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The neglect of equity and inclusion in open science policies of Europe and the Americas

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Abstract

National, international, and organizational Open Science (OS) policies are being formulated to improve and accelerate research through increased transparency, collaboration, and better access to scientific knowledge. Yet, there is mounting concern that OS policies—which are predicated on narrow understandings of openness, accessibility, and objectivity—do not effectively capture the ethos of OS and particularly its goal of making science more collaborative, inclusive, and socially engaged. This study explores how OS is conceptualized in emerging OS policies and to what extent notions of equity, diversity, and inclusion (EDI) and public participation are reflected in policy guidelines and recommendations. We use a qualitative document research approach to critically analyze 52 OS policy documents published between January 2020 and December 2022 in Europe and the Americas. Our results show that OS policies overwhelmingly focus on making research outputs publicly accessible, neglecting to advance the two aspects of OS that hold the key to achieving an inclusive and inclusive scientific culture—namely, EDI and public participation. While these concepts are often mentioned and even embraced in OS policy documents, concrete guidance on how they can be promoted in practice is overwhelmingly lacking. Rather than advancing the openness of scientific findings first and promoting EDI and public participation efforts second, we argue that incentives and guidelines must be provided and implemented concurrently to advance the OS movement's stated goal of making science open to all.

Keywords

Open science, open science policies, science and policymaking, EDI, public participation

1.0 Introduction

The Open Science (OS) movement has gained traction in recent years, with OS policies being enacted at national, international, regional, and institutional levels. While definitions and conceptualizations of OS vary across disciplines and stakeholder groups (Corrall & Pinfield, 2014; Fecher & Friesike, 2014; Vicente-Saez & Martinez-Fuentes, 2018), in its most holistic definition, OS is defined "as an inclusive construct that combines various movements and practices aiming to make multilingual scientific knowledge openly available, accessible and reusable for everyone" (UNESCO, 2021, p. 7). OS is rooted in principles of universal access, participation and transparency, enabling others to collaborate in, contribute to, scrutinize and reuse research and spread knowledge as widely as possible (Ross-Hellauer et al., 2020). It is conceptualized as an indispensable tool for the democratization of knowledge through the opening of resources, infrastructures, data, and publications to a wide range of social agents (Vicente-Saez et al., 2021). Although the OS movement is diverse, its proponents share the key assumption that promoting 'openness'—of multiple things, for multiple groups of people, and at multiple levels and geographies—will increase transparency, enhance trust and encourage innovation in science, as well as foster equity and widen participation in the scientific community (Levin et al., 2016; Willinsky, 2005).

Governments, funding agencies and research institutions worldwide have begun to support the idea of 'openness' as a crucial component of scientific research, often through open access (OA) mandates that require researchers to make their published research available in OA. Countries such as Colombia (MinCiencias, 2022) and Ukraine (Decree of the Cabinet of Ministers of Ukraine, 2022) have also implemented national OS plans, while others, like South

Africa and Argentina, are in the process of drafting their own at the time of writing. In addition, international organizations have issued recommendations and policies for the development and implementation of OS practices. These include multilateral organizations like UNESCO, the European Commission (EC) and OECD, as well as international scientific societies and professional associations like the International Science Council, the Research Data Alliance (RDA) and the Association of European Research Libraries (LIBER). While in Europe the EC has been a driver of OS implementation (Ross-Hellauer et al., 2022), Latin America has adopted a more grassroots approach through smaller scale initiatives at the national and institutional levels, rather than large organizational efforts (Manco, 2022b).

Broadly speaking, policy is concerned with political decisions designed to shape the behavior of particular social actors toward some perceived goal (Goodwin, 2011). Policy analysis literature is divided across two broad camps: one traditional, the other critical (Young & Diem, 2017). The traditional camp views policy as value-neutral and studies it using positivist approaches. Policy goals and their underlying assumptions are regarded "as common sense, necessary, and beyond question rather than particular political choices" (Swinkels, 2019, p. 3). In contrast, the critical camp views policy as a set of beliefs and ideologies embedded in power relations, challenging the notion that policy issues are neutral and value free. Critical policy scholars contend that policies both reveal and conceal hierarchies of power, conveying what is valued, who is valued and whose perspective matters (Fairclough, 2013; Howarth, 2010).

In this paper we adopt the latter, more critical approach to policy analysis. Scholars have expressed concern that increased implementation of OS policies could exacerbate inequalities between well-resourced and less-resourced institutions, senior and junior scholars, and well-

funded disciplines (e.g., medicine, STEM) and poorly funded ones (e.g., humanities) (Bahlai et al., 2019; Ross-Hellauer et al., 2022). It could also reinforce knowledge hierarchies that place the Global North at the center of knowledge production and the Global South as the site where this knowledge is consumed (Albornoz et al., 2018). Organizations such as UNESCO have sought to address these concerns by including explicit recommendations about ensuring equity, diversity and inclusion (EDI) in OS (Nair-Bedouelle, 2023). Yet, it is unclear to what degree such EDI-related considerations feature in the broader OS policy landscape.

Furthermore, scholars have cautioned that taken-for-granted assumptions can inform how policy problems are identified, legitimize certain policy solutions while marginalizing others and—in the case of OS specifically—define some research outputs and practices as more valuable than others (Levin et al., 2016; Levin & Leonelli, 2017; Whyte & Pryor, 2011). For instance, many policy documents focus on OA and open data (OD), suggesting "moral and evaluative judgements" (Levin & Leonelli, 2017, p. 282) about which types of openness are best for society and—consequently—which types of OS activities and outputs deserve investment and attention. In contrast, forms of openness that seek to engage and invite the public to participate in science are rarely set as policy objectives (Grand, 2012). These include *science communication* efforts—which share research knowledge with the public in ways that are engaging, accessible and useful (Barba et al., 2019; Burns et al., 2003) and *citizen and community science* initiatives—which invite nonscientists to contribute to conducting research (Conrad & Hilchey, 2011; Pelacho et al., 2021; Tebes, 2005).

The historic lack of focus on promoting forms of openness that invite public participation and engagement is perhaps unsurprising considering that arguments about the public benefits

from OA/OS have overwhelmingly focused on one-way communication of scientific findings from scientists to stakeholders including engaged citizens, citizen scientists, journalists, and clinicians. Knowledge co-creation and exchange between scientists and nonscientists has been much less debated in the OA/OS space until fairly recently (Chan, Hall, Piron, et al., 2020; ElSabry, 2017; Mačiulienė, 2022).

In particular, the COVID-19 pandemic underscored the importance of strengthening collaborations between scientists and nonscientific actors (Katapally, 2020; Tan et al., 2022), leading to calls to involve citizen and community stakeholders in the scientific process (Besson, 2023; Boggio, 2021; Chan, Hall, Piron, et al., 2020). The UNESCO Recommendation on Open Science (2021), the first international standard-setting instrument on OS, highlights the importance of opening science to society in the description of the key pillars of OS—particularly, the pillars of 'open engagement of societal actors' and 'open dialogue with other knowledge systems.

