EDITORIAL

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WHAT LECTURERS AND RESEARCHERS IN BUSINESS MANAGEMENT NEED TO KNOW ABOUT OPEN SCIENCE

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WHAT IS OPEN SCIENCE?

Is open science a new phenomenon? Definitely not (Vicente-Saez & Martinez-Fuentes, 2018). It is not a novelty in the field of business, within the international academic community, or in Brazil. The *Journal of Contemporary Administration* (*RAC*) holds the distinction of being the first scientific business journal in Brazil to adopt open data policies, beginning in June 2018 (Mendes-Da-Silva, 2021). Following *RAC's* pioneering initiative, several other scientific business journals published in Brazil have embraced open science policies with the aim of gaining international recognition. Among these are the *Brazilian Administration Review (BAR)*, the *Revista de Administração de Empresas* (*RAE*), the *Brazilian Journal of Public Administration (RAP)* (Peci, 2022), and the *Revista Brasileira de Gestão de Negócios (RBGN)*.

In addition, new international standards regarding research practices have been adopted in various fields of knowledge. Vicente-Saez and Martinez-Fuentes (2018) detailed four characteristics of open science that stand out in business research: transparency, accessibility, sharing, and development based on collaboration. Among other positive outcomes, these characteristics may play a role in preventing problems in the editorial process and serve as drivers in establishing the reliability of the research produced (Molloy, 2011).

Open science refers to a set of practices and concepts that are founded on the overarching principle of making science more transparent and accessible to both the scientific community and society at large. The most well-known form of open science is "open access," which involves making published articles available without restrictions. In Brazil, scientific business journals predominantly adopt open access, but it is imperative to invest in other aspects of open science

as well. Recently, additional concepts have entered the discourse, such as the pre-registration of research and open peer review. Some of the key practices within open science include:

> Open access refers to free, online, and unrestricted access to scientific documents published in academic journals. There are two main forms of open access: gold and green. Gold open access entails unrestricted access to the publication in all its forms from the outset. In this model, the authors or the journals' sponsoring or maintaining organizations usually bear the publication costs rather than the readers. On the other hand, green open access refers to publications made available for unrestricted access only after a specified embargo period. During this period, the publication can typically only be accessed if shared by the authors themselves.
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> Open data and open materials encompass the ability to access freely, without any technical or legal restrictions, all data and supplementary materials associated with research findings, such as questionnaires, interview scripts, analysis protocols, and validation procedures. The public can access and reuse these materials without the authors' consent. This facilitates the ability of other researchers to build upon the original research, test different hypotheses, and repurpose the data for various studies (Figure 1).
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> Open code refers to software and code packages that are made freely available to the public without legal or technical restrictions. Open source software, a subset of open code, can be customized and modified by users without any constraints imposed by copyright.
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> Open peer review is a variation of traditional peer review. In the traditional model, an article is typically published only after undergoing a review process, which is usually conducted anonymously, meaning that authors and reviewers do not know each other's identities. Open peer review, in contrast, makes the identities of all participants in the publication process publicly available. Additionally, reviewers' comments, suggestions, and the authors' responses are published as supplementary material alongside the article. As a result, authors, reviewers, and readers can become acquainted with each other and evaluate the article's review history in conjunction with the final published version (Ross-Hellauer, 2017).
>
> Pre-registration of research involves the author's commitment to adhere to a specific research protocol defined prior to data collection. The primary benefit of this approach is that it separates the generation of hypotheses from the data collection process and the evaluation of results. This enhances the transparency of the authors' choices and reduces the likelihood of HARKing (Hypothesizing After the Results are Known) or THARKing (Transparent Hypothesizing After the Results are Known). Pre-registered research can be submitted, evaluated by peers, and accepted for publication, irrespective

of whether the hypotheses are subsequently confirmed or refuted. In such cases, journals commit to publishing the final pre-registered research regardless of the outcome of its results.

In this context, it is worth pondering the following question: How should and could research in the field of administration adapt to these new standards? In this editorial, we briefly describe various contemporary practices that have transformed our field and seem poised to continue pursuing transparency and the quality of published research. These practices include open data, open materials, open code, open peer review, tutorial articles, and standards for replication. Research developed from diverse methodological approaches, including qualitative work, can be conducted and published in alignment with open science practices (Chauvette et al., 2019).

