DIAGNOSIS AND ROADMAP FOR AN OPEN SCIENCE POLICY IN ARGENTINA

MINCYT Argentina
Ministry of Science, Technology and Innovation

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Members of the Open and Citizens Science Advisory Committee of the Ministry of Science, Technology and Innovation MINCYT (Argentina) are specialists from multiple disciplines, who have contributed their expert knowledge to different chapters of this document.

Likewise, other specialists invited by the Committee have participated in this document and their contributions have been fundamental to reach the final results.

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Contributions by chapter

Antecedentes globales, regionales y nacionales
Fernanda Beigel, Dominique Babini, Valeria Arza

La Ley Nº 26.899: el acceso abierto a través de repositorios digitales
Paola Azrilevich, Marisa De Giusti, Alejandra Nardi

Publicar en acceso abierto
Cecilia Rozenblum, Maximiliano Salatino y Alejandro Dujovne

Datos primarios de investigación, software y código en acceso abierto
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Ciencia ciudadana y participativa
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Infraestructura abierta y colaborativa
Ariel Lira, Marisa De Giusti, Paola Azrilevich, Sol Terlizzi, Diego Ferreyra y Carlos Authier

Incentivos para la ciencia abierta en el financiamiento y la evaluación
Fernanda Beigel, Laura Rovelli, Mariano Zukerfeld

Monitoreo de la ciencia abierta
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OBJECTIVES AND TASKS OF THE COMMITTEE

The MINCyT Resolution 132 /2021 in its article 1 defines as the objective of this committee to provide expert advice to the Ministry regarding Open and Citizen Science.

The committee's tasks include:

- Advise and provide informed opinion to the different structures of the MINCyT in the areas of Open Science and Citizen Science, tending to the development of policies and planning of concrete actions.

- Prepare documents that can be used to support and promote Argentine participation in international forums of open science.

- Prepare proposals for a roadmap and reports leading to advise the MINCyT in actions linked to the practice of open science, open infrastructures and other initiatives in the country.

This document is the result of a series of both virtual and face-to-face plenary meetings during 2021 and 2022, and points out to build a diagnosis of the current situation of open and citizen science in the country. On this basis it also proposes a set of reccomendations and lines for monitoring advances

General Aim of the Open and Citizen Science Advisory Committee

To make a diagnosis of the implementation of Law 26.899 (2013) on Open Access Repositories in light of the new context proposed by the UNESCO Open Science Recommendation (2021), to promote the opening of Argentine science under the National Science, Technology and Innovation Plan 2030 and the Law 27.614 on Funding for the National Science, Technology and Innovation System.

Specific Goals of this Document

- Define open science basic concepts, dimensions and principles in the Argentine context.
- Understand the participatory and citizen science approach, its background and possibilities for development in the country.
- Disseminate the benefits of open science in society in general and in the Argentine academic community in particular.
- Describe the development of the National System of Digital Repositories and the progress of open access in the different institutions and organizations of the National Science, Technology and Innovation System.
- Promote the integration of national open access scientific information management systems.
- Foster the development of open infrastructures in the public domain, ensuring maximum interoperability and good open science practices.
- Review existing research evaluation and funding systems in Argentina and propose incentives to reward and increase open science practices.
- Propose a culture of open science that promotes multilingualism and bibliodiversity.
- Suggest to the MINCyT a mechanism to monitor the progress of open science in Argentina.

INTRODUCTION

Open Science from a global perspective

Open science encompasses all scientific disciplines and all aspects of academic practices, including basic and applied sciences, natural and social sciences, and humanities. It is based on the following key pillars: open scientific knowledge, open science infrastructures, scientific communication, participation of social agents and dialogue with other knowledge systems. It provides bases for increasing scientific collaborations and the interaction of the scientific community with society, and thus promotes the generation of knowledge for a fairer society. The core values of open science are: quality and integrity; collective benefit; fairness and justice; diversity and inclusion.

The Open Science Recommendation approved at the 41st General Conference of the United Nations Educational, Scientific and Cultural Organization (UNESCO) in 2021 recognizes the urgency of addressing complex and interconnected environmental, social and economic challenges for the people and the planet, including poverty, health issues, access to education, rising inequalities and disparities of opportunity, increasing science, technology and innovation gaps, natural resource depletion, loss of biodiversity, land degradation, climate change, disasters, spiraling conflicts and related humanitarian crises, among other priority challenges.

It considers that more open, transparent, collaborative and inclusive scientific practices, coupled with more accessible and verifiable scientific knowledge subject to scrutiny and critique, are a more efficient enterprise that improves the quality, reproducibility and impact of science and, thereby, the reliability of the evidence needed for robust decision-making and policy, and increased trust in science.

It affirms the human right to scientific progress and establishes that open science must be based on the respect for the diversity of cultures and knowledge systems around the world as foundations for sustainable development, foster open dialogue with community organizations and with indigenous peoples traditionally excluded from the production of knowledge in relation to problems that affect them and are being investigated. At the same time, it promotes respect for diverse knowledge holders, in order to respect their self-determination.

In addition, it states the growing importance of collective scientific processes carried out by research communities using shared knowledge infrastructures to address complex problems. This vision and these principles are accompanied by a definition that points to a global consensus on the benefits and challenges that open science entails, and the various means to access it.

> **Thus, UNESCO defines open science as an inclusive construct that combines various movements and practices aiming to make multilingual scientific knowledge openly available, accessible and reusable for everyone, to increase scientific collaborations and sharing of information for the benefit of science and society, and to open the processes of scientific knowledge creation, evaluation and communication to societal agents beyond the traditional scientific community.**

Argentina not only joined but also actively participated in this project. Indeed, it was the country that answered the highest number of surveys in the global consultation process. The new context that arises from the UNESCO Recommendation and the broader dimensions of open science, as well as the advances in open access at the international level, require an updated diagnosis and a plan of concrete actions for Argentine science to become open science.

A national view of Open Science

Law 26.899 on Open Access Repositories, adopted by the Argentine Congress in 2013, is among the pioneering initiatives at the regional and international levels, and its implementation is progressing in Argentina's research institutions.

Likewise, Law 27.614 on Funding of the National Science, Technology and Innovation System passed on February 24, 2021 opens a completely new path to support the progressive increase in the share of national budget allocated to the science and technology function until it reaches 1% of GDP in 2032, resulting in more opportunities for funding open science activities.

Under the National Plan for Science, Technology and Innovation 2030 (Plan CTI 2030), which assumes coordination, federalization and social and productive impact as management pillars, it is argued that knowledge is the central axis of sustainable development and the welfare of societies, and that the current challenge consists in generating, applying and distributing knowledge in order to guarantee growth with equity. The Plan includes open science, engineering and innovation as well as public communication of science and technology among the fundamentals of national policy.

In this sense, in its specific strategy for human resource training, a central proposal of the Agenda for Institutional Change of Plan CTI 2030 is ”to design an evaluation model referenced in a renewed framework of indicators that considers relevant, pertinent, impactful and open access scientific and technological production, and the effective transfer of technology and knowledge”.

Strategic management and transfer and extension of knowledge are among the main pending subjects of the National Science, Technology and Innovation System (SNCTI).

Plan CTI 2030 seeks to optimize knowledge production, circulation, protection, use, application and social appropriation processes by consolidating an adequate regulatory context that fosters Research, Development and Innovation (R&D&i), management, transfer and extension activities as well as the valuation and commercialization of intangible assets, among others.

It also proposes to take collaborative efforts to the citizenry, since through open science and engineering citizens become an active part in the generation of a virtuous circle of knowledge production-use.

All of these are necessary dimensions for science, technology and innovation to become components of culture and the social, political and economic reality, and to collaborate in the renewal, growth and diversification of human resources required by the R&D&I agendas.

In a complex context for Argentina and the world, marked by the COVID-19 pandemic and historical social debts, it is also of fundamental importance to coordinate the advancement of open science and education at all levels to attend to the needs of the most vulnerable groups for a fairer society that maximizes their human potential. Considering that the active Argentine citizenry of the coming decades will be made up of today’s boys, girls and young people and that the educational system is responsible for training them, by coordinating the educational system and open science unattended basic needs may be satisfied in the immediate future. This is how the participation in open science of social actors beyond the scientific community is envisioned.

Basic education is key for the development of scientific vocations and a collective intelligence for the new generations that may be used to solve problems in their community. In times when the digital transforms social practices, open science can contribute to make scientific knowledge more inclusive and accessible.

Es importante involucrar a la educación básica para desarrollar vocaciones científicas y una inteligencia colectiva para las nuevas generaciones, capaz de ejercitarse en la resolución de problemas de su comunidad. En tiempos en que la era digital transforma las prácticas sociales, la ciencia abierta puede contribuir a hacer más inclusivo y accesible el conocimiento científico.

One of the main challenges for the advancement of open science in low- and middle-income countries, already observed in the UNESCO Open Science Recommendation, lies in the digital divide between them and the most advanced countries. Hence the importance of one of the missions of the National Digital Transformation Challenge proposed in Plan CTI 2030, which establishes that, under a Digital Government strategy, interventions will be oriented towards strengthening technological sovereignty.

This translates into the generation of a sovereign national hybrid cloud (combining public and restricted access) and, accordingly focusing on strategic information based on a combination of public data sources, while preserving privacy and individual rights, technological convergence and interoperability, to promote the national problem-solving and safeguard access to data and reduce the digital divide.

To contribute to this medium and long-term prospects proposed by the Plan, this document makes a specific diagnosis about the current development status of open science in relation to its goals and proposes lines of action to improve the implementation of Law No. 26.899.

In times when basic needs require urgent satisfaction, the transition to open science, from its first stage, should contribute to guiding scientific development with social relevance, as well as ensuring education in general and scientific communication in particular, all of which will result in the enhancement of the national capacities of society as a whole.

Global, regional and national background

Early regulatory precedents of open science at a global level included the Right to Science already contemplated in the Universal Declaration of Human Rights in 1948, aimed at the generation of knowledge based on scientific evidence as the foundation of policies for sustainable development. This human right involves both access to and participation in the production and communication of science.

Although there are many experiences and precedents of the open science project in all corners of the world, open access was the first to take on an international character with the first declaration resulting from the meeting of the Open Society Institute in Budapest in 2002, where the concept was coined.

Recently, the Open Access Initiative recalled in a new international declaration that open access is not an end in itself but rather a means to other ends: above all, it is a means to the equity, quality, usability and sustainability of research. This new statement focuses on four high-level recommendations and 40 recommendations for action, which address systemic issues that hinder progress towards equitable and inclusive global open science.

The four recommendations are:

1. Host open access research on an open infrastructure. Host and publish text, data, metadata, code, and other digital research results on open, community-controlled infrastructures. Use an infrastructure that minimizes the risk of future access restrictions or control by commercial organizations. In cases where the open infrastructure is not yet adequate for current needs, develop it further.

2. Reform research evaluation and rewards to improve incentives. Adjust research evaluation practices for funding and hiring, promotion and ownership decisions of universities. Remove disincentives for open access and create new positive incentives for open access.

3. Favor inclusive publication and distribution channels that never exclude authors for economic reasons. Take full advantage of open access repositories and journals with no article processing charges (APC) i.e. “green” and “diamond” open access. Stay away from APC article processing charges.

4. When we spend money to publish open access research, let us remember what the medium is for. Favor models that benefit all regions of the world that are controlled by academic and non-profit organizations, that avoid concentrating new open access literature in commercially dominant journals, and entrench models that conflict with these goals. Move away from read-and-publish agreements.[1]

Types of publication paths and access

Golden route
Publication in an open access journal.

Green route
Dissemination of research results through a digital repository.

Diamond route
Publication in a journal that does not charge to publish or read.

[1] Read-and-publish agreements: agreements between institutions and scientific publishers that cover payment for access to articles published in the journals of these publishers, and payment for publishing open access articles in these journals.

Among open access policies, the Guidelines for policies for the development and promotion of open access were prepared by UNESCO in 2013 with the intention that they should be used to clarify basic doubts in the area of open access. They argue that "through open access, researchers and students around the world gain increased access to knowledge, publications gain greater visibility and are more widely read, and the potential impact of research is amplified. The increase in access to knowledge and its shared use implies opportunities for equitable social and economic development, intercultural dialogue and has the potential to stimulate innovation". For its part, the Global Research Council, which brings together the leaders of research funding organizations from countries around the world, published a report promoting open access in 2014.

More recently, during its 40th General Conference, UNESCO decided to begin a process to issue an Open Science Recommendation by organizing of a Global Online Consultation, which was held regionally for Latin America and the Caribbean in September 2020.

Throughout that year and 2021 numerous consultations, forums and webinars were held in the process of discussing the Recommendation and build global consensus on the definition, values, principles and lines of action for the open science project to become true. Finally, the Open Science Recommendation was approved at the 41st UNESCO General Conference held in Paris at the end of November 2021.

In October 2020 the Directorates General of UNESCO and the World Health Organization (WHO) and the United Nations High Commissioner for Human Rights made a joint call for open science, advocating for an open, inclusive and collaborative science. In it, they called on all Member States to guarantee the fundamental right of access to scientific research and its applications, with a view to creating a global pool of knowledge and bridging the existing gaps in science, technology and innovation, especially in developing countries and with regard to women.

The initiative for the development of Open Science in UNESCO has other precedents in the Organization itself, such as the Recommendation on Open Educational Resources (REA) of 2019, in which the Organization recommends that the Member States adopt measures for the development of capacities in terms of creation, access, reuse, reconversion, adaptation and redistribution of REA, while urging the development of support policies that guarantee effective, inclusive and equitable access to quality REA.

In the context of these global initiatives, the International Science Council (ISC) prepared the document called "Open Science for the 21st.Century", which establishes recommendations for scientists, universities, UNESCO and any scientific system stakeholders about the changes necessary for an effective operation of open science. No less important are the limitations and barriers to the application of open science model as noted in the document, including property rights, incentives for researchers or the resistance of the private sector to open science models. In November 2021 the ISC published its position paper on "science as a public good" reaffirming the need to open science with ethical and social responsibility.

Thus, at a global level, the research production output resulting from State funding increasingly entails the obligation to disseminate it in an open access format, whether through repositories or publication by commercial or noncommercial publishers. This also entails compliance with open science practices such as the use of data management plans, the promotion of FAIR practices2, the use of persistent identifiers for publications and authors, among others. Although repositories in Europe are considered a fundamental component of open science, the substantial difference between that continent and Latin America cannot be ignored.[2]

In Latin America and the Caribbean, the first precedent would be the Declaration of Salvador on Open Access of 2005 which urged governments to make publicly funded research openly available, among other items, and aimed to consider the cost of publication as part of the cost of research.

In the Declaration of Open Science (Panama) of the CILAC Forum 2018, members of universities and civil society organizations of Latin America and the Caribbean recognized the growing interest at the governmental level "in developing open scientific policies as a strategy to improve efficiency and productivity of investment in science and technology". This declaration establishes 13 points considered key for the practice of open science, including open access, open data, citizen science, open evaluation and open infrastructures.

[2] Prácticas FAIR (por sus iniciales en inglés): son aquellas que permiten que los datos sean localizables, accesibles, interoperables y reutilizables.

The regional report "Recent trends in science policies for open science and open access in Ibero-America (2020)" points out that:

> "Among the declarations on the subject by Latin America and Caribbean countries, the approach to knowledge as a public and open access good managed by the academic community as a common, non-profit good stands out. Added to the above are the proposals to review evaluation policies based on incentives for publication with an impact factor, to the extent that they affect the local autonomy of agendas, while discouraging good open access practices and research processes in interaction with society".

On the other hand, it highlights that the institutional repositories of universities and national science and technology organizations are the preferred instrument for policies and legislation to support and expand open access in the region. Thus we see that our region has a long history of open access, including both repositories and publications, the management of which is in the hands of the academia itself and has not been transferred to commercial publishers. On the other hand, in Europe, open access is mainly based on large commercial publishers that generate significant tax revenue and jobs, thus it is region inclined to support the traditional industry of dissemination of scientific knowledge.

That is why in European Union countries and in the United States, the transition to open access and open science is being carried out through commercial models, such as transformative agreements or the transfer to authors and institutions of open publication costs.

However, this scenario impacts differently in Latin America, because...., because it generates undesired consequences for less privileged institutions and countries that also participate in these publications. Participatory and citizen science also has important precedents in our region. In 2021 the Ministry of Science, Technology and Innovation of Colombia published its "Public Policy for the Social Appropriation of Knowledge in the framework of Science, Technology and Innovation (2021)" with the aim of developing strategies to bring science closer to society, including:

- Foster collaborative research between academic researchers and community members,
- Promote the use and reuse of scientific knowledge for different activities of community life
- Encourage the participation of communities in the processes of creating research agenda and priorities.