Given the growing recognition of the importance of designing equitable and inclusive OS systems, as well as shifting notions of what *should* constitute 'Open Science,' the objective of this study is to explore how OS is currently conceptualized in emerging OS policies and to what extent notions of EDI and public participation are reflected in policy language and recommendations. Specifically, we use a qualitative document research approach to critically analyze 52 OS policy documents published from 2020–2022 in Europe and in the Americas.

2.0 Literature Review

2.1 Previous research on Open Science policy

While a wealth of literature has analyzed OA and OD policies at the local, national, and international levels, research examining integrated OS policies that address multiple aspects of 'open' including open-source software and open education—and their implementation remains limited. Manco (2022a) carried out a literature review of works exploring OS policies published since 2007 in English, Spanish, Portuguese, and French, identifying fewer than 80 outputs in total. Of those, a significant proportion were theoretical works, small-scale case studies and works that discuss policy issues only tangentially. Empirical studies typically focus on specific aspects of OS, such as legal and ethical considerations, data sharing and research recognition and rewards, or on policies by a specific type of entity, such as journal policies, institutional policies, and national public policies. Additionally, many works analyze individual national contexts (e.g., Arza et al., 2017; De Filippo & Sastrón-Toledo, 2023; Manco, 2023; Rezende & Falgueras, 2020). While studies comparing policies across countries and/or regions do exist (e.g., Albornoz et al., 2018; Lasthiotakis et al., 2015; Manco, 2022b; Morais et al., 2021), they are only marginally represented in the peer-reviewed literature. This lack of comparative studies feeds into a concern that OS policies and their implementation are becoming increasingly universal and context-agnostic (Manco, 2022a). Several scholars have suggested that decisions around when, how and how much to open research can vary widely among institutional, disciplinary and cultural contexts, and that OS policies need to be more sensitive to the diversity of research contexts to which they apply (e.g., Hudson et al., 2020; Levin et al., 2016; Lilja, 2020; Reyes-García et al., 2021). A universal approach to OS, it is feared, may lead to disparities between

researchers and organizations that must follow OS policies without regard to their local capacities and needs.

In terms of research design, only a handful of studies employ qualitative content analysis techniques. Using a discourse analysis approach, Albornoz et al. (2018) examined the values and assumptions underpinning 49 OS policy documents published between 2012–2018 in Canada, Chile, Ghana, Portugal and South Africa. The authors demonstrate how these documents reflect power relations within the scientific community and threaten to reproduce global inequalities in scientific knowledge production and distribution. They also find that policy documents primarily define OS in relation to OA and OD and that "using the term Open Science is possibly more so about popularizing the term, rather than pragmatically adapting the system to open practices outside of what is comprised in OA and OD" (Albornoz et al., 2018, p. 4). Similarly, Manco (2022b) analyzed 31 institutional policies, declarations and statements on OS from research institutions in Brazil, France, Peru and the UK, finding that OS is often used as a proxy for OA and OD and that these components of OS are the ones most developed in the documents examined. Notably, only one out of the 31 documents mentioned EDI as inherent to OS**,** and most framed science communication as a process between researchers, rather than a dialogue with the public. A study of national and organizational OS policy documents from seven European countries identified a similar trend in terms of which OS components are privileged, noting that each country focused on those components of OS that aligned with its capacities and strategic priorities (Moradi & Abdi, 2023).

Collectively, the existing literature suggests that OS policies vary widely across geographies, generally focus on only two forms of openness (OA and OD) and seldom consider

the contextual factors that are so important to how openness is perceived and practiced. The literature also hints that OS policies pay little attention to the mounting concerns about EDI in OS—and even less to forms of openness that seek to invite wider public participation and engagement in science. Importantly, however, this apparent lack of attention to EDI and public participation may simply be an artifact of the methodologies employed by previous research, as few if any studies have explicitly examined these dimensions.

2.2 Equity, diversity, and inclusion in Open Science

EDI is a conceptual framework that promotes the fair treatment and full participation of all people, especially populations that have historically been underrepresented or subject to discrimination because of their background, identity, gender, religion, race, ability or location (Akbar & Parker, 2021). Equity—not to be confused with equality—refers to the principle of fairness and equality in *outcomes*, not just in resources and opportunities (Espinoza, 2007) and has arguably been a key goal of OS since the inception of the movement (*Budapest Open Access Initiative*, 2002). A stakeholder-driven study by Ali-Khan et al. (2018) found that increased equity was considered a key success factor for OS, while an analysis of OS initiatives in psychology suggests that OS practices like data sharing and collaborative analyses can further equity by mitigating both the financial burden and time constraints of conducting research for under-resourced researchers (Grahe et al., 2020). Diversity in science refers to the need for stronger representation of individuals from different backgrounds and perspectives in scientific practices and institutions (Swartz et al., 2019). At the forefront of discussions on diversity in science are generally two types of diversity: identity diversity, which refers to the representation of various facets of identity, such as race, age and gender among individuals within a given

group (Page, 2007), and cognitive or epistemic diversity, which refers to the recognition and validation of diverse ways of knowing and understanding the world that are historically and culturally situated (Agarwal & Sengupta-Irving, 2019). This includes non-Western knowledge systems that have historically been marginalized and objectified in academia and science more broadly (Chan et al., 2019). Scholars have long argued that OS projects, if planned intentionally, can broaden the diversity of science-producing actors (Arza & Fressoli, 2017; Chan, Hall, Piro, et al., 2020; Chan & Loizides, 2017), while a recent study by Gervais et al. (2021) illustrated how OS tools and practices like OD and preregistration can help legitimize the work done by women researchers. Lastly, inclusion refers to the act of creating an environment in which any individual or group feels welcomed, safe, supported, respected and valued to participate, regardless of background and identity (Urbina-Blanco et al., 2020). It has been suggested that participatory processes like citizen science (CS) could make scientific endeavors more inclusive and understandable for large audiences (Wynn, 2017). However, definitions around EDI and how they are operationalized are often controversial (Khalid & Snyder, 2023; Paresky, 2021), which may explain why some OS advocates have been cautious about linking OS explicitly with particular definitions or frameworks in this area (Pinfield et al., 2020).

As discussed earlier, while OS seeks to foster greater EDI in the scientific process, OS policies are nevertheless situated within power imbalances and historical inequalities with respect to knowledge production (Leonelli, 2021). Additionally, implementing OS policies requires capacities (in terms of knowledge, skills, financial resources, political will, technological readiness and motivation) which vary across regions, institutions and demographics (Bahlai et al., 2019; Ross-Hellauer et al., 2022). A study by Olejniczak and Wilson (2020), for example, found that authors who are male, employed at a prestigious

university, more advanced in their careers and funded by federal grants were more likely to publish OA by paying an article processing charge (APC). A growth in the adoption of this model for OA will therefore not automatically lead to a more diverse, equitable and inclusive science landscape. Without an intentional and systemic approach to infusing EDI into OS policies, structural barriers in knowledge production and dissemination will not be eliminated.