A valuable contribution of open science is the potential to address problems in the editorial process. Aguinis et al. (2017) highlight that the escalating pressure on researchers to publish in high-impact journals can lead to certain individual and/or collective behaviors that may not be in the best interest of scientific integrity. In this regard, in addition to data slicing, there may be a tendency to seek inappropriate shortcuts to achieve results that might increase the likelihood of research publication. Examples of such shortcuts include i) the deliberate selection of certain variables (possibly those more favorable to the desired outcomes) to be included in the empirical model to be tested; ii) the deliberate selection of specific control variables; iii) a less rigorous approach to the removal of outliers; and iv) the formulation of hypotheses after the results are already known, commonly referred to as HARKing or THARKing (Hollenbeck & Wright, 2017).

In this regard, Friedman and Sunder (1994) assert that a fair number of researchers 'torture' data until they confess. Additional issues can also arise, such as p-hacking, one of the most common ways analyses can be manipulated to produce statistically significant results even when they are not genuinely present; this is something that scientific reports must be vigilant against. Researchers must exercise caution and uphold an honest and scrupulous approach in collecting data and conducting analyses.

However, analysis techniques can sometimes be misused or manipulated to demonstrate effects that are not genuinely present. To prevent the reporting of spurious results as factual and to avoid the appearance of poor scientific practice, editors should develop the skills necessary to recognize when such methods are being employed. Alongside p-hacking, the underreporting of null results is another issue that should be discouraged (Morling & Calin-Jageman, 2020).

Entities with a broad international scope and reputation, such as Unesco (2021), the Committee on Publication Ethics (COPE) (https://publicationethics.org/data) and the Council of Science Editors (CSE), as well as funding agencies like FAPESP (https://www.youtube.com/watch?v=PTFK50IvRM4), CAPES (https://www.gov.br/capes/pt-br/assuntos/noticias/capes-apoia-o-compromisso-pela-ciencia-aberta), CNPq (https://www.youtube.com/

watch?v=a0TWZXB_-Fk&t=2s), and Scielo (https://eventos.scielo.org/viiireuniaoscielo/programa/), have advocated for the expansion of open science initiatives. Since the last decade, such initiatives have contributed to a certain acceleration in disseminating research findings (Woelfle et al., 2011).

However, while on the one hand, the adoption of open science policies can accelerate the development of reliable and transparent knowledge, on the other hand, there is still resistance, motivated by various factors (Kathwalla et al., 2021). Within the international community, the reluctance to share data or adopt other open science practices has raised questions about the intentions and motivations behind the dissemination of research data in scientific publications from Brazil (Erlandsson, 2010, p. 157).

OPEN DATA

Data sharing is a crucial component of open science, including within the business sector (Dosch & Martindale, 2020; Vicente-Saez & Martinez-Fuentes, 2018; Zhang & Ma, 2023). Over the past decade, renowned research institutions have been working to develop and promote data sharing. Notable examples include the Yale Open Data Access Project (YODA, https://yoda.yale.edu), which is one of the pioneering data sharing initiatives, and the Berkeley Initiative for Transparency in the Social Sciences (BITSS, https://www.bitss.org), which is dedicated to facilitating the reproduction of research results.

In Brazil, the *Journal of Contemporary Administration (RAC)* initiated a pioneering data sharing movement in the field of business studies in June 2018. Within a few months, this same scientific journal began requiring data to be published alongside the respective theoretical-empirical articles, except in duly justified exceptional cases (Mendes-Da-Silva, 2021). Following *RAC*'s lead, at least one other journal in the business field, *RBGN*, adopted open data policies in alignment with the policies suggested and recommended by the SciELO index.

Although some individuals may think otherwise, data sharing is not exclusive to quantitative studies (Chauvette et al., 2019; Pérez-Soria, 2022). Additionally, it should not be assumed that data sharing is appropriate in every situation. This means that research without open data can be published in exceptional cases, provided that the decision is properly explained and justified.