Likewise, in October 2022 the Ministry of Science, Technology and Innovation of Argentina created the National Citizen Science Program, institutionalizing the activities it had been carrying out to make visible and connect citizen science initiatives and capacities existing in the country and strengthening its public policy in citizen and participatory science. The specific goals of this National Program include:

- Fund Argentine Citizen Science programs and projects, from ideation stage to the improvement and scaling up.
- Map and monitor Citizen Science programs and projects developed in Argentina, generating systematic information and identifying opportunities, challenges and lessons learned in their different stages.
- Promote the generation and application of various specific tools—research, support, dissemination, public communication or other tools—for Citizen Science programs and projects.
- Promote and make visible the participation of civil society in Citizen Science initiatives and projects through coordination, dissemination and public communication activities.
- Encourage training in Citizen Science, in participatory research methodologies and other related areas of expertise.
- Promote studies, research and diagnoses related to Citizen Science in Argentina that are useful for the development of public policies in various areas of intervention.

We do not find this type of program in any of the other countries in the region, but there are initiatives to raise awareness about the importance of the link between science and society.

For example, in Chile, the Ministry of Science, Technology, Knowledge and Innovation developed a document entitled "National Policy on Science, Technology, Knowledge and Innovation (2020)", which has one line of work focused on the link between science and society. The document lists citizen science together with public communication of science and science education. There are also non-governmental organizations in Chile that promote citizen science, such as Fundación de Ciencia Ciudadana (Citizen Science Foundation) and the Red Chilena de Ciencia Ciudadana (Chilean Citizen Science Network).

Brazil has some initiatives in the education area to promote citizen science in schools (Cemadem Educaçao), especially in environmental monitoring, and also a number of specific publicly funded projects.

In 2017 the Open Data Program in Science and Technology (MINCYT-SACT) was created and included the Argentine Science and Technology Information Portal and the dissemination of open and citizen science by means of conversations and workshops. In 2021 the MINCyT and the PNUD signed a collaboration agreement that allowed them to co-produce a survey of citizen science initiatives, focused first on the environment and then on multiple topics. The National Directorate of Programs and Projects under the Undersecretariat for Institutional Evaluation of the Ministry, which conducts the survey within under the agreement with PNUD, is the area that endorses the policy for the promotion of these initiatives and is responsible for the National Citizen Science Program mentioned above.

In sum, there is a growing movement of non-profit open access and open science initiatives led by the academic community. UNESCO proposed promoting these initiatives to create a global alliance of open access academic communication platforms to democratize knowledge. The European Community itself warns of the undesired consequences of commodification, and in this line Science Europe, cOAlition S, OPERAS, and the French National Research Agency (ANR) have just launched a support plan for diamond open access journals, that is, those that do not charge for reading or publishing and that are managed by universities or scientific societies.

For our country and the region in general, it is of fundamental importance to participate in the international debate on the need for a global ecosystem of open science and open access led by the academic community itself and governments, rather than by the growing commodification of science and scientific communications and their indicators for evaluation.

LAW No. 26.899 - OPEN ACCESS THROUGH INSTITUTIONAL DIGITAL REPOSITORIES

Law No. 25.467 of 2001 created the National Science, Technology and Innovation System (SNCTI) and set out its structure, which includes political bodies that carry out substantive activities related to scientific, technological and innovation development, universities and all other agencies and institutions of the national, provincial, municipal public sector and private sector that adhere to this law.

This law establishes the objectives of the national scientific and technological policy; the first two of which are: a) Promote, encourage and consolidate the generation and social use of knowledge and b) Disseminate, transfer, coordinate and disseminate said knowledge; these are also the fundamental framework objectives for a national Open Science policy.

For its part, in 2011 the MINCYT created the National System of Digital Repositories (SNRD) under the auspices of the Secretariat for Scientific and Technological Coordination - Under-Secretariat for Institutional Coordination, more specifically in the area of the Electronic Library of Science and Technology.

The SNRD is an interoperable network of digital repositories in science and technology, which is based on the establishment of policies, standards and protocols common to all the members of the System. Supported by its Committee of Experts, the SNRD provides support and advice to member institutions, for the elaboration of institutional policies and other matters relevant to the conduct of tasks of the System. Through a web portal, the SNRD provides access to the scientific-technological production available from affiliated institutional repositories and also manages the Open Access Primary Data portal of Argentine Science and Technology (DACyTAr).

Law No. 26.899 on Institutional In-House or Shared Open Access Digital Repositories was adopted in 2013, with MINCyT being appointed as implementing authority. Its Operating Regulations were approved by Ministerial Resolution 753/2016 in 2016.

The SNRD is the technical-operational instrument for the fulfillment of the responsibilities of the MINCYT under Law No. 26.899. The regulations specify the obligations, stakeholders involved and application-related issues. This includes: maximum periods of embargo for open access dissemination, use licenses, data management plan requirements and possible exceptions, among other issues.

It must be noted that the SNRD provides services to third parties, a good practice that is possible thanks to its interoperability strategy and that of digital repositories. A clear example is the Portal for Studies on Civil Society (PESoC), developed by the SNRD in a joint effort with the Undersecretary for Relations with Civil Society of the Head of the Cabinet of Ministers.

The PESoCl provides access to the scientific production generated on the subject in Argentina and is available in open access through the SNRD. Additionally, it contributes information of interest to the Network of Studies on Argentine Civil Society (REDSoC) and adds value to it and at the same time facilitates identification and retrieval of content without having to resort to institutions and to the community and requesting them to deposit the relevant materials in another area or creating new infrastructures for it. Thus it avoids duplication of efforts, in addition to its institutional repository. The result is an enhanced visibility of the research results, one of the objectives of the National System.

Law 26.899 implies that the National State has opted for the green route—open access institutional digital repositories—for the dissemination of scientific knowledge generated with public funds, and requires that at least the final version of the authors' publication must be available in this way. This obligation extends to primary research data.

In addition to guaranteeing access to scientific information that is generated with public funds, it is intended that institutions and organizations take responsibility for and appropriate (in the best sense) the knowledge they generate and consequently manage and disseminate it; therefore, the route chosen was that of institutional repositories.

Full compliance with this regulation would prevent privatization of publicly funded knowledge and would discourage the requirement to pay to access it (either by paying subscription fees or by paying APCs), at least as regards the author's final version and the primary research data.

Argentina, with its legislation, is an example at the regional and international level. In our region, at present only four countries have Open Access legal regulations: Argentina, Peru, Mexico and recently Colombia. Other countries like Chile and Brazil are working on it.

At the same time, our country, through the MINCyT, is a founding member of La Referencia, the network of open access repositories for science in Ibero-America with a strong international impact, founded, supported and integrated by the highest S&T organizations of the countries that make it up (currently: Argentina, Brazil, Chile, Colombia, Costa Rica, Ecuador, El Salvador, Spain, Mexico, Panama, Peru and Uruguay).

La Referencia provides services by which it supports national Open Access strategies in Latin America, promotes regional and international agreements, defines interoperability standards, carries out computer developments that allow and facilitate the operation of national nodes and disseminates available scientific production in the region's open access repositories.

Also, through this network, the MINCyT is part of the Confederation of Open Access Repositories (COAR), an international association that brings together individual repositories and networks of repositories to build their capacities, align policies and practices, and act as a global voice for the repository community.

COAR has 151 members and partners from around the world representing libraries, universities, research institutions, government funders and others. Its vision is a sustainable, inclusive and trustworthy global knowledge commons based on a network of open access digital repositories.

Based on the above and to sum it up, in Law 26.899 requires the following:

- To research institutions and organizations - The creation of their own or a shared repository and their adherence to the SNRD, the dissemination of their scientific production through the repository (including primary research data), the implementation of a data management plan and the preparation of a fundamental tool so that all this occurs in the institutional setting: the Open Access Institutional Policy.

- To science funders in Argentina - Inclusion in their bases and conditions of the requirement to deposit the production resulting from their funding in the institutional repositories.

- To the scientific community - That they share their research results (including primary research data) in the repositories of their institutions.

Lastly, it should be noted that the Law establishes a maximum embargo period for dissemination in Open Access in repositories of 6 months for publications (once published or made known by other means) and 5 years for primary research data starting from the time they have been generated, with a series of possible exceptions.

Diagnosis

In relation to current status of implementation of Law , 26.899 we detail below a series of data and indicators to think of an action plan that will allow promoting and expanding the path towards Open Science in Argentina.

The latest “Science and Technology Indicators. Argentina 2019” report, prepared by the National Bureau of Scientific Information reporting to the Undersecretary of Studies and Foresight (Secretariat of Planning and Policies of the MINCYT) shows the following values for Argentine scientific production, measured in number of publications:

Type of Publication /Year	2015	2016	2017	2018	2019
Articles	10.695	10.861	11.138	11.999	11.963
Reviews	727	851	988	1.051	1.042
Articles in conferences	950	1.095	1.066	882	923
Books chapters	664	537	628	561	380
Letters	208	203	187	205	156
Notes	196	229	153	181	159
Editorial material	155	163	175	172	157
Other	139	153	158	175	124
Total	**13.734**	**14.092**	**14.493**	**15.226**	**14.904**

This information, prepared by the Directorate itself, is compiled based on data from the Scopus commercial database. To move forward monitoring compliance with the Law, it would be desirable to have information from the Ministry's own databases, for example, that which emerges from the researchers' bios and other datasources.

For a recent joint report by CONICET and COLAV (Colaboratorio de Vinculación para las Ciencias Sociales Computacionales y las Humanidades Digitales, Universidad de Antioquia, Colombia) a database of scientific articles by authors from Argentina was compiled from multiple databases; the articles were then filtered and sorted by a computerized procedure. A total of 134,412 articles published between 2013 and 2020 were collected, with more than half (73,271) ascertained to have been published in open access journals. As for the remaining half, there are many academic journals not indexed in DOAJ so access routes could not be verified, but it is to be expected that they are mostly diamond open access journals.

A large part of this production is harvested and made available in institutional repositories; therefore it can be presumed that a highly significant portion of the Argentine articles published in 2013-2020 are in open access with green, gold and/or diamond pathways. An analysis of the citations of closed and open access articles shows that the former are less read and cited, regardless of the journal impact factor.

Regarding open access costs, this report succeeded in collecting payment records for 14,703 articles by Argentine corresponding authors. The total APC expenditure estimated for Argentina for 2013-2020 was USD 11,634,112 (in 2018 constant dollars). The report shows no relationship between publications with higher number of citations in Google Scholar and higher APC amounts.

In relation to the Argentine scientific production available in open access in repositories, the Executive Secretariat of SNRD informs that the following types of publications can be accessed through its portal:

Type of Publication/Year	2015	2016	2017	2018	2019	2020	2021
Articles	14.841	15.761	17.029	15.179	14.472	14.744	8.315
Reviews	417	509	446	436	493	486	367
Documents of conferences	6.358	6.814	7.580	6.487	6.190	3.645	3.407
Books	370	478	468	528	582	576	433
Books chapters	507	909	951	845	995	1.249	856
Master´s theses	851	941	965	1.112	1.203	1.249	1.150
Doctoral theses	1.158	1.079	1.200	1.363	1.351	781	595
Dataset	6	10	13	18	21	38	56
Others	2.348	2.813	3.099	3.540	3.725	3.282	2.790
Total	**26.856**	**29.314**	**31.751**	**29.508**	**29.032**	**26.050**	**17.969**

It must be underlined that the SNRD Portal includes duplicate records, since on occasion authors have multiple affiliations. This problem is being addressed together with LA REFERENCIA by working on a complementary development to the harvesting tool. We also detect that other relevant resources are included that are not usually considered when considering scientific production.

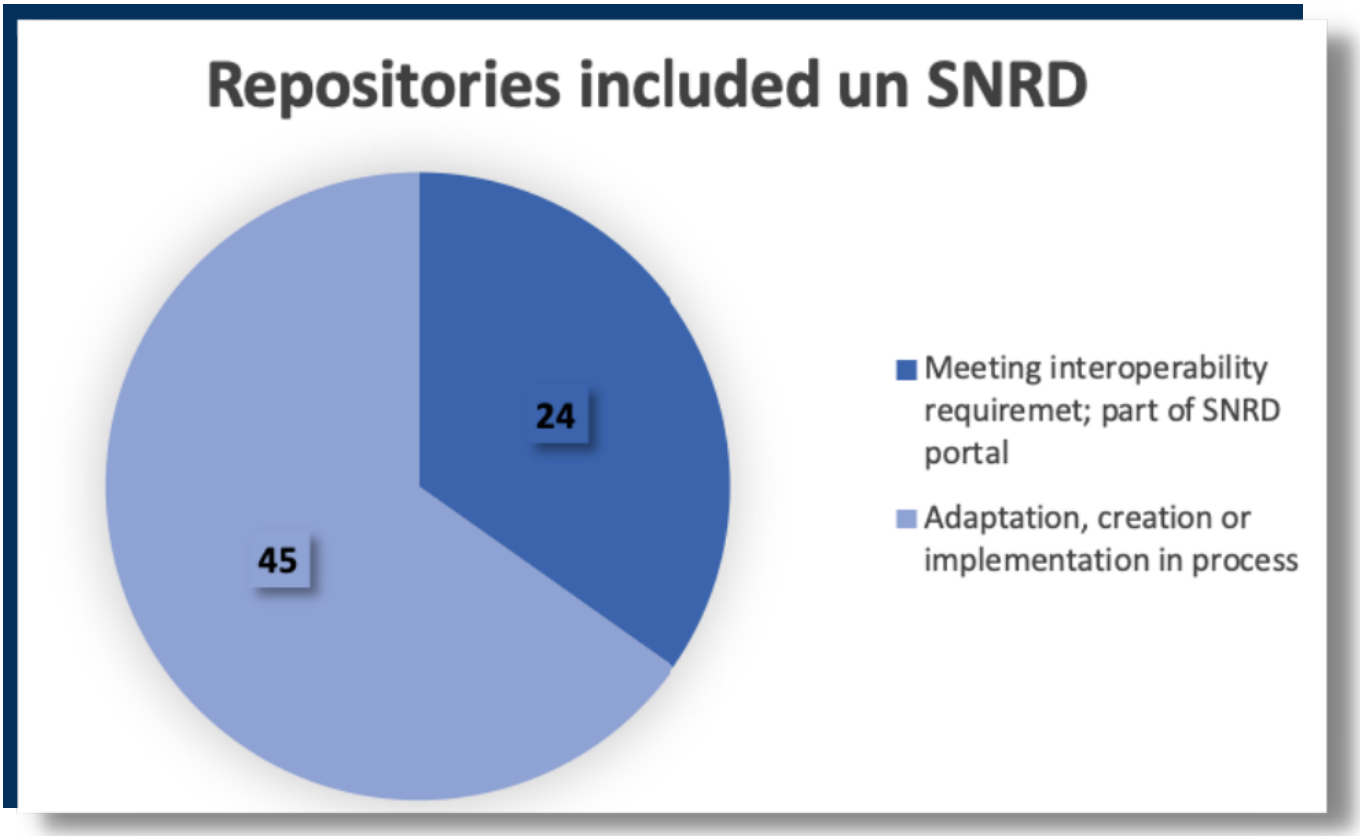
As of July 2022 the SNRD Portal shows more than 366,000 resources available in open access provided by 45 repositories included the System, distributed as follows:

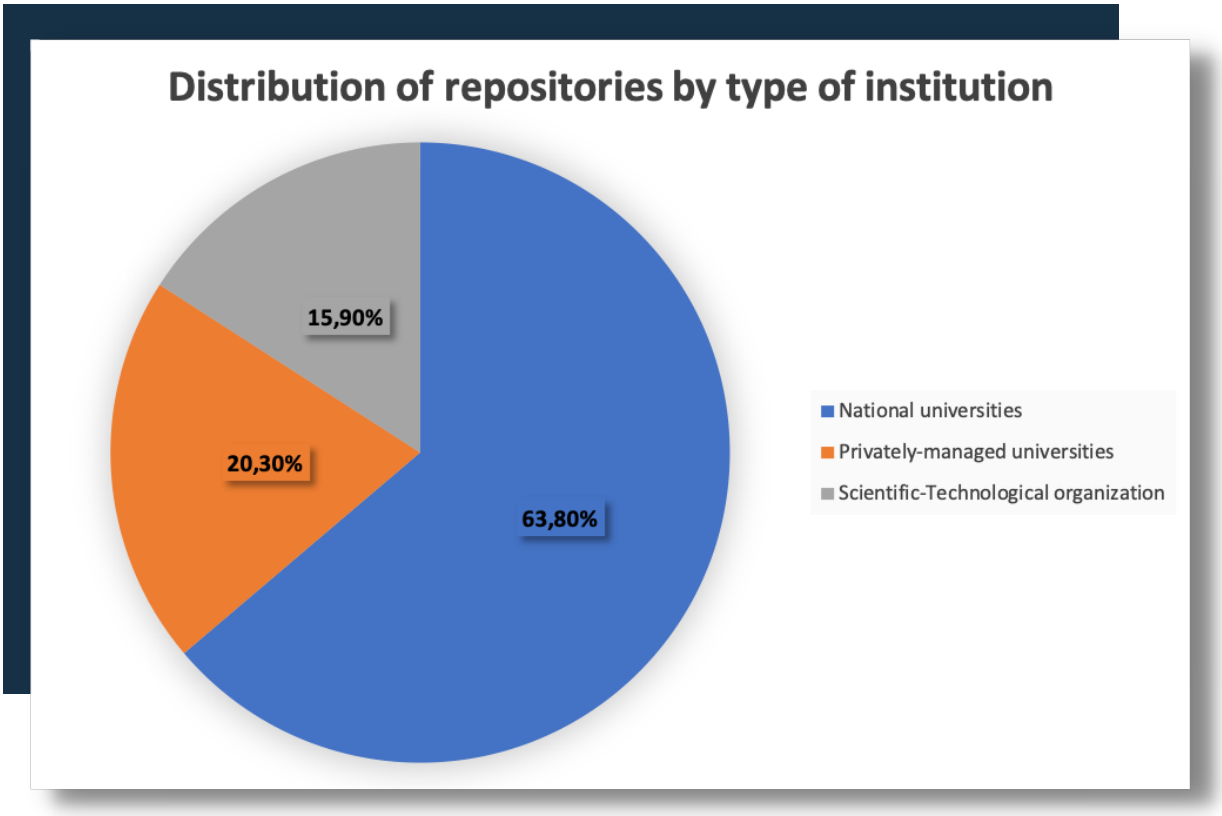
- By repository: the repositories of the National University of La Plata (with 29.91% of the contents), of CONICET (22.85%), of the School of Humanities and Educational Sciences of the National University of La Plata (8.44%), the National University of Córdoba (3.61%) and the National University of Rosario (3.11%).

