “standards” result from social processes in which weaker players have less influence.

Rather than making good use of global diversity, we observe a trend of mainstreaming and dominating cultures, where influence and followership trumps value and quality. This not only arises as a matter of language, but similarly within scholarly communities as a result of unequal power and opportunities. Forefront thinking is characterised by challenging conventional wisdom, and fresh ideas are facing a hard time getting through, particularly when coming from scholars with low visibility or recognition.

Cultural domination leads to breaks in the cultural record in many regions of the world, with the result of modern science being perceived as “foreign” rather than linking to the rich local cultural experience, which is frequently underappreciated in this context while science teaching tends to misrepresent history.

Open Science requires cultivating respectful open debate involving scrutiny and critique, as well as transparency. However, not all socio-cultural environments are supportive of these principles, and any form of established hierarchies can get in their way.

Researchers can get caught up in competing or conflicting interests of national states, and their efforts might be viewed as espionage. While we left the Cold War behind, we now see that Chinese researchers are not always welcome in the United States,¹⁶ and there are sometimes concerns about researchers from several Middle Eastern countries, placing them in awkward and unpleasant situations.¹⁷ Trust can be difficult to build over existing misperceptions.

In the global science ecosystem, nobody stands alone. Exchanging results or research data, or sharing infrastructure makes the process of advancing human knowledge and the record of science a collaborative venture, with or without any formal agreement. While Open Science fosters the interchange of information, the disparity of means to benefit from this calls for some caution and constitutes an obstacle to participation.

¹⁴ M. D. Wilkinson et al.: “The FAIR Guiding Principles for scientific data management and stewardship”. *Sci Data* 3, 160018 (2016). DOI: [10.1038/sdata.2016.18](https://doi.org/10.1038/sdata.2016.18).

¹⁵ The scholarly vocabulary however largely comes from Latin and Greek, mirroring the history of empires.

¹⁶ e.g., F. Wu: “Attacking Chinese on Our Campuses Only Hurts America”. *Inside Higher Ed*, 15 July 2019. <https://www.insidehighered.com/views/2019/07/15/significant-damages-america-attacking-chinese-academics-opinion>.

¹⁷ e.g., H. Esmaili & B. Ataie-Ashtiani: “The Autonomy of Science as a Civilian Casualty of Economic Warfare: Inadvertent Censorship of Science Resulting from Unilateral Economic Sanctions”. *Sci Eng Ethics* 27, 49. DOI: [10.1007/s11948-021-00321-w](https://doi.org/10.1007/s11948-021-00321-w) (2021).

Unequal partnerships that provide profit to some at the costs of others appear to be ubiquitous,^{18,19} but these are unsustainable and widely damaging. If equal access to data meets unequal means to exploit these, the investment by weaker actors into the creation of resources drives benefits mainly for stronger actors and thereby further widens the gap. Gradients in power also tend to determine whose interests a partnership primarily tends to serve and who is in charge of project design.²⁰ Again, these are generic features that apply to any form of collaboration, from global scale to within a lab, and it is an issue that should concern all of us. While we should not accept students working for the promotion of their supervisor, global interconnectivity must not be underestimated to provide negative feedback on abusive practices.²¹

Many countries suffer from having a broken research & development cycle, i.e. while they are able to carry out research at highest standards, the sectors of the local economy that could turn research into direct growth are underdeveloped or missing. This weakness is exacerbated by those who could fill the gap seeking their opportunities elsewhere. This poses a substantial systemic challenge for putting benefits back to local communities.

We need to think beyond the assumption that the key international actors are national states.²² Not uncommonly, big global corporations are at the forefront of research, which raises questions about the ownership of science, as well as about who holds the power, given that money can buy political influence. If public funds get systematically transferred into companies that drive profit only for a small number of shareholders, we are far from principles of equitable sharing of benefits. A key problem arises from the fact that science is global, but taxation is national. While some companies (understandably) aim at avoiding any tax liability, taxation follows organisational legal structures rather than the origin of intellectual property.

WAYS FORWARD

Open Science needs to be underpinned by a research culture that makes it work. Its values are fundamentally incompatible with greed, and instead we must not lose sight of collective long-term benefits. Holding power comes with responsibility and must not be abused. This has implications on what we value in scholarship and what we celebrate as success.

It is inevitable to move away from overcompetition that incentivises anti-social behaviour. We can only succeed as society by working together (the clue being in the word “society” itself). We fail to see the proper picture if we look at individuals in isolation, but rather need to consider both interactions and specific context. This holds at every level and scale, from research group to global society. Any society thrives from the diversity of skills and expertise of its population, while monocultures lack resilience and flexibility to adapt when facing new challenges. We need to appreciate diversity as one of our greatest assets; it is not a competing goal to excellence, right to the contrary.

Science needs to follow the soundness of arguments rather than adhering to authority. The content of scholarly work along with its rigour and integrity is what matters, not perceived prestige of journals, authors, or affiliations, nor the size of followership or amount of influence (as indicated by citation counts). The Hong Kong Principles²³ explicitly recognise trustworthiness of the research processes and behaviours that strengthen research integrity as basis for assessment.

