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# Scientific journals: guidelines for creating a data collection

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## *Revistas científicas: pautas para la creación de una colección de datos*

**ABSTRACT**

This article aims to suggest actions for the opening of scientific data, deposit, use and dissemination, so that scientific journals, linked to Higher Education Institutions, create open data collections. It is an applied social research, with a qualitative, exploratory, documentary approach and with action-research dimensions. A survey of the scientific data openness policies of the journals that use the Dataverse repository of Harvard University was carried out, based on the requirements of the quality seal of reliable digital repositories Core Trust Seal and the Transparency and Openness Promotion Guidelines. The information obtained in this survey supported the implementation of action-research steps, through which guidelines were formulated to meet the proposed objective. With such results, other journals will be able to join the movement of open data adjacent to the articles they publish, expanding the scientific practices related to the movement for open science and the democratization of scientific knowledge.

*RESUMEN*

*Este artículo tiene como objetivo sugerir acciones para la apertura de datos científicos, deposito, uso y difusión, para que las revistas científicas, vinculadas a Instituciones de Educación Superior, creen colecciones de datos abiertos. Se trata de una investigación social aplicada, con enfoque cualitativo, exploratoria, documental y con dimensiones de investigación-acción. Se realizó un relevamiento de las políticas de apertura de datos científicos de las revistas que utilizan el repositorio Dataverse de la Universidad de Harvard, con base en los requisitos del sello de calidad de repositorios digitales confiables Core Trust Seal y pautas Transparency and Openness Promotio Guidelines. La información obtenida en esta encuesta apoyó la implementación de pasos de investigación-acción, a través de los cuales se formularon lineamientos para cumplir con el objetivo propuesto. Con tales resultados, otras revistas podrán sumarse al movimiento de apertura de datos adyacentes a los artículos que publican, ampliando las prácticas científicas relativas al movimiento por la ciencia abierta y la democratización del conocimiento científico.*

**KEYWORDS**

Scientific Communication; Scientific journals; Open Science; Open Data; Scientific Data Repositories.

*PALABRAS CLAVE*

*Comunicación científica; Revistas científicas; Ciencia abierta; Datos abiertos; Repositorios de datos científicos.*

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## 1. Introduction

The ways of "doing" science and communicating its results have undergone many transformations throughout human history (Kuhn, 1998). According to the author, there are periods in which "normal science" is practiced, in which scientists direct their studies based on established paradigms, and times characterized by "scientific revolutions", in which various questions arise about the consolidated scientific bases, until a group of researchers form a consensus around a new idea, and a new paradigm emerges. A process that repeats itself from time to time.

Hey, Tansley and Tolle (2011) summarize the scientific revolutions as follows: 1st: research was based on empiricism and the description of natural phenomena; 2nd: studies, mainly theoretical, were based on models and generalizations; 3rd: centered on computer science and simulations; 4th: eScience, the current paradigm, focused on intensive computing and data sharing. In eScience, the most expressive movement that appears in global discussions is open science.

> *[...] open science is defined as an inclusive construct that combines various movements and practices that aim to make multilingual scientific knowledge openly available, accessible and reusable for all, increase scientific collaborations and information sharing for the benefit of science and society, and open up the processes of creating, evaluating and communicating scientific knowledge to actors in society beyond the traditional scientific community (UNESCO, 2022, p. 7).*

The first initiatives of the open science movement were focused on strengthening a previous movement, open access to scientific publications (Oliveira, 2020). Currently, as Albagli (2015) points out, when we talk about open science we have to consider two perspectives: that of the ongoing global movement, which suggests social and political reflections, especially on the commodification and privatization of scientific knowledge; and that of scientific practices, which enable debates around more transparent and collaborative scientific practice, culminating in the democratization of such knowledge. Looking at it in a holistic context, it is not possible to dissociate these two perspectives. After all, different institutions and the general population are interested in and benefit from open scientific practices, especially if you consider the issue of the data generated or obtained in research.

Based on these notions, the General Conference of the United Nations Educational, Scientific and Cultural Organization (UNESCO) drew up a wide-ranging document with recommendations that determine the standard and organization of science, technology and innovation from the perspective of open science. The document is clear in considering that different nations have different laws and cultures and should apply the provisions contained in the recommendation based on their realities, considering aspects such as open scientific knowledge, physical and virtual infrastructures, open engagement of social actors and open dialog with other knowledge systems (UNESCO, 2022).

Faced with this multiplicity of approaches, this study focuses on open scientific knowledge with the aim of outlining guidelines for scientific journals linked to Higher Education Institutions (HEIs) to create open data collections, defining norms for opening scientific data, populating, using and disseminating it.

This openness is very important so that in addition to the articles, the models, methods, annotations and data obtained can also be obtained, showing how the research was carried out, so that this information "can serve as a basis for more reliable evaluations and for testing the veracity and replication of experiments, be available to be reused more effectively by new research or allow the researcher to interact with other researchers" (Shintaku; Sales, 2019, p.11).

## 2. Scientific communication

In this study, scientific information is used as a synonym for scientific knowledge, as "what you want to communicate" and is contextualized under two scientific fields: Information Science and Communication.

For Le Coadic (1996), information is knowledge recorded in different forms: written, oral or audiovisual, and knowledge is the fruit of the act of knowing, through the simple identification of things (common knowledge) or the exact and complete understanding of objects (scientific knowledge).

The author also explains that:

> *Information carries an element of meaning. It is a meaning transmitted to a conscious being by means of a message inscribed on a spatio-temporal support: print, electrical signal, sound wave, etc. This inscription is made thanks to a system of signs (language) [...] which associates a signifier with a signified [...] (Le Coadic, 1996, p. 5).*

Although Information Science studies and works with information as a process and construction, concerned with content and the best channel for offering information to the recipient, and Communication interprets information as a process of messages between a sender and a recipient (Bazi, 2007), based on a context and with intentions and meanings that are too subjective to measure, it is not possible to dissociate the term information, based on the two scientific fields, in order to work specifically with scientific communication.