- By language: Spanish is the predominant language with 82.79% of the resources in this language, followed by English with 15.69%.

- By type of resource: article is the most frequent type of resource (53.45%), followed by conference document (22.62%) and doctorate and master's thesis (8%).

It should be noted that in March 2020—just after the pandemic was declared— this network of interoperable digital repositories made available a special COVID-19-dedicated collection in which documents generated in the SNCTI institutions are disseminated. Today this collection has more than 4,600 documents and 8 sets of primary research data.





In many universities, more than one repository has been created, which means that there are still several institutions under the scope of the Law that have not yet started working on the implementation of their repositories. It is important to note that only 12 harvested repositories have datasets. In this sense, we highlight the recent launch of a repository exclusively dedicated to this type of research results at the National University of Rosario, which is already part of the SNRD. The necessary interoperability tests are being carried out for its integration into the SNRD and DACyTAr Portals.

It must be highlighted that CONICET has begun to work hard in this regard and that institutions such as the National University of La Plata (UNLP), the National University of Córdoba (UNC) and INTA have been steadily working on data.

So far only the Argentine Antarctic Institute (IAA), the Universidad Nacional del Litoral (UNL) and CONICET have implemented their data management plans. However, a data management plan is already a requirement in 10 institutions , as shown in their Institutional Open Access Policies or calls for projects sent by the institutions to the Executive Secretariat of the SNRD for proper registration. Four institutions have also included this requirement in their draft Institutional Open Access l Policies shared with the SNRD.

For its part, the Undersecretariat of Institutional Coordination of MINCYT requires compliance with Law 26.899 as a condition for its funding lines, same as the as the following institutions do in their calls or Policies::

- Administración Nacional de Laboratorios e Institutos de Salud (ANLIS)
- CONICET
- Argentine Antarctic Institute (IAA)
- National Water Institute (INA)
- INTA
- National University of Misiones (UNaM)
- National University of Córdoba (UNC)
- Universidad Tecnológica Nacional (UTN)
- School of Humanities and Education Sciences UNLP National University Arturo Jauretche (UNAJ)
- National University of Patagonia San Juan Bosco (UNPSJB)
- National University of Rosario (UNRC)
- UCA
- UMaza
- A R
- UNRN
- CPU
- School of Economic and Social Sciences of the National University of Mar del Plata

Likewise, in December 2021 the National Agency for the Promotion of Research, Technological Development and Innovation (Agencia I+D+i) approved its Intellectual Property and Management of Intangible Assets policy guidelines in which it states its adherence to Law 26,899 on Institutional Open Access Repositories. Additionally, starting with the launch of the 2021 Scientific and Technological Research Projects (PICT) Call, its model agreements include a reference to Law 26.899 obligations.

Finally, it is important to say that only relative progress has been made by the institutions in the elaboration of Institutional Open Access Policies in accordance with Law 26.899 . To date, 51 documents sent by the institutions for analysis and registration are listed in the SNRD, including but not limited to institutional mandates preceding the adoption of the Law, repository regulations and draft policies currently in the approval stage at the applicable institution or organization—twelve are draft Institutional Open Access Policies and only 19 are actual Policies already been approved by the institutions.

If we analyze them in detail, we see that:

- 19 require deposit of publications in the institutional repository,
- 9 respect the deadline for the dissemination of publications,
- 16 require the deposit of data in the institutional repository,
- 13 respect the deadline for data dissemination,
- 5 require that the DMP be deposited with the dataset,
- 18 require Use Licenses,
- 11 require inclusion of the caption on Law and Funding in publications,
- 16 implement exceptions in accordance with the Law.

Excellent examples of Institutional Open Access Policies are those written by ANLIS, IAA, UNR, UMaza, UTN, INA, INTA, UNRC and the School of Humanities and Education Sciences of the UNLP. It is both important and necessary that all institutions and organizations under the scope of Law 26.899 move forward in its implementation to provide their researchers with the framework they require.

From the previous information we see that still relatively few institutions under the scope of Law No. 26.899 have made progress towards compliance and in general have not yet achieved 100% compliance. Even so, open access of Argentine scientific production advances in step with repositories, and we can say that there is currently a relevant proportion of scientific articles in open access available in the different institutions of the National Science, Technology and Innovation System.

Although regulatory compliance by institutions is requiring more time than expected, progress is being steadily made, with significant achievements being shown.

We highlight the role played by the National System of Digital Repositories vis-a-vis repositories and institutions, which included not only the provision of greater visibility to their scientific production, but also the analysis of draft institutional policies, joint work for the validation and improvement the quality of metadata records and interoperability of repositories, its participation as a national node in the Red Federada de Repositorios de América Latina “LA Referencia” and also the collaboration of its Committee of Experts with MINCYT particularly providing advice on the approval of new repositories and funding requests, among other issues.

Regarding funding, the SNRD grants funds both for the creation and strengthening of repositories. To date, 15 projects have been funded (submitted and approved) for a total of ARS 5,141,166.

Below, we provide a list of the main obstacles and needs that, at a general level, we observe in relation to compliance with Law 26.899:

At the institutional level (institutions and organizations):

- Not all authorities give yet the necessary relevance to the subject matter or to the current regulations and the obligations established thereunder.
- Few institutions and organizations that developed Institutional Open Access Policies that are 100% adequate to what is required by the regulations.
- Compliance with private agreements with publishers is allowed over and above compliance with current national legislation. There are no penalties or warnings to authors and projects.
- Not all institutions have implemented their repositories, and when they have, most of them consider only publications and not primary research data.
- Little progress has been made in the management of research data and the implementation of data management plans.
- A larger budget is needed for repositories, not only for the acquisition and maintenance of infrastructure but also to pay for qualified human resources.
- Institutional support areas are required for repositories to apply for funding.
- It is necessary to assume a social commitment regarding Open Access and Open Science. Greater intra-institutional coordination between the different areas that should actively participate for the success of the Institutional Open Access Policy would be favorable (this means science and technology and academic secretariats, editorial areas, libraries, computer systems, repositories, legal areas, intellectual property offices and researchers, among others).
- Not all rules for calls for grants require compliance with Law 26.899 either for the projects publications or for research data.
- In Universities it is not always easy or possible to reuse the information that researchers deposit in SIGEVA.
- Editorial strategies and policies need to be adapted based on current national regulations and also editorial efforts must be coordinated with those of institutional repositories.
- Communication between the scientific community and repositories must be encouraged.

At the repository level:

- There is a strong demand for adequate technological infrastructure and sufficient human resources.
- New technical capacities must be updated and generated for the implementation and management of repositories. An improvement in technical quality is required to accompany the short-term challenges and increase the number of services provided by repositories, in terms of what is known as “next generation repositories”; institutions should be advised on the role of repositories regarding information for evaluation and decision-making, Law 26.899, the development of Institutional Open Access Policies, development of data management plans, implementation of Open Access and Open Science strategies, etc.
- Without adequate institutional policies, getting new content incorporated in repositories demands a great effort on the part of the staff. This problem becomes more evident with research data.
- Greater importance should be given to persistent links and unique identifiers.
- It is necessary to set up multidisciplinary teams that can assist researchers with regard to copyright, use licenses, data management, etc.

In the scientific community:

- The scientific community should be made better aware of the benefits of dissemination in open access, the services and functions provided by repositories, the requirements of Law 26.899 and the importance of regulations as a tool against the demands of publishers.
- Even where the institutions have the infrastructure, a greater awareness is required of the obligations set out by Law 26.899 and the importance of depositing in repositories.
- The misinterpretation that Open Access through repositories is in contradiction with the usual evaluation criteria leads to resistance to comply with Law 26.899.
- The absence of institutional policies contributes to the resistance to opening data. However, there is a greater willingness to open data in external repositories (sometimes due to unawareness of the availability of inhouse repositories) and/or at the request of a journal. Sometimes this brings the authors closer to their repositories but sometimes it means that data is privatized.
- Many times editorial “prestige” prevails over other issues. Here again evaluation plays an important role.

In the Scientific System in general:

- Despite the progress made by Argentina and the region in the path to open access, there is still no collective awareness on the subject.
- Rarely do incentive policies reward open dissemination or support open science practices. It would be favorable to recognize the complexity of the process of doing science among multiple and diverse stakeholders.
- Usually, evaluation follows traditional criteria and does not consider either the diverse open science materials or new indicators that can supplement the traditional ones. Repositories should be a source of information for or included in evaluation processes.
- Most researchers must deposit their production in systems such as SIGEVA. However, these are not open or interoperable and do not help to include the production in the repositories of the institutions.

At the MINCyT:

- A systematic campaign is needed to raise awareness on Law 26.899 and its regulation targeting the different levels involved.
- It is necessary to work with the institutions on a system of incentives and rewards to promote compliance with Law 26.899.
- A national infrastructure of unique, open, and interoperable identifiers for authors, institutions, funders, and projects is needed. These identifiers would improve the quality of the information collected in the repositories and would make it possible to generate useful indicators for monitoring, evaluation and decision-making.
- Information available on Law 26.899 compliance monitoring must be published.
- The SNRD does not have yet sufficient capacity to assist institutions with information technology aspects relevant to repositories and the implementation of data management plans.

Proposals and lines of action

Considering that open access digital repositories are recognized as a fundamental space for the implementation of open science and that in Argentina Law No. 26.899 establishes open access to scientific-technological production through institutional repositories, it is vital to move forward with compliance with current regulations.

That is why, in accordance with said regulations, SNCTI institutions are recommended to:

- Develop and implement short-term cultural change programs targeting all institutional levels (authorities, staff, scientific-academic community, students) that aim to promote and make Open Access and Open Science come true.
- Prepare their Institutional Open Access Policies in accordance with current regulations and duly notify them to the SNRD. Legal deadlines have expired.
- Implement and require the use of data management plans and duly notify the SNRD.
- Legal deadlines have expired.
- Implement their interoperable Open Access institutional digital repositories and include them in the SNRD. Legal deadlines have expired.
- Facilitate maximum interoperability and alignment between open science services: CV systems, evaluation systems, etc. for which it will be necessary to agree a priori on standards that allow the exchange and reuse of data.
- Support the repository teams in obtaining funding lines for the development of the activities required to comply with Law 26.899.
- Consider that Law 26.899 allows for the creation of shared repositories. These can be a good option to optimize resources and make strategic alliances with other institutions.
- Strengthen, train and/or set up work teams.
- Increase computer personnel efforts assigned to the repository and Open Access.
- Create the necessary standard infrastructures.
- Promote changes in evaluation processes that support the dissemination of scientific-technological[3] production in open access through institutional repositories. Promote the dual role of authors as producers and consumers of information to guide them towards open access and open science.
- Review contractual conditions and the requirements for admission to institutions and/or careers, so that they include open access dissemination in institutional repositories from the beginning of the relations between individuals and the institutions where they work or are trained.
- Adapt their publishing strategies and policies.
- Review the bases and conditions of grants or funding to adapt them to current regulations and notify them to the SNRD.
- Carry out training activities in relation to the regulatory framework applicable to the intangible assets produced by the system, particularly those that are subject to copyright (documents, data, software[3]), Law 26.899, etc.

3 Software: conjunto de programas y rutinas que permiten a la computadora realizar determinadas tareas.

At the same time, the MINCyT is recommended to:

- Position open science as fundamental to scientific ethics and indispensable for receiving public funding.
- Implement promotion and awareness campaigns on Law No. 26.899, its regulation and Open Access through institutional digital repositories, targeting the various stakeholders governed by the regulation.
- Promote studies that investigate the reasons—particularly sociological, cultural and institutional reasons— of low compliance to supplement training, dissemination, incentives and rewards actions with specific mechanisms that address these causal factors.
- Continue its support to institutions through the SNRD regarding the implementation of their repositories, development of Institutional Open Access Policies and Data Management Plans.
- Increase the SNRD capacity to support institutions in information technology issues relevant to the implementation of repositories and automated data management plans.
- Work with the Secretariat for University Policies (SPU-MINEDUC), the National Interuniversity Council (CIN) and CONEAU on the evaluation of universities in relation to access to and dissemination of information and inclusion of curricula-related issues. Likewise, promote the updating of librarian profiles for the management of digital objects, repositories, open access and open science as well as the profiles of scientific editors and personnel working on intellectual property.
- Work together with the National Directorate of Copyright in updating the National Copyright Law in order to promote and guarantee the dissemination, through institutional repositories, of scientific-technological production resulting from research totally or partially funded by the national state.
- Provide the SNRD with a budget allocation to carry out training activities aimed at institutions.
- Generate supporting documentation for the implementation of Law 26.899 and the development of online materials for guidance in the creation and maintenance of repositories. Promote changes in evaluation processes that support the dissemination of scientific-technological production in open access through institutional repositories.
- To the extent possible, streamline the procedures in place at member institutions for granting funding.
- Incorporate in all its funding lines and grants open access clauses that are in line with Law 26.899 provisions.

- Continue supporting the international work carried out in the context of LA Reference and COAR as well as the joint positioning of the region in the international arena, and promote the development of next-generation repositories.
- Strengthen instances and instruments for monitoring compliance with Law 26.899 and its regulation. Evaluate the need to move towards the implementation of penalties in case of non-compliance.
- Publish information on compliance with Law 26.899 by the agencies and institutions concerned.

Finally, it is recommended, whenever possible, that the SNRD regularly harvests any publications by authors/co-authors with affiliation in Argentina that are available in interoperable repositories around the world, and export these records to the Institutional Repositories (IRs) of each above mentioned institution.

PUBLISHING IN OPEN ACCESS

Diagnosis

National journals are fundamental to increase compliance with UNESCO recommendations for open science and to promote socially relevant research that involves/values local content and knowledge.

Meeting Plan CTI 2030 and the 17 Sustainable Development Goals require both international contributions and knowledge about local needs and social problems. Also, contributions published in national journals and/or indexed in the region along with output published in other formats are valuable.

At the same time, diamond open access journals are becoming more and more necessary, so that Argentine journals with this profile are a decisive instrument to move towards a multilingual and bibliodiverse open science.

A recent study carried out at the Interdisciplinary Center for Studies in Science, Technology and Innovation (CIECTI), which engages in planning, design, evaluation and foresight analysis of science, technology and innovation policies and institutions, identified 786 active academic Argentine journals (Beigel, Salatino & Monti, 2022). Their continued existence is difficult, even more so in a country where no specific funding is available.

In Latin America, contemporary discussion has highlighted the role of scientific journals in the evaluation of agents, institutions and projects. Historically, scientometric indicators and journal rankings linked to what is known as “mainstream science” have been favored.

Thus, national and local journals have been relegated and considered to be endogamous or of poor academic quality. However, in the region in general, and in Argentina in particular, the number of scientific journals founded increases year after year.

Based on data from the CIECTI study, 50% of journals have been created in the country the last two decades —21% between 2000-2009 and 29% between 2010-2020 (Beigel, Salatino & Monti, 2022). 66% of the Argentine journals classify themselves as social sciences and humanities (42% and 24%), and the other 44% is distributed among medical and health sciences (16%), natural and exact sciences (8%), agricultural sciences (5%), multidisciplinary (3%), engineering and technology (2%).

Their editorial management is mainly performed by universities (66%) and scientific societies (27%), with the remaining 5% corresponding to governmental agencies such as CONICET, museums, hospitals and governmental departments. Only 2% of the Argentine journals are edited by commercial publishers. These features are consistent with a strong public component in the development of Argentina's academic publishing.

Among these active journals, more than 84.3% are completely published in digital format, which points to a decisive transformation of publishing practices comparing with the previous decade. Likewise 95% of journals offer open access to the full text of published documents, although a small part of them have licenses for use. Only 3.5% offer their content on a pay per article or subscription basis and/or have restricted access.