Therefore, in light of the characteristics of open science highlighted by Molloy (2011), it is important to adhere to the Findable, Accessible, Interoperable, Reusable (FAIR) Data Principles (https://force11.org/info/the-fair-data-principles). These principles guide the process by ensuring that data can be discovered (findable), made available to others (accessible), integrated with other data (interoperable), and reused by others (reusable). The purpose of applying the FAIR Data Principles is to enable and enhance the reuse of data (and other digital objects) by both humans and machines (Tenorio-Fornés et al., 2021).

Data sharing in scientific research bolsters credibility, transparency, and reproducibility while also accelerating the production of reliable knowledge, often at lower costs (Kirtley et

al., 2022; Vazire et al., 2020). Moreover, data sharing policies can curb undesirable behavior within the scientific community, particularly practices known as "data slicing" (Colquitt, 2013; Kirkman & Chen, 2011) or "salami science." This behavior involves using the same data (or very similar data) to produce multiple publications on the same topic, which increases the author's publication count but contributes little to the field (Mendes-Da-Silva & Leal, 2021). Additionally, it is anticipated that works accompanied by open data will garner significantly more interest within the community. It's important to note that the published data can be cited in addition to the article. Educational activities, especially in graduate programs, can also benefit from the use of open data.

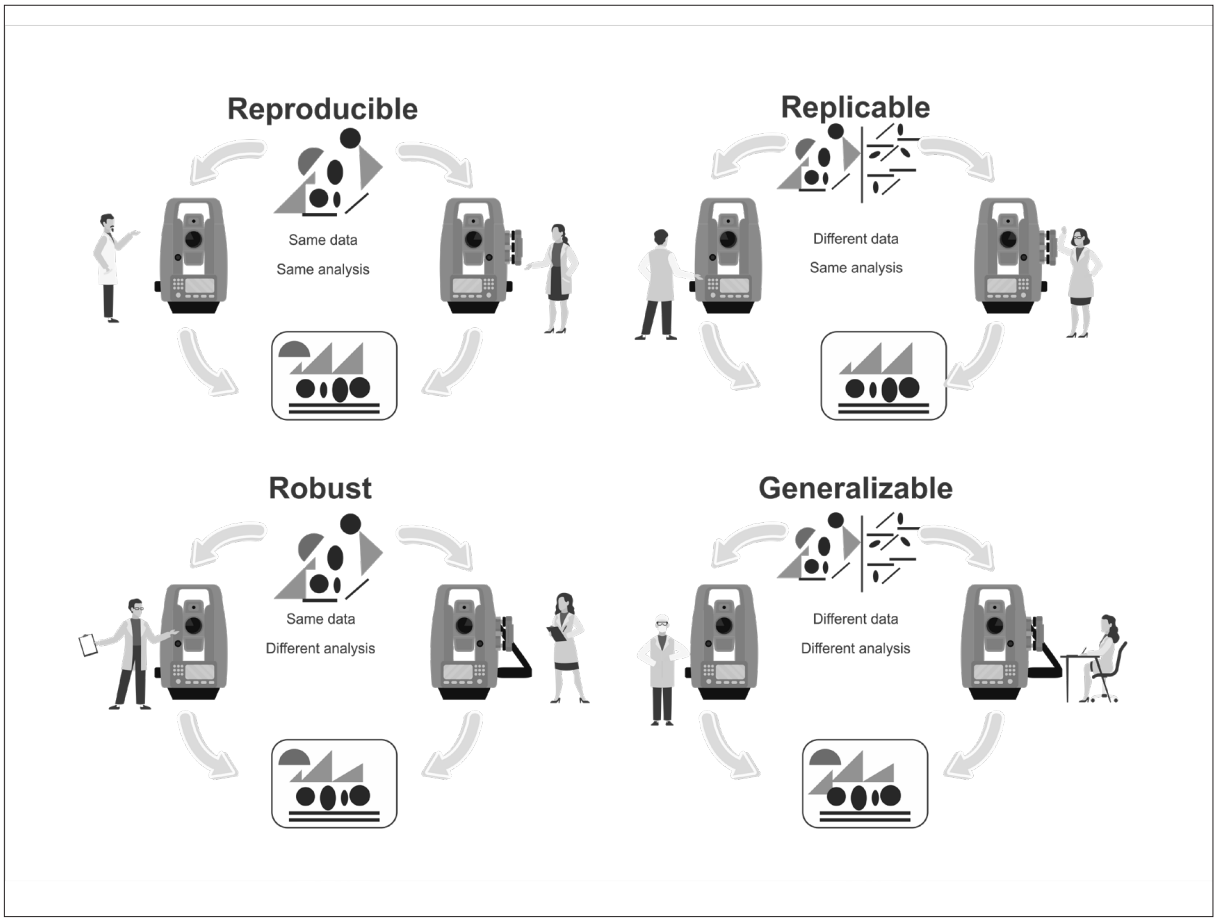
REPRODUCIBILITY AND REPLICABILITY

Wittman et al. (2020) provide a selection of resources for delving into reproducibility in open science. According to the authors, the capacity to reproduce and replicate scientific experiments forms a cornerstone of the scientific method. Sharing ideas, workflows, data, and protocols not only facilitates testing the generalizability of results but also accelerates the pace of scientific progress and enhances the quality control of published work (Easley & Madden, 2013; Ryan & Tipu, 2022).

Reproducibility and open science serve as evidence validating the researcher's claims rather than allowing for baseless assertions. In essence, the motto should be: 'Show your work.' To expand upon this: 'Show your work in its entirety.' To elaborate even further: 'Provide sufficient information to corroborate your claims by describing your intentions and presenting persuasive evidence that your actions align with those intentions.' Internationally, there are initiatives aimed at classifying scientific journals based on the typical reproducibility of the research they publish, such as the Replicability-Index (https://replicationindex.com/tag/replicability).