The term "scientific" qualifies communication in a peculiar way, in which it needs to be considered that it occurs in situations that are specific to scientific fields and has established objectives (Bufrem, 2019).

It is worth noting, as Caribé (2015) points out, that this communication has as its specific audience other researchers or students within the same field of specialization; when it comes to communication for people in more general scientific fields, interdisciplinary fields, or the lay public, it is called scientific dissemination.

Thus, scientific information is information that can be communicated through structured systems or formal means of communication. Therefore, it is conceived that:

> *[...] communication is a vital process for science, of transferring knowledge and stimulating the flow of ideas between a generating source (scientist) and a receiver (other scientists or subjects who make use of scientific information). Scientific information conveyed in an information product becomes a source of information that can stimulate future research and possibly the processing of new information among researchers (Vanz; Silva Filho, 2019, p. 23).*

Just as the history of scientific revolutions, according to Kuhn (1998), has shown methodological, ontological, semantic or mixed trends that have changed, there have been changes in the ways science is communicated.

As for the means used, in its early days, speech and writing were basically used, in other words, formal communication (such as letters between researchers, which until then had been handwritten) and informal communication (conferences, for example).

The emergence of the printing press enabled the growth of circulating publications and represented a major revolution in communication, which also affected the communication of scientific information (Gomes; Santos; Reis, 2020). Researchers saw the opportunity to print their letters, instead of handwriting them, in order to reach a greater number of peers, and this was the historical beginning of scientific journals or periodicals.

After the printing press, the emergence of the computer and later the internet led to a leap in the possibilities for disseminating scientific discoveries. Added to this are the large volumes of data generated daily and the need for agility and transparency, both in the conduct of research and in the communication of its results, especially in the context of Open Science. In this scenario, two other means of communicating scientific information have emerged: the so-called semiformal and super-formal channels.

In semiformal channels, communication allows sharing while still in the production process, that is, before scientific manuscripts are peer-reviewed or formally published in a scientific journal, for example, in preprint repositories (Bufrem, 2019). Super formal channels, on the other hand, are those in which the scientific literature already exists. It is up to them to indicate its existence and facilitate its identification, location, and retrieval for reading and further study, such as databases (Bufrem, 2019).

Thus, when considering the concept presented by Bufrem (2019, p. 15) that "scientific communication encompasses a cycle of activities that include the production, dissemination and use of scientific information", the researcher moves daily between the stages of effective research production and the way in which they must report (disseminate) what they have done, so that these results are accepted as scientific knowledge, supporting other studies, or even find use in society. In short, a researcher (author) expects the results of their studies to be accessed by peers, validated and cited, and one of the possibilities for achieving this is submission to a scientific journal, which will be discussed below.

### 2.1. Scientific journals

Since their popularization in the scientific world, journals have become the main channel for communicating science, as they allow researchers to know what is being published on a given subject and also because of the need to present their results to their peers (Vanz; Silva Filho, 2019).

However, the slow process of publishing research in printed scientific journals characterized the slow dissemination of research for many years (Bomfá; Castro, 2004). These authors cite that, even at the beginning of the 21st century, the main problems with these types of publications were: the length of time it took for the article to be analyzed by the editorial board and scientific committee (an inconvenience that still persists, even in the context of electronic journals); the cost of print production; the high cost for readers to acquire a complete collection; and the difficulty of distributing copies to all university libraries.

These factors, coupled with the popularization of the internet, have boosted the creation of online journals, which have enabled new possibilities for dissemination and distribution, such as: greater audience reach and diversity, interactivity, hypertext navigation, cost reduction and ease of retrieval (Vanz; Silva Filho, 2019).

As for publishing on the internet, Castro (2006) points out the benefits:

> *[...] that articles are available immediately after approval by the editors. This type of publication helps to increase the visibility of research results and reduce the time between approval and publication in printed form. The scientific article becomes an independent informational unit, although it is later collected in fascicles, as long as the traditional principles remain in force (Castro, 2006, p. 63).*

With the exponential increase in the number of online scientific journals, many concerns have arisen, such as bibliographic control and issues related to the preservation of records held in a virtual environment.

Just as there is the International Standard Book Number (ISBN), which identifies and individualizes books by their country, publisher, title and edition, the International Standard Serial Number (ISSN) was created, an internationally accepted identifier to individualize serial publications, such as scientific journals, both physical and electronic. In addition, the Digital Object Identifier (DOI) was created, a unique numerical sequence for digital content (documents, images, articles, e-books, etc.), which allows content available online to be easily located and accessed (Fachin; Hillesheim, 2006).

With regard to the organization, processing and preservation of scientific information communicated through journals, especially those managed by HEIs, it is worth noting the adoption of the Open Journal System (OJS), an open source software developed by the Public Knowledge Project (PKP) with the aim of managing the editorial flow and facilitating publication.

The existence of journal portals in HEIs ensures that the journals of the same institution are organized in such a way as to record the identity of the scientific production associated with it and that principles of standardization, data preservation, supported file types and security are guaranteed (Garrido; Rodrigues, 2010). An important feature of these portals, and one that comes up when mentioning the distribution of the OJS, is open access.

The idea of open access was one of the fruits of the Budapest Open Access Initiative (BOAI) event held in Budapest in 2002, which initially aimed to bring together existing projects around this common goal. The event gave rise to the definition that, even today, is still reaffirmed by the movement:

> *"Open access" to peer-reviewed scientific literature means free availability on the Internet, allowing any user to read, download, copy, distribute, print, search or reference the full text of these articles, collect them for indexing, enter them as data in software, or use them for any other legal purpose, without financial, legal or technical barriers that are not inseparable from access to an Internet connection itself. The only restrictions on reproduction or distribution and the only role for copyright in this domain is to give authors control over the integrity of their work and the right to be properly acknowledged and cited (Budapest Open Access Initiative, 2012).*

Open access practices are already well defined in the editorial policies of journals. From the discussions on open science, other concerns began to emerge, such as the policies and infrastructures needed to open up the scientific data adjacent to the manuscripts published in these journals (Santos; Almeida; Henning, 2017).

