Implementing the UNESCO Open Science Recommendation: Common but Differentiated Actions

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Abstract

The UNESCO Open Science Recommendation, as an international normative instrument, has elicited strong reactions at the international level. This article aims to briefly introduce the development history, connotations, and principles to be followed of the UNESCO Open Science Recommendation, thereby assisting relevant stakeholders in correctly understanding the value of open science and participating in the implementation of this Recommendation at the national level and within the global network. The article analyzes potential challenges that may arise during the national-level implementation of the Open Science Recommendation. As open science can serve as a long-term tool oriented towards new paradigms of future science, this paper further proposes recommendations that may serve as references for formulating implementation plans for the Open Science Recommendation at the national level.

Full Text

Preamble

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Abstract

As an international normative instrument, the UNESCO Recommendation on Open Science has generated strong resonance at the global level. This article aims to briefly introduce the drafting history, essential meaning, and guiding principles of the UNESCO Recommendation on Open Science to help relevant

stakeholders properly understand the value of open science and engage in its implementation at the national level and within the global open science network. The article analyzes potential challenges that may arise during national-level implementation. Open science can serve as a long-term tool oriented toward a new paradigm of future science, and this paper further proposes reference recommendations for developing national-level implementation plans for the Recommendation.

Keywords: UNESCO Recommendation on Open Science; Implementation; Recommendations

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The COVID-19 pandemic has ushered the world into a new reality, creating an urgent need for timely solutions to accelerate global scientific cooperation and build an open innovation ecosystem worldwide. In November 2021, at its 41st General Conference, UNESCO adopted the *UNESCO Recommendation on Open Science*, establishing an international normative instrument for Member States to pursue open science. This Recommendation thus sets forth a vision for a new scientific research paradigm with profound implications for international scientific cooperation, narrowing knowledge gaps, and sharing global innovation resources.

Pursuant to UNESCO General Conference resolutions, Member States must submit national reports every four years that align with the Recommendation' s requirements within their respective legal frameworks. To actively participate in this UNESCO-led global initiative and integrate into the worldwide open science network, it is necessary to introduce the development process, value, and main contents of this international normative instrument to fully comprehend the definition of open science and its basic requirements as articulated in the document. This article analyzes and reflects on the inclusivity of the open science normative instrument, aiming to propose corresponding strategies and recommendations to inform future development of national-level open science implementation plans.

1. Drafting Process of the International Normative Instrument

At the 40th UNESCO General Conference in 2019, delegates discussed open science and recognized that it would increase access to knowledge, improve research efficiency, and make scientific processes more transparent, collaborative,

and inclusive. Consequently, the 193 Member States passed a resolution tasking UNESCO with preparing and drafting an international normative instrument in the form of a Recommendation on Open Science—namely, the *UNESCO Recommendation on Open Science*—to be submitted for discussion and adoption at the 41st UNESCO General Conference in 2021.

Following the roadmap for drafting the open science Recommendation outlined by the General Conference [Figure 2: see original paper], UNESCO first established an International Advisory Committee on Open Science. Based on principles of geographic balance and gender equality, the UNESCO Director-General appointed 24 experts nominated by regional groups and 6 experts recommended by major research institutions related to open science. Together, they formed the International Advisory Committee to provide consultation and draft the initial version of the Recommendation. Second, UNESCO organized global and regional multi-stakeholder consultations and negotiations through online platforms. Over nearly a year of research at global and regional levels, UNESCO collected opinions and suggestions on the definition of open science, common principles and values, key objectives, scope of the Recommendation, practices and policies, potential challenges, the role of open science under COVID-19, and major stakeholders—all of which enriched the draft content of the Recommendation.

The global online consultation involved an extensive range of individuals and institutions, with 2,900 participants from 133 countries contributing suggestions and feedback. Respondents represented government agencies, major research institutions, scientific societies, relevant UN agencies, UNESCO chairs, UNESCO Category 2 centers, UNESCO National Commissions, and related public and private institutions. Many influential scientists, young scholars, researchers, citizens and traditional knowledge holders, library and open access platform personnel, indigenous peoples, data experts, cryptographers, publishers, engineers, entrepreneurs, lawyers, and policymakers participated. Concurrently, UNESCO held thematic meetings addressing topics such as open science and youth, indigenous peoples, Africa, COVID-19, and intellectual property. The findings from these consultations further refined subsequent drafts of the Recommendation. In September 2021, approximately 40 Member States provided feedback on the draft Recommendation.

In May 2021, UNESCO convened an open-ended online meeting of the Intergovernmental Special Committee. Technical and legal experts provided opinions and suggestions that shaped the revised version of the Recommendation, which was finalized and submitted to the 41st General Conference. The development of this international normative instrument was conducted through consultative, transparent, and inclusive processes, with the final content representing the maximum consensus acceptable to Member States. It provides a non-binding international framework to overcome digital, technological, and knowledge divides between developed and developing countries, reduce existing inequalities in science and technology, and accelerate implementation of the 2030 Agenda

for Sustainable Development.

