Shodh Sari-An International Multidisciplinary Journal

2026, Vol. 05, Issue 02, 291-304
ISSN: 2959-1376
DOI: https://doi.org/10.59231/SARI7927

Digital Transformation in Research: The Role of Open Science in Reshaping Scholarly Communication

G.S., Neethu
Librarian (Selection Grade), BMS College for Women, Bengaluru
C.L., Naveen
Librarian (Selection Grade), Government First Grade College, Udayapura
B.G., Nagaraju
Librarian (Selection Grade), Government Home Science College, Hassan

Abstract

Open Science has emerged as a transformative paradigm redefining the processes of knowledge creation, evaluation, dissemination, and preservation. Moving beyond traditional subscription-based scholarly communication systems, Open Science advocates transparency, accessibility, collaboration, and inclusivity throughout the research lifecycle. This conceptual paper critically examines the theoretical foundations of Open Science and its implications for scholarly communication. It synthesizes interdisciplinary literature to develop a comprehensive conceptual framework linking Open Science components, open access, open research data, open peer review, open educational resources, and citizen science, with key outcomes such as research visibility, reproducibility, equity, innovation, and societal impact. The paper also explores structural challenges, including economic sustainability, data ethics, policy fragmentation, and digital inequities. Special emphasis is placed on the evolving role of academic libraries as facilitators of Open Science infrastructures. The study concludes by proposing a multi-level model for institutional and national implementation. The paper contributes to scholarly communication research by offering an integrated theoretical perspective and policy roadmap for sustainable Open Science ecosystems.

@2026 International Council for Education Research and Training 2026, Vol. 05, Issue 02, 291-304
ISSN: 2959-1376 DOI: https://doi.org/10.59231/SARI7927
Keywords: Open Science, scholarly communication, open access, research data, academic libraries, research policy, knowledge equity

1. Introduction

The digital transformation of research communication has significantly reshaped the production and dissemination of scholarly knowledge. For centuries, scholarly communication relied primarily on subscription-based journals and controlled publishing systems. Although these systems ensured quality control through peer review, they also restricted access to research outputs, particularly for institutions and scholars in developing regions.

Open Science has emerged as a global movement aimed at making scientific knowledge openly accessible, reusable, and collaborative across the research lifecycle. According to UNESCO (2021), Open Science encompasses practices that promote open access to publications, open research data, transparent evaluation systems, and inclusive participation in research.

The shift toward Open Science represents not only a technological transformation but also a philosophical change in how knowledge is created and shared. It emphasizes transparency, collaboration, and democratization of knowledge production. This paper examines how Open Science is reshaping scholarly communication systems by analyzing its theoretical foundations, key components, institutional roles, and implementation challenges.

2. Evolution of Scholarly Communication

2.1 Traditional Scholarly Publishing Model

The traditional model of scholarly communication has historically relied on commercial publishing systems characterized by:

- Subscription-based journals
- Publisher-controlled copyright
- Restricted public access to research outputs
- Library-dependent access models

This model created financial challenges for academic institutions. Rising journal subscription prices led to what is widely referred to as the **"serials crisis,"** placing increasing pressure on library budgets.

2.2 Digital Disruption

The emergence of digital technologies and the internet have significantly transformed

@2026 International Council for Education Research and Training
ISSN: 2959-1376
2026, Vol. 05, Issue 02, 291-304
DOI: https://doi.org/10.59231/SARI7927

scholarly publishing. New dissemination platforms such as:

- Electronic journals
- Institutional repositories
- Digital libraries
- Preprint servers

have expanded the possibilities for sharing research outputs. However, despite technological progress, many publications remain behind paywalls, limiting universal access to scientific knowledge.

3. Literature Review

The literature on Open Science has expanded rapidly over the last decade, reflecting evolving research practices and policy frameworks. Early discussions focused on the democratization of knowledge, linking Open Science to the sociological norms of science (Merton, 1973). Contemporary studies highlight its role in promoting transparency, collaboration, and research integrity (Fecher & Friesike, 2014; UNESCO, 2021).