This openness can be a challenge, especially given the vast volume of data generated daily: the era of eScience, and there is a defense that this data needs well-established curation so that it is constantly accessible to anyone interested (Hey; Tansley; Tolle, 2011).

Therefore, thinking about opening up data also requires addressing the necessary policies and infrastructures and the important requirements for its management and curation, points discussed below.

### *2.2. Scientific data*

For this topic, the question is: what makes revolutions possible within scientific fields? Among many possible answers, it is conceived that accumulated knowledge is the basis on which the next theoretical links and experimental procedures will be built (National Research Council, 1997).

In this sense, data from scientific research is very important as it can be used to support new studies, reproduce previous experiments or even be used for other analyses. Conceptually,

> *scientific data is information recorded or produced in any form or by any means during the course of a study. They can be numerical, descriptive or visual and can be reproduced in paper [...] or digital format. [...] In short, [...] they are all the evidence that a researcher needs to validate their conclusions after a study (Silva, 2019, p. 21).*

When it comes to scientific data, there are basically two types of data generated: Big Science (large collaborative projects that naturally involve high costs, investments and well-defined infrastructures, both technological and personnel) and Small Science (small laboratories and individual researchers or small groups at universities and research institutes that carry out a large number of scientific projects). Some scholars metaphorically call this dataset from Small Science the long tail of science, as it generates a significant and heterogeneous amount of data that is more difficult to understand, manipulate and archive, while the data from Big Science is the "head of science" (Sales; Sayão, 2019).

One indisputable fact is that standardized instrumentation, both in terms of collection methods and subsequent curation, facilitates access to and use of data in the so-called "Big Science". On the other hand, depending on the scientific field, each long-tail research study presents different methods of data collection and format and, for this reason, "the data is not forwarded to any formal archiving infrastructure and therefore, in most cases, falls into disuse and obscurity" (Sales; Sayão, 2019, p. 162).

Opening up such data is beneficial for all areas of knowledge, not only to reproduce research, but above all to show its transparency, validate the results presented in scientific manuscripts or enable other studies to integrate data from different sources.

For these reasons, the discussions in this section focus on the elements necessary for scientific data to be, more than simply open, also findable, accessible, interoperable and reusable, in other words, for this data to be managed in accordance with the FAIR principles, in their original language, findable, accessible, interoperable, reusable. The FAIR principles are set out below in the context of opening up scientific data through repositories.

## *2.3. Scientific Data Management*

In many countries around the world, the culture of sharing scientific data is being built under the foundation of many challenges such as "[...] inherent costs, such as for generating and maintaining identifiers, acquiring and maintaining hardware and software, maintaining and updating physical infrastructure, training and educating personnel" (Laender et al., 2020, p. 11-12).

There are also barriers in the international sphere, such as computational resources and coordination protocols for collecting, storing, processing large volumes of data and, subsequently, accessibility and interoperability for such data. "Added to these is the growing need to use technologies and methods based on artificial intelligence to analyze data, which is increasingly becoming too voluminous to be analyzed, inspected directly or supervised by people" (Laender et al., 2020, p. 12), and difficulties related to the culture of scientists "such as the resistance of researchers to hand over their data for fear of losing the priority of discoveries" (Santos; Guanaes, 2018).

For this reason, Silva (2019, p. 45) warns that "for any initiative in which it is necessary to rely on the goodwill of sharing data, the sociology of science must be considered: researchers will have to see the advantages of sharing it and will need incentives to do so". Borgman (2015, p. 8) presents at least four advantages: 1 - Reproducing research; 2 - Making public assets available; 3 - Leveraging investments in research; 4 - Investing in advanced research and innovation.

"It is understood that once there is a continuous flow of structuring, publication and consumption (reuse) of scientific data, there will be clarity about the process of accelerating discoveries [...]" (Santarem Segundo, 2020, p. 6).

In addition, shared data with well-defined management leads to many benefits, such as:

- Increases the impact and visibility of research;
- Promotes innovation and new potential uses of data;
- Leads to new collaborations between data users and creators;
- Maximizes transparency and accountability;
- Enables scrutiny of research results;
- Encourages the improvement and validation of research methods;
- Reduces the cost of duplicating its collection;
- Provides important resources for education and training (Córdula; Araújo, 2019, p. 198).

It is therefore conceived that depositing scientific data in a repository is the most efficient way of sharing such data, as it broadens the scope of access, mainly because of the standardization required in the description of the data, the possibilities of interoperability with other systems and the policies that depositors must be aware of and follow.

In addition, as Akers (2014) points out, the emergence of so-called data journals, or specific sessions for publishing data in traditional scientific journals, also represents an incentive to share data in a systematized structure. Following descriptive standards, which increases the impact and recognition of authors.

These types of articles describe datasets in detail and don't include any interpretation or discussion. They may also refer to the persistent identifier where the dataset is published, if they're not linked to the articles in general.,

Journals that necessitate the deposit of data in repositories may indicate the necessity of preparing a descriptive document, as will be observed in the subsequent section. But the existence of data articles, in addition to making peer review more important, increases the chances that other researchers can use or reuse datasets in the future (Akers, 2014).

Thus, the management of scientific data is a task that begins before it is collected and is guided by the FAIR principles (Henning; Moreira, 2020).