2.3 Public engagement and participation in science

In the last decade, the principle that the public has a right to access scientific knowledge and to participate in its development has been gaining traction in academic and science policy discourses (Donders et al., 2022; Hoy, 2018; White, 2023). Scientists have aimed to put this principle into practice in a number of ways, including *public engagement* activities such as sharing their research in the media and facilitating dialogue with diverse stakeholders to support mutual learning (Riesch et al., 2016; Weingart & Meyer, 2021). The public's right to contribute to science has also been enacted through efforts to increase *public participation*—that is, to give more weight to citizens and civil society actors in defining research needs and implementing research and innovation (Rask et al., 2018). As public engagement and participation have similar goals, they are often used interchangeably (Riesch et al., 2016; Weingart & Meyer, 2021). Broadly speaking, they are believed to lay the groundwork for a science that is, as Sayre et al. (2012) have argued,

> *public* in multiple senses of the word: a science whose practices and data are transparent and accessible as broadly as possible, that serves public needs and interests and is receptive to public participation, that is applicable as one of many inputs to policy, and that is communicated in ways that enable it to contribute to those policies and improved quality of life for the citizens who support it (p.50).

Some of the activities that may be used to foster this kind of 'public science' include science cafes (i.e., events that encourage open debate between scientists and the general public) and direct involvement of citizens in research activities—e.g., through practices such as community science, CS, and crowdsourcing (Burns et al., 2003; Schiele, 2020; Weingart & Meyer, 2021). Scholars, however, have pointed out that there are different types and levels of participation and engagement, some more democratic than others (e.g., Dawson, 2014; Wynne, 2006). For example, Wynne (2006) has argued that 'engaging' the public in two-way dialogue in order to win their trust is not truly an act of listening or mutual learning; it is a way to maintain science's authority that only strengthens existing power imbalances between those within and outside of science. In contrast to this *deficit model* approach to public engagement (Bucchi, 2008), activities that cultivate a sense of belonging in science, facilitate equitable collaborations among diverse stakeholders and encourage members of the public to bring their experiences, critiques, perspectives and questions into conversations about science are believed to be more inclusive and empowering (Canfield et al., 2020). These activities can take many forms but are generally described as following either a *dialogue* or *participation* model of engagement (Metcalfe, 2019).

In other words, *how* public participation and engagement activities are implemented shape the nature, impact, and implications of those activities. In the policy landscape, policymakers often opt for citizens' participation when they need resources that would otherwise be difficult to obtain (Bobbio, 2019). In doing so, they look to participation as a tool which can provide both cognitive and political resources (ibid.), using dialogic or participatory forms of public engagement in pursuit of deficit model goals. Similarly, activities like CS can be an important vehicle for democratizing science and promoting the goal of universal and equitable

access to scientific information (de Sherbinin et al., 2021), but they can also perpetuate power differentials when those who have labored on data collection are not in control of the data (Cooper et al., 2021). Infusing public engagement and participation activities with OS values to truly make science 'open' to all requires intentionally planning for public engagement and participation (Grand, 2012; Holliman, 2023). Simply put, there is no 'open' science without meaningful and intentional inclusion of diverse publics in scientific processes and practices.

2.4 Research questions

By analyzing 52 OS policy documents published in English, Portuguese, Spanish, Greek, and German between January 2020 and December 2022, our study aims to answer the following research questions (RQs):

RQ1: How is open science defined and conceptualized in OS policy documents?

RQ2: How and in what context are EDI mentioned in OS policy documents?

RQ3: How and in what context are public engagement and participation mentioned in OS policy documents?

In doing so, the study also examines whether the values of EDI and public engagement/ participation are operationalized via concrete and actionable items in these documents to reveal the extent to which they are *actually* prioritized by policymaking actors and whether or not they are treated as essential to advancing the OS agenda.

3.0 Methods

This study adopts a qualitative document research approach (Bowen, 2009), wherein thematic content analysis was used to examine the assumptions, values and discourses represented in OS policy documents released between 2020 and 2022. Previous research used similar research designs to examine OS policies across geographic lines (Albornoz et al., 2018; Manco, 2022b). As described by Bowen (2009), document analysis entails "finding, selecting, appraising (making sense of), and synthesizing data contained in documents" (p. 28). This data is subsequently organized into themes, categories and case examples related to the central questions of the research. To identify themes, we followed the thematic analysis approach outlined by Braun and Clarke (2012). We familiarized ourselves with the data and generated an initial set of codes that categorized available information from the policy documents, relying on NVivo12. We then reviewed and organized the themes, clustering similar codes. Finally, we named and structured all themes into coherent stories that addressed the objectives of this research.

3.1 Sample

Sampling in qualitative document research does not strive for completeness, but on including a wide array of documents, prioritizing quality and diversity of points of view over comprehensiveness (Low, 2019). The sample in our study comprises 52 OS stemming from Europe and the Americas, and published between January 1, 2020, and December 31, 2022. The aforementioned regions were chosen to reflect the regional expertise of our research team, while the timeframe was selected to reflect the most current state of OS policy and to extend previous research in this area. In line with previous research (Albornoz et al., 2018; Hämäläinen et al.,

2016), we defined policy documents as written documents that contain guidelines, rules, regulations, laws, principles or directions to put OS values and principles into practice. We included documents that sought to create or implement policy, or shape policymaking processes more broadly, including national plans, funder mandates, internal and external organization policies, and policy recommendations by professional organizations and international agencies. The documents included, intentionally encompass multiple geographies and multiple policy levels in order to capture the visions and priorities of various policy actors and examine how they play out in the policy arena. While the vast majority of documents in our sample are concerned explicitly with OS policy, we also included documents on public access to research and scientific data published during the pandemic period, as well as OA/OD policy documents by key stakeholders in the OS space (e.g., funders) in the absence of integrated OS policies published by said stakeholders. This methodological choice was made to capture the diversity of emerging nature of OS policy and with the understanding that the term 'open science' has varying uptake across regions and stakeholder groups. We excluded institutional policies by research institutions as they have been examined elsewhere (e.g., Manco, 2022b; Wakeling et al., 2022) and because including them would have made it difficult to achieve sufficiency, given the size of the geographic regions being investigated. Only documents published in a language our research team was familiar with—i.e., English, German, Greek, Portuguese, and Spanish—were included. That is, documents within Europe in a language not spoken by our research team (e.g., Serbian) were not included in the sample.

Still, over half of documents obtained were from Europe. Roughly one fifth were from international organizations and governing bodies, and the rest from the Americas (Table 1). Government ministries or departments published around 30% of the documents, while

multilateral organizations, academic associations and/or networks, national advisory bodies or coalitions, scientific organizations, and private or public funders each published less than 15% of the sample (Table 2). A full list of documents can be found in Appendix A.