Stark (2018) emphasizes that it should be possible for others to verify that the tables and figures in your research genuinely result from the methods you claimed to have used, with the data you stated you possessed. This verification includes ensuring that the code corresponds to the mathematical models and that the math aligns with the verbal descriptions presented in the research (Figure 1). Stark (2018) further points out that this does not prove that the chosen methods were the most appropriate, but rather confirms that they were employed. Importantly, it allows others to evaluate the appropriateness of the methods, and consequently provide evidence supporting or contradicting the scientific conclusions. Mistakes can happen, but they must be counterbalanced with intellectual honesty.

Figure 1. Research reproducibility and replicability



Source: Elaborated by the author. Note: Illustration available at: https://doi.org/10.5281/zenodo.7996442

WHAT IS OPEN PEER REVIEW

Open peer review does not have a uniform definition in the literature. There are numerous approaches to providing greater transparency to the dialogue between authors and reviewers, with editors serving as mediators (Ross-Hellauer, 2017, Groves, 2010). In this context, it is important to understand that adopting open peer review does not necessarily mean abandoning the double-blind review process, a misconception that editors, reviewers, and authors who are less familiar with open science may initially have.

Open peer review is expected to facilitate collaboration in various ways, especially in enhancing the quality and impartiality of reviews (Rooyen et al., 1999). When doubts arise, transparency is often an excellent tool for dispelling mistrust and uncertainty. The call for transparency is growing in various sectors of society, from the corporate environment to public management. Similarly, the scientific community has discussed the need for more transparent practices (Hopewell et al., 2014, Langley-Evans, 2022).

Even before the COVID-19 pandemic – a time when there was intensified public scrutiny of scientific production (Benedicto, 2021; Braga & Cabral, 2021) – practices of open science could already be found in the literature (Ross-Hellauer et al., 2017; Smith, 1997). In Brazil, such initiatives were already taking shape within the business research community (Mendes-Da-Silva, 2019). Among the various facets of open science, open peer review stands out as one of the most widely accepted across different fields of knowledge (He et al., 2023; Wei et al., 2023).