The term 'digital repositories', in the context of open access, is used to refer to the various types of data provider applications that are designed to manage scientific information, necessarily

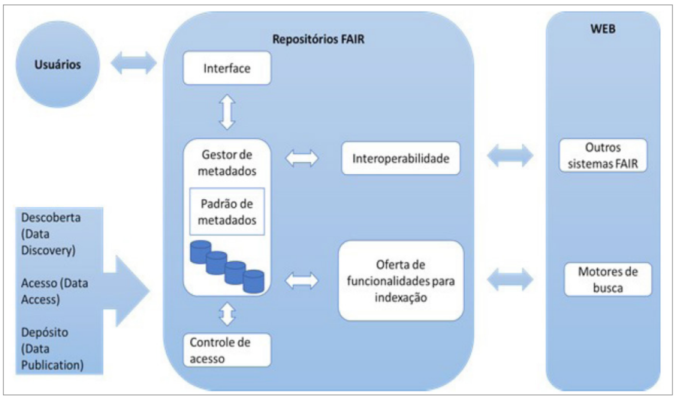


Figure 1. Architecture of a repository that meets the FAIR principles. Source: Shintaku; Appel; Oliveira, 2021, p. 148.

constituting alternative means of scientific communication (Leite, 2009).

With regard to the software infrastructure of repositories, Shintaku, Appel and Oliveira (2021) summarize that:

[...] the architecture of a repository that meets the FAIR principles serves human users through a Web interface, offering interoperability for other systems and allowing search engines to index its metadata. Access to metadata and databases must be controlled in order to enable staggered dissemination due to different levels of data sensitivity. Metadata follows standards that facilitate the integration, discovery and description of databases (Shintaku; Appel; Oliveira, 2021, p. 148). In Figure 1, the authors represent the intended architecture.

When analyzing Figure 1, it is important to mention that in order to use and reuse scientific data, it is important to consider the licenses applied to the datasets, in compliance with copyright and intellectual property rights.

Intellectual property has a broad definition and includes different forms of protection for human creations. By definition, it "[...] refers to creations of the mind, such as inventions; literary and artistic works; designs; and symbols, names and images used in commerce" (WIPO, 2022a).

Copyright is a part of intellectual property rights that specifies the rights "that creators have over their literary and artistic works. Works covered by copyright range from books, music, paintings, sculptures and films to computer programs, databases, advertisements, maps and technical drawings" (WIPO, 2022b). Scientific information falls within this definition.

Therefore, journals and data repositories need to clearly state the terms for use and reuse of works. In this scenario, data repositories (as well as scientific journals) have adopted licenses that guarantee the rights of authors, especially to be cited in the event of reuse. The most widely used are the Creative Commons licenses (from the global organization of the same name, which provides them standardly and free of charge) and have as a mandatory element the need for the user to give credit for the original creation (Guanaes, 2020).

All the reflections undertaken so far have led us to reflect on open and public access to scientific data, seen as common goods. For effective management, it is necessary to consider that there are data of different types and natures and that it is necessary to worry about protecting the rights of authors. These issues should be clear in the policies of scientific journals that wish to require the sharing of data adjacent to the articles they publish.

## 3. Methodological paths

This is applied social research with a qualitative approach, justified by the "[...] interest in the application, use and practical consequences of knowledge" (Gil, 2008, p. 27). In terms of objectives, the research is exploratory and in terms of procedures, it is documental and has action-research dimensions:

Documentary research on the websites of scientific journals of different nationalities and with some kind of link to HEIs, which already have scientific data collections in Harvard University's Dataverse repository.

Stages of action research in which a Brazilian scientific journal was selected from the institution where the authors work, the Universidade Federal de Goiás (UFG), Brazil. UFG has two campuses in the state capital (Goiânia), a campus in the city of Aparecida de Goiânia, and a campus in the city of Goiás. The organizational structure comprises administrative bodies and academic units (AU). UFG's AUs are: Faculties, Schools and Institutes for undergraduate and postgraduate teaching, a total of 28 in the capital campus, where the authors work. On consulting the UFG Journal Portal, it was found that, specifically on this campus, there are 32 scientific journals linked to 23 different AUs.

The Instituto de Estudos Socioambientais (IESA) is the UFG AU with the largest number of scientific journals, with a total of four: Boletim Goiano de Geografia, Ateliê Geográfico, Revista Terceiro Incluído and Revista Signos Geográficos.

Considering the aim of the study, it is hoped that the opening up of scientific data from research published in journals will be extended, firstly within the unit itself, to the other three journals and then to the rest of the institution.

Thus, of the IESA journals, Boletim Goiano de Geografia (BGG) was selected because it is the oldest in the unit and the best rated in the latest Qualis CAPES (2017-2020), with an A2 rating. Qualis CAPES is a system that classifies the scientific production of Brazilian postgraduate programs into strata A1, the highest, A2, A3, A4, B1, B2, B3, B4, C, in descending order. It is also worth mentioning that the BGG publishes the results of studies that have generated quantitative and qualitative data, which opens up the possibility of discussions, especially about the populating of scientific data repositories.

Participatory actions were therefore organized with the BGG editorial team, characterized by the action research method, with the theoretical support of Thiollent (1986) who calls the process of interaction between researchers and those being researched in the search for a solution to the problem encountered a "Seminar":

a. Definition of the topic: by the researchers, prior to the Seminar being formed;

b. Elaborating the problem and hypotheses: from an open science perspective, what actions are needed to open up data from scientific journals linked to HEIs?

c. Forming the members of the Seminar: made up of researchers and members of the BGG editorial team.

d. Centralizing the information: possible based on the diagnosis of scientific journals of different nationalities that already have data collections in Harvard University's Dataverse repository and, consequently, the presentation of their respective data openness regulations.

The aim of the action research was to infer or even propose essential points to be considered in the regulations of the BGG and other scientific journals linked to the HEI, based on the requirements for reliable and sustainable data repositories, Core Trust Seal certification - Extended Guidance 2023-2025 (Core Trust Seal, 2022b). Core Trust Seal (CTS) is an international, community-oriented, non-governmental and non-profit organization that promotes sustainable data infrastructures and offers a basic level certification, according to what they consider necessary requirements for a data repository to be considered trustworthy (Core Trust Seal, 2022a). This is a self-assessment carried out by the management team of the repositories to be certified, based on the TRAC - ISO 16363 standard.

