

Reflections on Open Science and the Teaching of Library and Information Science: A Perspective from Brazil

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Abstract

The essay analyzes aspects regarding the education of librarians in the context of open science, integrating a Brazilian viewpoint based on Paulo Freire's pedagogy. It argues that open science, as a contemporary phenomenon of scholarly communication, aims to promote inclusion and social justice but faces challenges and contradictions that could intensify historical inequalities. In this scenario, librarians play a crucial role as political and technical agents, requiring training that develops both practical skills and critical consciousness. This discussion highlights essential skills for librarians, as identified in the literature, including managing repositories, promoting content, developing information policies, enhancing data literacy, and establishing institutional partnerships. Additionally, it emphasizes the importance of understanding the contradictions of scholarly communication systems, the specific needs of local communities, and the structural challenges of open science. From a Freirean perspective, education is framed as a dialogical process that fosters mediation, emancipation, and social transformation. This approach seeks to empower librarians not only as skilled technicians but also as active agents of change, capable of shaping a more just and inclusive reality. Thus, the article proposes integrating open science principles into Library and Information Science (LIS) curricula, empowering librarians to act as mediators and advocates for equitable academic practices.

Keywords: open science, scholarly communication, LIS education, social justice, Paulo Freire's pedagogy.

Introduction

Scholarly communication encompasses the essential processes that enable the advancement of science. It goes beyond merely disseminating records of knowledge to include the production and utilization of that knowledge. Throughout history, the forms of scholarly communication have been shaped by the values, practices, and technological capabilities of each era.

These forms are the result of actions taken by individuals and institutions that promote or participate in these practices, deeply rooted in their historical contexts.

The complex network of stakeholders involved in scholarly communication underscores the need to understand its dimensions beyond distribution processes. Contemporary technological phenomena, tied to open science, have profoundly reshaped and broadened this understanding. Within this framework, open science represents a widespread movement advocating for increased access to research outputs. At the same time, it aims to innovate methods for producing and (re)utilizing academic knowledge (Beigel, 2023).

Open science projects aim to make things more democratic and to include groups and areas that have been left out in the past, which is a problem that Albornoz et al. (2020) point out. Consequently, new communication flows are expected to emerge both within and beyond traditional knowledge production environments. Discussions on open science highlight various structures that influence the processes of knowledge construction. As open access to academic publications has matured, new demands have emerged, including the openness of research data, the sharing of resources, and enhanced transparency in evaluation processes. These evolving expectations pose direct challenges to traditional academic cultures and researchers' practices. Simultaneously, they bring non-academic communities, academic system administrators, and librarians to the center of the discussion, expanding the scope of stakeholders engaged in shaping the future of scholarly communication.

Librarians play a critical role in information systems and scholarly communication (Santos-Hermosa & Atenas, 2022). Their contributions go beyond making informational products; they also offer services and come up with informational policies that guide and shape open science projects. Therefore, we must analyze the education of librarians to tackle scholarly communication in line with the current demands for restructuring academic communication practices.

Considering these requirements, this essay aims to deepen the discussion by addressing two key questions: What responsibilities do librarians assume within the context of open science? How can we prepare librarians to take on these responsibilities? This study uses literature from the field of Library and Information Science (LIS) to answer these questions. It looks specifically at three meta-analyses that explore the roles of academic libraries in open science (Liu & Liu, 2023; Giustini et al., 2021; Ogungbeni et al., 2018) and what that means for LIS education (Santos-Hermosa & Atenas, 2022).

To contextualize the Brazilian perspective in the debate, we analyzed contextual data published by Alencar & Barbosa (2021; 2022), Bosman et al. (2021), Silva (2023), and Santillán-Aldana and Mueller (2016). We conducted the reflections on librarian education in the context of the Freirean perspective on education (Freire, 1996; Freire, 2024).

Open science as a contemporary social phenomenon of scholarly communication

Scholarly communication is a human activity that shows typical features of social change in a certain setting, as experienced by people living in that historical reality. Thus, the phenomena of scholarly communication offer a lens through which the dynamics, values, and interests that emerge at each time and space can be analyzed.

In contemporary times, open science stands out as a relevant historical and social phenomenon, offering not only a deeper understanding of the dynamics of scholarly communication but also an insight into the diverse actors and interests involved. Proposals aimed at renewing the production, dissemination, and utilization of scholarly knowledge are at the core of discussions and practices related to open science.

This idea of renewal makes a point of showing that open science not only upholds old academic values and practices, like being open, letting everyone see results, and sharing them widely, but it also comes from a time of crisis. In a Gramscian sense (2022), this crisis is a time when things aren't quite right: old ways of thinking don't work in dealing with reality anymore, and new ideas for how to fix things haven't come up yet.

The first major crisis in the context of open science was the so-called "serial crisis," as described by Van de Sompel and Lagoze (2000). This crisis highlighted the disparity between the expansive access possibilities afforded by digital culture and the restrictions imposed by commercial publishers, who charged increasingly high subscription fees, despite the growing demand for access to materials that emerged in the 1990s. In response, researchers worldwide began organizing around a vision of scholarly communication that was more accessible and freer, drawing inspiration from the free software movement and the nascent initiatives of open archives, rooted in what Costa (2006) termed "free philosophies." Thus, the open access movement was born, initially focused on democratizing academic publications.

To achieve open access goals, two main paths were proposed: gold and green. The gold route encouraged the creation of new open access journals or the adaptation of existing ones to models aligned with open access principles, initially involving publishers and researchers.