Table 1. Distribution of documents by region

Region	No. of documents
Europe	29
International	10
North America	9
Latin America	4

Table 2. Distribution of documents by policy actor

Type of policy actor	No. of documents
Government ministries or departments	16
Multilateral organizations	8
Academic associations and/or networks	7
National advisory bodies or coalitions	7
Scientific organizations	7
Private/public funders	6

The outsized number of European stakeholders in our sample is in line with what Albornoz et al. (2018) found in their own analysis of OS policy documents. Europe's leading

role in OS policy development and implementation—e.g., via initiatives like the Open Science Policy Platform (OSSP), the European Open Science Cloud (EOSC), OpenAIRE, and cOAlition S—has also been noted in previous research (Abadal & Anglada, 2020). In addition to the uneven geographic distribution of the documents in our sample, regional differences can be observed in terms of the stakeholders involved in OS policy planning and implementation. For example, we identified several policy documents published by academic associations and scientific organizations in Europe, but almost no such documents in the Americas, where most documents identified were published by government ministries/departments and national advisory bodies. This may be in part due to our search strategy but is likely also indicative of OS being governed differently across different regions. Our search strategy is described in detail in the next section.

3.2 Search strategy

We searched for policy documents between July 2022–January 2023 using several sources including: Google.com, The Council for National Open Science Coordination, bibliographic databases (Policy Commons, Overton), Zenodo.org, the UN Digital Library, recommendations from subject matter experts and reference lists from relevant literature. We used keywords such as “open science,” “open research,” “policy,” and, “guidelines” to identify relevant documents, along with equivalents in Spanish, Portuguese, German, and Greek—the additional languages spoken by our research team. Because policy documents are often labeled using words such as “plan,” “guidelines” or “strategy,” we also included such synonyms in our search strategy. As our initial searches yielded few relevant results and we found pertinent documents to be widely dispersed around the web, we adopted a flexible search strategy.

Specifically, we identified and added new documents to our sample using a snowballing approach until we reached *information sufficiency*—that is, the point at which we felt that we had gathered enough data to answer our research questions (LaDonna et al., 2021; Vasileiou et al., 2018). Our search was not designed to be exhaustive but to be indicative of the nature and range of OS policies current at the time of research.

3.3 Data extraction and analysis

We adopted a hybrid approach using both inductive and deductive analysis (Auerbach & Silverstein, 2003). In the first step of the analysis, we reviewed and classified documents in NVivo according to region, country, type of document, type of policy actor and level of policy making. The first round of coding was deductive and was based on research questions or prominent themes in the literature. At this stage, simple nodes like "OS definitions," "proposed activities," "EDI" and "participation" were used to locate relevant sections within the documents and to get a better sense of the data. In subsequent coding rounds, we used an iterative, inductive approach to identify patterns and interrelationships in the data by means of thematic codes (Braun & Clarke, 2012), such that new codes and sub-codes were added, deleted and merged in each round of coding. All the coding was performed by the first and third authors. While the documents were loaded in NVivo in their original languages, coding was conducted in English to ensure comparability and data access for all authors. An excerpt from our codebook can be found in Appendix B.

4.0 Findings

4.1 Conceptualizations and definitions of Open Science

As discussed in the Literature Review, OS is often narrowly defined within policy documents, typically as synonym for OA and/or OD. Our analysis, however, draws a more nuanced picture. While the documents analyzed generally place OA and OD over other OS components—such as open peer review, CS, and OS education/skills development—many also adopt a broader, more inclusive view on OS. For example, in Europe, the *Lindau Guidelines for Global, Sustainable and Cooperative Open Science in the 21st Century* (2020) emphasize the importance of global cooperation, public-facing science communication, inclusion of marginalized scholars and capacity building. *SPARC Europe's Strategic Plan 2021–2024*, meanwhile, highlights open education—alongside OA and OD—as a core component of OS, and an area of major strategic focus for the organization. Along these lines, Slovakia's *National Strategy for Open Science 2021–2028* notes that OA "represents only one aspect of OS" (p. 9), listing open peer review, open-source software (OSS), OER and CS as examples. Similarly, in Argentina, national plans include a focus on investing in the "the generation and application of various specific tools—research, support, dissemination, public communication or other—for Citizen Science programs and projects" (p. 17). In Colombia, the national policy outlines a plan to

> implement a strategy of public communication of science directed at the different actors and institutions of the SNCTI [National System of Science, Technology and Information] and to the citizens in their territories, to promote participation in all the processes of generation and use of scientific and technological knowledge, as well as the dissemination and valuation of its results (p. 57).

The *UNESCO Recommendation on Open Science* (2021) also appears to have impacted how OS is framed and discussed in subsequent OS policy documents, particularly in Europe and Latin America. In Europe, the *Irish National Action Plan for Open Research 2022–2030*, *Slovakia's National Strategy for Open Science 2021–2028*, and Science Europe's *Open Science as Part of a Well-Functioning Research System* adopt UNESCO's definition and reference it several times throughout. In Latin America, Colombia's *National Policy for Open Science 2022–2031* and Argentina's 2022 guidelines for the development of a national OS policy (*Diagnóstico Y Lineamientos Para Una Política de Ciencia Abierta en Argentina*) are written in response to, and in concert with, UNESCO's Recommendation for Open Science. Overall, nine of 15 documents published after the UNESCO Recommendation adopt its definition of OS, the majority of which are national plans and policies. In addition, the Spanish Foundation for Science and Technology (FECYT)—while not referencing the definition directly—mentions that all actions included in its 2022–2024 Strategic Plan are based, amongst other, on the principles of the UNESCO Recommendation.

Some documents, however, take a narrower view, focusing on certain components or aspects of OS (e.g., open infrastructure, reproducibility) to the exclusion of others (e.g., citizen science, public engagement). The Greek *National Plan on Open Science*, for instance, notes that "Open Science is the new standard for practices, tools and collaboration for producing and distributing scientific output and research results, with a direct scientific, economic and social impact" (p. 2), emphasizing the importance of national infrastructures to the implementation and furthering of OS without mentioning aspects like science communication. The plan also frames OS as a way to increase Greece's national competitiveness—both within the European Union,

and more broadly—and to strengthen local opportunities for innovation. This framing is found across documents from mid- and lower-income EU countries.

Lastly, several European national OS plans that adopt a broader definition such as the one put forth by UNESCO (2021), ultimately focus on *actions* that promote OD, OA, and open infrastructure. That is, there is a clear disconnect in these documents between the broad definition of OS and what is prioritized in terms of implementation. For instance, Ireland's national OS plan notes that its vision for open research "align[s] with and support[s] UNESCO's definition of the core values of open research" (p. 4). Yet the three national priorities it outlines are to achieve "100%" OA for publicly funded research, to enable FAIR data principles, and to embed recognition and rewards for OS into academic policies and procedures.