The certification assesses the repository based on requirements that are grouped into three strands: Organizational Infrastructure, Digital Object Management and Security and Technology Information.

The Transparency and Openness Promotion (TOP) guidelines were also taken into account, which aim to promote transparency and openness in the editorial policies and practices of scientific journals and which set out the following standards: 1 - data citation, 2 - data transparency, 3, and 5 - transparency of collection and analysis methods, as well as codes, 4 - transparency of research materials, 6 - acceptance or encouragement of pre-registration of studies (as in preprints repositories) or 7 - registration of analysis plans and 8 - policies regarding data replication (Center for Open Science, 2011, SciELO translation).

e. Developing interpretations: guidelines are presented for creating data collections in scientific journal repositories, with definitions for populating, curating and using scientific data.

f. Finding solutions and defining guidelines for action: model texts on opening up data were drawn up for the BGG website and for presenting the collection in the repository. In addition, templates were created for the declaration of data availability and the metadata form to be filled in by authors, as well as guidelines for preparing and sending data, also aimed at authors.

g. Disseminating the results: posters were designed for the BGG website and social networks on the themes of open science and open scientific data, to publicize the existence of the collection and encourage a culture of making the data associated with scientific articles available.

It is worth noting that the tasks of monitoring and evaluating the actions, as provided for in action research, according to Thiollent (1986), were not carried out, so there are no explicit results in this study.

## 4. Characterization of open data regulations for scientific journals

Firstly, we present the results of the documentary search on the websites of scientific journals that already have collections in Harvard University's Dataverse data repository. The selection of this repository is justified by the fact that it is free and open to any researcher, internal or external to Harvard University1. Individual researchers, journals or organizations can create customizable collections within it to organize, manage and display datasets. In addition, different institutions around the world can use the free software of the Harvard Dataverse Project to create their repositories, using their own technical and technological resources for this installation.

In addition, Rodrigues, Dias and Lourenço (2022) conducted a study on the management and curation of scientific data repositories in South America, showing that the software used is Morpho, DSpace or Dataverse. Based on the analyses carried out in the study, they concluded that "the repositories that were most compliant with the FAIR principles were those established using Dataverse" (Rodrigues; Dias; Lourenço, 2022).

In Dataverse, when a dataset is shared, it is possible to define licenses for use and reuse, in line with the process of opening up scientific work. In addition, when they are published, they automatically obtain a standard citation with a DOI and their metadata becomes available and can be found through search engines, even when the data is restricted (Harvard Dataverse, 2022).

This study will focus on the conceptual and technological elements necessary for its use by scientific journals in general. In this regard, there are four ways in which journals can use the Harvard Dataverse infrastructure:

1. By creating a collection within the repository and, for each article accepted, the editors instruct the authors to send their data to this collection or to the editor himself, who makes the deposit. When it is the author who deposits the data, the editor is informed by email so that they can review and publish the datasets. In this scenario, curation is the responsibility of the journal's editors or a team associated with it;

2. Creating a collection within the repository and contracting a paid third-party curation service. The curation team at Harvard University offers this type of service;

3. Journals that use Open Journal Systems (OJS) to manage their editorial flow can integrate their submissions module with Dataverse. This requires creating a collection within Dataverse and then, in OJS, installing a plugin to establish a connection with the repository and require the scientific data to be uploaded to the Dataverse collection at the same time as the article is submitted. A plugin is an extension module to be installed within a piece of software to add functions that the original software did not have. This type of descriptive file can also be used as supplementary material for scientific articles or data papers in journals that need the datasets to be referenced or deposited;

4. Recommending a scientific data repository to authors on your own website, including Dataverse. Thus, authors deposit their datasets and add the DOI of the dataset when submitting their article or after acceptance, according to the journal's policy.

For this study, a survey was carried out of scientific journals that use Dataverse to host their collections.

The survey took place as follows: on September 1, 2022, the repository's[2] website was accessed and "Journals" was selected in the "Dataverse Category" option. 124 collections were found. Of these, 23 did not contain any deposited datasets and were not considered in the study.

Of the remaining 101, the pages of the collections and associated journals were accessed to identify whether they were linked to any HEI. The journals selected for analysis are those that mention partnerships with HEIs, are based or hosted on the portals of these institutions, or are from university publishers such as Cambridge University Press in the United States of America (USA).

According to these criteria, 57 journals were selected. The others are from private publishers, associations or independent research institutes. We then moved on to an individual analysis of the collections, as well as the websites

| Associated requirement | Analyzed requirement | Included | Not included |
|---|---|---|---|
| R0 | Purpose/Presentation of the data collection in Dataverse | 51 | 6 |
| R0 | Community served/Partners | 57 | - |
| R0 | Link to any network, consortium, community of practice, etc. | 57 | - |
| R0 | Additional resources (statistics / impact factor, glossary, etc.) | 57 | - |
| R1, R2 e R8 | Access and use policy | 57 | - |
| R5 | Collection governance | 57 | - |
| R9 e R14 | Request to send a declaration of data availability | 19 | 38 |
| R10 e R12 | Bidirectionality: Collection/Journal | 43 | 14 |
| R11 | Data deposit preparation guide | 34 | 23 |
| R11 | Information on who makes the data deposit | 49 | 8 |
| R11 | Self-deposit | 45 | 12 |
| R11 | Workflow | 41 | 16 |
| R12 | Guidelines on citing the dataset | 57 | - |
| R13 | Information on reproducibility and replicability | 57 | - |

Table 1. Elements observed in the policies of the selected scientific journals. Source: the authors.

of the respective journals, which are of the following nationalities:

39 from the USA; 04 from Brazil; 03 from the Netherlands; 02 from South Korea; 02 from Canada; 01 from Germany; 01 from France; 01 from Italy; 01 from Japan; 01 from China; 01 from the UK; and 01 from Turkey.

