Open Science MOOC Response to UNESCO Draft Open Science Recommendations

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The Open Science MOOC[1] 2020 Steering Committee (info@opensciencemooc.eu) responds on behalf of our community to the UNESCO consultation on open science. We offer this response from our perspective as a global source of open educational materials for teaching and learning open science principles and practices. Our community and recommendations center early career researchers as a key audience for and as valuable creators of educational materials.

Our steering committee offers our response to the UNESCO Draft Open Science Recommendations based on our own reactions and on comments from the broader Open Science MOOC community. Our response is structured around the following categories:

- Promoting a common understanding of Open Science
- Developing an enabling policy environment for Open Science
- Investing in Open Science infrastructures, services and capacity building for Open Science
- Transforming scientific culture and aligning incentives for Open Science
- Promoting innovative approaches for Open Science at different stages of the scientific process
- Promoting international cooperation on Open Science

Promoting a **common understanding** of Open Science

Definition of Open Science is a continuous debate. It can differ a lot for different communities. Consequently, it is extremely important to agree with the universal and common definition of Open Science and its components. This will make Open Science not a manipulative but a democratic agenda and prevent violation of Open Science principles and their usage subject to third party interests. Generally, Open Science's definition, discussion, promotion and implementation need support from non-governmental, international and national governmental organisations, educational institutions and scientific unions, media and citizens. In the form of recommendations, initiatives and supporting funding programs from UNESCO, Open Science practices can be promoted and proposed to governments and local educational institutions.

National governments should inform the public and educational institutions about the urgent need to adopt Open Science practices and policies. This can be done by promoting and educating about Open Science with workshops and courses on relevant topics: usage of preprint repositories, sharing unpublished data and code, all under open licences. At the same

[1] Our organization is planning a name change to OpenScience OpenEd in 2021.

time, the best promotion of Open Science is the investment in building and maintaining scientific infrastructures and managing public finances, which currently include large expenditures for subscription and article processing charges for scientific publishers.

Citizens are an important part of the Open Science concept where non-scientists can participate in the research process (Citizen Science) as well as in its reformation and optimisation. Involvement of citizens to the promotion of openness in academia can help to support the strength of the Open Science movement. However, the broad public should understand how scientific research and communication are done and why it is necessary to make them open. It is always important to mention that there is nothing artificial, new and revolutionary in Open Science practices, as Open Science is just the right way of doing science according to the right of universal access to knowledge. There are a lot of examples that show how society benefits from openness. One example is Open Source Software development, which showed a lot of advantages: it is free to use, modify and optimise and it provides independence and transparency. Creative Commons licences also show the benefit of open principles by avoiding long legal processes linked to copyright, decreased costs, and enhanced sharing of creative works, which therefore can gain popularity and attention very fast.

At the same time, existing science communication and popularisation media content which aims to increase public interest in science does not show deeper problems in academia linked to flawed research, the reproducibility crisis, and limited and paid access to research literature. Also, often this content does not show how the broad public can actively interact with research and use results of scientific findings. Media outlets are recommended to adopt media literacy policy and are asked for more accuracy while communicating scientific information to the broad public. Therefore, promoting Open Science principles among citizens and the media are crucial.

Developing an **enabling policy environment** for Open Science

Our community advocates for “a broad, international strategy for the implementation of open scholarship that meets the needs of different national and regional communities but works globally (Tennant et al., 2019).” At the national and global level, we expect such a strategy to include a transparent governance structure for the scholarly commons, coordinated development of open standards for the scholarly commons, requirements for implementation of open infrastructures with open standards, strategic spending favoring open infrastructures and defunding closed infrastructures, and sustainable funding models for infrastructure based on capital investment and support for ongoing maintenance (Tennant et al., 2019).

As a global community devoted to open education for open science, we emphasize the central role of early career researchers in development and implementation of policies for open science. Early career researchers are an important audience and for and should also have leadership roles in creating resources for implementing these policies.

We appreciate the attention in UNESCO’s draft to the role of heterogeneous actors in co-production of knowledge. We would encourage UNESCO to add guidance scrutinizing

requirements for institutional affiliation for participation in scientific funding, publication, and other activities. The COVID-19 pandemic and other constraints on mobility have disrupted many scientific careers. Policies should be developed to create alternative mechanisms for scholars to be accountable that do not rely on traditional affiliation mechanisms tied to employment.