The fact that 67% of journals are managed and published in OJS (Open Journal System) also shows a strong trend towards the use of free and open systems, which is one of the most used in Latin America and Argentina. Among the rest only a small number uses their own or a commercial system, consistent with the fact that only 5% of the total apply charges for article processing (APC). The price of these are quite low (between 1,000 and 4,000 Argentine pesos). Only 37.5% of journals offer permanent identifiers for their articles, especially the well-known DOI, since it involves costs in dollars, which is often unaffordable for the Argentine journals given that they are mostly published by public universities as described above.

Regarding the indexing of Argentinean scientific journals, 304 are included in DOAJ, 319 in the Latindex Catalog, 152 in Scielo Argentina and 93 in Redalyc, with a relatively minor representation in mainstream databases such as Wos or Scopus (91 and 69). The high percentage of indexed journals (many of them with double or triple indexation) highlights the quality and professionalized standards of Argentine editions.

It is worth mentioning the fundamental role played by the Argentine Center for Scientific and Technological Information (CAICYT-CONICET) in the development and strengthening Argentinian journals. The Center, founded as such in 1976, is a service center and at the same time a research institute within the remit of the National Council for Scientific and Technical Research (CONICET).

Over the years, four programs were set up in this institution that made CAICYT a benchmark for scientific journals in the country: ISSN Argentina, Latindex, Núcleo Básico de Revistas Científicas Argentinas (NBRCA - 1999) and Scielo Argentina.

Each of them is aligned with open access policies and the positioning of national journals in the international arena. The coordination of these four projects, supported by CONICET, has shown, over the years, that these institutions and the State intend to foster the development and strengthening of national journals.

The NBRCA interacts with the Latindex criteria and serves as a filter for entry into Scielo, which shows a system at the national level to favor journals committed to open access. Currently the NBRCA is made up of 306 journals, with 19 corresponding to agricultural sciences, engineering and materials; 25 to natural and exact sciences; 41 biological and health sciences and 221 social sciences and humanities.

In this context, it is worth mentioning the 2014 competitive call under the Program to Strengthen Periodic Publications of Social and Human Sciences of the Research Program on Contemporary Argentine Society (PISAC, MINCYT-CODESOC), which resulted in a number of experts being selected who developed two specific activities: a MANUAL of quality criteria and good practices in the editorial management of Argentine periodical publications of social and human sciences (Aparicio, Banzato and Liberatore, 2015) and a series of 8 training workshops on editorial management of periodical publications in social and human sciences, distributed by region throughout the national territory. Both lines (manual and workshops) aimed at strengthening open access policies and digitizing journals for a greater global visibility of the content published in Argentina.

Management, edition, publication and dissemination of open access digital academic journals involve a various costs that must be met in the long term to guarantee their continuity. Given that Law 26.899 fosters the open access green route, it is convenient to analyze the best way to support journals published in public spheres and how to coordinate them with Institutional Repositories without them losing their identity. Such coordination could also promote the advancement of open peer evaluation and its currently main type, pre-prints, which have but just recently emerged in Argentina.

Proposals and lines of action

Sustainability

- Secure maintenance plans for management teams of academic journals from SNCTI institutions that are published in diamond access, and the acquisition of marking instruments in complex systems (XML-JATS or DOI, among others).
- Identify centralized journal portals in public universities to ensure interoperability with institutional repositories while preserving the identity of journals and journal portals.
- Strengthen the visibility, interoperability, and allow automatic harvesting of journals, through the implementation of persistent identifiers, the OAI-PMH protocol, and compliance with established metadata guidelines.
- Promote and support academic publishing activity and coordinate it with institutional repositories under Law 26.899.

Editorial Professionalization

- Train authors to facilitate availability of research data in open access (with a link from the article to the corresponding dataset, codes, software).
- Hierarchize and recognize the role of editor and editorial bodies in the academic career.
- Expand and encourage digitization, work with content, multimedia links, formats and accessibility (reading/languages/digital inclusion).
- Promote the use of CC BY-NC-SA licenses, to strengthen knowledge sovereignty, indicating property rights of documents, use licenses, self-archiving policies, and provide the minimum elements necessary for a correct citation (for example: incorporation of persistent identifiers, not necessarily against payment, of articles, authors and institutions of affiliation).
- Coordinate editorial work with the work of repositories, in order to transfer experience and knowledge that facilitate and improve management and visibility of academic journals. (Examples: OAI-PMH[4] interoperability protocol implementation, persistent identifiers, metadata schemas and guidelines, metadata curation, etc.).

4 OAI-PMH (Open Archives Initiative Protocol for Metadata Harvesting): protocolo de interoperabilidad para el intercambio de información entre diversos sistemas, que permite que los portales y buscadores especializados cosechen los metadatos de los objetos digitales existentes en los repositorios.

Academic Quality

- Promote the extensive practice of open review and evaluation of articles.
- Promote permission to spread pre-prints and post-prints on as many sites as possible.
- Link published documents with supporting data in repositories. Promote publication of different types of documents, which means appreciating bibliodiversity over the hegemony of the article format.
- Promote the development of multilingualism in national journals in order to amplify their visibility, access and circulation. Revalue the evaluation of journals in the NBRCA.
- Promote indexing of journals in non-commercial open access regional systems such as Scielo, Latindex, Redalyc and DOAJ.

Open Access Scientific Publication Policy

- Promote and disseminate good open access publishing practice standards.
- Recognize, encourage and value national scientific journals with diamond access in the evaluation of researchers, projects and institutions.

ACADEMIC BOOKS IN OPEN ACCESS

The academic book plays a key role in both scientific production and communication, especially in the field of social and human sciences, and in the dissemination of scientific knowledge among a broader public. Unlike what happens with specialized journals, the production and circulation of which are limited to the scientific and university spheres, the academic book is located in the intersection between the university, scientific and commercial logics. This is key to understanding its uniqueness with respect to open access.

To facilitate the analysis, we will distinguish between commercial and university academic publishers, and we will focus on publishers of national universities from among the whole set of university publishers. On the one hand, these category bring together most university publishing houses—close to fifty, of which just over thirty are active—and account for most of the production. On the other hand, scientific research in Argentina is carried out primarily in public universities, and the Open Access Law is applicable to scientific production that is partially or totally publicly funded.

The commercial pole of academic publishing lacks a common or widespread open access policy. There are specific cases of publishers that offer their books digitally and openly as part of their editorial policy. These are publishers whose business model is based on charging authors or sponsoring institutions the full cost of publishing their work. However, beyond the publisher or its commercial strategy, at least one copy of the author's final version should be available in open access through the institutional repository within the established deadlines and in accordance with the exceptions provided by Law. No. 26.899.

Along these individual experiences, a number of publishers also have authors or an institution fund publications, but that do not have a sustained or explicit open access policy. They make their books digitally and openly available on an exceptional basis—if the work has any commercial viability, it is hardly offered in open access. There are hardly any commercial publishers that would regularly offer their books in open access several years after their original publication, when the commercial possibilities of the work have already dwindled.

On the other hand, although payment for publication to the publishers by authors or by an institution tends to favor open access, the truth is that, at least in Argentina, publishers that work fundamentally under this scheme have laxer selection criteria and mechanisms compared to publishers that assume the total or partial cost of their production. Such laxity conspires against the development of quality catalogues.

Diagnosis of public university edition

Public university editorials have four basic differences from commercial ones that, at least potentially, create different and more favorable conditions for the adoption of an open access policy:

1. Their mission fall within the goals and focus of public universities in which education, research and extension are the three fundamental pillars.
2. Some or all of their operating costs are included in the universities' budgets, which is paid from the National Treasury.
3. These publishers are grouped in the Network of National University Publishers (REUN), a common space that favors collective discussions and agreements, and which is within the remit of the National Interuniversity Council (CIN).
4. These publishers belong to public universities that, as members of the National Science, Technology and Innovation System, must comply with the requirements of Law 26.899 on open access.

Nevertheless, there are a number of factors that limit the adoption of open access policies and highlight the complexity of university publishing production:

a. The relationship with the market:

- University budgets variably cover publishing costs. In some universities support meet both the fixed costs and a good part of the variable costs of production, but in others funding is limited to fixed costs, which in some cases leave out agreements for specialized services (translators, designers, proofreaders, etc.). Those publishers whose production, especially of printed books, is not fully funded must, necessarily, market their books in bookstores and digital platforms.
- The role of bookstores is not limited to the sale of books: the bookstore circuit is a key link in offsetting the book value. The bookstore continues to be a privileged place of visibility and recognition, inside and outside the world of academic readers.
- While none of this is necessarily inconsistent with making books freely available, it certainly discourages it. This is illustrated by the fact that some local and international bookstores and distributors, including international platforms, are reluctant to add new titles that have a free access digital version.

b. Technical and human limitations:

Although in recent years, thanks to the collective work of REUN, the socialization of experiences and individual training, a group of publishers has increased their capacities, very few have team members with the necessary and up-to-date technical knowledge to embark on such a project. This would be explained by three reasons:

- A change of management in universities usually includes changes in the senior officials of publishing. The publishers that work best are those where senior officials outlast the term of office of the university rector as this allows the professionalization of a team and the progressive sophistication of a project.
- With few exceptions, human and economic resources allocated to publishers limit themselves to guaranteeing the production of printed books and basic marketing. Venturing into new lines of work, such as investing in a sustained manner in digital distribution, marketing and communication actions, depends on the will of the university authorities or require the generation of the necessary income through sales to hire a specialized person.
- The dominant publishing paradigm is focused on the production and marketing of printed books. Beyond the economic reasons and those of symbolic value mentioned above, which undoubtedly reinforce this paradigm, publishing senior executives, as well as university authorities, tend to leave the publication, marketing and distribution of digital books in a second place.

There is a limited number of open access projects in the national university edition setting that, with varying degrees of development and success, offer a first group of useful experiences to open a discussion and propose possible alternatives. Some advanced experiences of publishing in open access and pre-prints can be seen in the Editorial Universidad de Villa María (EDUVIM).

Proposals and lines of action

- Promote forums that bring together officials from the National Ministry of Education and the National Ministry of Science, Technology and Innovation that are responsible for matters, specialists in science policy and book policy, and university publishers to reflect on the objectives of the Open Access Law and create awareness on the reality of this segment of the publishing field.
- Implement technical support measures that facilitate the adoption of open access policies in university presses, as was the case of PISAC with respect to social science journals.

- Promote joint actions between institutional repositories and university publishers by developing persistent identifiers, while preserving the identity of the catalogs to optimize their visibility, interoperability and automatic harvesting.
- Design support programs for the digitizaliztion of national university catalogs and the incorporation of the necessary skills for an open access policy. The three-year national university edition improvement plan 2014 is a good example, although in this case with a more specific goal.

PRIMARY RESEARCH DATA, SOFTWARE AND CODE IN OPEN ACCESS

In general, scientific productions are associated with the final product of the research, that is, the scientific article, the scientific publication. However, scientific production encompasses other components such as the primary research data and the software created and used in the research.

While primary research data is explicitly regulated by Law 26.899, this is not the case for software. Recommendations are suggested below for both classes of products taking into account the presence/absence of regulations.

Primary Research Data

Primary research data is but another type of research result considered under Law 26.899 that must be made available in open access through institutional repositories, subject to the conditions and exceptions established by the Law. However, they have certain peculiarities. For this reason, the following recommendations are made:

Related to opening policies

1. Promote the adoption of data policies that cover the entire life cycle of research data, ensuring that they are findable, accessible, interoperable and reusable (FAIR).
2. Harmonize data policies with more general policies on artificial intelligence.
3. Generate, together with the Committee of Experts in Repositories, strategies and actions for training, promotion and technical support for an improved management of research data in research institutions, as required by Law 26.899. At the same time, move forward with the analysis and definition of best practices for the management, description and opening of data specific to each discipline or field of research.
4. Create a national working group on research data management that defines strategies and actions for training, promotion, and technical support to strengthen research data management in research institutions, as required by Law 26.899.
5. Encourage the practice of opening data in those cases that is not mandatory according to the exceptions of the repository law.
6. Regarding collaborative research with social stakeholders outside the scientific field and citizen science activities, include training aimed at these needs, facilitate the incorporation of social stakeholders connected with the topic under research in the decision-making process for the design of the research data management plan, management of collected and processed data and its publication if they so wish.

Regarding fulfillment of the deposit requirement

1. Train the scientific community regarding the obligation to deposit research data arising from public funding research, in accordance with Law No. 26.899.
2. Strengthen the knowledge and use of the Primary Data in Open Access of Argentine Science and Technology (DACyTAr) portal.
3. Promote scientific production evaluation systems to value especially the production available in digital repositories as required by law.
4. Ensure widespread definition and effective implementation of data management plans, which guarantee economic conservation. For example, research proposals applying for public funding should be required to inform in which repository the data will be deposited and the open data management plan for data produced during the research.

Regarding the forms of deposit and publication

1.Recommend that, in addition to being deposited in institutional repositories, data is deposited in other repositories, which should be interoperable and follow the FAIR principles.
2. Promote data sharing statements, publicly detailing the conditions and procedures for accessing data that cannot be opened.
3. Recommend to journal editors that they require that their publications in the repositories include links to the datasets described in the work. Whenever possible, for Argentine authors these datasets should be disseminated in their institutional repositories; in the case of foreign authors, the repositories must be interoperable repositories that follow the FAIR principles.
4. Use persistent identifiers for citable data, and include the persistent identifier[5] of the citing publication if published.

Software and Open Source

In recent years, open access publishing has increased in the scientific community, partly because articles published in open access journals naturally have higher downloads than those with restricted subscription access. However, the same is not true of software; we could say that there is no culture of openness in this area.

Unlike scientific publications, in which one of the forms of opening occurs through use licenses such as Creative Commons licenses, in the case of software opening is done through free software licenses, such as the General Public License (GPL) from the Free Software Foundation. These types of licenses allow users to freely use, study, share and modify the software.

5
Persistent identifier: this is an identifier that allows data to be precisely findable, accessible and citable (for example, the Digital Object Identifier o DOI)

There are also other types of more "permissive" licenses that allow redistributing the work under the free or proprietary system that may or may not be compatible with the principles of the GLP.

The source code[6] associated with research is increasingly relevant in current research, characterized by the intensive use of technologies and collaborative work. In the area of biomedical sciences, for example, artificial intelligence systems is frequently used to develop predictive models capable of detecting patterns in the occurrence of diseases in the future. In these cases, the possibility of sharing source codes is essential for progress in this area of knowledge.

Software can be a tool (to carry out the research), a result (the aim of the research) or a research object. Thus, developing open source software—with the possibility of modifying, reusing and disseminating it—contributes to the reproducibility of scientific findings and promotes the creation and exchange of knowledge, in line with the spirit of open science.

The promotion of open source software is especially relevant when findings and knowledge are the result of public funding; it seeks to guarantee society's access to research results and allow other researchers to use them.

Along these lines, the Second French Plan for Open Science 2021-2024 seeks to develop a continuum of openness for all publicly financed scientific productions and thus give value to productions that are considered less important or central, such as codes. It is a global vision that covers the entire scientific process, and not just the end of the process, which is publication.

This Plan dedicates one of the four pillars to source code policies, structuring actions that promote the production of open source software. In addition, it is also part of a broader national science and technology strategy, which includes, for example, a national artificial intelligence plan that seeks to boost economic development from the value created by the use of AI and protect national sovereignty by limiting the use foreign AI solutions.

In the case of Argentina, Law No. 26.899 does not explicitly regulate the deposit of software, but it does not exclude it either. In addition, the Guidelines for an Intellectual Property Policy in Agencia I+D+i, of the National Agency for the Promotion of Research, Technological Development and Innovation (Agencia I+D+i), establishes that software created with the Agency's funding must be archived and made available to the SNCTI and the community in general, wherever possible.

6
Source code: refers to a program written in computer language

As can be observed, the guidelines refer to software deposit; however it also establishes that, with the sole exception of duly justified particular situations, all software must be open source.

Taking this context into account, the following recommendations are made:

Related to opening policies

1. Define and promote a comprehensive policy for publicly funded open source software that values source code as scientific production.
2. Foster the adoption of licenses that do not contribute to the unpaid appropriation by corporations located in central countries of the code/software developed with local public funding.
3. Encourage widespread production of open source software and promote release under an open license.
4. In calls for projects, request that the software be first published under an open license recognized by the Free Software Foundation and the Open Source Initiative.
5. Create a national working group on open source software that defines strategies and actions for training, promotion, and technical support to strengthen the production of open source software in research institutions.

Related to CTI institutions

- Promote the diffusion of the software/code through its deposit in institutional repositories.
- In order to increase the visibility of software and recognize its contribution to research, it is recommended to build an accessible catalog of software resulting from research, using a standardized metadata model shared by all stakeholders in higher education, research, and innovation.
- Highlight the open source production of higher education, research and innovation, for example, by giving greater recognition to the production of software in the research career, the career of research support staff and in the evaluation of research organizations.

CITIZEN AND PARTICIPATORY SCIENCE

Diagnosis

The concept of citizen science appeared in the 1990s with two meanings. Coined by Irwin, it referred to the need to democratize the production of scientific knowledge, to bring science closer to society, allowing for different forms of public participation, but thinking of citizens more as an interested party in the future of science than as an active knowledge producer. Simultaneously, Bonney associates citizen science with the participation of volunteers in the collection of data based on the observation of the natural world.