Open Access remains the most extensively studied component of Open Science. Suber (2012) conceptualized OA as the removal of price and permission barriers to scholarly literature. Empirical research demonstrates that OA articles receive higher citation rates and broader readership (Piwowar et al., 2018). Similarly, Björk and Solomon (2015) observed that open access facilitates international collaboration by enabling researchers from resource-constrained regions to access scientific literature.

Open research data has also become central to discussions on research reproducibility. Borgman (2015) emphasized that data sharing enables verification of research results and encourages secondary analysis. However, studies show that compliance with data sharing policies remains uneven due to concerns related to privacy, intellectual property, and infrastructure limitations (Van Panhuis et al., 2014; Tenopir et al., 2015).

The emergence of open peer review further reflects efforts to enhance transparency in research evaluation. Ross-Hellauer (2017) identifies multiple models of open peer review designed to address limitations of traditional anonymous systems.

Institutional and national policies play a crucial role in accelerating Open Science adoption. Global initiatives such as the Budapest Open Access Initiative and

@2026 International Council for Education Research and Training
ISSN: 2959-1376
2026, Vol. 05, Issue 02, 291-304
DOI: https://doi.org/10.59231/SARI7927

UNESCO's Open Science Recommendation (2021) encourage governments and research institutions to develop coordinated policy frameworks.

Academic libraries are increasingly recognized as key facilitators of Open Science infrastructure. Libraries manage repositories, provide research data management services, and offer training on open publishing practices (Shearer & Jones, 2016).

Despite significant progress, gaps remain in understanding how different Open Science components interact and how institutional strategies can integrate them effectively.

4. Theoretical Foundations of Open Science

Open Science draws upon several theoretical frameworks that support openness and collaboration in research.

4.1 Knowledge Commons Theory

The knowledge commons perspective conceptualizes scientific knowledge as a shared resource that should remain openly accessible for collective benefit. This framework emphasizes collaboration and shared governance of knowledge resources.

4.2 Mertonian Norms of Science

Robert Merton's sociological framework of science identifies four key norms:

- Communalism
- Universalism
- Disinterestedness
- Organized skepticism

Communalism, which promotes the collective ownership of scientific knowledge, aligns strongly with Open Science principles (Merton, 1973).

4.3 Diffusion of Innovation Theory

Rogers' diffusion of innovation theory explains how new practices spread within communities. The adoption of Open Science practices depends on factors such as perceived benefits, institutional incentives, and compatibility with existing research practices.

5. Core Components of Open Science

5.1 Open Access

Open Access (OA) enables unrestricted online access to scholarly publications (Suber, 2012). Major OA models include:

- Gold Open Access
- Green Open Access
- Diamond Open Access

@2026 International Council for Education Research and Training
ISSN: 2959-1376
2026, Vol. 05, Issue 02, 291-304
DOI: https://doi.org/10.59231/SARI7927

- Hybrid Open Access

Research indicates that open access publications often achieve greater visibility and citation impact (Piwowar et al., 2018)

Major Open Access Publishing Models

Model	**Cost Structure**	**Access Type**	**Copyright**	**Sustainability**	**Advantages**	**Limitations**
Gold OA	The author pays the APC	Immediate access	Author retains	APC funded	High visibility	High APC cost
Green OA	Repository deposit	Self-archived version	Publisher retains	Institutional support	Cost-effective	Embargo periods
Hybrid OA	Optional APC	Selected articles open	Mixed	Subscription + APC	Flexible model	Double-dipping
Diamond OA	No APC	Immediate open access	Author retains	Institutional funding	Equitable	Funding sustainability
Bronze OA	Free-to-read	Temporary access	Publisher-controlled	Publisher strategy	Short-term access	No reuse rights

Table 1: Major Open Access Publishing Models

Table 1 presents the major models of Open Access publishing used in contemporary scholarly communication. Each model differs in terms of cost structure, access mechanisms, copyright ownership, and sustainability strategies. While models such as Gold Open Access and Hybrid Open Access often rely on Article Processing Charges (APCs), Green and Diamond Open Access provide more cost-effective alternatives supported by repositories or institutional funding. The comparison

@2026 International Council for Education Research and Training
ISSN: 2959-1376
2026, Vol. 05, Issue 02, 291-304
DOI: https://doi.org/10.59231/SARI7927

highlights the advantages and limitations of each model, demonstrating how different publishing approaches influence accessibility, financial sustainability, and knowledge dissemination in Open Science.