2. Response to the Open Science International Normative Instrument

After two years of preparation and drafting, the *UNESCO Recommendation on Open Science* was reviewed and adopted at the 41st General Conference. During the conference, representatives from 49 countries and 3 international organizations spoke in support of the Recommendation. Member State representatives unanimously reaffirmed the importance of open science for advancing science and benefiting society, commending UNESCO' s contribution to developing this international normative instrument. The historic significance of this instrument lies in its potential to reduce scientific and technological gaps between and within countries, promote international scientific cooperation, and make science more inclusive, transparent, collaborative, and accessible. Inclusivity remained a crucial principle throughout the drafting process. Some delegates expressed their desire to implement the Recommendation promptly, while others noted they were already developing relevant strategies and taking actions aligned with its principles.

Regarding implementation, several delegates emphasized that "solidarity" and "enhanced international cooperation" would be key to success, alongside considerations of capacity building for open science, complementarity between open science and intellectual property, and investment in scientific research. Member States stressed the principle of equal access to data, information, and technology regardless of nationality, gender, or belief. Some delegates raised concerns about trade restrictions on scientific exchanges, a view supported by representatives of certain countries.

The strong support and adoption of the open science normative instrument by Member States reflects not merely an emphasis on open science itself, but a recognition of the fundamental importance of science. Using open science to narrow gaps among Member States and regions and to promote innovative practices represents a forward-looking initiative. Delegates acknowledged that UNESCO has made a monumental contribution to the field of science by targeting the core of science' s future and humanity' s future, creating conditions for science to foster world peace.

The General Conference requested the UNESCO Director-General to support international cooperation in open science, including by strengthening existing open science platforms and encouraging South-South and North-South cooperation. During the debate, the International Science Council, World Federation of Scientific Workers, and International Association of University Professors and Lecturers explicitly expressed support for the Recommendation and called for its swift implementation.

3. Connotation of the Open Science International Normative Instrument

As a normative instrument, the Recommendation provides a definition of open science, core values, guiding principles, and priority areas for action. It frames the vision of open science as "a new paradigm where scientific information, data, and outcomes are more accessible and reliably usable (open access and open data) through the active engagement of all stakeholders (open to society). By encouraging closer alignment between science and societal needs and promoting equal opportunities for all—scientists, policymakers, and citizens—open science can truly transform the landscape, narrow gaps in science, technology, and innovation between and within countries, and fulfill the human right to science." This vision represents an ideal state, envisioning a transition from a closed, isolated, individualistic system to one that is participatory, interconnected, shared, and innovative. The pathway to achieving this vision is problem-oriented, addressing issues at the interface of science and societal needs through open access to data, information, and outcomes; shared research processes and facilities; and ensuring that all people, including marginalized and vulnerable groups, benefit equally from open science.

The Recommendation emphasizes that the core values of open science are quality and integrity, collective benefit, equity and fairness, and diversity and inclusiveness. Quality, as understood in the Recommendation, necessarily implies high research efficiency. Common concerns such as intellectual property, private sector participation, and research integrity have been adequately addressed in the document.

Open science encompasses four main dimensions: open scientific knowledge, open science infrastructures, open engagement of societal actors, and open dialogue with other knowledge systems. The Recommendation not only provides a universal definition of open science but also outlines its values and principles, proposing seven priority areas to facilitate fair and equitable implementation of open science for all at individual, institutional, national, regional, and international levels: (1) promoting common understanding of open science and its benefits and challenges, and enabling diverse pathways to open science; (2) creating a policy environment conducive to open science; (3) investing in open science infrastructures and services; (4) investing in human resources, training, education, digital literacy, and capacity building for open science; (5) fostering a culture of open science and aligning incentives; (6) promoting innovative approaches to open science at different stages of the scientific process; and (7) promoting international and multi-stakeholder cooperation in the context of open science, with a focus on narrowing digital, technological, and knowledge gaps.

Open science is a tool for addressing the complex and interconnected environmental, social, and economic challenges facing humanity and the planet—this is its essence. For global challenges, more open, transparent, collaborative, shared,

and inclusive scientific research, combined with scientific knowledge that is more accessible and verifiable, yields greater efficiency. This significantly enhances research quality, reproducibility, transparency, and impact, thereby strengthening decision-making effectiveness and research integrity. UNESCO emphasizes the use of interdisciplinary approaches to problem-solving and respect for cultural and knowledge system diversity, which aligns with the content of the Recommendation.

Member States are the primary implementers of the Recommendation, and the most feasible approach is to build upon and strengthen existing successful experiences within Member States, with UNESCO providing intellectual and coordination support to implement the priority areas together. Implementation of the Recommendation will help achieve UNESCO' s Medium-Term Strategy objective of "strengthening Member States' capacity to improve science, technology, and innovation policies and increasing access to information on scientific and technological advances, including through knowledge sharing via open science."