Conflict of interest is an aspect that is frequently addressed in the editorial process. In this context, it is common for journals to request that authors suggest reviewers who can contribute to the evaluation of the manuscript, although editors are not bound to accept these suggestions (Kowalczuk et al., 2013). Below, I describe the main types of open peer review, drawing on the work of Ross-Hellauer (2017). It is important to note that this list is not exhaustive, and journals may adapt or modify these approaches based on their own initiatives (Ford, 2013):

- Open Identities: Both authors and reviewers are aware of each other's identity.
- Open Reports: Review reports are published alongside the article.
- Open Participation: The broader community is encouraged to contribute to the review process.
- Open Interaction: Direct reciprocal discussions between authors and reviewers, as well as among reviewers, are allowed and encouraged.
- Open Manuscripts for Pre-review: Manuscripts are made available to the public immediately (e.g., through preprint servers like arXiv) before undergoing any formal peer review. This may include some form of moderation or revision, as exemplified by Scielo Preprint.
- Open Comments on the Final Version: This includes analyses or comments on the final version of the publications, often referred to as the "version of record."
- Open Platforms: The review process is separate from the publication and is facilitated by an entity other than the publisher

Surveys exploring the perspectives of researchers have indicated that, for the most part, authors are satisfied with the peer review process. However, there is also a prevailing agreement that open peer review should become a common practice within the academic community (Ross-Hellauer et al., 2017). A wide array of potential advantages and possible disadvantages are associated with different forms of open peer review.

For example, among the most frequent trade-offs are: i) Reliability and consistency: Open identities and open reporting aim to improve reviews, as the prospect of having one's name publicly associated with a review, or having one's opinion published, may encourage reviewers to be more diligent and thorough. ii) Increased accountability: Open identities and reporting can enhance accountability through heightened transparency, making any conflicts of interest more evident to authors and future readers. iii) Reduction of social and publication bias: Open identities remove the cloak of anonymity for reviewers, which may combat social biases. However, there is no strong evidence that this anonymity was effective. Moreover, reviewers may be hesitant or fearful of critiquing a manuscript submitted by prominent researchers. iv) Creation of incentives: Open reports coupled with open identities enhance the visibility of peer review activities, allowing reviewers to be recognized and cited for their contributions in other publications and career advancement activities. However, experiences so far suggest that reviewers in different fields have varying degrees of inclination to review under these conditions (Ross-Hellauer et al., 2017). v) Synergy and attraction of new reviewers: Open reporting renders scholarly information, which was previously invisible but potentially valuable, accessible for reuse. This also provides novice researchers with guidance regarding the tone, length, and phrasing of critiques, helping them as they begin to undertake reviewer roles (Mendes-Da-Silva, 2020). If they perform well as reviewers, these budding researchers may gain recognition, drawing the attention of more seasoned researchers (and editors) for future collaborations or editorial contributions.

HOW TO RECOGNIZE OPEN SCIENCE PRACTICES IN SCIENTIFIC ARTICLES

Awarding badges for open science practices encourages researchers to share data, materials and/or codes (Figure 2). In addition, badges signal to the reading public that the content has been made available and attest to its accessibility in a persistent location (e.g., Zenodo, Mendeley Data, and Harvard Dataverse).

There are several important benefits to offering Open Science badges in scientific journals. First, adopting badges signals a commitment to support open research practices, which authors from different fields of knowledge increasingly expect from the journals to which they submit their work. Second, there is evidence that implementing these practices can dramatically increase the rate of data sharing. A study by the Center for Open Science suggests that offering these badges is predominantly associated with better open science practices. Third, data sharing presents an opportunity to connect the reading public to the broader research agenda.

Figure 2. Examples of badges to identify open science practices in published articles

	The Open Materials badge is earned by making the research method components necessary to reproduce the reported procedure and analysis publicly available. Shareable materials (e.g., questionnaires, protocols, among others) are digitally available in an open-access repository. Materials must have a persistent identifier and be provided in a time-stamped, immutable, permanent format (e.g., university repository).
	The Open Data badge is awarded when the digitally shareable data needed to reproduce the results is publicly available. Digitally shareable data is publicly available in an open-access repository. The data must have a persistent identifier, provided in a time-stamped, immutable, permanent format (e.g., university repository).
	The Open Code badge is awarded to publications based on computational procedures that archive the source code necessary to reproduce their reported results in a trusted, open-access digital repository that follows best practices for citation of FAIR software and data. Badge issuers must pass the Center for Open Science's open disclosure statement with a transparent peer review process and/or author disclosure of open research objects to be deposited.
	The Open Peer Review badge is awarded to publications when any peer-reviewed publications were generated from the interaction between authors and reviewers through public sharing of the full content of such interaction, expressed in the form of a persistent document, registered with DOI (Digital Object Identifier), and exposed as a component of the article.