4.2 Equity, diversity, and inclusion (EDI) in Open Science policies

Much like with definitions of OS, there is a mismatch between statements about the importance of EDI and the proposed actions or paths in most of the documents analyzed. These documents often include broad statements about the importance of OS for achieving a more just society, but advance policies and recommendations that address only a narrow subset of topics related to EDI. Specifically, documents focus on combating economic, geographic, institutional and career stage-related disparities, with little mention of other disparities (e.g., relating to language, gender, religion, etc.). Similarly, the documents tend to focus on the potential inequitable impacts of a few key developments: transformative agreements negotiated by research institutions, the APC-funded OA market, and commercial deals and market structures. Many also note that OS, if implemented too rigidly and universally, could perpetuate systemic inequalities by ignoring the needs of researchers in the Global South, smaller institutions, and

industry. In contrast, other developments with the potential to disadvantage particular groups—such as data-sharing mandates that ignore the needs of less well-resourced scholars, or CS projects that only seek to extract free labor from the public—are seldom mentioned, if at all. In other words, the OS policies we analyzed overwhelmingly embrace EDI in principle but fail to provide concrete guidance on how those values can be translated into practice.

This disconnect between stated values and suggested practice can be seen in the types of documents that most commonly mention EDI: position statements and guiding documents, rather than actual policies and interventions. EDI does feature prominently in some of these documents, such as the *UNESCO Recommendation on Open Science*, the *RDA COVID-19 Recommendations and Guidelines on Data Sharing* and France's *A Global Strategy for Open Science*. One document—ALLEA's statement *Equity in Open Access*—is dedicated exclusively to equity, noting that "issues of equity and diversity need to be central to any discussion of how the scholarly communication system should be structured" (p. 2).

This is not to say that EDI is not mentioned at all in other types of documents. EDI is mentioned in some national plans, but it is generally not emphasized as a strategic priority or a core component of OS—at least in Europe and North America. A notable exception is Netherland's *NPOS2030 Ambition Document*, which mentions EDI as one of the five "core principles" of OS and argues that "diversity, equity, and inclusiveness are crucial for the success of Open Science" (p. 5). Similarly, some of the Latin American documents examined also emphasize EDI as an essential aspect of OS, particularly in terms of inclusion of citizens and community stakeholders in OS processes and practices. For instance, the *Colombian National Policy for Open Science 2022–2031* lists equality of opportunities as a core principle, arguing

that OS "should strive to generate conditions for everyone to access scientific knowledge and other knowledge systems" (p. 36).

What can be seen more readily across many of the documents is an argument for the need to bridge disparities in access and outcomes caused by the unequal distribution of resources between the Global South and North, and between southern and northern countries of the European Union. The European University Association (EUA)'s *Open Science Agenda 2025*, for example, asserts that institutions and countries must receive the support they need "to make more OA progress, irrespective of their current situation," so that "everyone has the necessary resources to transition to OA" (p. 10). A similar sentiment is expressed in OSI's O*pen Science Roadmap: Recommendations to UNESCO*.

Relatedly, concerns about the marketization of OA are also common, with several documents calling for a move away from APCs, which are seen to disproportionately disadvantage researchers from certain disciplines or regions of the world, or those who are unaffiliated with an academic institution (Alperin, 2022). For instance, France's *A Global Strategy for Open Science* cautions against "generalizing this kind of model, which generates serious forms of inequality" (p. 6) within the global research community. It suggests that mechanisms that redeploy funds in favor of OS publishing without publication costs be explored instead. Similarly, Ireland's *National Action Plan for Open Research 2022–2030*, *BOIA20*, France's *A Global Strategy for Open Access* and Argentina's *Diagnóstico Y Lineamientos Para Una Política de Ciencia Abierta en Argentina* express strong support for inclusive publication and distribution channels, such as society and academic-led publishing initiatives, OA

repositories and OA journals without APCs. These documents also embrace the concept of bibliodiversity, which refers to

> supporting and promoting a diversity of publishing actors, a plurality of communication languages, publication formats or funding methods and a variety of levels of intervention (support for local initiatives created by communities) and points of view in a context of greatly varying constraints and capacities for action (Moreau, 2020, p. 7)

Related concepts of linguistic diversity and multilingualism are also mentioned in documents such as the *UNESCO Recommendation on Open Science*, *Open Science 2030 in the Netherlands*, *Diagnóstico Y Lineamientos Para Una Política de Ciencia Abierta en Argentina* and Ireland's *National Action Plan for Open Research 2022-2030.* For example, the *Second French Plan for Open Science* notes that the French government will "[e]ncourage multilingualism and the circulation of scientific knowledge by translating publications by French researchers" (p. 4). Additionally, the Irish and French documents acknowledge the Helsinki Initiative on Multilingualism in Scholarly Communication (2019), which advocates for the promotion of language diversity in research. Notably, especially considering the inclusion of documents from 20 non-English speaking countries, France is the only country that places a strong emphasis on multilingualism, both in its national OS plan and global OS strategy. Although, it should be said, its planned actions focus on extending the reach of French-language research, not encouraging French researchers to engage with science in multiple languages. Multilingualism, in other words, appears to be framed as a strategy for increasing France's global influence, and not a commitment to linguistically diverse research more broadly. Health Canada's *Open Science Action Plan* also integrates linguistic diversity in the context of the Official Languages Act (OLA), which was enacted in 1969 to ensure the promotion and

protection of Canada's two official languages, English and French. However, it does not make a case for the importance of integrating multilingualism or linguistic diversity into OS practices and processes more broadly.

Lastly, factors like race, age, disability status and gender are hardly mentioned, and when they are, it is only in passing. The same is true of Indigenous inclusion and Indigenous rights (specifically, data rights), which are only discussed explicitly in two of 52 documents (the *RDA COVID-19 Recommendations and Guidelines on Data Sharing* and the *UNESCO Recommendation on Open Science*) and mentioned in passing in two others (Canada's *Roadmap for Open Science* and Health Canada's subsequent *Open Science Action Plan*).

4.3 Participation and engagement with science in Open Science policies

Overall, the documents analyzed recognize the importance of public engagement with science, but the extent and ways in which they do vary widely. Interestingly, while societal engagement is frequently mentioned among the justifications for OS, the public is not always recognized as a key stakeholder of OS. That is, members of the public are more frequently described as potentially *benefiting from,* rather than *contributing to,* OS—aligning with a deficit model of public engagement (a notable exception here are the guidelines published by Argentina's Open Science and Citizen Science Advisory Committee in 2022). This is also reflected in proposed actions and activities, which tend to emphasize providing access to scientific information rather than promoting meaningful participation in scientific endeavors. Policies emerging from Latin America appear more concerned with citizen engagement and involvement compared to other regions, though, due to the sample size, it is hard to draw conclusions that extend beyond the specific documents we analyzed.

Across the documents, it is generally acknowledged that scientists have an ethical and moral responsibility to share knowledge with the public in an accessible manner. For example, the *Lindau Guidelines* suggest that "[s]cience has a distinct responsibility to communicate its procedures and results to society" (p. 5). Furthermore, as discussed above, the *UNESCO Recommendation on Open Science* mentions science communication and open engagement of societal actors as key pillars of OS. In response to UNESCO, *The EUA Open Science Agenda 2025* acknowledges global efforts "to open the whole research process and bring it closer to society," adding that "EUA will consider opportunities to help its members engage in activities fostering participatory science and openly involving different societal actors, as recommended by UNESCO (p. 15).