The analyses carried out sought to identify the information and characteristics described in Table 1 and contained in the descriptions of the collections, on the journals' websites, or both. The elements in the table were drawn up based on the requirements of the Core Trust Seal and TOP Guidelines, with adaptations to the specific characteristics of scientific journals.

Based on the quantitative analysis shown in Table 1, it is possible to make some observations:

a. The purpose of the collection of six journals was not presented in Dataverse, so it was necessary to go to the journal's website, where it was possible to understand their Mission/Scope and, consequently, the datasets deposited in the repository;

b. The information needed for the analysis was found on the journals' websites, in the following menus (or submenus): "About"; "Instructions to authors"; "Submission requirements"; "Data transparency"; or "Data sharing policy";

c. Fourteen repositories/collections do not have a bidirectional link, which meant that the journals' web pages had to be found using search engines;

d. Regarding the community served, the scientific field served usually appears;

e. It was considered that all journals provide information on governance, since they minimally inform the team responsible for the journal, the universities or other associated institutions and, in some cases, the budget source;

f. All journals are automatically part of the Dataverse Network, which is why it was considered that they all have links to some network, consortium or community of practice. In addition, the journals also provide information on their affiliations with academic research associations or specific scientific fields;

g. With regard to the additional resources used, Dataverse itself, for each dataset deposited, presents the resource called "Replication data for + 'the name of the article or research associated with it'", in addition, it informs the access metrics and generates, based on the metadata informed, a bibliographic reference (standardized by the American Psychological Association (APA) format). Similarly, journals provide statistical information on their websites, such as the number of views, downloads, impact factor, etc. for scientific articles;

h. For this study, "data deposit guide" was considered to be the information that guides authors on how to submit their data sets;

i. Nineteen journals request a Data Availability Statement which must be included at the beginning or end of the article and which expresses agreement with the datasets being made available in the Harvard Dataverse for replication purposes. Some journals require the declaration to be deposited in Dataverse along with the data, this document being a detailed description of the correct use of the data from a technical, technological and methodological point of view, which favors replicability and reproducibility and guarantees the guideline of transparency of both the data and the collection and analysis methods, as recommended by the TOP guidelines.

j. With regard to data deposit, the majority (45 journals) have guidelines for the researchers themselves to deposit the datasets in the Dataverse collection (self-deposit). Another eight journals do not provide very precise information on this subject, but only state that once the article has been accepted, the authors will be instructed on how to make the data available.

k. Access and use policies are also a feature of the Dataverse repository software. When someone creates a collection, it is possible to configure permissions both for others to include datasets and for use of the datasets made available;

l. With regard to workflow, both for scientific articles and datasets, we sought to identify whether there is information on when scientific data should be deposited;

m. Finally, some data sharing policies are standardized by the academic publishers with which the journals are associated.

It is recognized that the sharing of scientific data associated with articles is still an emerging practice and this survey proved to be very important to support the creation of data opening regulations by journals, which will be described below.

### *4.1. Guidelines for scientific journals to create open data collections in repositories*

Based on the documentary survey, it appears that the following aspects should be considered when implementing journal data collections, especially those linked to HEIs, in scientific data repositories:

1. Organizational and regulatory structure;

| Actions / Preliminary definitions | | Operational actions | |
|---|---|---|---|
| **Institutional (Repository)** | **Journal** | **Institutional (Repository)** | **Journal** |
| 1. Approval of the creation of the journal collection in a repository (institutional or other general purpose);<br><br>2. If it is an institutional data repository:<br>• Definition of the licenses applicable to the data;<br>• Definition of the types of data to be deposited (formats);<br>• Drawing up the terms of access and use of the data;<br>• Requirement to deposit terms of approval with ethics committees, where applicable. | 1. Definition of the journal collection's mis-sion;<br><br>2. Preparation of the Data Availability Decla-ration template in ac-cordance with the terms of access and use of the institutional repository, general regulations regarding use licenses and research ethics (for authors). | 1. When using the insti-tution's repository, monitor access to and use of it and compliance with previously established policies and definitions; | 1. Monitoring access to and use of the collection (statistics). |

Table 2. Actions for implementing a scientific journal data collection in a data repository - Organizational and Regulatory Structure. Source: the authors.

| Actions / Preliminary definitions | | Operational actions | |
|---|---|---|---|
| **Institutional (Repository)** | **Journal** | **Institutional (Repository)** | **Journal** |
| 1. Creation of the institutional scientific data repository, where appropriate.<br><br>2. Drawing up a standard form (template) for filling in the repository's bibliographic metadata. | 1. Creation and configuration of the data collection in the institutional or other general-purpose scientific data repository, depending on the resources available;<br><br>2. Definition of the members of the editorial team responsible for the collection;<br><br>3. Creation of a workflow for the preparation and submission of data by the authors;<br><br>4. Creation of a workflow for depositing data in the collection by the team;<br><br>5. Creation of a standard metadata form (template) to be filled in by the authors, complementing the institution's template, where appropriate. | 1. Technical and technological support for the operation of the repository, where appropriate. | 1. Receiving and checking the datasets and respective metadata sent by the authors;<br><br>2. Depositing the data in the collection. |

Table 3. Actions for implementing a scientific journal data collection in a data repository - Technical and Technological Structure. Source: the authors.

| Actions / Preliminary definitions | | Operational actions | |
|---|---|---|---|
| **Institutional (Repository)** | **Journal** | **Institutional (Repository)** | **Journal** |
| 1. Formation of the editorial team responsible for the collection. | 1. Drawing up a dissemination plan for the journal's data collection.<br><br>2. A document guiding authors on describing the context of the research project that gave rise to the article submitted to the journal, anonymizing the data, among other factors to be considered before releasing the data. | 1. Ongoing training for the editorial team responsible for the collection. | 1. Guidelines for authors regarding data deposit.<br><br>2. Preparation of actions to publicize the collection and the policy of strengthening Open Science (on the journal's website, data collection page and social networks). |

Table 4. Actions for implementing a scientific journal data collection in a data repository - Training and Dissemination Structure. Source: the authors.