Source: Adapted from the Center for Open Science: https://www.cos.io.

TUTORIAL ARTICLES: WHY?

One modality of open science is Open Education, which involves sharing materials and procedures relevant to teaching and research in the form of articles. In this regard, tutorial articles serve as a means of sharing methods by prioritizing their practical nature and integrating concepts, theories, recommendations, data, materials, and codes. This modality of open science reduces redundant efforts in research planning and execution procedures, thereby accelerating and enhancing the productivity of research outcomes. The accumulation and sharing of expertise are invaluable for ensuring the quality and rigor of the research produced. In Brazil, initiatives embracing this modality of open science are already taking shape in the field of business research (Martins & Mendes-Da-Silva, 2020).

Tutorial articles, also known as 'Methodological Articles,' address a specific area or technique in business research, making it comprehensible to both beginners and experts by focusing on the practical aspects of implementation. Examples include guidance on using a particular type of computer software, conducting a specialized form of econometric testing for causal inference, and understanding the theory behind a specific business research technique, among other quantitative or qualitative research methods. Tutorial articles tend to be less detailed than textbooks and often focus on recent advances or important topics. Typically, the purpose of tutorial articles is evident in their titles, as exemplified by Marques et al. (2021), Schiozer et al. (2021), and Genaro and Astorino (2022).

THE FUTURE OF OPEN SCIENCE

In an editorial I penned for *RAC*, I cited Stark (2018, p. 613): "Science is not 'trust me.' It's 'show me.'" From this viewpoint, the term "open science" could be considered somewhat redundant, as the very essence of science necessitates transparency and reliability in research (Rocha et al., 2023). Even before the surge in societal interest in the role of the scientific community - a consequence of the COVID-19 pandemic - skepticism regarding fabricated scientific evidence and the interdependence with (and contributions to) a functional democratic system had already led to a significant increase in the number of retractions by scientific journals, including some of the most prestigious ones (Mirowski, 2018). About the trust (or distrust) in evidence derived from confidential data (especially when this is not properly justified), a renowned professor at the University of Chicago Booth School of Business wrote:

> Many facts that you think are facts are not facts. Yet as more and more papers use secret data, it's getting harder and harder to know. The solution is pretty obvious: to be considered peer-reviewed 'scientific' research, authors should post their programs and data. If the world cannot see your lab methods, you have an anecdote, an undocumented claim, you don't have research. (Cochrane, 2015).

In the coming years, it is anticipated that there will be a growing demand for various forms of open science. Table 1 illustrates the different levels of openness that can be achieved in the dissemination of scientific research results

Table 1. Trajectory of the science "openess"

Horizon	Access to bibliography	Data	Initial analysis	Paper's draft	Article	Comments from third parties
2010	Not for public access	Not for public access	Not for public access	Partially accessible to the public	Not for public access	Internal. Public access only through articles
2030	Public access	Public access	Public access	Public access	Public access	Public access at every stage of the study's development