4. Implementation Principles of the Open Science International Normative Instrument

Inclusivity is a fundamental principle of open science, applied not only during the drafting process but also equally important during implementation. A full understanding of inclusivity reveals that differences exist in how open science is implemented. Openness is an essential characteristic of science and a requirement of our times. Open science establishes a fair, shared, and collaborative research environment where stakeholders can collaborate and participate, scientific outputs and knowledge creation processes are accessible, and research facilities are available for evaluation and reuse. This undoubtedly provides an effective solution for accelerating knowledge integration, facilitating exchange between different knowledge systems, and mobilizing collective strength to address major global challenges such as pandemics, climate change, biodiversity loss, and environmental degradation. The open science international normative instrument contributes to achieving sustainable development goals and improving human well-being.

The priority areas proposed in the Recommendation serve as themes or platforms for international bilateral and multilateral scientific cooperation, representing a new covenant for international scientific collaboration and a common topic for in-depth exchange of knowledge and experience. For example, by leveraging existing transnational, regional, and global cooperation mechanisms and organizational models, the Recommendation promotes and incentivizes cross-border multi-stakeholder cooperation on open science, using interdisciplinary knowledge, reliable information and data accessible to all, infrastructures and platforms, and science- and knowledge-based decision-making to jointly address complex and interconnected global problems and challenges.

Open science is a powerful tool available across generations and a complex solu-

tion to intricate problems. The open science international normative instrument represents a consensus forged through inclusive, consultative, and transparent processes involving both scientists and non-scientists, necessarily taking into account differences at international, national, and regional levels. If future science and research can bridge digital, technological, gender, and knowledge gaps under more inclusive, collaborative, and equitable conditions, then this Recommendation will have truly fulfilled its purpose, heralding a new era of science for all and becoming a visionary, historic decision. The priority areas listed in the Recommendation are sufficiently inclusive, but in specific practices, actions, strategies, and policy formulation, adherence to open science values and principles must be ensured. Focusing on differences in concrete actions with these values at the center will prevent open science from repeating the mistakes of traditional closed scientific systems.

Open science is not a one-size-fits-all strategy. For instance, how to achieve equity and equality, and how to adopt collaborative, inclusive, and innovative approaches will pose challenges in implementation. Narrowing digital, technological, and knowledge gaps requires creating and accumulating mature conditions for transitioning to open science within countries.

Inclusivity means recognizing differences between countries, disciplines, and regions, and more importantly, understanding that domestic transition toward open science is a long-term process. Whether in developed or developing countries, transforming and opening the entire scientific research process and changing the scientific paradigm requires accumulating mature conditions. Therefore, the Recommendation advises Member States to adopt appropriate measures consistent with their institutional and governance models, including legal approaches, to implement the Recommendation' s principles within their jurisdictions. Member States' quadrennial periodic reports serve as the primary means of understanding global implementation progress.

5. Recommendations for Implementing the Open Science Recommendation

To fully embody the common values proposed in the Recommendation, develop inclusive, participatory, and effective national open science plans, promote international scientific cooperation, and build a sustainable open science system, many factors must be coordinated and numerous barriers overcome in practice. These include sustained investment in open science infrastructures; capacity building that recognizes digital era requirements and conducts targeted research, education, and training based on the principles outlined in the Recommendation; and developing feasible incentive mechanisms to promote research transparency and reproducibility that genuinely differ from existing academic recognition systems. Therefore, national-level implementation requires research and breakthroughs in policy, infrastructure, open mechanisms, capacity building, evaluation, and demonstration standards.

5.1 Creating a Policy Environment Conducive to Open Science

Within existing legal and regulatory frameworks, establish cross-ministerial and cross-sectoral national coordination and communication mechanisms for open science. Develop effective national open science policies and implementation plans. During policy formulation, account for regional differences in culture, economy, institutions, ethnicity, and development models; support and develop open science roadmaps; and create a policy environment favorable to open science.

5.2 Strengthening Capacity Building in Facilities, Platforms, and Talent for Open Science

Enhance capacity building for open science by deploying infrastructures and scientific data centers in the priority areas identified in the Recommendation, improving platform sharing levels and comprehensive utilization efficiency. Establish open science-related research, education, and training centers and alliances. Summarize existing experiences in open science, conduct case studies, and cultivate talent. Gradually realize the vision shaped by the Recommendation in accordance with its principles.

5.3 Organizing International Cooperation Targeting Major Issues and Challenges

Plan and promote international scientific cooperation projects based on the priority areas in the Recommendation. Uphold open science values and implementation principles to develop more open, inclusive, reciprocal, and shared international scientific cooperation strategies. Proactively design and lead major international collaborative research projects aimed at addressing common human challenges.

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Note: Figure translations are in progress. See original paper for figures.