Since, the use of the concept has extended and has become an umbrella that encompasses very different forms of public participation in science, ranging from mere observation to action-research. Today we could say that this is an approach that involves community participation in scientific research projects.

A recent survey carried out by PNUD and the MINCyT identified a total of 55 citizen science initiatives in Argentina that work on multiple topics. The survey includes very diverse projects, which cover a variety of disciplines and promote actions as diverse as seed improvement, environmental monitoring use or environmental justice in the Matanza-Riachuelo Basin. In total, more than 25,000 people participated in some of these environmental citizen science projects. In 60% of the cases the projects dealt with local problems and most were initiated by scientific institutions.

At the regional level, the Ibero-American Network of Participatory Science (RICAP) seeks to promote citizen and participatory science, generate spaces for discussion and make experiences visible. Several organizations and individuals from Argentina have a prominent role in the governance of this network. Among other activities, a working group is developing a regional map of citizen and participatory science.

Finally, in our country, at the Argentine Open and Citizen Science Congress (CIACIAR), experiences of openness and collaboration in science are discussed, as well as the actions and policies that could promote them. All this shows that citizen and participatory science is gaining attention in different areas of Argentina. However, we still know little about the factors that affect key dimensions for the generation of both immediate benefits and socio-environmental impact. Also, we do not know what main challenges are faced by those who start these activities in Argentina.

Based on a literature review and their field experience promoting a citizen science initiative, Arza et al. (2021) classified the main challenges faced by citizen science projects into three large groups:

1) Associated with the participation of stakeholders outside the academic field: A great challenge is to be able to mobilize and manage participation. Some citizen science projects tend to rely on pre-existing communities of practice (for example, bird watchers in the e-bird project). However in most projects it is necessary to design ad hoc engagement strategies.

These strategies also build on pre-existing collective mobilization and knowledge, for instance, reaching out to Network of Popular Libraries interested in environmental issues and neighborhood associations already mobilized, for example, to protect natural areas in the CoAct project. At the same time, the projects face the challenge of guaranteeing opportunities to participate to all the people who potentially would like to do so. There are also ethical issues ranging from managing expectations to conflicts of interest and managing sensitive data.

2) Associated with the quality of the data produced: A first problem is data representativeness, since their production is voluntary and not the result of sampling techniques. This may mean that data is very partial, biased or fragmentary. For this reason, citizen science data is often not considered reliable or comparable with data from other sources and, therefore, is not used in the expected transformation actions.

3) Tensions between citizen science and traditional research: Citizen science projects require the development of capacities that are very different from those necessary to carry out a traditional research project. For these projects to move forward, they require the researchers involved to establish early alliances with other stakeholders in public policy and civil society. The generation of these links implies capacities that are not developed in academic spaces, nor are they institutionally facilitated. In addition, incentive schemes do not promote practice-based learning, since getting involved in this type of activity implies postponing other activities necessary to advance in the research career given the current incentive schemes.

Table 1 match benefits to challenges, showing how the potential of citizen science can be affected if its main challenges are not addressed.

Table 1: Summary on the Benefits and Challenges of Citizen Science.

BENEFITS	CHALLENGES
Improves efficiency because it mobilizes more resources for research, decentralizing data collection and analysis.	Linked to data: representativeness; fragmentation; objectivity bias.
It bridges the gaps between science and society. It democratizes the production and use of knowledge.	Linked to participation: problems to engage individuals expected to participate; tokenism; asymmetries in participation opportunities; other ethical problems (conflict of interest; handling of sensitive data; unpaid work; management of expectations). Related to tensions with traditional science: capacities; scientific production incentive scheme
It allows science to better serve the relevant socio-environmental needs because the people concerned contribute their experience and situated knowledge.	Linked to participation: representativeness; tokenism; conflicts of interest; lack of interest in getting involved; barriers to engaging the groups you want to work with. Related to tensions with traditional science: capacities; scientific production incentive scheme.
It generates political tools for transformation by mobilizing communities in the production and use of data and legitimizing their claims by producing scientific evidence.	Linked to data: representativeness; fragmentation; objectivity biases; distrust of policymakers and participants—if the results are not used or are not as expected. Linked to tensions with traditional science: capacities.

Fuente: Tabla 1 Arza et al. (2021)

7 Tokenism: practice of making small symbolic concessions towards a discriminated or minority group without the intention of producing a real impact.

Proposals and lines of action

In Argentina, most citizen science projects are initiated at scientific institutions. This highlights the importance of designing scientific policy instruments that contribute to promoting and recognizing those who apply this approach at academic institutions.

In developed countries there are three stages of commitment to policies to promote citizen science. It usually begins with a survey of initiatives that allows knowing their practices, benefits and obstacles; then the use of existing funding tools is encouraged to promote citizen science activities; and finally, based on inputs from the previous stages, national strategies and plans are formulated to promote citizen and participatory science.

Beyond the need to better understand how citizen science is developed in our country and the challenges it faces in order to establish a consistent plan to promote this approach to the production of scientific knowledge, there are a number of general recommendations that we believe will contribute to overcome some obstacles:

For participation problems

- Creation of ethics and monitoring committees in scientific institutions that develop participatory research so that they operate as areas of review and recommend appropriate practices.
- Development of dynamic informed consent procedures.
- Support community outreach activities through fairs with schools in the area, science clubs, and open calls to participate in scientific projects, and coordination with existing outreach bodies (such as extension and outreach areas in universities).
- Create visibility mechanisms for citizen science projects for their legitimization (platforms, events, magazines).
- Promote a culture for citizen participation both in the production of scientific knowledge and in the discussion and definition of research priorities.

For problems related to data and other results of participatory science

- Organize instances of experimentation with citizen science data and other results generated with the participation of stakeholders from the communities, academics, and policymakers.
- Provide institutional support through the establishment of open data policies and the generation of metadata, including the creation of institutional spaces for evaluation and recommendation of technologies.
- Promote institutional support for the generation of digital tools to automate data validation and personal data protection processes.
- Generate guidelines and recommendations for citizen collaboration in the governance of the tools made in the context of citizen and participatory research projects.

For tensions with the traditional scientific system

- Evaluate collaborative and participatory practices and processes in the evaluation criteria.
- Value co-authorship in general and transdisciplinary co-authorship in particular.
- Recognize the role of local knowledge in solving socio-environmental problems in the territory.
- Define institutional priorities in terms of socio-environmental impact in accordance with the missions of each academic institution and incorporate indicators of community or social impacts and/or incidence in public policy in the evaluation criteria consistent with those priorities.

OPEN AND COLLABORATIVE INFRASTRUCTURE

Diagnosis

Regardless of their size, implementation characteristics or budget, open science platforms generate, sort, preserve and distribute valuable content for the entire global scientific system. This applies to both digital repositories and journal portals, publishers and archives, and many more.

The usefulness of these platforms is evident not only in the growing number of sites in operation, but also in the diversity of services provided both for users and for institutions and governments. Undoubtedly, this transformation movement will continue and lead to more complex interconnected technological platforms, present at more and more levels of the global scientific system.

However, as these platforms are largely digital spaces that depend on an underlying technological infrastructure, it is vitally important to contribute efforts to reach consensus and strengthen these infrastructures at the institutional, national and regional levels.

In concrete terms, the technological infrastructure (of repositories, CRIS Systems aggregators, journal and conference portals, and many more) can be thought of as a combination of physical (hardware),[8] logical (software) and human (personnel) resources. In addition to these resources, there are practices and strategies that govern and coordinate the operation of these resources and their interactions with the community.

The physical resources would be the servers on which the digital platforms and related services work; storage systems (used to safeguard data and backup copies; network resources that allow connectivity and access control; equipment necessary to keep other equipment running such as UPS, air conditioning, etc.; scanners used for digitizing; staff computers, among many others.[9]

The **logical resources** would be:

a) The software used to implement the main services of each platform (For example in the case of repositories and journal platforms, DSpace, OJS, Atom, Fedora, among others);

8 Hardware: set of physical or material elements that make up a computer or a computer system.

9 UPS (acronym of uninterruptible power supply or Uninterrupted Power System): device for maintaining power supply constant and without fluctuations.

b) The secondary services that support the main services (databases, indexers, caching mechanisms, etc.);
c) Software that supplements the functionality (OAI servers, identifier services, etc.);
d) Cross-use tools for backup generation, monitoring and cyber security (firewall, antivirus, phishing detection, intrusion prevention, etc.);
e) Data editing and publishing software;
f) Image, audio and video digitization and enhancement tools;
g) Hypervisors or solutions for virtualization;
h) Operating systems used in physical or virtual machines among many others.

Human resources would logically be the personnel hired to carry out different technical tasks such as:

a) Control and maintenance of network infrastructure, servers, security;
b) Development and maintenance of each software platform;
c) Monitoring and setup of supplemental or secondary tools;
d) Use of digitizing hardware and software;
e) Maintenance of any kind of physical resources;
f) Recovery and massive loading of works (data or publications) obtained from other external platforms or from internal systems of the institution;
g) Standardization of data and file formats to be published; control of materials and anonymization of sensitive information, among many other tasks not connected with technology.

To build and manage this technological infrastructure, each institution must define its own strategy based on legal provisions, budget availability, convenience and internal management capacity, among many aspects.

Furthermore, this definition will be largely driven by three very important initial questions:

1. Will the organization use its own resources or will outsourced resources be hired?
2. In the case of outsourced resources, what level of service agreement will be chosen?
3. Will the (in-house or third party) resources be for the exclusive use of the institution or will they be shared with other institutions by mutual agreement?

The first question posit that the resources, mainly physical and logical resources, can be acquired and managed by the institution itself or sourced from a third party such as a company or organization that will let the institution use them as a service, generally for a fee.

Examples of this are housing[10] of servers, loan of physical resources, contracting of virtual machines, hosting of services and use of multiple services on external platforms known as "cloud". Each of these variants has different characteristics in terms of economic cost, reliability, performance, data sovereignty, delegation of responsibility, and much more.

It should be clarified that the provider will delete the data and cancel the services for lack of payment, except in the case of infrastructure housing, in which the equipment is usually disconnected. In contrast, managing the entire infrastructure internally has other benefits such as not incurring a fixed monthly expense, 100% control of data and, in specific cases, achieving better performance at a lower cost.

The second question applies only when you decide or need to outsource part of the infrastructure and refers to what part of this infrastructure should be delegated.

Depending on the provider, there will be various services, which are usually grouped into three levels: IaaS (that is, infrastructure as a service), PaaS (platform as a service) and SaaS (software as a service), where each implies a greater delegation of responsibility to the service provider.

In addition to the trained human resource that is needed and the cost to pay for the services, there are many aspects that can tip the scales in favor of either side, for example, considering data sovereignty as a central element.

Proposals and lines of action

About physical resources

For hardware sizing:

- *Computation:*

1. Each platform is supported by at least one primary and several secondary services, each typically requiring its own virtual server. In turn, each service has space, computation and memory requirements.
2. These requirements, added together, will determine the minimum necessary characteristics of the servers to be implemented.
3. Services should be separated into isolated units such as virtual machines or containers. This improves security, maintainability and simplifies migrations and backups.

[10] Server housing: server housing in specially equipped rooms, with secure power supply, air conditioning and stable internet connection.

4. A redundant server infrastructure is not essential. Instead, it is convenient to use all efforts to generate updated and tested backups, with a disaster recovery plan in place to restore the infrastructure to the previous point.

- *Storage*

1. To estimate the space needed for raw data and database, the space used by a similar platform that has been in operation for a few years can be taken as a reference, considering more or less space depending on the amount and size of the data to be stored. .
2. A space should be considered for auxiliary files such as support files for digitization, internal files that should not or cannot remain on the platforms due to quality or safety, etc.
3. Space for backups: the amount of space must be considered based on the number and location of backups.

- *Selecting hardware and/or services when using dedicated hardware, either the institution's own or shared hardware:*

1. It is important to use equipment intended for implementing professional server solutions, also known as enterprise-grade equipment. This applies to servers, network resources, storage, uninterruptible power supplies, among others.
2. Home-use or entry-level equipment is not robust enough to meet the reliability, electrical safety, mean time between failures, and availability requirements needed on these platforms.
3. For storage, disk aggregations should be used that support at least one device failure, that is, arrays with redundant data (RAID). The RAID level and solution will depend on the technical feasibility and whether the institution uses a hardware or software solution. Minimally acceptable examples are: raid1, raid5, raid6, raid10, zraid or any other that supports a failure of one physical disk and preferably two.
4. For each RAID array it is recommended to have available disks (spare) that can be added to the array automatically (hot-spare) or at least manually (cold-spare).
5. Considering the high costs and low availability of hardware in our country, it is advisable to initially obtain each piece of equipment with all the necessary parts to function for several years. Purchasing additional parts or replacements after the initial purchase is often very expensive and time consuming.
6. Given that platforms will grow in services, data and users over time, it is advisable to oversize computing resources by at least 50%.

- *Selecting hardware and/or services when using hardware infrastructure as a service, that is, cloud or similar:*

1. It is essential to implement a cost control mechanism and guarantee the payment of the services used month by month.
2. The monthly charge varies according to the use of computing resources, traffic and storage, and in some cases may exceed what was initially planned.
3. The services agreement must be reviewed and analyzed to ascertain if the provider maintains safe copies and if it is liable for loss of data. Storage services associated with computing resources (servers) seldom provide recovery warranties in extreme circumstances.

About logical resources

Implementation of logical resources usually involves one or several stages of surveying existing solutions, followed by the configuration of one of them or the development of a new one, depending on whether or not a viable solution is found.

During the survey phase, the following should be considered:

1. Self-development is hardly a necessary path. Given the level of technological advancement and the number of software products available, it is highly likely that several open source solutions exist that fully or partially solve the problem you want to tackle.
2. It is always more appropriate to use open source software, since it is not only free, but also allows access to the source code, customization of functionality and even use developments and documentation from other institutions across the world.
3. Faced with two valid software options to implement a solution, it is advisable to choose the one with a clearer development horizon and a more active and transparent development community.
4. It is better to consider software solutions used by the most prominent open science platforms both globally and regionally.
5. For each software, analyze requirements, programming languages and tools necessary for development since the institution must thereafter have human resources trained for maintenance. In this sense, it is desirable to discard any platforms developed on obsolete or disused technologies, and also those developed on emerging technologies, which are not yet stable and the medium term continuity of which is not guaranteed.

6.Choice of software for an open science platform is of a temporary nature since all software has a useful life, after which it must be replaced by another solution. This means that it is valid to opt for a quick solution, not very complete, and migrate in the coming years to another maybe novel solution, with more and better functionality.

About human resources

It is strongly recommended to have an interdisciplinary team, given the diversity of tasks to be carried out in the different open science infrastructures that involve technology implementation and maintenance, interoperability, technical aspects of digitization and preservation; content management, data science, legal aspects, communication, among many more specialties.

About practices and strategies

General Practices

Current practices recommended for any technological platform for academic and/or open science publications include but are not limited to:

- Use standard and open formats, whenever possible.
- Publish as much information as possible about each posted resource.
- Adapt websites for access from mobile devices.
- Adapt websites for proper indexing by search engines (SEO).
- Implement standard interoperability protocols, such as OAI-PMH or ResourceSync.
- Adapt the data posted in these protocols to the national (SNRD), regional (The Reference) and international (COAR; OpenAire, etc.) guidelines.
- Use simple metadata profiles, based on formal standards or conventions.

Training

Given the technological progress and the advent of new practices in the scientific community, it is of vital importance to have interdisciplinary profiles. Therefor it is essential to have a continuous training and updating plan, both in the computer area and in data management, cataloguing, communication channels, bibliometrics, and many topics under development.

Preservation

Digital preservation, according to UNESCO, can be defined as the set of processes aimed at ensuring the continuity of digital heritage materials for as long as they are needed. Specifically, this continuity implies that each digital object can be accessed and understood by the interested community over time.

Preservation involves countless actions during the life cycle of the digital object and is strongly related technologically to the implementation capabilities of the infrastructure where the file is stored, but it also involves legal (permissions) and organizational aspects.

Among the more general preservation-related practices and strategies to be taken into account, the following can be considered:

- **Traceability:** this involves keeping track of all the changes on each item, including date, person in charge and action carried out. In this way, a history of actions on each digital object can be maintained. Ideally, the pre-change state of the object and its metadata can be recorded, which is known as item versioning.
- **Integrity check:** Files stored on platforms can change unintentionally for at least 3 reasons: accidental tampering (in infrastructure management), intentional replacement (for example in a hacking event), or underlying storage hardware failure. Checking and calculating checksums for each digital object allows detecting corrupted files and taking early action.
- **Monitoring and migration of file formats:** this allows files of all types to be converted from closed or obsolete formats to other open and current ones. Ideally, each platform should have a content policy that requires the use of open and stable formats.

- **Disaster recovery plan:** along with what is reported in the backup section, ideally there should be a disaster recovery plan including risks, recovery mechanisms, responsible parties, among other matters.

For higher and better readiness in this area the ISO 14721 Standard should be considered. ISO 14721 defines an abstract functional model for an archival information system with 6 entities and the functions that it should have as well as the structure of the information package that includes the necessary structure to ensure long-term preservation and access to digital objects.