To integrate citizens in OS, only a few documents emphasize the need to design and implement effective and inclusive science communication strategies beyond academia. For example, Colombia's national OS policy includes amongst its strategic priorities the implementation of a science communication plan that "promotes participation in all processes of scientific and technological production, dissemination and use" (p. 50) for scientists and citizens alike. Within the few documents that mention science communication, most position it as a way of improving public epistemic trust (Wynne, 2006), which is often framed as a critical issue in contemporary societies (Jamieson et al., 2019; Weingart, 2022).

In terms of *forms* of participation and engagement described in the documents, CS is by far the most common. CS is mostly mentioned in national plans and related national-level documents, with some governments (mostly in Latin America and Eastern Europe) emphasizing it more than others. The benefits ascribed to CS include community development, increasing

public trust and interest in science, fostering scientific literacy, and increasing the social relevance of research. Additionally, in documents stemming from Eastern Europe, CS is framed as contributing to national development and reducing disparities between different regions within Europe. However, some documents suggest that the primary goal of CS activities is to aid researchers in their work, using hierarchical language that places scientists in power over laypeople. For example, Hungary's *Position Paper on Open Science* defines CS as an area of OS "where researchers and research communities take the initiative to involve citizens, local communities and the wider society in certain research processes" (p. 6), while the Slovakian *2021–2028 National Strategy for Open Science* notes that "citizen science projects are carried out under the guidance of researchers" (p. 32). The Slovak plan is one of few European documents that proposes concrete plans for fostering CS, including creating educational materials, engaging students in CS projects and building a network of cooperation and support for Slovak CS initiatives. The interlinkage of CS with traditional and Indigenous knowledge systems (Albagli et al., 2018; Bhawra et al., 2022; Reyes-García et al., 2021).

Much like with the documents' treatment of EDI, we observed a disconnect between abstract support for participation/engagement and the activities proposed to achieve it. For example, Montenegro's national OS plan (2020) mentions "collaboration and participation of society" as a key tenet of OS and notes that "Open Science entails a fundamental paradigmatic change where scientific quality implies much more than the published scientific publications" (p. 10). However, it distinguishes between 'primary' pillars of OS (OA, OD and open infrastructure) and 'secondary' ones (open methods, open source, open education and citizen science) and organizes its planned activities and operational goals and performance indicators purely around the primary pillars. Additionally, the plan does not list the public among its key OS stakeholders.

Similarly, Canada's *Open Science Roadmap* mentions public engagement third among its justifications for OS, yet the proposed actions it recommends focus almost exclusively on OA, OD and scientist-to-scientist communication. Meanwhile, Ireland's *National Action Plan for Open Research 2022–2030* mentions developing "commitments to embed, within Irish RPOs, the engagement of citizens, broad publics and the end users of research across the entire research process" (p. 13). However, the document ultimately highlights the need to re-examine rewards and recognition structures to fuel cultural and behavioral changes toward OS—not to foreground public engagement and participation in pursuit of openness.

Nevertheless, several documents illustrate an ongoing effort to include citizens as active stakeholders in the OS ecosystem. NPOS's *Open Science 2030 in the Netherlands* argues that in order to "create a sustainable and equitable system of knowledge creation and sharing, societal stakeholders should be included in [the] transition [to OS]" (p. 14) and encourages the use of public engagement and CS projects. The White House Office of Science and Technology Policy's *Breakthroughs for All: Delivering Equitable Access to America's Research* similarly notes that

> [a]ll members of the American public should be able to take part in every part of the scientific enterprise—leading, participating in, accessing, and benefitting from taxpayer-funded scientific research.

5.0 Discussion & Concluding Remarks

The OS movement aims to "make scientific research from all fields accessible to everyone" (UNESCO and Canadian Commission for UNESCO, 2022, p. 2) in pursuit of a scientific system that is not only more efficient, but also more equitable, transparent and

beneficial to both science and society (Levin et al., 2016). Yet, our analysis of 52 OS policy documents from three geographic regions suggests that there is a lack of policy response for how to turn this vision of an inclusive and participatory scientific system into reality. That is, our results suggest that existing OS policies—while supportive of a wider, more inclusive approach to openness in theory—fail to provide stakeholders with the guidance needed to put that approach into practice. This lack of concrete guidance is surprising given the importance given to EDI by funders and research institutions (*Our Commitment to Tackling Racism at Wellcome | Statements*, 2020; Tamtik & Guenter, 2019; Wolbring & Nguyen, 2023) increasing calls for public engagement in science (Katapally, 2020; Nair-Bedouelle, 2023; Tan et al., 2022) and well-documented concerns about the potential for OS to contribute to inequities in science (Bahlai et al., 2019; Dominik et al., 2022; Ross-Hellauer et al., 2020). It is also detrimental to scientists' and institutions' ability to implement practices and strategies that foster more equitable and inclusive outcomes for all communities OS purports to serve.

Our study is, to our knowledge, the first to examine EDI and public participation in OS policy—two dimensions of OS that are seen by many as essential for democratizing science, but which have received little attention within the policy context until now. It is also one of the few to simultaneously analyze multiple geographies and multiple levels of policy design and implementation, offering insights into the visions, goals, and priorities of different actors in the OS policy landscape. While our sampling approach limits our ability to make broad generalizations, it does allow us to see both commonalities and differences across regions. The sourced documents were linguistically and geographically diverse, stemming from 24 countries across North America, Europe, and Latin America—three regions with unique histories and approaches to OS. We found that OS policies in Europe and North America focus on increasing

international and transdisciplinary collaboration and developing more effective data sharing systems in order to promote scientific transparency and integrity, further innovation and enhance national competitiveness. In contrast, Latin American policies focus more on building national capacities and infrastructure with and through OS, emphasizing efforts to address participation and equity among citizens. As such, the findings of our study illustrate how countries across various regions emphasize OS differently, responding to national goals (e.g., France's efforts to increase its global influence) and contexts (e.g., the prevalence of CS in Argentina). In highlighting these nuances, our research provides evidence that—despite the influences of one-size-fits-all types of OS governance exemplified through developments like Plan S—policymaking efforts remain responsive to and shaped by local contexts to some degree. In doing so, this study highlights the importance of context-specific tensions and gaps within OS policy that warrant further exploration—ideally through analyses of larger and more representative samples.

With respect to definitions of OS, we observed a stark disconnect between how openness is conceptualized in the documents and what is prioritized in terms of action and implementation. That is, many of the documents advance broad definitions of OS that foregrounded engagement with non-academic actors (often drawing on the definition provided in the *UNESCO Recommendations on Open Science*), but recommend a narrow set of actions focused predominantly on a small subset of open practices, namely OA, OD and open infrastructure. This may change in the coming years with the release of UNESCO's Open Science Toolkit, which provides practical information for supporting the implementation of its 2021 landmark recommendation documentation—along with the wider diffusion of UNESCO's 'equitable and inclusive OS' discourse. Yet, the tendency we observed in the documents to select specific

aspects of OS and frame them as urgent priorities, whilst leaving other aspects unaddressed, suggests that this change may require active reorienting of policies rather occurring organically.