2. Technical and technological structure;
3. Training and dissemination structure.

Based on these aspects, necessary actions were established with the BGG editorial team that can help other journals (Tables 2, 3 and 4).

Based on the guidelines described in Tables 2, 3 and 4, meetings were held with the BGG team to draw up models for the preliminary definitions for creating the collection. In order to open up data on articles published in scientific journals, "[...] the editorial policy should include guidelines on where the author will deposit their data, the minimum set of metadata to describe it, as well as the license for use and distribution" (Pavão, Silva, Silveira, 2020, p. 169).

In this sense, the TOP guidelines were also considered. It should be noted that with regard to guideline number 1 - data citation, this is a feature of the software tool of some repositories, such as Harvard's Dataverse, which automatically generates a citation in the APA standard, according to the metadata filled in. Some repositories also provide a DOI.

For the preliminary definitions of the collection, the starting point, as set out in the UNESCO Recommendation, is to "promote a common understanding of open science, the associated benefits and challenges, and the various paths to open science" (UNESCO, 2022, p. 6). A text entitled "Compliance with open science" has therefore been prepared and will appear in the "About" menu on the journal's website. Likewise, when creating the data collection in the repository, it must be informative about its focus and present an access path to the journal's website (bidirectionality).

In conjunction with the BGG editorial team, it was agreed that all

authors should send a document entitled "Declaration of Data Availability" when submitting the article, in which the authors will inform whether or not they intend to share the scientific data associated with the article they are submitting.

The action research defined that the repository's data collection would not be self-depositing. Once the manuscript has been approved, the journal's editorial team will encourage the authors to submit the data set. The guidelines for preparing and submitting this data will be available in the "Instructions for authors" tab on the journal's website.

In line with the TOP guidelines, which provide for transparency of data collection and analysis methods and all research materials, so that it is possible to replicate, validate studies or reuse data, it is hoped that they will be made available for deposit in the repository:

1. Data set: the files should include all the data collected or obtained through analysis, such as images, spreadsheets, text files or others, with preference being given to formats that can be accessed by free software.

If variables are used, they should be named in such a way as to make them easy to identify.

If the authors use existing data sets (e.g. surveys), the commands used to obtain them and their location must be reported in the article itself.

2. Descriptive form with metadata: this will also be made available on the journal's website for authors to download and fill in. For datasets with access restrictions, only this form can be sent. The fields on this form can be defined according to the specifics of each scientific journal, but they must contain enough information to identify the dataset and allow it to be searched and retrieved later. Some of the metadata defined as essential include: Title of the associated article (related publication); Author data; Data description; Field of Knowledge; Time period covered; Geographic coverage; Keywords; Creative Commons license; Language; Funding information; Data types; Software; Other related datasets; and other information that may be necessary.
3. Descriptive file of methods and/or formulas: a text file that describes in detail the methods used to collect and process the data, as well as any mathematical formulas used in the analysis. Comments can be used to describe commands or variables. Necessary information should be provided on all the steps taken (e.g. coding variables, removing certain values, etc.). The aim is to provide a detailed path for replicating the results of the research work. It should also include information on the computing resources required (hardware, software and their versions).
4. Source codes: if programming codes were used to obtain the data. In the "readme" file described below, provide information on the software needed to run the code and its version.
5. Readme file: a text file containing contact information for the authors (name, institution and e-mail address) and a brief description of all the other files.

To sum up, Figure 2 shows a summary of the workflow when data is required and deposited in the data repository collection.

Once the authors have sent in the data set, according to the instructions provided and the metadata form, the editorial team will proceed to deposit it in the data repository collection. It is well known that the editorial teams of journals run by HEIs are generally made up of a limited number of members who are involved in a multitude of other academic activities. The choice to adhere to the data sharing policy, although an irreversible trend in the scientific world, cannot disregard the responsibility to promote long-term accessibility and compre-


Figure 2. Flowchart for authors submitting scientific data. Source: the authors.

hensibility of the data according to the needs of the community to which it is assigned (Core Trust Seal, 2022b). This means that the editorial team must appoint staff to deposit and curate the data. The proposals drawn up so far are intended to ensure that authors provide most of the information and files that facilitate these tasks. After all, the authors are the holders of the knowledge about the data produced or obtained during their research.

Even so, the editorial team will curate at some level (A, B, C and D), in accordance with the Core Trust Seal certification (2022b):

A. Content deposited in the collection as submitted by the authors.

B. Basic curation - brief check, addition of basic metadata or documentation.

C. Enhanced curation - conversion to new formats during deposit, enhancement of documentation and metadata.

D. Data-level curation - as in C above, but with additional editing of data to be deposited.

All of the action-research constructs described so far allow the editorial team to request the submission of data adjacent to approved articles so that they can be deposited in the selected repository. In order to make this possible, together with the BGG editorial team, it was concluded that, first of all, there would need to be a campaign to raise awareness of open science and the openness of scientific data.

Therefore, promotional pieces on the subject were created to raise awareness among BGG readers and authors. The idea is that these pieces (Figure 3) can be used as models to support the creation of other promotional pieces by other scientific journals.

Of course, the guidelines presented here, although broad, are not complete, as each journal and each institution will adapt to its own academic, operational and human, technical and technological resource realities. This study represents the first steps on a long road to consolidating open science within the scope of scientific journals managed by HEIs, which will require the commitment and responsibility of the entire academic community to bring about this change.

## 5. Final considerations

The study presented here, based on the concerns of philosophers of science and contemporary researchers in Communication and Information Science, is presented as a reflection, with practical guidelines, for editors of scientific journals, with the bias of Open Science.

Open science is a broad term that is associated with in-depth discussions on the socialization of knowledge and its privatization, as well as scientific practices in the production, communication and popularization of science. In this study, it is seen as one of the most expressive movements of the current scientific revolution: eScience, the era of the explosion of data, of ways to enhance its sharing, maximize its use and, as Albagli (2015) points out, enable collaboration between researchers and the participation of society in science.