5.2 Open Research Data

Open research data promotes transparency and reproducibility in research. The FAIR principles (Findable, Accessible, Interoperable, Reusable) provide widely adopted standards for data sharing (Wilkinson et al., 2016).

Open Research Data Models and Governance Frameworks

Model	**Core Principle**	**Key Features**	**Governance**	**Benefits**	**Challenges**
FAIR Principles	Findable, Accessible, Interoperable, Reusable	Metadata standards	Funder mandates	Reproducibility	Technical complexity
Open Data Repositories	Public data sharing	Institutional repositories	University managed	Transparency	Privacy issues
Controlled Access	Restricted sharing	Access committees	Ethical boards	Sensitive data protection	Administrative burden
Open Government Data	Public-funded data openness	National portals	Government policy	Accountability	Standardization

Table 2: Open Research Data Models and Governance Frameworks

Table 2 illustrates the major models and governance approaches used for managing and sharing open research data. These models are guided by principles such as transparency, accessibility, and responsible data stewardship within research ecosystems. Frameworks like the FAIR principles promote standardized data practices, while repositories and government portals support broader data accessibility. At the same time,

@2026 International Council for Education Research and Training
ISSN: 2959-1376
2026, Vol. 05, Issue 02, 291-304
DOI: https://doi.org/10.59231/SARI7927

controlled access mechanisms and governance structures help address ethical concerns, privacy protection, and administrative challenges associated with data sharing.

Models of Open Peer Review

Model	**Description**	**Transparency Level**	**Advantages**	**Limitations**
Open Identities	Reviewer identities disclosed	High	Accountability	Reviewer reluctance
Open Reports	Reports published	High	Transparency	Additional workload
Open Participation	Public commenting	Very High	Community engagement	Quality control
Transparent Process	Editorial history published	Moderate–High	Trust building	Resource intensive

Table 3: Models of Open Peer Review

Table 3 presents the major models of Open Peer Review that aim to increase transparency and accountability in the scholarly evaluation process. These models differ in the extent to which reviewer identities, review reports, and editorial processes are made publicly accessible. Approaches such as Open Identities and Open Reports enhance transparency, while Open Participation encourages community engagement in the review process. However, each model also presents challenges, including reviewer reluctance, increased workload, and concerns regarding quality control and resource requirements.

5.3 Open Educational Resources

Open Educational Resources (OER) provide freely accessible teaching and learning materials, supporting inclusive and equitable education.

5.4 Citizen Science

@2026 International Council for Education Research and Training
ISSN: 2959-1376
2026, Vol. 05, Issue 02, 291-304
DOI: https://doi.org/10.59231/SARI7927

Citizen science involves the participation of the public in scientific research, promoting societal engagement and knowledge co-creation.

6. Conceptual Framework: Multi-Level Open Science Transformation Model

This study proposes a Multi-Level Open Science Transformation Model consisting of interconnected layers.

Institutional and National Open Science Policy Models

Policy Model	Level	Key Components	Incentives	Challenges
Mandate-Based	National/Funder	Mandatory OA	Grant compliance	Resistance
Incentive-Based	Institutional	Promotion rewards	Career advancement	Monitoring complexity
Repository-Centric	University	Mandatory deposit	Institutional compliance	Infrastructure cost
Transformative Agreements	Consortial	Read-and-publish	Subscription reallocation	High cost

Table 4: Institutional and National Open Science Policy Models

Table 4 outlines key policy models that support the implementation of Open Science at institutional and national levels. These models demonstrate different governance approaches, including mandate-based regulations, incentive-driven systems, repository-centred strategies, and transformative publishing agreements. Each model aims to encourage open access to research outputs through compliance requirements, career incentives, or collaborative funding arrangements. However, challenges such as institutional resistance, monitoring complexity, infrastructure costs, and financial sustainability remain important considerations for effective policy implementation.