Preservation information includes identifier, archival provenance data, integrity check, context information, and licenses (distribution permitting transformation and use).

The life cycle of the digital object must also be addressed, that is, there will be many recurring actions. Given the characteristics and length of this document, for greater detail we suggest using the OAIS model.[11]

Persistent Identifiers

Persistent identifiers are primary infrastructure for the representation, formalization, circulation and operationalization of scientific knowledge, offering mechanisms for the unambiguous, persistent and functional identification of components involved in scientific research, development and communication practices.

They allow all kinds of artifacts to be formally and unambiguously referenced, whether they are abstract constructs, physical entities, people, institutions or communication mediation components.

They make it possible for a component of the scientific system to be identified, represented and used, facilitating the reuse, citation and socialization of productions, tools and results. Some examples of the strategies developed to designate constructed knowledge in a systematic and unambiguous way are catalogues, nomenclatures, conventions and standards. The challenge we currently face calls us to design and adopt a persistent identifier scheme in a highly integrated digital environment through global computer networks.

In this sense, a strategy consistent with the current socio-technical context requires a model that meets the following conditions:

- Unambiguous reference in networked digital contexts: it must be able to reference an entity unambiguously in the global context of the Internet.

11 Open Archival Information System (OAIS) is a conceptual model for the management, archiving and long-term preservation of documents (ISO 14721:2012 standard).

- Functional resolution: it must be able to be associated with a resolution mechanism that guarantees the availability of and access to referenced digital entities.
- Persistence: the relationship between the reference and the referenced digital entity must be maintained over time.

There are different initiatives and projects currently under development aimed at consolidating standards and mechanisms capable of complying with the aforementioned conditions. The MINCyT should assume the responsibility, in consultation with the SNRD, to provide a persistent identifier service for institutions, projects and authors that is interoperable, open and compatible with international standards. This is an item of the agenda of the Board of Directors of LA REFERENCIA the purpose of which is to find/develop a non-commercial regional solution.

Backups

There is no single solution that guarantees 100% success of backups. However, there are solutions that if combined will offer high reliability levels.

It begins by defining a backup rotation and safe copy scheme to be able to withstand extreme situations such as disaster for natural causes, accidents, attacks, multiple hardware failures, among others.

As a minimum guide, a 3-2-1 scheme can be considered, i.e. at least 3 copies of each data, in at least 2 disjoint physical devices and with 1 of those storage devices outside the disaster/vulnerability area where the main storage is located.

It is essential to always have external copies physically distant from the main infrastructure, even if they cannot be kept 100% up to date.

Additionally, to v that the backup mechanism is sufficient and effective, backups, rotation schemes, and containment plans must be regularly reviewed and tested.

A very important step is to review access permissions for all components of the infrastructure and analyze possible intrusion scenarios, for example, one in which an attacker accesses sensitive information, takes control of the infrastructure and/or encrypts data.

Own or Shared Repositories:

To determine whether or not it is desirable to maintain a repository, each institution should analyze its production, budget and internal policies.

Building a new infrastructure is relatively simple compared to keeping it running over time. Therefore, it is of vital importance to build or adhere to simple infrastructures, based on current practices that can be sustained over time from the point of view of economic cost and specialized human resources, both of which are very scarce resources in the current context.

In the event that the institution does not wish to maintain its own repository in operation, the possible paths are:

- Develop a shared repository[12] infrastructure with one or more other institutions, agreeing on conditions and responsibilities.
- Leave custody of their production to another institutional repository that meets the requirements that the institution establishes and adequately protects that production based on a formal agreement between the institutions (Framework Agreement) and a specific agreement for these tasks and responsibilities.

It should be noted that an institution may initially participate in a multi-institutional repository project and in the future separate its production into its own institutional repository and vice versa, that is, it may transfer its resources from a proprietary repository to a shared or delegated one.

[12] Shared repository: repository created by more than one institution, either because of their subject matter or regional affinity or any other common interest.

INCENTIVES FOR OPEN SCIENCE

There is a fairly advanced international consensus around the fundamental role that research evaluation systems play for the advancement of open science. In fact, the UNESCO Open Science Recommendation points out that in order to promote an open science culture, it is essential to harmonize the incentives existing in research funding and reform evaluation systems.

It takes up the principles of the San Francisco Declaration on Research Evaluation DORA (2012) and advocates greater attention to the quality than the quantity of research results, and uses adapted indicators and diversified processes that dispense with the use of bibliometric criteria such as the impact factor of the publication.

As a contribution to this path of transforming evaluation systems, DORA has recently developed a tool called SPACE (Schmidt, Curry & Hatch, 2021) to analyze indicators of institutional progress and conditions for successful change.

Along these same lines, the recent decisions of the Dutch funding bodies (VSNU, NFU, KNAW, NWO and ZonMw) aim to align with the DORA principles, abandoning the use of the Impact Factor in evaluations. The Global Research Council report on responsible academic evaluation (GRC, 2021) advocates for a number of good evaluation practices, among which the existence of adequate feedback between evaluating/funding bodies and evaluated people is worth mentioning.

To review evaluation systems, there are some international references such as the Leiden Manifesto and the Latin American Forum for Academic Evaluation (FOLEC), which has been advocating for a transformation of science evaluation and producing tools to open this discussion in all levels.

Every day it is possible to come across declarations and measures adopted in different countries all over the world that promote reforms of their evaluation systems to recover the dynamism of national and local research agendas and direct research towards socially relevant results.

For example, the Council of the European Union approved at its Meeting No. 3877 (June 10, 2022) the "Research assessment and implementation of Open Science" guidelines, which highlights the close relationship that exists between the progress of open science and the reform of evaluation systems, while highlighting the need for this reform to contemplate the defense of multilingualism.

Argentina has a fairly heterogeneous research evaluation system and, compared to other countries in the region, it is less standardized around the exclusive use of publication impact indicators to allocate funding and positions. But this diversity does not have an impact on two strongly negative features for open science, such as the predominance of quantitative evaluations and a strong academicism in evaluations that prioritizes publications as the main format to assess a research result.

Although the universities and CONICET fund projects, based on the amount of funding, Agencia I+D+i is the main organization that supports research. Agencia is currently in the process of reviewing the accreditation criteria for project managers and it is a propitious time to introduce differential incentives and a diversity of profiles that are necessary to promote open science.

For their part, the SNCTI institutions also have evaluation processes in place, in the charge of CONEAU or the Institutional Evaluation Program (PEI, MINCyT), that can use the diagnosis offered here to analyze possible changes in a direction compatible with open science. In addition, it is also necessary to analyze the evaluation of academic careers, both in CONICET and in national universities, to detect what rewards open science practices receive and stimulate new evaluation indicators.

The decision about what evaluation models should be used to encourage open science is a very complex one and cannot be resolved homogeneously at the global or regional level, because it requires in-depth consideration of national and institutional specificities. Thus it is of fundamental importance to collectively build alternative and/or complementary evaluation models that take into account cultures, languages and local contexts.

The biggest challenge for a profound change in evaluation policies that allows generating rewards and incentives for open science involves the promotion of open access publications and the publication of datasets as required by law. Evaluation policies should encourage good NON-COMMERCIAL open access practices (where no fee is charged for reading or for publishing in open access) in the process of evaluating career paths, in scientific production and the publication of research results.

A relevant dimension of open science that has not yet found significant development in Argentina is open peer review. The opening of the identity of those who evaluate and of the evaluation process itself in preprints or in New Generation Repositories (RGN) are some alternatives to the traditional closed evaluation of the academy that must be stimulated (FOLEC-UNESCO, in press).

It should be noted, however, that there is no consensus about the benefits of abandoning the anonymity of the evaluations or the certainty if it is more convenient for opinions to be always signed.. At present there is no known sufficiently extensive research on the effects of abandoning blind peer evaluation to assert that a better system exists that can decisively overcome its problems. There is however a growing consensus that it is essential to open the evaluation to social interactions, including collaborative evaluation with social groups involved in the benefits or impacts of the research results.

It is worth mentioning that the open evaluation project also includes the opening of new evaluation instances based on non-academic readers, students, citizens in general and communities involved in ongoing research. These are forms of participatory evaluation that are beginning to develop in the framework of the citizen science movement, with particularities depending on the country and the discipline.

Some experiences in Venezuela show, for example, that it appears as a new form of research in the community or with the community, such as the action-research proclaimed by Fals Borda several decades ago. Albagli et. alia (2021) identified citizen science initiatives in Brazil during the period of the COVID-19 outbreak showing mutual learning between citizen science approaches and participatory actions to reduce disaster risks. These experiences strengthened the role of citizen production of data, information and relevant knowledge for resilience and risk management.

López and Arza (2017) state that, in contrast with the traditional peer review mechanisms that are characterized by guaranteeing the anonymity of the author and the reviewer and by keeping the review reports private, the open peer review models (RAP) publish the reports signed by the reviewers as annexes to the articles. This aims to increase the responsibility and commitment put into each review. Incentives are created for reviewers to do their work as diligently as possible since their names are associated with the article and are part of the academic record. Furthermore, any tensions between different meanings of 'relevance', for example, those linked to different development contexts, are transparently presented to the audience.

Funding of research projects

The purpose of this chapter is to understand and analyze the existence and orientation of incentives for open science in the evaluation guidelines for calls for funding research, development and innovation (R&D&i) projects by the main science, technology and innovation organizations and agencies and national universities in Argentina.

Additionally, and from an evaluation standpoint, this study also examines the inclusion of stimuli around some components of open science in the institutional self-assessment processes of the Institutional Evaluation Program (PEI) of the Ministry of Science, Technology and Innovation and in the institutional evaluation and accreditation processes for undergraduate and postgraduate courses run by the National Commission for University Evaluation and Accreditation (CONEAU), a decentralized body under the remit of the Ministry of Education.

This is an exploratory and descriptive study, carried out in October-December 2021, based mainly on documentary sources, which offers a first approach to identify progress, gaps and/or good practices for the promotion of open science implemented throughout the world derived from the forms of evaluation of some Science, Technology and Innovation and higher education institutions that fund and execute programs to promote research, development and innovation. Based on this, the study sought to outline to what extent and in what way those who investigate find stimuli for the adoption of such practices. It should be noted that since this first survey was completed several organizations began or strengthened processes of adaptation to current regulations; this has resulted in gradual and increasing changes in the promotion of some components of open science in their respective calls or programs. This will require further analyzes to update and/or expand data on the subject matter of this study.

The results of the survey for this diagnosis are structured in three sections. The first one describes the incentives for open science found in the MINCYT's calls for funding research, with emphasis on some programs selected by Agencia I+D+i, CONICET, national universities and public science and technology institutions such as the National Institute of Agricultural Technology (INTA), the National Atomic Energy Commission (CNEA) and the National Institute of Industrial Technology (INTI). The second part introduces the data collected at the level of institutional evaluation and undergraduate degree programs by the CONEAU and the PEI of the MINCyT. The third section displays a set of proposals for the promoting some open science components in calls for research, development and innovation.

Diagnosis

Within the scope of the MINCyT, it is possible to identify two calls for research funding that incorporate open access to publications and open data as an evaluation criterion, through an institutional repository in the SNRD: the National X-Ray System and the Pampa Azul Initiative. The Pampa Azul call requires the deposit of research data in DACyTAr, MINCYT's primary research data portal. However, neither call has yet requested a Data Management Plan as a condition for application.

In relation to Agencia I+D+i, one of the most outstanding actions is the approval, in December 2021, of the Intellectual Property and Management of Intangible Assets policy guidelines, based on the creation of the Unit of Intangible Assets and Intellectual Property (UAIyPI), which seeks to coordinate institutional work and arrange intellectual property guidelines for both innovative companies and research groups. In addition, the Board established a set of guidelines that will serve to guide the promotional actions on the subject.

Of the Agency's set of R&D&i promotion instruments, the study prioritizes calls from the Fund for Scientific and Technological Research (FONCyT): terms and conditions and documents related to current public calls for PICT, PICTO, PID and PISAC II projects were reviewed and model agreements for PICT, PICTO, PID and PISAC II projects.

The survey shows that as of the launch of the PICT 2021 Call, model agreements include a reference to the obligations set forth by Law 26.899. In line with regulatory requirements, a "Data Management Plan" is requested, while the guides for interim and final reports require that a scientific-technological production list (publications, patents, technical reports, books, etc.) be made available in open access in institutional repositories, although in both cases the expected deadline for deposit still remains to be established as set out in the regulation.

Finally, under the Oriented Scientific and Technological Research Projects (PICTO), the PICTO 2021 Malvinas, Antarctica and South Atlantic call makes special reference to open access since it establishes that the results of the projects will be made available in public domain through open circulation publications or documents.

"Publications" are eligible costs in all these calls, but it is still not clarified whether that production should be timely and duly hosted in institutional repositories.

In the PICTO 2021 UNLu and PISAC II calls, new efforts to regulate open access were identified, namely a mention of the need of having results made available in the "public domain" or their "integration into existing databases and platforms".

In relation to the evaluation of the research team in the research proposals, all projects have a CV accreditation process by which their publications are evaluated according to the requirements established by each evaluation committee.

In the context of the guidelines approved at the end of 2021 and in view of the concern for the growth of the APC-based publication model , Agencia I+D+i commissioned the Interdisciplinary Center for Studies in Science, Technology and Innovation (CIECTI) a series of studies. The first sought to learn how much Agencia I+D+i spends in this area and to prevent a growing phenomenon that directly affects the possibilities of open access publication of Argentine scientific results.

The study, carried out for the 2013-2020 period, shows that the total cost of APC publications by Argentine corresponding authors was USD 11,634,112. On the other hand, payments actually made with national funds from the FONCyT or the Argentine Technological Fund (FONTAR) amount to USD 1,317,536. This difference can be explained in several ways: a) payment with other national funds that may have contributed to the APC payment; b) direct payment by the individual effort of the researchers from their own salaries; c) shared payment of the APC jointly with authors from other countries; d) payment of APCs with international funds; e) obtaining exemptions; of) publishing in hybrid journals that have open access with APC but still offer closed access publishing by subscription, without APC payment. In fact, the latter had traditionally been the prevailing style of publication in mainstream journals by researchers in Argentina.

However, given the progress of open science, it does not seem possible or desirable to sustain these commercial and restrictive publication schemes through public funding. Rather, it is about aligning the incentives and rewards in the evaluation processes to strengthen the alternatives for open, collaborative and inclusive publication and circulation of knowledge, through open access repositories (green route) and journals without APC (diamond route), in which there is no charge for reading or publishing.

When analyzing the two existing calls in 2021 for research promotion by CONICET, PIO 2021 UNAJ-UNLP and PIP 2021, there is still little reference to open access or open research data in the context of the implementation of Law 26.899, despite the fact that CONICET has moved forward with regulating the development of the Data Management Plan, within its implementation units and most recently, as part of the call for regulatory reports in the research career, in the voluntary self-archiving of individual or team research data sets through the SIGEVA Data Bank.

Recently, a survey was carried among science and technology and universities leaders in Latin America and the Caribbean about the implementation of forms of responsible evaluation of research oriented towards development problems. Most responses stated that they use a combination of quantitative methods with one or more qualitative evaluation methods and promote various aspects, such as ethics and integrity, diversity, inclusion of underrepresented groups, and geographic, thematic and gender balance, among other issues, with 65% valuing open science and open access dimensions (Gras, 2022).

In addition, more than half considered it as very important or moderately important the written commitment that data generated in the project and research results should be made available in open access. However, indicators on peer-reviewed publications with local/regional circulation and open access used in the ex-ante evaluation of the proposals and their teams are considered very important informational inputs by less than a third of the organizations surveyed (Gras, 2022).

In Argentina, the history of the implementation of a responsible research evaluation by the main STI agency evidences the early incorporation of the equity and inclusivity dimension (including gender, underrepresented generational groups and/or institutional strengthening) in scientific ecosystems and a search for regional balance in the distribution of funding. The incorporation of evaluation indicators linked to open science in calls for project funding is still an emerging but increasing trend; this can also be seen in a certain blurring of related but diverse concepts used to refer to the opening in the calls.

Among national universities, at least 50% of them had grants for R&D promotion with their own funds using the budget allocated to the science and technology function. In this sub- universe of institutions, there was but little reference to Law 26.899. More broadly, some studies have shown the lack of mandates to regulate open access to publications and research data and a weak culture of institutional self-archiving among those who conducted research, teaching and /or outreach activities.

In terms of good practices, in recent years the case of the Universidad Nacional del Litoral stands out. Since 2020 this institution regulates in its calls for Programs and Projects for the substantiation of the Course of Action for Research and Development both open access to publications (requiring the deposit or self-archiving in the University library of research works partially or totally supported with public funds) as well as open research data resulting from grants funded by the institution, while requesting researchers to provide a model Data Management Plan.

For its part, the National University of Córdoba incorporates in its calls for Research, Technological and Artistic Development Programs and projects the requirement of open access to publications resulting from the funded project.

Other universities, such as the National University of La Plata, have recently developed processes to adapt to current regulations to align pioneering and long-term institutional actions in open access, among which institutional repositories with research data stand out, with the research evaluation guidelines in calls for research and development projects (PIP).