Our global community is especially concerned with policy solutions that allow open access to the positive spillovers resulting from publicly funded research. In countries that fund significant research, we support policies that remove these barriers, while affirming that restrictions based on security, confidentiality, privacy and respect for subjects of study can be essential for their equitable implementation.

Countries that lack significant budgets for public investment in science are crucial potential beneficiaries of open science policies. We encourage global institutions to provide funding for scholars in these countries to adapt the knowledge commons for local contexts, including but not limited to multilingual implementations.

Investing in Open Science **infrastructures, services and capacity building** for Open Science

We center our response around three aspects of this topic. We address infrastructure and services for Open Science in terms primarily of information and communications technologies (ICT). We address two aspects of capacity building: sustainable funding and building of capacity, skills, and knowledge in the people that make up the scientific community.

A fundamental aspect for many open science efforts is that infrastructure should be shared, community developed and managed. Open science infrastructure should allow for seamless integration across open source, decentralized services. A core set of open science principles, around governance, sustainability, and insurance, can help guide community infrastructure efforts while also building trust (Bilder, Lin, Neylon, 2015). Principles from a variety of community initiatives exist and can be harmonized to create a shared, core set of principles to help guide open science infrastructure development. While there is a role for social media in open science, our community believes that developing a robust and inclusive infrastructure for open science should not be left to the Big Tech oligopoly.

Many barriers still exist in open science, preventing full participation in developing a truly shared experience. Design thinking can be employed to empower participation from underrepresented communities, to incorporate new and intersectional perspectives in Open Science efforts, and address current power structures (Okune et al, 2019). Open Science infrastructure solutions should consider both expanding access to resources from the Global North as well as extending solutions that are already being developed successfully in the Global South. Language is one barrier to overcome, where the integration of open translation services into Open Science infrastructure can expand participation.

Funding sustainability is also critical to keeping momentum in open science efforts. Adequate and sustained funding will be essential for development and maintenance for technical infrastructure. Funders and supporters of open science projects and initiatives can benefit from a proposed framework for evaluating sustainability.

The professionalization of new roles across the research enterprise is already underway. Aligning these professionalization efforts and the underlying work being done on elements of these roles (e.g. job duties, skills) with work around new forms of credit will be valuable. The FAIRification of professional development resources will also be critical to aligning with international and national open science initiatives and further maximize the potential of openly licensed material.

Our organization focuses on early career researchers, approximately upper-division undergraduates to 7-10 years post-PhD. In this context, we conclude our response to the recommendations on capacity building with a reminder that the scope of open educational resources will need to extend beyond what we think of as the traditional scope of formal education.

Transforming scientific culture and aligning **incentives** for Open Science

The Open Science movement is a direct response to challenges like a lack of open research data; a crisis of reproducibility; unreliability of the peer review process; inadequate research assessment; a lack of communication between scientists and the public, the business sector and society as a whole, etc.; and an appeal to engage in science properly. The research process should be more transparent, and research outputs should be findable and available in standardised formats through an interoperable infrastructure. This would allow for the reuse and reproducibility of scientific research.

Motivations for adopting Open Science practices range from ideological commitments to human rights and democratic ideals to more pragmatic concerns (Veletsianos & Kimmons, 2012). Current career advancement criteria in most of the European countries do not encourage research data sharing or openness in general. The problem of incentives is recognised as the main barrier to adoption of the Open Science agenda. There appears to be a lack of political will, and research data seems to be a low priority to policymakers. Furthermore, research data is not integrated into internal institutional processes. Skills for handling research data must also be strengthened.

National Open Science policies are often absent or inadequate. Financial resources for Open Science are not consistently available. National Open Science policies should significantly support research assessment reform, raise awareness, and help the research community cover the costs involved. The absence of incentivising policies and guidelines is one of the main barriers for research institutions in their adoption of open research data, open publications and open educational materials. Institutions deal with a lack of processing skill and capacity and a

lack of cooperation and coordination. Significant benefits of Open Science are often not recognised; greater awareness is needed.