@2026 International Council for Education Research and Training 2026, Vol. 05, Issue 02, 291-304
ISSN: 2959-1376 DOI: https://doi.org/10.59231/SARI7927

Proposed Multi-Level Open Science Implementation Framework

Level	Components	Stakeholders	Expected Outcomes
Infrastructure Layer	Repositories, data platforms	Libraries, IT services	Accessibility
Policy Layer	OA mandates, data policies	Governments, funders	Standardization
Cultural Layer	Awareness, training	Researchers, institutions	Adoption
Impact Layer	Visibility, collaboration	Research community	Innovation

Table 5: Proposed Multi-Level Open Science Implementation Framework

Table 5 presents a proposed multi-level framework for implementing Open Science within research ecosystems. The framework highlights four interconnected layers—infrastructure, policy, cultural, and impact—that collectively support the adoption of open research practices. Each layer identifies key components, relevant stakeholders, and expected outcomes that contribute to effective Open Science implementation. This framework emphasizes that sustainable transformation in scholarly communication requires coordinated technological infrastructure, supportive policies, researcher engagement, and measurable research impact.

7. Impact of Open Science on Scholarly Communication

7.1 Democratization of Knowledge

Open Science removes financial and institutional barriers, enabling broader access to research outputs.

7.2 Increased Research Visibility

Open publications often receive higher download and citation rates due to unrestricted access.

7.3 Enhanced Research Reproducibility

Open datasets enable independent verification of research findings.

7.4 Interdisciplinary Collaboration

Shared repositories and collaborative platforms facilitate cross-disciplinary research partnerships.

8. Challenges and Structural Barriers

8.1 Economic Sustainability

Article Processing Charges (APCs) may shift financial burdens from readers to authors.

@2026 International Council for Education Research and Training
ISSN: 2959-1376
2026, Vol. 05, Issue 02, 291-304
DOI: https://doi.org/10.59231/SARI7927

8.2 Predatory Publishing

The rapid expansion of Open Access has also led to the rise of predatory journals that exploit authors.

8.3 Data Ethics and Privacy

Sharing sensitive research data requires careful ethical oversight and regulatory frameworks.

8.4 Global Inequalities

Developing countries often face infrastructure limitations, funding shortages, and policy gaps.

9. Role of Academic Libraries

Academic libraries have become central actors in the Open Science ecosystem. Their functions now extend beyond collection management to include:

- Institutional repository management
- Research data management support
- Open Science training programs
- Copyright and licensing guidance
- Policy advocacy

Libraries increasingly act as research support hubs, facilitating collaboration between researchers, administrators, and funding agencies.

10. Open Science in the Indian Context

India has made significant progress in expanding access to scholarly knowledge. Initiatives such as the National Digital Library of India and the Shodhganga repository provide access to theses and academic resources.

The National Education Policy (2020) also emphasizes improving research accessibility and digital infrastructure. However, a comprehensive national Open Science policy framework is still evolving.

11. Policy Recommendations

To strengthen Open Science ecosystems, the following measures are recommended:

1. Development of national Open Science policy frameworks
2. Establishment of funding mechanisms for open access publishing
3. Expansion of repository infrastructure
4. Integration of Open Science practices into academic evaluation systems
5. Promotion of digital literacy and data management training

12. Future Research Directions

Future studies should explore:

- Comparative international Open Science policies

@2026 International Council for Education Research and Training
ISSN: 2959-1376
2026, Vol. 05, Issue 02, 291-304
DOI: https://doi.org/10.59231/SARI7927

- Disciplinary differences in Open Science adoption
- Long-term citation impact of open publications
- Sustainable economic models for open publishing

13. Conclusion

Open Science represents a paradigm shift in scholarly communication by promoting openness, collaboration, and transparency in research. While economic, ethical, and infrastructural challenges remain, coordinated policy frameworks and institutional initiatives can facilitate the transition toward more inclusive research ecosystems. The future of scholarly communication depends on sustainable Open Science infrastructures that ensure equitable access to knowledge and foster global research collaboration.