Despite these initiatives, and considering the university subsystem as a whole, the implementation of Law 26.899 in calls for R&D grants at national universities is, in general, poor.

In this sense, together with a policy that harmonizes the institutional open access and open science guidelines with the regulatory framework and national repositories and initiatives, it also seems necessary to advance with a greater coordination—within the universities— between the research management, academic and postgraduate areas with the libraries and/or any existing open access areas, for a better alignment of the different actions.

To this we must add, in many cases, the urgent demand to update the texts of the calls for R&D&i grants, which in some cases are partially renewed by complementary resolutions on specific aspects that are attached to the original, but without achieving a more comprehensive reform of evaluation criteria to align them with an open access and/or open science policy.

When examining the calls for R&D&i grants from public science and technology institutions such as INTA, CNEA and INTI, the first two show certain dynamism, while the third has an adaptation in process in relation to open access to scientific information and research data. The long history of these institutions in the production and circulation of knowledge in connection with various public, socio-productive and community stakeholders in agriculture, nuclear energy and industry and their respective needs explains, in part, these capacities.

In its R&D&i promotion instruments INTA requires the deposit of data in INTA Digital (Institutional Repository-Digital Library) and disseminates data sets through this channel, which are indexed in DACyTAr. For its part, the data generated in R&D projects funded by CNEA are available in the institution's Digital Repository (RP 391, BAP No. 66/14), which brings together all the intellectual production of research, development, academic, institutional activities, etc.

Finally, INTI regulates open access to reports and publications resulting from its projects and include them in its institutional repository.

All in all, although Argentina adopted a National Law on Institutional Digital Open Access Repositories earlier than the rest of the countries in the region, the greatest progress in its implementation has been in terms of the creation of institutional digital repositories; while its adaptation to the criteria and evaluation processes of the programs and/or calls for supporting research with public funds is still in progress.

Although several significant institutional efforts to harmonize research evaluation with current regulations on open access and open science have been seen in recent times, these initiatives still need to be expanded and coordinated with the set of institutions that promote and implement R&D&i, so that they contribute to strengthening new practices of responsible research evaluation.[13]

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Proposals and lines of action

- **Base the evaluation** of research projects and reports mainly on **qualitative evaluation by peer review**, supported by a responsible use of quantitative indicators, avoiding the use of rankings for organizations, journals or people.
- **Strengthen the CV information systems** of public science and technology agencies, research funding agencies and universities through interoperable databases, with the purpose of contributing to improving current evaluation systems, through open, reliable and inclusive data that reflect the diversity of production existing in international repositories and the production disseminated in regional and national databases, and that, due to their importance for social sciences and humanities, also include books that have been peer reviewed (CLACSO, 2022).

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La noción de evaluación responsable de la investigación refiere a “enfoques de evaluación que incentivan, reflejan y recompensan las características plurales de la investigación de alta calidad, en apoyo de culturas de investigación diversas e inclusivas” (Curry et al., 2020).

- **Introduce in the terms of the agreements for funding R&D&i projects a mechanism** that facilitates and contributes to open access to specific information on the deposit and immediate open access to publications and data (subject to the exceptions contemplated in Law No. 26.899 and within the deadlines established therein) through a trusted repository, and under open licenses.
- **Expand the requirement to implement a mandatory research data plan** for projects that generate or reuse data.
- **Require information** in research proposals about whether and how **the project will share data early and openly**, and for what part of the production this is planned, such as pre-prints or pre-registration reports, recording, and what platforms are planned to be used.
- **Provide information on the reproducibility of the research results** through the repository where the publications and data on the research results have been deposited or any other tool and instrument.
- **Provide specific information on open peer reviews** for publishing spaces and highlight which ones might offer open peer review.
- **Provide clear and precise information** on the **participation of citizens, civil society and/or end users in research projects**, if applicable, as well as on the types of participation in relation to expected R&D&I activities, the areas of knowledge and sectors involved.
- **Promote the choice of diamond open access modes** for the results of publicly funded research without the payment of article processing charges (APC) or book processing charges (BPC).

Evaluation of institutions

Diagnosis

The National Commission for University Evaluation and Accreditation (CONEAU) is the main agency that evaluates the quality of universities, and carries out a regular accreditation of postgraduate degree programs—categorized as A (maximum), B (intermediate) and C (minimum)—only at the request of the programs. The categorization is not requisite for obtaining greater government funding, but it has influence on the academic recognition and prestige of the program and indirectly influences the selection of the university by beneficiaries of scholarships

On the other hand, the Institutional Strategic Program (PEI), of the Secretariat of Scientific-Technological Coordination of the MINCyT, guides the R&D self-assessment process of science and technology institutions and universities, and provides them with technical assistance for the preparation of improvement plans and their implementation on a voluntary basis.

Although the above evaluation instances and processes are not mandatory, they have some impact in the orientation of evaluation policies and in the instruments for promoting research and postgraduate studies in national universities, among other institutions.

The survey and analysis of the institutional self-assessment guides for undergraduate courses and the accreditation of postgraduate courses by the CONEAU show the absence of references connected with open access to publications, undergraduate and/or postgraduate theses or other types of academic information and/or the promotion of open research data. Rather, it is some national universities that regulate by internal resolutions the mandatory deposit of defended and approved theses and final projects for master's and doctoral degree programs in their institutional repositories.

In the same direction, the Institutional Evaluation Program (PEI) does not contemplate the dimension of open access to publications, thesis reports, etc. and open research data in the self-assessment guides of science and technology organizations, universities in general and developing universities.

However, when evaluating the scientific-technological production of institutions, the self-assessment guide considers both the international bases such as Science Citation Index, Scopus and Pascal as well as the regional ones such as LILACS (health sciences), PERIODICA (multidisciplinary) and CLASE (social sciences and humanities) and SciELO (Scientific Electronic Library Online) and national databases.

Proposals and Lines of Action

- Base the accreditation of institutions on the qualitative evaluation of peers, supported by a responsible use of quantitative indicators, avoiding the use of rankings for organizations, journals or people.
- Design in a participatory and consensual manner an institutional policy for open access and open science that is harmonized with the evaluation systems, coordinated between the different institutional management areas and that includes monitoring processes and instances of improvement.

- Train undergraduate and graduate students, teachers, researchers and outreach agents in self-archiving their production in digital institutional repositories and under open licenses as well as guide open research data practices.
- Continuously develop and assess training in open science competencies throughout the career path of students, teachers, outreach practitioners and researchers.
- Value open science and the diversity of scientific production in the evaluation of teachers, researchers and/or outreach/linkage practitioners, projects, universities and research organizations.
- Promote collaborative work in higher education around open educational resources to make them more visible and easy to share and encourage their reuse.
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Evaluation of academic careers

Diagnosis

There are two large spaces for the development of scientific careers in Argentina. One is located in national universities, with a decisive role of the Incentives for Research Professors (PROINCE) program , converted in 2019 into the National System of University Research Professors (SIDIUN), still in the process of implementation. In the regulation of the last PROINCE categorization, evaluation criteria do not take into account, or even mention, open access to publications and open data. Open access and/or open data are also not included in the new Ministerial resolution that creates the SIDIUN (Res. 1216/2019) despite the fact that its main objectives include extending the visibility of the results of scientific production at universities; the Resolution makes no reference to Law 26.899 or open access.

The other science implementation agency in the country with its own research career is CONICET, which has two unique features that differentiate it from other similar agencies in other Latin American countries. In the first place, it does not offer monetary incentives to reward publication in journals with a higher impact factor. This paves the way to promote new incentives aligned with open access and open science.

The second feature is linked to the autonomy enjoyed by the social and human sciences to prioritize publications by giving the highest score to journals indexed in Scopus, WoS (Clarivate), SciELO, Redalyc and Latindex (Directory Resolution No. 2249/2014). This explains, to a large extent, the characteristics and diversity of publication styles in CONICET, which help promote open science practices in general and open access publication practices in particular.

Resolution 2249 is very important not only for CONICET but for the entire region as well because it incorporates the Latin American indexing bases in the most valued group and with it a large number of diamond access journals that are published in Latin America. This makes it possible

to diversify circulation scales and encourages dialogue with other Latin American communities as well as the development of publications in Spanish.

Attention must be paid to the fact that in some social sciences evaluation committees created a new ranking criterion a few years ago., It is called Group 0 and it ranks higher than the old Group 1. It is applied to Scopus or internationally relevant journals, which as a result hierarchize these journals on top of the indexers accepted by Resolution 2249. This practice could establish the predominance of the impact indicators that the world is seeking to eradicate.

From the detailed examination of the evaluation criteria by large area and disciplinary committee, the first general observation emerges that there is no explicit weighting of the open access of publications or a review specifically aimed at verifying whether the researchers make their publications and primary data available in the CONICET repository in a timely manner, as required by Law 26.899.

With regard to the weighting of the articles in the global evaluation of the production, a fairly sophisticated mechanism is observed in all committees for the quantification of published pieces in which journals are evaluated based on their indexing and that unanimously favors international publication over domestic publication. In most “hard” science committees, three quality groups identical to the first Scopus quartiles are identified, and these with a weighting directly proportional to their “hierarchy”. It is also common in these areas to consult the H index of each candidate in the Scopus platform (and not on Google Scholar, which are broader parameters) to establish general assessments.

There are numerous studies that point to the harmful effects of the transition to open access promoted in Europe with the extension of the APC model, because it implies a growing disparity between researchers and/or their institutions that can afford APCs with respect to of the rest. Likewise, the generalization of the payment of APC is promoting a growing commodification of journals, with the distortions that this can cause in science evaluation processes.

This phenomenon impacts the entire Argentine scientific field, with special emphasis on CONICET, responsible for most of the publications in the mainstream circuit. These payments are made from multiple national and international sources, including in addition to CONICET, Agencia I+D+I and national universities, among others.

iFor this reason it is essential to coordinate the evaluation criteria of the instruments for research promotion and funding, directing them towards non-commercial open science.

The problem of journals with an APC model appears with particular extension in some disciplines. Beigel and Gallardo (2022) note that 62.7% of APC payment records at Agencia I+D+i belong to Biological Sciences and Health, followed by Agricultural Sciences, Engineering and Materials with 20.4% and Exact and Natural Sciences with 12.4%. From the perspective of universe of publications and journals, there is a great similarity in the area of Biological Sciences, given that 62% of the captured journals where Argentines publish charge APCs. On the other hand, there is more distance between the records of payments with national funds in comparison with the number of publications with APC in other areas: double for Agrarian Sciences (40%) and triple for Exact and Natural Sciences (37%).

Proposals and lines of action

Short Term Proposals:

- Incorporate as a requirement for promotion in CONICET and categorization in SIDIUN a minimum percentage of publications deposited in open access repositories and their declaration in the CV.
- Reward open access publications, and especially those indexed in international/regional databases available in diamond access
- Promote researcher profiles that combine different university missions, such as teaching, research and social/technological links.
- Provide evaluation committees and researchers with lists of diamond access journals to promote their evaluation in the different science evaluation bodies.

Medium-term Proposals:

- Recognize the diversity of contributions and academic careers according to the needs and nature of the research, avoiding the use of rankings for journals or individuals.
- Create a qualitative ranking of journals by discipline, weighting non-commercial open access, circulation, and quality of peer review.
- Reward publication of data and open software in institutional repositories.
- Increase the incidence of weighting of the accessibility and quality of the journals, reduce the influence of the impact factor of journals in the calls for admission, effective appointment to teaching positions or promotion in universities and CONICET.
- Establish as a requirement for approval of the annual or biennial reports of researchers, effectively appointed teachers and other academics that, at least, one article or book chapter or other form of publication of the results for the reported period must be available in a diamond access medium.
- Value the publication in diamond-access Argentine journals that are indexed and/or belong to the Basic Nucleus of Argentine Journals (CAICyT).

OPEN SCIENCE MONITORING

Diagnosis

There are various initiatives for monitoring open science and they were especially highlighted for this document, with a link to the initiatives and/or documentation of interest.

For its part, UNESCO begins this year a debate process among specialists to prepare a guideline for the first monitoring at the country level, which should be ready in time for the international report that UNESCO will publish in four years.[14]

International Background

The UNESCO Recommendations for Open Science, approved in November 2021 by 193 countries, in section V. "Monitoring", states that Member States should monitor policies and mechanisms related to open science through a combination of quantitative and qualitative approaches.

Member States are encouraged to consider:

a. Deploying appropriate monitoring and evaluation mechanisms to measure the effectiveness and efficiency of open science policies and incentives against defined objectives, including the identification of unintended consequences and potential negative effects, especially on early-career researchers.

b. Collecting and disseminating progress, good practice, innovation and research reports on open science and its implications, with the support of UNESCO and with a multi-stakeholder approach.

c. Considering the development of a monitoring framework with qualitative and quantitative indicators, within national strategic plans and shared at the international level, with objectives and actions in the short, medium and long term for the implementation of the present Recommendation. The monitoring of open science should be explicitly kept under public oversight, including the scientific community, and whenever possible supported by open non-proprietary and transparent infrastructures. This monitoring aspect could include but should not be delegated to the private sector.

d. Developing strategies to monitor the effectiveness and long-term efficiency of open science, which include a multi-stakeholder participatory approach. Such strategies could focus on strengthening the nexus between science, policy and society, increased transparency and accountability for inclusive and equitable quality research, which effectively responds to global challenges.

14 Consultation with Ana Persic, UNESCO, held on 9-6-2022 on the occasion of the meeting called by UNESCO for the Open Science Funding and Incentives working group. It would be desirable for the CAC-MINCYT presidency to maintain contact with Ana Persic to learn about progress in the design of the monitoring system that UNESCO proposes for the countries.

According to the survey carried out for this document, Europe is the region of the world that has made the most progress in proposals and implementation of open access and open science monitoring. The development of the first Open Science Monitor in Europe can be mentioned, a project designed as of 2013 (Lisbon Council, 2019), debated for years in regional meetings, such as in Copenhagen in 2016, where national monitoring experiences were shared and recommendations were published for monitoring open access journals across Europe.

The European Commission announced the Open Science Monitor in 2013 (Osimo et al., 2019) to monitor open access to publications, research data and open collaboration, through bibliometric data, data mining and surveys. In 2017 it was launched as a pilot project developed for the European Community by RAND Europe (together with Deloitte, Digital Science & Research Solutions, Altmetric.com and Figshare), a project that generated adhesions, and also criticism for involving Elsevier as a subcontractor, a monitor that was part of the European Community website (Schöpfel & Prost, 2019).

In 2018 the European Commission carried out a public consultation to improve the indicators, identifying new data sources. It received 300 comments. And in 2018, another group of convened experts—The Lisbon Council consortium, ESADE and CWTS (with Elsevier as a subcontractor)—presented a methodological update for the Science Monitor Open , based on the results of the public consultation and discussion in an expert workshop, adding new indicators to the initial pilot project. In both experiences, Elsevier's participation generated resistance (Jon Tennant, 2018 and 2019; Sicco de Knecht; French Open Science Committee).

In 2019 a group of experts was convened to prepare a report on indicators to be used for monitoring. And, for the Final Report Monitoring the Open Access Policy of Horizon 2020 (2014-2020), the implementation was carried out by a team made up of Athena Research & Innovation Center, PPMI and Maastricht University/UNU-MERIT, with supervision of the European Commission15. It is expected that once the European Open Science Cloud is fully operational, the indicators will be generated automatically with open data (Osimo et al. , 2019).

For its part, Science Europe, which brings together the main research funders in Europe, published its Guide and Recommendations for Monitoring Open Access in 2021. And the European network of repositories, OpenAIRE, announced in 2022 its Open Science Observatory to monitor peer-reviewed European publications and datasets in repositories, and track collaboration patterns. Likewise, it announced in 2022 its new Dashboard for Monitoring at the Institutional level.

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15 Intercambio por mail (16-6-2022) con Jean-François Dechamp, Directorate General-DG Research and Innovation, Comisión Europea <Jean-Francois.DECHAMP@ec.europa.eu>

Already in 2016, the European meeting on monitoring of open access publications mentioned that a key factor for the successful monitoring of open access publications in Europe turned out to be the information available in the CRIS information systems in the countries, and they recommended improving its integration with institutional repositories. The final report of the European Union on the monitoring of open access in Horizon 2020, page 68, summarizes the key gaps that exist in terms of the coverage of the metadata necessary to calculate the values of the open access indicators. A limitation highlighted several times is the lack of information in the metadata about the existence or not of peer review in the deposited digital object (text or data).

At the moment, what is known as "grey literature" seems out of the scope of the European open science monitoring policy, since the different sections of the monitor make almost exclusive use of publication indicators in journals, showing trends for open access to publications, policies of funders in this regard and policies of research journals (Schöpfel & Prost, 2019).

Among the global challenges for monitoring open science, we can mention the lack of indicators for "gray literature", which would benefit if it would gradually incorporate quality peer review, unique identifier, metadata, according to these authors.

The monitoring of progress in open science at the country level is in the initial and experimental stage, and depends on political decisions, technological advances and, mainly, on the availability of data sources that reflect the diversity of open science productions.