Often Open Science initiatives are voluntarily founded by individual researchers and activists and are therefore local, limited in time, and unsustainable. From the perspective of educational institutions, it is indispensable to favour and choose usage of Open Science practices as criteria for researchers' academic advancement and success, through mechanisms such as rewards for practicing Open Science. Because now success is usually linked to the closed available-for-a-cost rankings provided by commercial companies, practices, ideas and propositions in alternative and open science communication reformation are not fairly rewarded. The message of support for scientists in their willingness to work in an open academic environment should be widely disseminated by governments and educational institutions.

The incentives and rewards for Open Science can be summarised through the following topics and associated activities to be adopted by all stakeholders (researchers, institutions, policymakers, funders, infrastructure providers, publishers) as articulated by the NI4OS-Europe Consortium (Macan, et al., 2020):

1. Enforcing Open Science. Mandating Open Access publishing, including datasets and software, setting up policies for FAIR data publishing and archiving.
2. Changing research assessment and promotion criteria. Integration of Open Science activities into research assessment and evaluation at different levels: promotion of researchers, recruitment procedures, project proposal assessment, institution's evaluation, funding allocation systems, research awards.
3. Providing support for Open Science infrastructure. Organisational and financial support for Open Science infrastructure creation, development and maintenance, for personnel costs, for training activities.
4. Increasing Open Science skills, capacity, and awareness. Education and training of researchers, students and support staff, provide discipline-specific and stakeholder-specific guidelines and training, helpdesk, publication and data stewards.
5. Enforcing research integrity. Adopting research integrity policy at all phases of a research lifecycle and publishing processes.
6. Fostering collaboration. Sharing information about best practices, collaboration with national and international partners.
7. Standardising metadata for datasets' citations and metrics. Facilitating and standardising dataset attribution and citation, developing new and innovative research data metrics.
8. Improving publishers' practices. Enabling and mandating fully transparent editorial policies, publication/availability of datasets alongside research papers in Open Access, developing interoperability with other Open Science infrastructures, implementing more transparent peer review processes and high ethical standards into publishing practices, enabling text and data mining etc.

Major changes in the current reward systems in scholarly communication that would fully acknowledge Open Science practices could provide sufficient visibility of individual research output, including research data. Improved systems of incentives and rewards for researchers, institutions, projects, and funders should "put scientific quality over quantity, ensure reproducibility of results, notably through methodological rigour, generate FAIR data; curate and

preserve data; share data and results; reuse data, work with stakeholders across disciplines and sectors, and interact with societal stakeholders for defining research questions and co-creating results" (Nosek, et al., 2012).

We offer the preceding suggestions based largely on the European context, where existing incentive structures must shift to motivate Open Science practices. However, our membership is not confined to these contexts and we advocate for the recommendations to also develop appropriate systems of incentives especially for African, Asian, and Latin American contexts (Irawan et al., 2020; Onie, 2020). In these settings, incentives should focus on enabling structural change in the academic sector and fostering the emergence of new institutions.

While many of the recommendations we have shared in this section are situated within scholarly publishing and academic careers, the scope for changing culture and incentives is much broader and encompasses the whole variety of research and teaching practices (Elder, n.d.; Stacey, 2018). Initiatives to shape culture and incentives should apply an inclusive, holistic approach to science and research.

Promoting innovative approaches for Open Science at different stages of the scientific process

We advocate for an approach to Open Science that starts with culture and community, centers the focus of science on process rather than products, and treats public engagement as integral to the process.

Inspiring innovative Open Science approaches across the research process begins with fostering a supportive and inclusive culture. For Open Science spaces to be friendly and respectful, and to truly welcome broad and inclusive participation and contributions, model governance mechanisms such as codes of conduct should be more widely accessible to communities and easy to implement. In addition, to inspire cultural change, and ultimately an open mindset, put Open Science recommendations into context at the various regional, domain, institutional, and individual levels. There, they can shape developmental and assessment goals. Example case studies from current and pilot programs incorporating Open Science recommendations would be invaluable to the wider community.