Similarly, although equity, diversity and inclusion were often described as important goals of OS, the documents primarily addressed concerns about APC-based models of OA and the potential for OS to perpetuate existing inequalities between researchers in the Global North and Global South. To be sure, these are both important issues that warrant consideration in OS policy, but the outsized attention they received may have come at the expense of broader equity-related concerns. Noteworthy is the lack of emphasis on linguistic diversity in the documents, given that scholars have long argued for the importance of communicating scientific findings in local languages in order to combat knowledge inequities within academia (Hultgren, 2019) and foster wider societal impact (Márquez & Porras, 2020). Similarly notable is the lack of discussion around inclusion of Indigenous and non-Western knowledge in OS practices and methods despite ongoing efforts—led primarily but not exclusively by UNESCO—to help "bring about a fair, decolonial Open Science" (Chan, Hall, Piron, et al., 2020, p. 1) that serves all people, rather than the interests of a select few.

Along similar lines, the documents often framed widened *access to* research outputs (e.g., OA journal articles, open datasets) as the main—and often only—public benefit of OS. Moving beyond access to ensure that the public can effectively engage with and utilize such outputs was rarely treated as a priority. Instead, documents largely focused on providing material access (i.e., making articles and data open), overlooking the importance of conceptual access (i.e., understandability) for the public to really benefit from science (Kelly & Autry, 2013). Most documents also failed to outline opportunities for the public to productively participate in

research design and analyses. Of those that did present concrete recommendations for encouraging public engagement, CS was by far the most common means for doing so. However, even in these cases, the documents predominantly framed scientists, rather than citizens, as the primary beneficiaries of CS.

More broadly, we found that public engagement and participation are predominantly framed as a way to build public trust—and thus maintain science's cultural power and authority—rather than incorporate citizens' unique perspectives, experiences, knowledge and expertise into science. This has allowed us to show how OS policy documents often claim to support social justice and inclusivity in science and society, but still perpetuate longstanding power imbalances between scientists and the public (Wynne, 1992, 2006). Specifically, the documents illustrate how OS policies—much like traditional science communication efforts—operate within the long-critiqued deficit model of knowledge transfer (Bucchi, 2008; Simis et al., 2016). That is, they advance a vision of a public that lacks the knowledge or skills needed to contribute meaningfully to science, rather than one with unique knowledge and experiences that could enrich and broaden scientific understanding.

This lack of prioritization of both EDI and public engagement/participation in OS policy documents arguably limits the democratic and emancipatory potential of OS. Part of the current enthusiasm about OS stems from its promises to reform scientific practice in service of the common good, to ensure that scientific findings serve the interests and needs of diverse communities and to enhance scientific impact on policy and society (Nair-Bedouelle, 2023). This necessitates moving beyond a focus on improving access to research outputs and recognizing the public as an important actor in science and innovation. However, the reality we documented

provides further evidence that OS policies overwhelmingly focus on making research outputs (e.g., publications and data) publicly accessible (Albornoz et al., 2018; Levin & Leonelli, 2017; Manco, 2022a). neglecting to advance the two aspects of OS that hold the key to achieving a more fair, participatory, and inclusive scientific culture—namely, *equity, diversity and inclusion* and *public participation and engagement*.

From a practical perspective, our findings highlight the need for policies and guidelines that go beyond merely mentioning principles of equity and inclusion and instead provide concrete guidance toward advancing the OS movement's stated goal of making science open to all (European Comission, n.d.; UNESCO, 2021). Rather than normalizing OS practices like OA and OD first and promoting EDI and public participation efforts second, we argue that these incentives and guidelines must be provided and implemented concurrently. Ideally, equitable and inclusive OS policies would be developed in partnership with diverse stakeholders—including scholars of different backgrounds and lived experiences but also other societal actors. As has been suggested by other scholars (Levin et al., 2016; Lilja, 2020; Reyes-García et al., 2021), and as is backed up by our findings, such policies will need to be context-specific to accommodate the different priorities and realities found across countries and regions. Until policies that prioritize the inclusion and participation of more diverse actors are developed, the OS movement will not be able to truly deliver on its promise to democratize research knowledge.

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Conflicts of Interest

We have no conflicts to declare.

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Appendix A. List of OS policy documents analyzed

Document	Actor	Region	Type of document	Country	Level	Year	Type of actor
Manifesto for EU COVID-19 Research	Directorate-General for Research and Innovation (European Commission)	Europe	Statement	NA	International	2020	Multilateral Organization
EUA Open Science Agenda 2025	European University Association	Europe	Strategic Plan	NA	Organizational	2022	Academic Association
National Open Science Plan of Bulgaria	Ministry of Education and Science (MES), Bulgaria	Europe	National Policy/ Plan	Bulgaria	National	2021	Government Ministry
Position Paper on Open Science	National Research, Development and Innovation Office (NRDI Office)	Europe	Position Paper	Hungary	National	2021	Government Ministry
CERN Open Science Policy	CERN	Europe	Organizational Policy	Switzerland	Organizational	2022	Scientific Organization
Declaration for Open Science and Research (Finland) 2020-2025	The Committee for Public Information (TJNK) and Federation of Finnish Learned Societies (TSV)	Europe	Declaration	Finland	National	2020	Academic Association
Model Policy on Open Science for Research Performing Organisations (RPOs)	OpenAIRE	Europe	Recommendations/ Guidelines	NA	International	2021	Multilateral Organization
National Open Access Policy Malta	Malta Council for Science and Technology (MCST)	Europe	National Policy/ Plan	Malta	National	2021	National Advisory Body
Open Science 2030 in the Netherlands: NPOS Ambition Document	National Programme Open Science (NPOS)	Europe	National Policy/ Plan	Netherlands	National	2022	Government Ministry

Estrategia de Fecyt en Ciencia Abierta	La Fundación Española para la Ciencia y la Tecnología (FECYT)	Europe	Strategic Plan	Spain	National	2022	Public Foundation
Second French Plan for Open Science	Ministry of Higher Education and Research (Ministère de l'Enseignement supérieur), France	Europe	National Policy/ Plan	France	National	2021	Government Ministry
Politica Nacional de Ciencia Aberta Em Portugal Recomendacoes Do Grupo de Trabalho Sobre Avaliacao Cientifica	Government of Portugal, Ministry of Science, Technology and Higher Education (MCTES	Europe	Recommendations/ Guidelines	Portugal	National	2022	National Advisory Body
Überlebensfrage - und Beispiel für offene Gesellschaft; Globale offene Wissenschaftskooperation im Zuge der Covid-19 Pandemie	Deutsche UNESCO Komission	Europe	Statement	Germany	National	2020	Multilateral Organization
UKRI Open Access Policy	UK Research and Innovation (UKRI)	Europe	Funder Policy	United Kingdom	National	2021	National Funding Agency
Open Science As Part of a Well-Functioning Research System	Science Europe	Europe	Strategic Plan	NA	International	2022	Scientific Organization
Porgramme of Implementation of Open Science Principles in Montenegro 2020 - 2021	Government of Montenegro	Europe	National Policy/ Plan	Montenegro	National	2020	Government Ministry
Declaration of the National Open Science Cloud nosci.mk	National Open Science Cloud, Northern Macedonia	Europe	Declaration	North Macedonia	National	2021	National Coalition