For this reason, open science monitoring focuses mainly on open access to peer-reviewed scientific publications, a survey in place in several countries, taking research databases and institutional repositories and other sources as a source of data.

Some examples are:

- **The Netherlands:** openaccess.nl started in 2016 its Open Access Publications Monitor coordinated by VSNU (now called UNL; it is the association of Dutch universities) together with universities, limited to peer-reviewed articles, with more than 80% open access compliance. The Netherlands Research Council (NWO) monitors open access to publications resulting from the research it funds, with monitoring by CWTS-Leiden University, in 2020 and 2021.

- **UK:** In 2017 Universities UK announced their Monitoring of the Transition to Open Access, and JISC has a Monitor UK to monitor APC payments in the UK.
- France: The Ministry of Higher Education, Research and Innovation established the French Open Science Monitor, and in the Second Open Science Plan 2021-2024 commits to developing the Open Science Barometer as a tool to monitor, observe and measure the impact of open science, beyond publications (Bracco, l´Hote, Jeangirard and Tomy, 2022; Jeangirard, 2021).
- **Germany:** The German Open Access Monitor, funded by the German Federal Ministry of Education and Research and managed by Forschungszentrum Jülich, one of Europe's largest research institutions, measures the publication output of German research institutions and at the same time informs about its open access status. In addition, it analyzes the development of subscription fees and publication fees (for open access, e. g. APC). Elsevier collaborates with their data.
- **In Finland,** open science monitoring begins in 2022, based on the European monitoring experience, and following a monitoring model, a survey for monitoring, and what quantitative indicators used. Each indicator receives points. Baseline points are given to practices that are critical to policy implementation for all organizations. Additional points are given to practices that are still new, under development, or create added value.
- **Denmark:** Danish Open Access Indicator of the Danish Ministry of Higher Education and Science.
- **In Latin America**, several countries that make up La Referencia have access to data in repositories that, in some cases, are publicly released.[16] Several countries in the region are reflected in the indicators published by RICYT and in the indicators of regional indexing systems such as Latindex, Redalyc, SciELO, BIBLAT, among others.

At the institutional level, some monitoring systems are already in place. Only by way of example, since the purpose of this document is to guide a possible open science monitoring system at the national level, the Monitor Portal can be mentioned, which annually reports compliance with the Open Access Mandate of the Higher Research Council-CSIC of Spain since 2020 (Bernal and Román Molina, 2022), or the Open Science Monitor of the University of Paris-Saclay.

Another institutional case is the Open Science Monitor of the University of Utrecht in the Netherlands, which in its 2020 edition conducted a survey with the aim of obtaining information on the attitude and behavior of university academics towards various open science practices.

[16] Ver las estadísticas del SNRD de Argentina.

In addition, a study (Robinson-Garcia, Costas and van Leeuwen, 2020) presents open access indicators at the institutional level for 963 universities around the world, with data from WoS, Unpaywall and Ranking Leiden.

Proposals and lines of action

Some of these initiatives, both at the institutional, national and regional levels, cover mainstream journals in their analysis but do not include non-mainstream journals, and other productions available in repositories and other platforms, which is what should be done to include diversity of productions and formats to communicate science.

Some proposals include monitoring of statistics on the use of content in repositories, platforms, publication websites, ... and university journal portals that, in our region, in some cases universities exceed 100 journals published by each universities (e.g.: UNAM, USP, UBA, UChile).

Monitoring Objectives

Among the most frequently mentioned objectives for monitoring are:

- Provide data and knowledge to understand the development of open science in a country or institution.
- Monitoring of policies, practices and impact related to open science.
- Measure compliance with open access and open science mandates.
- Compile or develop the most relevant indicators needed to monitor the implementation of open science in a country, the availability of these indicators for research evaluation (institutions, projects, researchers).
- Detect areas where it is necessary to apply incentives for the development of open science.
- Track spending on APCs at the country/institution level.
- Make the monitoring of a country compatible with the monitoring guidelines that UNESCO will set for the implementation of its Open Access Recommendations in the member countries. Follow-up, by the monitoring team, of international trends in open science monitoring progress in other countries and regions of interest. Experiment with monitoring systems and define methodologies for monitoring.
- Support the process with guides and training for the individuals who will integrate the monitoring system.

Open Methodology for Monitoring

An objective is to design and implement an open, transparent and reproducible methodology for the operationalization of open access and open science monitoring, with rules that can be shared and accepted by the community to be surveyed, and based,

primarily on, openly available data such as national repository systems and the national CRIS, supplemented with data from private sources such as WoS and Scopus when necessary, and other available data sources.

This methodology has been successfully applied to open science monitoring under Horizon 2020 in Europe, an interesting case because the Horizon program promotes the use of repositories as a way to provider open access to publications and research data.

In the case of Argentina, it is estimated that part of the monitoring data is generated automatically and is interoperable (for example SNRD data). Other data, such as data entered by research personnel in the information systems of the SNCyT agencies that fund research, should be processed when monitoring is implemented at the country level, to avoid duplication and errors, or diversity of formats for institutional affiliations, among other examples of possible compatibility problems when processing data from various sources.

It will be necessary to move forward with the available data and document which most requested indicators are not yet available and promote their development, e.g. metadata in repositories to show whether there has been a peer review, information on funders, among other.

Monitoring Areas to be Considered

Variables to be monitored most frequently mentioned or described in the monitoring systems analyzed for this document are mainly related to open access to publications, primarily peer-reviewed articles.

Variables to be analyzed are diverse, as are, for example, the data sources that complement the WoS and Scopus indicators for articles considered in the monitoring systems mentioned in this document,.

With the progress of review processes in research evaluation and in open science practices, open science monitoring has been enriched by the incorporation of new variables as data has become available as a source of information for the development of new necessary indicators.

Each country or institution decides what areas to monitor and, for each area, the priority or possible variables to be monitored, since standardized, comparable and consolidated data and indicators are needed. For this reason, if in the future it is decided to move forward with designing

an open science monitoring system for Argentina, some possible areas to be monitored are included below, which vary according to the priorities to be defined, the variables of interest in each area, available or unavailable sources of data in each case and, mainly taking into account the guide that UNESCO will develop for countries to monitor open science.

- **Open science policies** at the national and institutional level.
- **Published scientific production and percentage of that published scientific production available in open access in repositories in Argentina** (compliance with Law 26.899) and in other national, regional and international platforms.
- Openly available **research** data.[17]
- Other type of **productions of interest** for open science and available in open access repositories and platforms.
- Use of **open licenses**.
- Use of **persistent identifiers.**
- **Open Scientific Collaboration**[18].
- **Participatory and citizen science**[19] .
- Funds earmarked for the promotion of open science and open access.
- Recognition and incentives to promote open science.
- APCs and BPCs paid by Argentina.
- Other possible areas to be monitored will be defined according to priorities and available data, in addition to the UNESCO recommendations for monitoring at the country level that will be published in due course.

17 Does the data that is disseminated in open access follow the FAIR principles? (e.g.: European Union, Monitoring the Open Access policy of Horizon 2020-Final Report, Indicators for Datasets, 2021, p.60-63). Are they shared with open applications for science?

18 An international biomedical research group proposed a toolkit for monitoring quantitative and qualitative variables in the application of open science in the case of collaborative research teams (Gold ER, Ali-Khan SE, Allen L et al., 2019) by which they identified possible contents for the annual report, including, among others, 1) quantitative data: type of participating -academic, community, industrial, governmental- institutions in the collaboration; number of researchers and students involved; openness in all aspects—design, proposal, management, budget, infrastructures, project products, monitoring and evaluation—of the collaborative project; preprint data, publications and datasets, citations received, patents; 2) semi-structured interviews to better understand standards and attitudes towards open science, and 3) a survey to identify the implementation of open science practices in the group.
In monitoring open science practices scientific research carried out through collaborative alliances between researchers from various institutional settings and/or countries—in which all members of the group agree to comply with open science practices when carrying out their work to increase efficiency, reproducibility and foster innovation—it is necessary to use measurements that can be compared between institutions and/or countries, to know to what extent open science practices have been implemented in the group, shared.

19 In scientific processes that include social stakeholders and citizens, public commitment is significant when it contributes to the democratization of knowledge development. It is necessary to monitor such participation, for example in terms of 1. Accessibility: How high are the barriers to influencing the research where they participate? 2. Inclusion: Are all stakeholder groups and stakeholders involved in the issues being researched? 3. Participation: To what extent do external stakeholders determine the role they play and the contribution they make to the research? (Rathenau Instituut, The Netherlands. Towards meaningful public engagement with research)

Data Sources for Monitoring

Possible data sources are very diverse, but their availability in formats appropriate for processing must be verified. For example, standardization, compatibility, interoperability, systems to rule out duplication must be verified when considering various data sources, among other issues to be addressed

Among the possible data sources to be considered, we list here just but a few examples, as the actual data sources will depend on the priorities and methodologies to be defined once the country receives the guidelines that UNESCO will develop for monitoring open science at the country level:

- MINCyT – Various information systems available, including those of the Portal of
- Information, the National System of Digital Repositories (SNRD), including the
- Statistics and funds allocated to the support of open access and open science, such as monitoring indicators,[20] and CRIS-Argentina in development.
- CONICET SIGEVA, CONICET Digital and other available data systems.
- RICYT – Indicators (among other): number of articles from Argentina in journals indexed by SCI-Scopus-Medline-Periódica-CLASE-LILACS
- Collections of journals from Argentina indexed in SciELO , Redalyc and Latindex Catalog ; these same services must be consulted to know the availability of data on articles with Argentine authorship in journals in all their collections, in addition to journal collections from Argentina.
- Articles by authors from Argentina in journals indexed by the portals of institutional journals of universities in the region and national portals of quality journals (e.g.: Núcleo Básico in Argentina, CAPES in Brazil, Publindex in Colombia, etc.)
- Production authored by Argentina in international thematic repositories of publications and research data.
- For publications by authors from Argentina in international journals with DOI, as an open data query source, Crossref could also be used, which has an APP for data mining and would allow the information collected to be incorporated into an open database.[21]
- CrossRef, Unpaywall, Scholar Google, BASE, CORE, Altmetric are other examples of services with indicators to identify production in Argentina. Surveys and interviews to supplement data sources
- Other data sources to be defined according to the priority of areas to be monitored.

20 The SNRD, a member of La Referencia, can benefit from the methodological developments of the OpenAIRE Monitor https://monitor.openaire.eu/

21 This is a recommendation by the French Open Science Committee, for the European monitor, based on the analysis of the CWTS (2018) according to which it "studied matches between Crossref, WoS

Orientation Guide-Research Assessment

Finally, it is proposed the development of a training/orientation guide for individuals who must design or evaluate research projects, which includes guidelines and (national and international) examples both for individuals who design research projects as well as for individuals who evaluate the projects that request funding.

This guide would allow verifying whether the projects include objectives, methodologies, activities and funding that promote the characteristics and requirements of open science described in the CAC-MINCyT documents for compliance with the UNESCO Open Science Recommendations in the countries that adhered to the recommendations, such as the concepts listed among the following objectives of the "UNESCO Open Science Toolkit · Guidance for Open Science Funding":

- Equitable participation of scientific producers from less privileged institutions and regions.
- That the scientific production to be funded is accessible, equitable and more connected with the needs of society.
- That the scientific practices proposed are:

  - *open*
  - *transparent*
  - *collaborative and inclusive* to solve problems of local/international social importance: collaborations with geographic, linguistic, generational, economic, and disciplinary diversity, and with society stakeholders beyond the conventional scientific community)

and Scopus using the DOI as the join key for the 2012-2016 period. According to this article, it seems that "Crossref has 19.1 million posts for the period, which is substantially more than the 11.9 and 13.9 million publications respectively for WoS and Scopus. It also states that a large part of the academic literature indexed in WoS and Scopus is also available in Crossref. During the last years, 68% of the WoS publications and 77% of the Scopus publications can be compared to Crossref using DOIs as the crossover mechanism. These figures likely underestimate the true overlap between data sources, as DOI-based matching presents several difficulties, such as missing, incorrect, and duplicate DOIs. This is pretty encouraging for selecting an open database like Crossref as a backbone on which to build a publication dataset."

- That the scientific knowledge that is produced is
    - *accessible* (both posts and the data itself)
    - *verifiable* (subject to scrutiny and criticism)
    - *reproducible*
    - *has impact*

Various initiatives in the world that deal with the review of evaluation in times of open science have documents where recommendations, guides or guidelines can be found to support individuals who prepare this Guide of guidelines for individuals who design research projects and for individuals who evaluate the projects to be financed.

In the selection of national and international guidelines and examples, it is necessary to adapt it to the possibilities and realities of the context in which they will be applied, so as to verify if the research projects that are designed or evaluated meet the characteristics listed in the UNESCO document. Among other documents to analyze to guide the design of the guidelines, the following should be taken into account:

- International recommendations for review of research evaluation processes (FOLEC-CLACSO can be consulted for a more complete list, if necessary, at the time the guide is developed) for example:

1. DORA- San Francisco Declaration on Research Evaluation
2. The Leiden Manifesto on Assessment Indicators
3. FOLEC-CLACSO Declaration: A new academic and scientific evaluation for a science with social relevance in Latin America and the Caribbean
4. In Europe, COARA-Coalition for Advancing Research Assessment documents and consulting with CONOSC-Council for National Open Science Coordination, of the European region, if they have developed guidelines for individuals who design or evaluate research projects. The European Association of Universities has also developed the document "Agreement on Reforming Research Assessment ".

- For communication of the knowledge produced in the research, please refer to:

1. The FAIR principles for research data
2. The CARE Principles for First Peoples Research Data
3. BOAI20 recommendations for open access journals
4. The – How to make scholarly publishing work for science in the digital age

GENERAL RECOMMENDATIONS

It is suggested to intensify the efforts to offer adequate statistics about the production housed in the SNCTI institutions and exposed in the national harvesters SNRD and DACyTAr as well as to strengthen actions that increase the visibility of these records of resources in coordinated actions as is the case with La Referencia.

In addition to interoperability, long-term preservation and access to content must be ensured, which means that there must be an infrastructure capable of replicating content, metadata and any significant data in different areas to reconstruct and recover production in the event of faults, fires, etc.

Personnel and project management systems (from CV systems to research reports) were promoted by managers from the research areas of universities or national funding agencies, resulting in multiple overlaps between databases. To achieve a national information system according to current needs, a central challenge is to achieve interoperability between the data of people, institutions and projects, with permanent links (of the DOI, ORCID, Handle, ARK type) that allow interaction with regional or global infrastructures with free software such as Open AIRE and LRHarvester. Linked data applications can absorb other contributions and thus free metadata specialists from having to re-describe things already described elsewhere, allowing them to focus on providing access to unique and distinctive collections at their institutions. This will allow a richer user experience and greater searchability with more context relationships than is possible with our current systems.

In relation to the people informed by these systems, not all institutions incorporate the same populations. They generally include professors, researchers, and support professionals, but only a few include postdoctoral fellows, and very few undergraduate students and alumni. The limitation of the profiles of people that can be incorporated into these systems can curtail the participation of various actors and even of social organizations or citizens, which will be an increasingly demanded requirement as participatory science advances.

The same is true for research projects when rigid schemes are created that do not allow the incorporation of technological services, ventures with productive sectors, social outreach projects or public communication of science.

TRANSVERSAL SUGGESTIONS

1. CULTURAL AND REGULATORY CHANGE

- Promote the understanding of the deposit of production and research data supported by public funds in open access institutional repositories as a contribution to the sovereignty of the technological scientific system.

- Create open science offices and focal points in the different SNCTI institutions to promote training instances that create new capacities or update physical, logical and human resources.

- Promote dialogue between institutions by generating joint open science projects, reducing costs and optimizing resources.

- Promote the dissemination of successful open science experiences to promote their discussion and validation in academic settings.

- Develop a training/orientation guide for those individuals must design or evaluate research projects, promoting compliance with the UNESCO Open Science Recommendations.

2. OPENING OF KNOWLEDGE AND OPEN PRACTICES

- Promote the creation of forums for discussion and dissemination of open science with specific instances for students, officials, professors, researchers,, librarians, and other social actors involved in open science processes.

- Promote experiences of knowledge dialogue and co-production of existing knowledge in the university environment through the outreach/ social linkage function.

3. INFRASTRUCTURES

- Generate support instruments for decentralized, collaborative, open and interoperable infrastructures.

- Create a national and federal program for digital preservation that allows long-term care and access to archived content in institutions.

- Promote the coordination and interoperability of current scientific information systems (Sigeva, CvAr, SIGEO, etc.) for the use and re-use of information.

4. INCENTIVES AND PROMOTION OF OPEN SCIENCE

- Create a National Open Science Award with different categories (open access, open data, participatory and citizen science) with special mentions for young people.

- Review, modify and update the evaluation systems of the scientific community (institutions, projects, people) to value open access and open science good practices.

- Include production of citizen and participatory science in the evaluation criteria (at all levels).

- Produce open science progress indicators with systematic monitoring, and contribute this information to international monitoring to be carried out by UNESCO.

- Generalize the use contractual clauses for open access results for the provision of funding by the SNCyT institutions and organizations of the (Agencia I+D+i, CONICET, MINCyT, national universities, etc.).

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