18 e.g., F. M. Okwaro & P. W. Geissler: “In/dependent Collaborations: Perceptions and Experiences of African Scientists in Transnational HIV Research”. *Med Anthropol Q* 29(4), 492. DOI: [10.1111/maq.12206](https://doi.org/10.1111/maq.12206) (2015).

19 e.g., J. T. Crane: “Unequal ‘Partners’. *AIDS, Academia, and the Rise of Global Health*”, *Behemoth* 3, 78. DOI: [10.1524/behe.2010.0021](https://doi.org/10.1524/behe.2010.0021) (2010).

20 c.f., D. Albornoz & L. Chan, “Power and Inequality in Open Science Discussions”, *Revista IRIS - Informação, Memória e Tecnologia* (ISSN: 2318-4183) 4, 70 (2018).

21 c.f. “When the rich turn their backs on the plight of the poor, the microbes triumph” [in German: “Wenn die Reichen sich abwenden von der Not der Armen, triumphieren die Mikroben“] (Robert Koch).

22 e.g., J. Mikler: “*The Political Power of Global Corporations*”, Wiley. ISBN: 978-0-745-69845-8 (2018).

23 D. Moher et al.: “*The Hong Kong Principles for assessing researchers: Fostering research integrity*”. *PLoS Biology* 18, e3000737. DOI: [10.1371/journal.pbio.3000737](https://doi.org/10.1371/journal.pbio.3000737) (2020).

It has been the primary role of publishers to establish the connection between authors and matching audiences, making records visible and information findable. However, the relevant information is no longer within one or a few journals that one could subscribe to and read for keeping up-to-date. The global record of science should be re-indexed, overcoming the conundrum of “unknown knowledge”, i.e. a large amount of the existing knowledge not reaching those who would benefit from knowing about it. Moreover, the entire past record of science should become universally accessible free of charge. Revoking copyright protection might be a means for achieving that, but one also requires sustainable infrastructure for archiving.

One might wonder how much research is carried out to find answers that could directly be inferred from what is already on record somewhere. It would seem to be an excellent investment to develop tools for querying the entire global record that deliver well-structured results regardless of what language information is originally provided in. While universal visibility counteracts the social trend of mainstreaming and enables prompt and efficient use, such tools would also ultimately bridge the gap for citizens who want to access and engage in their first language. Moreover, the record should include “negative” results, which currently often do not end up published in journals or accessible by other means. Bibliodiversity, including local and regional infrastructures, rather than concentration in scholarly publishing can further aid building a more equitable system of knowledge production.²⁴

Flipping the paywall is not a solution for scholarly communication in a global Open Science ecosystem. Author-pays-charge models for disseminating research results are not viable in practice and simply absurd. Recognising that the record of science is a resource that forms part of the shared cultural heritage of humankind, it becomes apparent that different models of Open Science for different parts of the world will not do the job. A strikingly simple globally sustainable approach that recognises and supports collaboration has been presented in the form of Plan U,²⁵ fostering immediate universal access via funder preprint mandates. It builds on community-led initiatives that started with the establishment of arXiv²⁶ in 1991 and which have seen a surge across various fields of research since the creation of bioRxiv²⁷ in 2013. These materialise on the advantage of decoupling the dissemination from the much slower process of evaluation and certification. Plan U is also fully compatible with decoupling peer review from scholarly communication platforms and making it a transparent recommendation process rather than a gatekeeping process. Moreover, it is also in line with other globally sustainable approaches strengthening academic scholarship, notably AmeliCA²⁸ and the Rights Retention Strategy of Plan S.²⁹ Latin America has led the way in creating and maintaining non-commercial Open Access Infrastructure and the AmeliCA initiative to develop an open, cooperative, academic-led system for scholarly communication is now seen as a global model (and not one just for the Global South).

With ongoing technology development, inequalities in the provision of communication infrastructure will remain. Such inequalities apply not only in comparing countries, but are also present within countries where the roll-out of communication technologies typically follows a combination of population density and economic power. Data provision within the framework of Open Science therefore needs to be mitigated by exclusively following open standards that support commonly-available technology rather than restricting meaningful global access by being too demanding on resources.

24 K. Shearer & A. Becerril-García: “Decolonizing Scholarly Communications through Bibliodiversity”. DOI: [10.5281/zenodo.4423997](https://doi.org/10.5281/zenodo.4423997) (2021).

25 R. Sever, M. Eisen M, J. Inglis: “Plan U: Universal access to scientific and medical research via funder preprint mandates”. PLoS Biol 17(6): e3000273. DOI: [10.1371/journal.pbio.3000273](https://doi.org/10.1371/journal.pbio.3000273) (2019).

26 <https://arXiv.org>.

27 <https://www.biorxiv.org/>.