Declaracion a Favor Del Conocimiento Abierto Y Sostenible	Multiple academic organizations	Europe	Statement	Spain	National	2020	Academic Network
SPARC Europe's Strategic Plan 2021-2024	SPARC	Europe	Strategic Plan	NA	Organizational	2021	Advocacy Organization
Open Access in Horizon Europe	CESAER	Europe	Statement	NA	International	2020	Academic Association
National Plan for Open Science in Greece	Greek Open Science Task Force	Europe	National Policy/ Plan	Greece	National	2020	National Advisory Body
Richtlinie zur Förderung von Projekten zur Beschleunigung der Transformation zu Open Access	Federal Ministry of Education, Science and Research of Austria (Bundesministerium für Bildung, Wissenschaft und Forschung)	Europe	Recommendations/ Guidelines	Austria	National	2020	Government Ministry
ALLEA Statement Equity in OA	Open Science Taskforce, European Federation of Academies of Sciences and Humanities	Europe	Statement	NA	International	2021	Academic Association
National Strategy for Open Science 2021-2028	Minister of Education, Science, Research and Sport of the Slovak Republic	Europe	National Policy/ Plan	Slovakia	National	2021	Government Ministry
National Open Science Plan Ukraine	Ministry of Education and Science of Ukraine	Europe	National Policy/ Plan	Ukraine	National	2022	Government Ministry
National Action Plan for Open Research	Department of Further and Higher Education, Research, Innovation and Science	Europe	National Policy/ Plan	Ireland	National	2022	Government Ministry

Wellcome Open Access Policy	Wellcome	Europe	Funder Policy	United Kingdom	National	2021	Private Funder
Joint Statement by CESAER, EUA, and Science Europe on Authors' Rights	CESAER, EUA & Science Europe	Europe	Statement	NA	International	2021	Scientific Organization
A Global Strategy for Open Science	Ministère français de l'Enseignement supérieur, de la Recherche et de l'Innovation	Europe	National Policy/ Plan	France	National	2020	Government Ministry
RDA COVID-19 Recommendations and Guidelines on Data Sharing	Research Data Alliance	International	Recommendations/ Guidelines	NA	International	2020	Multilateral Organization
Call for Open Access to COVID-19 Publications	Chief Science Advisors from 16 countries	International	Call to Action	NA	International	2020	National Advisory Body
Lindau Guidelines 2020	Global Young Academy	International	Recommendations/ Guidelines	NA	International	2020	Scientific Organization
Sorbonne Declaration on Research Data Rights	Sorbonne University, the University of Amsterdam (UvA) and University College London (UCL)	International	Declaration	NA	International	2020	University Association
Joint Appeal for Open Science	UNESCO, CERN, WHO & UNHCR	International	Statement	NA	International	2020	Multilateral Organization
BOAI20 – Budapest Open Access Initiative	Budapest Open Access Initiative/ Open Society Foundations	International	Recommendations/ Guidelines	NA	International	2022	Private Funder
UNESCO Recommendation on Open Science	UNESCO	International	Recommendations/ Guidelines	NA	International	2021	Multilateral Organization
WHO Policy on Open Access	WHO	International	Organizational Policy	NA	Organizational	2021	Multilateral Organization

Sharing Research Data and Findings Relevant To the Novel Coronavirus (COVID-19) Outbreak	Wellcome	International	Statement	NA	International	2020	Multiple Organizations
Action Plan for Diamon Open Access	Science Europe, cOAlition S, OPERAS, and the French National Research Agency (ANR)	International	Recommendations/ Guidelines	NA	International	2022	Scientific Organization
Politica Acceso a Informacion Cientifica 2022	Chilean National Agency for Research and Development (Agencia Nacional de Investigación y Desarrollo de Chile)	Latin America	National Policy/ Plan	Chile	National	2022	Government Ministry
Colombia National Policy for Open Science 2022-2031	Ministry of Science and the National Planning Department, Colombia	Latin America	National Policy/ Plan	Colombia	National	2022	Government Ministry
Diagnostico Y Lineamientos Para Una Politica de Ciencia Abierta en Argentina	Comité Asesor en Ciencia Abierta y Ciudadan, El Ministerio de Ciencia, Tecnología e Innovación de Argentina	Latin America	Recommendations/ Guidelines	Argentina	National	2022	National Advisory Body
Policy for Open Access to Publications Resulting from FAPESP Grants and Scholarships	São Paulo Research Foundation (FAPESP)	Latin America	Funder Policy	Brazil	National	2021	National Funding Agency
Final NIH Policy for Data Management and Sharing	National Institutes of Health, U.S. Department of	North America	Funder Policy	USA	National	2020	National Funding Agency

	Health and Human Services						
Statement on NIH plans to speed access to federally funded research results	National Institutes of Health, U.S. Department of Health and Human Services	North America	Statement	USA	Organizational	2020	National Funding Agency
A Call for Public Access to Monkeypox-related Research and Data OSTP The White House	The White House	North America	Call to Action	USA	International	2022	Government Ministry
Breakthroughs for All Delivering Equitable Access to America's Research	The White House, OSTP	North America	Statement	USA	National	2022	Government Ministry
Health Canada's Open Science Action Plan	Health Canada, Government of Canada	North America	Action Plan	Canada	Organizational	2021	Government Ministry
Open Science Roadmap: Recommendations to UNESCO	Open Scholarship Initiative (OSI)	North America	Recommendations/ Guidelines	USA	International	2020	Scientific Organization
Public Access Is Not Open Access	American Association for the Advancement of Science (AAAS)	North America	Organizational Policy	USA	Organizational	2022	Scientific Organization
Executive Order on Ensuring a Data-Driven Response to COVID-19 and Future High-Consequence Public Health Threats	The White House	North America	Executive Order	USA	National	2021	Government Officer
Roadmap for Open Science	Government of Canada	North America	Recommendations/ Guidelines	Canada	National	2020	Government Ministry

Appendix B. Codebook excerpt

Code	Sub-code	Description
Civic engagement and participation	Passive benefit	Citizens benefit indirectly from open science efforts
	Communication	Importance of communicating science efforts to citizens
	Education	Role of education in efforts to build open science ecosystems
	Citizen science	Citizen science as an element of open science
	Stakeholders	Citizens as key active actors in open science ecosystems
EDI	Disabilities	Role of physical or mental disabilities on open science
	Disciplines	Disciplinary inequities across open science
	Economic status	Barriers to participate in open access due to on economic status
	Gender	Gender inequities on open science
	Geographical location	Geographical barriers to participate in open science
	Indigeneity	Efforts to recognize, embrace, and promote indigenous peoples in open science
	Language	Language barriers and efforts in open science
	Race	Race inequalities on open science

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