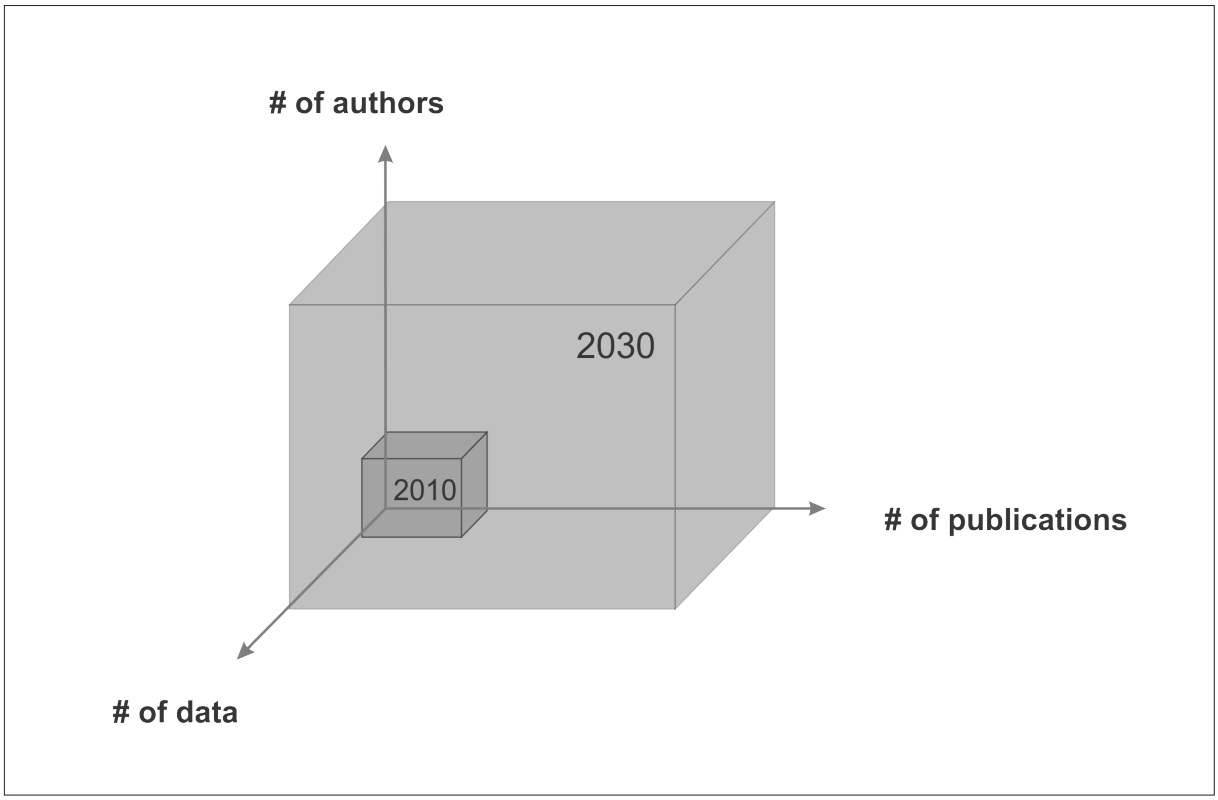
Source: Adapted from Burgelman et al. (2010).

Data sharing is a crucial aspect of open science, and an increasing number of institutions and journals are implementing policies to promote this practice. According to Zhang and Ma (2023), open data significantly enhances the academic community's impact on society and accelerates scientific discoveries and development. In their study, the authors investigate the various effects that open data policies have on citation patterns of articles, focusing on economics journals published in China. Notably, *China Industrial Economics* (*CIE*, ISSN 1006-480X) stands out as the first and, to date, the only social science journal in China to implement a mandatory open data policy. This policy requires all articles published in the journal to share the original data and processing codes.

Zhang and Ma (2023) employed the difference in differences (DiD) models, analyzing data from published articles to pinpoint any potential causal relationships between the implementation of open data policies and the citation rates of articles published in *CIE* and 36 other comparable journals. Their findings indicate that the open data policy led to a swift increase in the number of citations each article garnered. However, they also observed that the benefits of the open data policy in terms of citations waned rapidly over time, even turning negative in the fifth year post-publication. This pattern of citations implies that an open data policy can have both positive and negative consequences, highlighting the importance of additional research to delve deeper into these dynamics in different institutional settings, particularly in Western democracies.

Governments are faced with the challenge of formulating apt research policies in an unpredictable and ever-evolving world. Both in industrialized and developing countries, innovation and research occupy a paramount position on the political agenda. There are three key areas of rapid transformation that are likely to culminate in systemic changes in the scientific domain, each accompanied by its own set of opportunities and challenges: the proliferation of authorship, the exponential rise in the number of publications, and the increased accessibility to data (Figure 3). Moreover, global competition exerts pressure on corporations and regions to enhance their competitiveness and circumvent commoditization by leveraging knowledge, advanced skills, and scientific research, further contributing to these changes.