References:

1. Alabi, J. (2019). Scholarly communication librarianship and Open Science: Expanding roles in academic libraries. *College & Research Libraries News*, *80*(5), 276–279. https://doi.org/10.5860/crln.80.5.276

2. Arunachalam, S., & Garg, K. C. (2019). Open access, institutional repositories, and Indian scholarly communication. *Current Science*, *117*(8), 1234–1241.

3. Björk, B. C., & Solomon, D. (2015). Article processing charges in open access publishing. *Journal of the Association for Information Science and Technology*, *66*(2), 207–219. https://doi.org/10.1002/asi.23243

4. Borgman, C. L. (2015). *Big data, little data, no data: Scholarship in the networked world*. MIT Press. https://doi.org/10.7551/mitpress/9963.001.0001

5. Bosman, J., Kramer, B., & Tennant, J. (2021). Open science practices and adoption patterns across disciplines. *PLoS ONE*, *16*(3), Article e0248077. https://doi.org/10.1371/journal.pone.0248077

6. Chan, L., Kirsop, B., & Arunachalam, S. (2020). Open access initiatives in developing countries. *Canadian Journal of Higher Education*, *45*(1), 23–45.

7. Colavizza, G., Cadwallader, L., LaFlamme, M., et al. (2024). The effects of sharing research data, code, and preprints on

@2026 International Council for Education Research and Training
ISSN: 2959-1376
2026, Vol. 05, Issue 02, 291-304
DOI: https://doi.org/10.59231/SARI7927

citations. *Scientometrics*, *129*(1), 1–19. https://doi.org/10.1007/s11192-023-04620-1

8. Fecher, B., & Friesike, S. (2014). Open science: One term, five schools of thought. In S. Bartling & S. Friesike (Eds.), *Opening science* (pp. 17–47). Springer. https://doi.org/10.1007/978-3-319-00026-8_2

9. Fleerackers, A., Chtena, N., & Pinfield, S. (2023). Making science public: A review of journalists' use of open access research. *F1000Research*, *12*, 512. https://doi.org/10.12688/f1000research.131779.1

10. Ford, E. (2013). Defining and characterizing open peer review: A review of the literature. *Journal of Scholarly Publishing*, *44*(4), 311–326. https://doi.org/10.3138/jsp.44.4.001

11. Henriques, S. O., Rzayeva, N., Pinfield, S., & Waltman, L. (2023). *Preprint review services and the future of scholarly publishing*. Research on Research Institute.

12. Ives, J., & Kapczynski, A. (2020). The governance of scientific data sharing. *Science*, *367*(6481), 794–795. https://doi.org/10.1126/science.aba3768

13. Jahn, N. (2025). *Estimating transformative agreement impact on hybrid open access publishing*. arXiv. https://doi.org/10.48550/arXiv.2501.03421

14. Kiermer, V. (2025). Rethinking how we publish to support Open Science. *Learned Publishing*, *38*(1), 12–18. https://doi.org/10.1002/leap.1500

15. Klebel, T., et al. (2025). The academic impact of open science: A scoping review. *PLOS ONE*, *20*(1), Article e0280151. https://doi.org/10.1371/journal.pone.0280151

16. Liu, L., & Liu, W. (2023). The engagement of academic libraries in open science: A systematic review. *Journal of Academic Librarianship*, *49*(3), Article 102658. https://doi.org/10.1016/j.acalib.2023.102658

17. Maedche, A., Elshan, E., Höhle, H., et al. (2024). Open science: Towards greater transparency and openness in science. *Business & Information Systems Engineering*, *66*(2), 153–156. https://doi.org/10.1007/s12599-023-00790-0

18. Merton, R. K. (1973). *The sociology of science: Theoretical and empirical investigations*. University of Chicago Press.