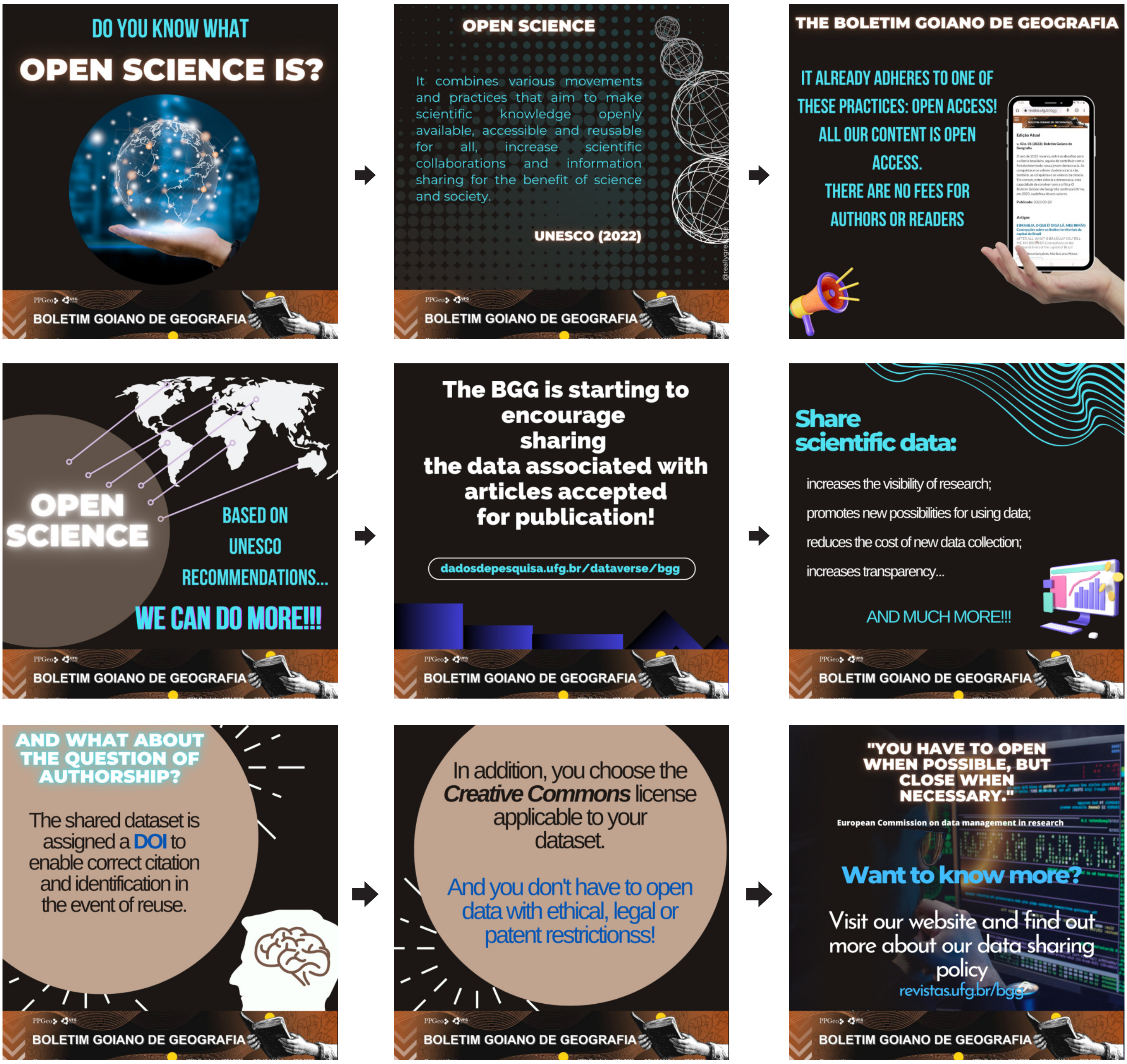


Figure 3. Carousel[3] on open science and scientific data sharing. Source: the authors.

The opening up of scientific data represents a significant change that requires, before any other action, the awareness of researchers, because open science practices will represent a new paradigmatic conception.

This openness allows for transparency in science, the reproducibility or replicability of previous experiments, the attribution of validity to the results described in articles and the use of data for other analyses, which reduces new costs with collections that have already been carried out. The fact is that open science researchers such as Borgman (2015) and Córdula and Araújo (2019) can cite countless other advantages, including increased impact and visibility of research, among others that have already been listed in the course of the study. At this stage, it should be concluded that effective openness of scientific data requires such data to be findable, accessible, interoperable with other systems and reusable, thus meeting the FAIR principles (findable, accessible, interoperable, reusable).

The path built includes guidelines for creating open data collections, rules for populating and curating data. Any scientific journal can use these guidelines to reflect the creation of its own open data collections. If the journals' home institutions do not have their own repository, they can use open and free options, such as Harvard University's Dataverse, Figshare, Zenodo, Dspace, among others. Regardless of the choice, it is important to understand that a repository, as well as a collection of data, must guarantee long-term access and comprehensibility of the data deposited. It is hoped that this study will lead to further research aimed at evaluating and validating the proposed actions.Especially since the institution where the research was carried out has faced bureaucratic obstacles that have not yet allowed the repository to be used effectively, but this will happen soon, according to the managers.

Furthermore, it is believed that with the passage of time and the popularization of the use (and reuse) of scientific data available in scientific journal data collections, more people will see the benefits of sharing and support the cause. New studies will tell us!

## Endnotes

1. See: https://dataverse.harvard.edu
2. See: https://dataverse.harvard.edu
3. In the language of social media, carousel refers to a post with up to ten media.

## Note

This text was based on the results of a master's thesis, which dealt with open science in the field of scientific journals at the Federal University of Goiás, Brazil:

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