Figure 3. Observable dimensions of changes in science

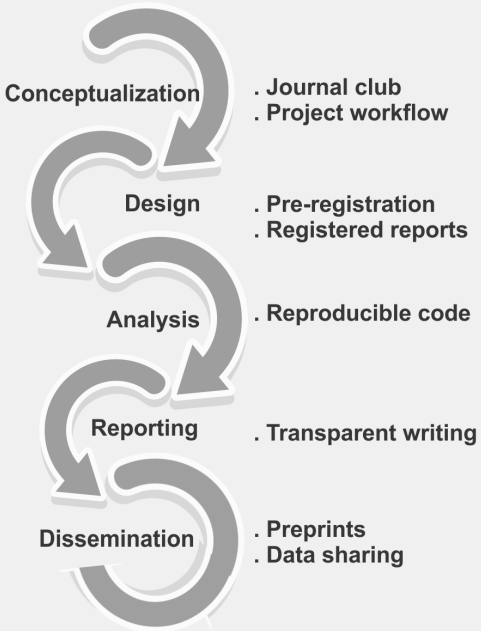


Source: Adapted from Burgelman et al. (2010). Note: Illustration available at https://doi.org/10.5281/zenodo.7998085.

Prominent international scientific journals have noted that a number of scientists are now employing chatbots as research assistants – utilizing them for organizing thoughts, receiving feedback on their work, aiding in code writing, and summarizing research literature (Hustson, 2022). As researchers venture into the uncharted territory of sophisticated AI chatbots, it is imperative for publishers to acknowledge the legitimate applications of these tools and formulate comprehensive guidelines to curb misuse (Nature, 2023). In the field of finance, specifically, the technology is yet to reach a level of maturity in terms of generating literature syntheses and devising appropriate testing frameworks (Dowling & Lucey, 2023). Nonetheless, there are signs of the technology's ramifications across various segments of the job market (Eloundou et al., 2023).

It is anticipated that the open science movement will play a more prominent role in the operations of graduate programs. In this context, Kathawalla et al. (2021) offer a structured guide to assist graduate students and their advisors in actively participating in open science practices (Figure 4). These authors enumerate eight open science practices that students could readily adopt. The practices highlighted by Kathawalla et al. (2021) encompass journal clubs, workflow designs, pre-prints, reproducible code, data sharing, transparent writing, pre-registration, and registered reporting.

Figure 4. Open science research practices during the research cycle



Source: Adapted from Kathawalla et al. (2021). Note: Illustration available at https://doi.org/10.5281/zenodo.7998085.

Apart from global governments, research institutions have also been striving to foster and solidify the open science movement. The European Commission, in this context, has identified open science as a priority in public policy. Among various initiatives is the acknowledgment and incentivization of individual researchers who comply with open science policies (O'Carroll et al., 2017). In January 2023, the White House Office of Science and Technology Policy (OSTP) inaugurated the Year of Open Science, highlighting the US federal government's endeavors throughout 2023 to: i) progress national open science policy, ii) facilitate access to the outcomes of taxpayer-funded research, iii) expedite discoveries and innovations, and iv) bolster public trust and foster more equitable results. Among other efforts, starting May 2023, this policy encourages data integration and sharing through platforms such as the Community for Data Integration (CDI, https://www.usgs.gov/centers/community-for-data-integration-cdi/2023-cdi-workshop).

The topics discussed in this editorial are among many others pertaining to open science, which contribute to the valorization, acknowledgment, and incentivization of researchers. Additionally, there is an anticipation of fostering transparency and accountability within the scientific community, coupled with the enhancement of knowledge production (Molloy, 2011). As a result, addressing these issues is imperative in constructing and disseminating scientific knowledge in the 21st century, encompassing the business domain (National Academies of Sciences, Engineering, and Medicine, 2018).

I extend my heartfelt and genuine thanks to the Editor-in-Chief of *RAE* for graciously inviting me to author this editorial. I am profoundly indebted to Jorge Carneiro, Thomaz Wood Jr., and Ilda Fontes for their thoughtful and invaluable suggestions.

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CONFLICT OF INTEREST

The author have no conflict of interest to declare.