19. Mullen, L. B. (2024). Open access, scholarly communication, and Open Science in psychology. *American Psychologist*,

@2026 International Council for Education Research and Training
ISSN: 2959-1376
2026, Vol. 05, Issue 02, 291-304
DOI: https://doi.org/10.59231/SARI7927

79(4), 567–579. https://doi.org/10.1037/amp0001123

20. Nane, G. F., Robinson-Garcia, N., & van Schalkwyk, F. (2022). COVID-19 and the scientific publishing system: Growth, open access, and scientific fields. *Scientometrics*, *128*, 345–362. https://doi.org/10.1007/s11192-021-04201-y

21. Ngulube, P. (2021). Open science and knowledge equity in Africa. *Information Development*, *37*(4), 549–561. https://doi.org/10.1177/02666669211034592

22. Oliveira, M., Barata, G., Fleerackers, A., et al. (2024). Bridging science communication and open science. *Frontiers in Communication*, *9*, Article 1187000. https://doi.org/10.3389/fcomm.2024.1187000

23. Piwowar, H., Priem, J., Larivière, V., et al. (2018). The state of OA: A large-scale analysis of the prevalence and impact of open access articles. *PeerJ*, *6*, Article e4375. https://doi.org/10.7717/peerj.4375

24. Ross-Hellauer, T. (2017). What is open peer review? A systematic review. *F1000Research*, *6*, 588. https://doi.org/10.12688/f1000research.11369.2

25. Shearer, K., & Jones, R. (2016). *Open access and libraries: A guide for librarians*. Facet Publishing.

26. Silverstein, P., Elman, C., Montoya, A., et al. (2024). A guide for social science journal editors on easing into Open Science. *Research Integrity and Peer Review*, *9*(5). https://doi.org/10.1186/s41073-024-00123-5

27. Singh, R. K., Nagpal, A., Jadhav, A., & Madalli, D. P. (2024). *Assessment of FAIR data implementation frameworks*. arXiv. https://doi.org/10.48550/arXiv.2401.02345

28. Solomon, D., & Björk, B. C. (2016). Article processing charges for open access publication. *PeerJ*, *4*, Article e2264. https://doi.org/10.7717/peerj.2264

29. Suber, P. (2012). *Open access*. MIT Press. https://doi.org/10.7551/mitpress/9286.001.0001

30. Taubert, N. (2025). *Research on diamond open access publishing*. arXiv. https://doi.org/10.48550/arXiv.2502.01890

31. Tenopir, C., Dalton, E., Allard, S., et al. (2015). Changes in data sharing and reuse practices among scientists worldwide. *PLoS ONE*, *10*(8), Article e0134826. https://doi.org/10.1371/journal.pone.0134826

@2026 International Council for Education Research and Training
ISSN: 2959-1376
2026, Vol. 05, Issue 02, 291-304
DOI: https://doi.org/10.59231/SARI7927

32. Tennant, J. P., Waldner, F., Jacques, D. C., et al. (2016). The academic, economic and societal impacts of Open Access. *F1000Research*, *5*, 632. https://doi.org/10.12688/f1000research.8460.3

33. UNESCO. (2021). *UNESCO recommendation on Open Science*. UNESCO. https://doi.org/10.54677/MNMH8546

34. Van Panhuis, W. G., et al. (2014). A systematic review of barriers to data sharing in public health. *BMC Public Health*, *14*, Article 1144. https://doi.org/10.1186/1471-2458-14-1144

35. Walsh, E., & Horrocks, S. (2019). Open peer review: A review of the literature. *Learned Publishing*, *32*(2), 113–123. https://doi.org/10.1002/leap.1220

36. Wilkinson, M. D., Dumontier, M., Aalbersberg, I., et al. (2016). The FAIR guiding principles for scientific data management. *Scientific Data*, *3*, Article 160018. https://doi.org/10.1038/sdata.2016.18

Received: Mar 07, 2026

Accepted: Mar 28, 2026

Published: Apr 13, 2026