The Role of Open Science in Our Research

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This editorial considers Open Science, what it is, what are its potential benefits, what are the pillars of engagement upon which it rests, and what are some of the main challenges facing its further adoption by research communities. At its core, Open Science involves sharing not only the contents of a traditional research article, but also of any source data and methodologies upon which the reported findings are based. Though some extra work may be required, usually without anyone providing additional resources to do that work, continuous developments in digital technology are making Open Science easier to implement. While not all data is suitable to be shared, Open Science practices are widely supported within the wider research community and funding organizations.

DOI: 10.15376/biores.19.2.2013-2016

Keywords: FAIR data; Sharing of data; Engagement; Citizen science; Standardization; Open research

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Open Science – What It Is

When we speak about Open Science, it should be clear what we mean and how it is understood. A high effort has been carried out in the last years to clarify the concept of Open Science (UNESCO 2021; OECD 2022). However, several controversial aspects persist. These are primarily related to the phase of Open Science implementation in which different organizations are engaged at a given moment and to the existence of diverse research cultures.

Initially, Open Science was considered as a process based on open and collaborative ways of producing and sharing knowledge and data, as early as possible in the research process, and for communicating and sharing results. It was mainly focused on Open Research, referring to research practices that make the research process more transparent, accessible, and collaborative. This was related to open access and FAIR (findable, accessible, interoperable, and reusable) data. However, as shown in Fig. 1, Open Science covers much more than just providing a wider share of results or being transparent. These aims have been continually promoted within the technological limits of each era. Imagine the accessibility to a thesis or publication 30 years ago, in comparison to nowadays, in the digitalization era. In the past, the searchability for specific information was limited and time-consuming. Furthermore, we had accessibility limitations as well as distribution challenges. Nowadays, the evolution of search and navigation technologies and the Internet has made information fast and easily accessible worldwide, improving discoverability, and enhancing collaboration among researchers. These developments have democratized the access to knowledge. Therefore, we have an overwhelming amount of information, making it challenging to process and select the relevant high-quality information.

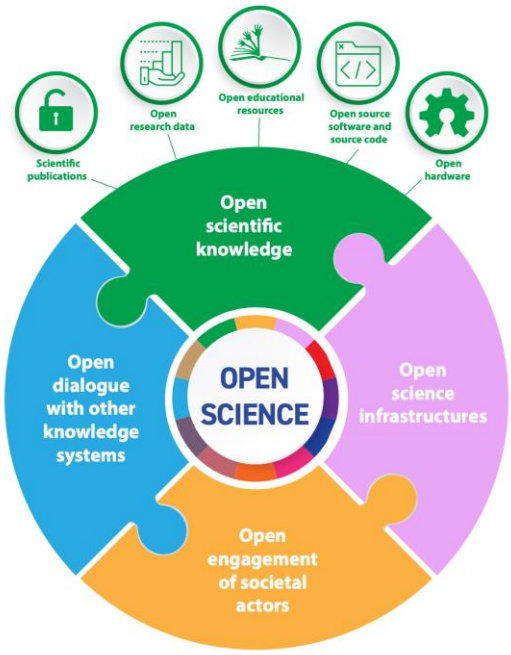

Fig. 1. UNESCO Open Science vision (Source: UNESCO 2021)

Today, Open Science aims to go beyond traditional practices throughout all the research lifecycle, being more open and more transparent in all research steps from the inquiry to the output. It also has a broader approach, involving new actors in the scientific process to make science more inclusive and highlighting the value of open science infrastructures. The aim is to further improve the impact and quality of the work. However, it is not the same if someone tells us "you need to be transparent," or instead they say "you need to be more transparent by publishing not only results but also the methodology and all the data in a format useful for other researchers".

Many institutions have embraced the principles of Open Science in the last few years, and researchers need to follow new rules. Opinions on Open Science are generally positive, although many researchers consider it a burden. In many cases, this is because communication plays a key role in how researchers feel about it. In addition, researchers have been asked sometimes to adopt new practices, such as publishing in open access venues, adding the publications into open repositories, or publishing data and methodologies, without being provided with additional resources (budget, time, specific training, or guidelines). Furthermore, the recognition provided in exchange for good practices until last year has been very low.

There is no doubt that sharing all outputs from the different stages of the research constitutes an opportunity for better, high-quality research, which is more reproducible and subject to verification. By sharing data and methodologies, other researchers may be able to interpret results in a different way, thus achieving additional or better conclusions. Alternatively, they may complement results with their own data and knowledge proposing new solutions. In this way, the value of research is increased as well as its global impact. Therefore, we should not be afraid of Open Science; rather, we should see it as a new world of opportunities.

The terms Open Science and Open Research are not interchangeable, and their precise meanings can vary depending on the vision and context in which they are used.

However, both concepts aim to promote a culture of openness, sharing, and collaboration in the academic and research community. Today, Open Science is considered to be embedded as part of a larger more systemic effort to foster all practices and processes that enable the creation, contribution, discovery and reuse of research knowledge more reliably, effectively, and equitably (European Commission).

Pillars and Engagement

Open Science is built on different pillars:

- Open access peer-reviewed publications.
- Open FAIR data.
- Research integrity and reproducibility of scientific results.
- New complementary indicators for a better evaluation of research quality beyond citations and journal impact.
- Education and skills on Open Science routines and best practices.
- Citizen Science to engage citizens in the co-design of solutions to increase creativity and acceptability of the solutions.
- Rewards to acknowledge Open Science activities in the research career.
- Linked existing interoperable infrastructures to store, share, process, *and* reuse research digital objects (*e.g*., publications, data, methodologies, software) to enable greater collaboration between researchers.

Challenges

Beside the great advance carried out in the last years, Open Science practices have still several challenges:

- Resources both in terms of time and funding.
- Quality control, which is crucial to maintain the integrity of scientific research.
- Standardization of data formats, metadata, and methodologies to facilitate the interoperability and reusability of open research outputs.
- Development and maintaining robust and user-friendly technical Infrastructure to support open research practices.
- Intellectual property and ownership: not all research has to be open.
- Data security of sensitive data.
- Training and education to increase the Open Science skills.
- Cultural change to adopt new practices and evaluation criteria.
- Public engagement and new communication skills.

Conclusion

We should understand Open Science as a value, as part of a research ecosystem, but not as a burden. The value is related to accessibility, understandability, collaboration, and sharing. It breaks the barrier of knowledge and extends the limits of collaborative research, providing new solutions beyond our own borders. It has an exponential potential to provide a higher number of alternatives and solutions to current challenges that we may expect. The initial concepts of Open Research have been an inherent feature of science from its beginnings. It is what many scientists, often unconsciously, have practiced in their work. However, with the opportunities of the digital era, Open Science represents a valorization of knowledge that benefits the scientific community and society in general. It also benefits researchers at all levels.

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