28 A. Becerril-García & E. Aguado-López: “Redalyc – AmeliCA: A non-profit publishing model to preserve the scholarly and open nature of scientific communication”. United Nations Educational, Scientific and Cultural Organization; Latin American Council of Social Sciences; Network of Scientific Journals from Latin America and the Caribbean, Spain and Portugal; Autonomous University of the State of Mexico; National University of La Plata; University of Antioquia. (2019) <http://www.amelica.org/wp-content/uploads/2019/04/proyecto-extendido-AmeliCA-eng.pdf>.

29 cOAlition S: “Plan S Rights Retention Strategy”, <https://www.coalition-s.org/rights-retention-strategy/>.

Financing of open-science infrastructure constitutes a major challenge, and low- to medium-income countries might not be able to close gaps without regional or international funding mechanisms. However, offers from stronger economies in exchange for control are likely to create dependencies that could be damaging in the longer term.

Culture evolves and cannot be enforced. Similarly, ethical behaviour does not derive from rule books, but from fostering responsible actors. Researchers can drive positive change if they are empowered to do so and receive adequate support. Engaging them on Open Science needs to come with training opportunities. Policies should build on viable solutions that already exist and will not cut through if they are perceived to add further ‘red tape’. We get further by shaping collaborative models in which everybody gets raised up. In particular, researchers deserve due credit for their various kinds of contributions to scholarship and society.

Moving towards equitable partnerships is an issue that research funders should give their attention to. Several sets of guiding principles have been drawn up,^{30,31} considering trust, responsibility, transparency, and enhancing capacities as key elements. The CARE Principles for Indigenous Data Governance³² complement the FAIR principles by considering both people and purpose, reflecting the crucial role of data in advancing indigenous innovation and self-determination. Furthermore, models for equitable sharing of benefits have already been developed, e.g. the **Nagoya Protocol on Access to Genetic Resources and the Fair and Equitable Sharing of Benefits Arising from their Utilization to the Convention on Biological Diversity**,³³ a supplementary agreement to the **Convention on Biological Diversity (CBD)**³⁴ in accordance with and building on several principles of the UN Declaration on the Rights of Indigenous Peoples (UDRIP). Sharing benefits from genetic resources is of great interest for Africa, because of its rich heritage of biological diversity, genetic resources and associated traditional knowledge. As part of many international research networks, Africa frequently provides specimens, access to pathogens, as well as species adapted to its climate. Such resources are much sought after by pharmaceutical, cosmetic, plant and animal breeding industries. A smooth implementation of the Nagoya Protocol however suffers from lack of information and training, as well as a lack of support by national states to amend or establish respective new legal, administrative, or political measures.

A detailed look at the money flows in research and development would be informative for modelling how intellectual property should be protected and what protection would be rather counterproductive, with the goal to “reduce inequality within and amongst countries” in accordance with SDG 10 and to foster vibrant research communities. We are currently operating with frameworks that have historically developed over centuries, sometimes following guesses, rather than having been designed to address current realities or specifically scholarly research. In particular, profits need to flow back into strengthening local capacities, permitting research to drive development. The interests of weaker parties will not be served unless protected by legislation.

CONCLUSIONS

History has seen both cultural interchange and cultural dominance, with science not being singled out. Science is an integral part of culture, deeply anchored in local cultural heritage across the world, and education has its role to play in rediscovering these connections. Moreover, appreciating and benefiting from diversity requires sharing a common platform for a respectful global polylogue.

30 Swiss Commission for Research Partnerships with Developing Countries (KFPE), Swiss Academy of Sciences: “A Guide for Transboundary Research Partnerships: 11 Principles & 7 Questions”. 3rd ed. (2018) https://kfpe.scnat.ch/en/11_principles_7_questions.

31 Canadian Coalition for Global Health Research (CCGHR): “CCGHR Principles for Global Health Research”. (2015) <https://www.ccgrr.ca/resources/principles-global-health-research/>.

32 Global Indigenous Data Alliance: “CARE Principles for Indigenous Data Governance”, <https://www.gida-global.org/care>.

33 Secretariat of the Convention on Biological Diversity, United Nations Environmental Programme: “Nagoya Protocol on Access to Genetic Resources and the Fair and Equitable Sharing of Benefits Arising from their Utilization to the Convention on Biological Diversity”. ISBN 92-9225-306-9 (2010).

34 United Nations: “Convention on Biological Diversity”. <https://www.cbd.int/doc/legal/cbd-en.pdf> (1992).

The UNESCO Recommendation on Open Science provides a framework for nation states to develop and maintain a supportive environment in global collaboration, but the job is not done yet.

Open Science must not equate to freedom of exploitation by the strongest actors, but rather transparency of all processes, responsibility for the common good, nourishing development, and equitable sharing of benefits.

Equity is not a binary issue between “developed” and “developing” countries, and such a picture of two confronting worlds is inadequate. Similarly, open sharing is not a matter of bilateral agreement but needs to be based on multilateral principles. It is also not about reciprocity, given disparities in resources to turn results and data to good use.

We, the authors of this essay, do not accept to be divided. We are stronger together as a single diverse global community, engaging in conversation without barriers of access and supporting each other in working towards common global goals that respect local circumstances and serve local needs.

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