The Open Science effort can only gain from the involvement of a broad array of stakeholders from individual researchers to research institutions, public and private organizations and small- and medium-scale enterprises, start-up firms and consolidated large commercial enterprises. Cultivate a shared vocabulary to bring these stakeholders to the Open Science table and motivate them to participate. It is also critical to discover how each group defines Open Science per their own interests. Stakeholder focus groups will be helpful in crosswalking the recommendations and descriptions to fit these groups' own understandings and ultimately aid in broader outreach.

Rather than placing the focus production of a research paper, Open Science should focus on developing a research compendium including data, code, documentation, and other scientific artifacts for reproducing the research workflow. Such a compendium should be as open as possible at all stages, subject to minimal practical and ethical constraints. Open formats, source, standards, protocols, and licenses must be used so that the research is fully auditable and available for assessment (Tennant et al, 2019). The auditing and assessment approaches being implemented in the FAIR community can serve as helpful examples.

Perhaps the best way to advance data sharing is to promote a workflow-centric approach where researchers use interactive technologies and do not really notice they are using underlying infrastructure services and tools. In other words, they can share data in their workflows via integrations and automation tools without having to visit and submit data to fragmented online data repositories. Including researchers in the development of these approaches is a must. Support efforts to connect data and other research products to papers. In the process, consider a flipped approach where scientific products such as data are an entry point to the paper and overall compendium of work. To put it another way, pilot and demonstrate new discovery systems where researchers can see the value in describing their data, where it can be a filter for the paper and not the other way around. Demonstrating the value of well curated data to researchers will ultimately lead to greater efficiencies.

Through large scale, high performance research computing infrastructure, the potential of fostering research collaboration that transcends all geographical, technical, and disciplinary boundaries is great. The benefits include improved networking, marketing and promotion/discovery connections, academic/non-academic information exchange, pipelines/workflows efficiencies, and discussion forums. The potential of high performance computing infrastructure lies in fostering re-use and remixing to help create a thriving scholarship community around collaboration and sharing. In other words, researchers will look to use cases, reuse of materials, and mentorship opportunities. Moreover, the challenges around calculating cloud storage and computing costs is a universal theme that can be improved through cloud credit incentive programs, community calculation tools, and sharing of use cases.

Greater support, in the form of training and credit, is needed to further inspire scientific research collaboration and participation with the public. More can be done to inspire training on how scientists can engage the public (i.e. science communication) via social media platforms and collaboration tools but also to incorporate credit for these activities into programs. Also, open access to research is fundamental to public engagement. Engage in outreach and offer guidance for those communicating science to incorporate open vs closed access to research.

Promoting **international cooperation** on Open Science

We appreciate how the draft highlights the importance of international collaborations for the development of Open Science, including broad access to the products of science and including solidarity among nations as a key element.

A key element mentioned in the draft is the creation of funding opportunities for promoting Open Science at the international level. Funding may be one of the main challenges for strengthening these collaborations, considering the differences between countries in funding for science and political attitudes toward Open Science. Another important element that the draft includes is the relevance of the implementation of strategies to avoid the exploitation of open data across international borders.

Additional elements related to open Science would benefit from collaborative revision taking a global perspective. For example, such collaboration could address the multiple challenges related to the broad use of open data (for several research fields, such as health sciences), in terms of local legislation aiming to protect privacy of participants. In addition, collaborative revision should be brought to bear on challenges of the broad use of open methods, in terms of differences in institutional policies related to intellectual property. In this context, Open Science should be aligned, or include, international initiatives related to Open Innovation.

As the draft mentions, previous experiences from countries with advanced levels of implementation of Open Science would be helpful for its development in countries with less Open Science experience. A fundamental aspect for a global implementation of Open Science around the world would be a close collaboration with major stakeholders, such as local and international funding institutions and governments. In this context, national and institutional implementations of policies that value and promote the implementation of Open Science, such as the use of Open Methods and Open Data, would be of high importance. Finally, a consideration of the relative high costs for some resource-limited countries of some dimensions of Open Science, such as the author publishing charge (APC) for some open access journals.

Conclusion

We appreciate the work that has gone into developing this draft. We also appreciate this opportunity to share responses from our community. We look forward to advancing the implementation of the final recommendations by serving as a resource for open educational materials to help foster learning about Open Science.

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