Over time, however, it became evident that this transformation required a broader network of actors, including funding agencies and academic libraries, which came to play a central role in the *library as publisher* model (Lippincott, 2017). The green route positioned academic libraries as key players. As part of this strategy, copies of articles are put in institutional repositories, and libraries are expected to play a big role in building these repositories and making sure they follow institutional rules so they can work properly (Costa & Leite, 2017).

Systems for expanding the reach of academic publications were not the only proposals surrounding the open access movement in the early 21st century. They introduced a set of principles and values positioning science as a public good, built collaboratively, transparently, and accessible to all. Additionally, they emphasized commitments for the inclusion and the democratization of scholarly knowledge. Chan et al. (2005) highlighted the potential of open access to create communication flows originating in the Global South that could reach both the Global North and other regions of the South.

As discussions matured, the demands expanded to include not only publications but also research data, tools, evaluation methods, and distribution licenses. The movement engaged new actors and commitments, such as the inclusion of students through open educational resources and collaboration with non-academic groups in science initiatives. Open science offers a comprehensive framework for transforming scholarly communication, encompassing the entire knowledge lifecycle from creation to reuse. Pontika et al. (2015) proposed a taxonomy (Figure 1) that reflects this complexity.

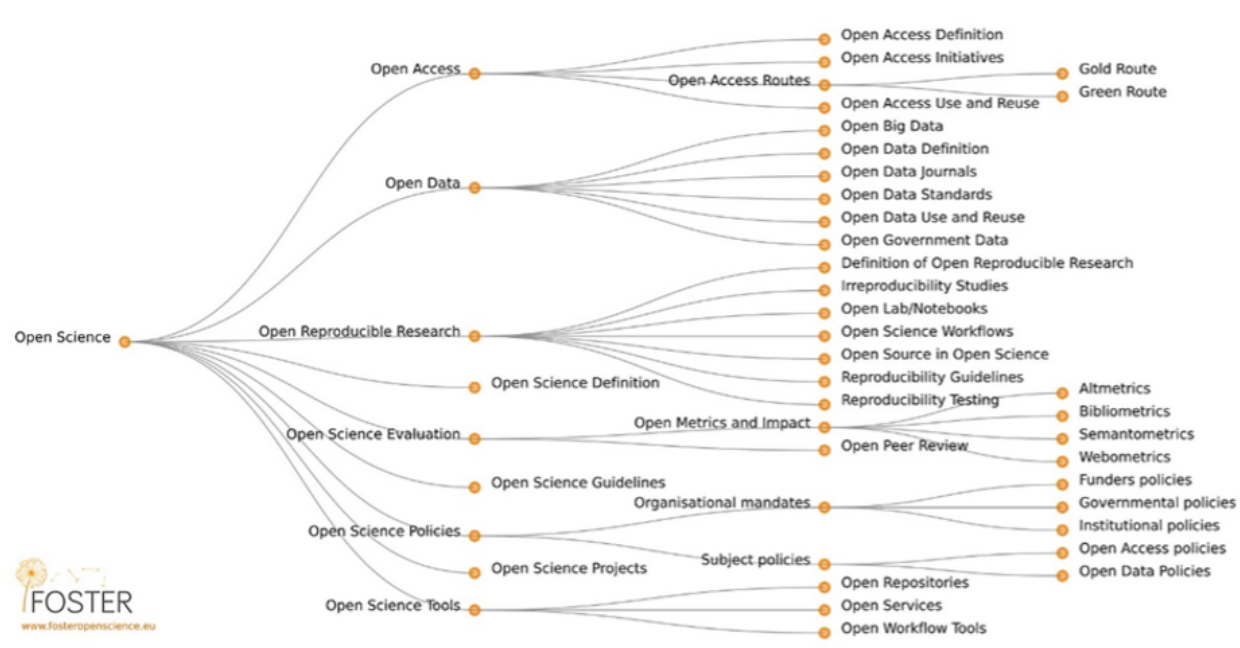


Figure 1: Open Science Taxonomy. Source: Foster Project apud Pontika et al. (2015)

Despite over two decades of experience with the open access movement, it is evident that, although its demands have become more complex and have engaged a broader network of actors and interests, some fundamental aspects of the initiative have seen limited progress.

In particular, the initiatives have shown limited effectiveness in creating new pathways to promote more equitable participation of researchers from marginalized regions in the context of mainstream science.

From crisis to contradictions in open science

A fundamental contradiction at the heart of open science lies in the antagonism between forces within scholarly communication, particularly the dominant role of major commercial publishing groups. As Shashok (2017) pointed out, commercial publishers have kept a lot of power over scholarly communication, affecting the creation and implementation of policies and being almost entirely responsible for the evaluation of research. This is true even though open science projects have grown up.

Faced with demands for open access, large publishers, such as Elsevier, have played a pivotal role in consolidating alternative business models that partially address researchers' calls for greater access to publications while maintaining, and in some cases expanding, their profitable business models within the core of science. As Buranyi (2017) pointed out, Elsevier's revenue and profit margins have continued to grow in recent years, despite efforts within the open access movement to create alternatives to the commercialization of scholarly publications.

Commercial groups maintain dominance and economic exploitation through the Article Processing Charge (APC) model, which replaces subscription fees for reading articles with publishing fees. While this model makes articles freely available with no cost for readers, it exacerbates existing inequalities in the already unjust relationships among researchers worldwide, as argued by Demeter and Istrate (2020). A significant issue lies in the inability of many researchers, particularly those from countries with limited research funding, to afford APCs. As Raju (2017) noted, "Even though it was never the intention for APCs to be unaffordable, the reality is that African researchers cannot publish in top-end open access journals." Moreover, Pinfield et al. (2015) noted that large commercial publishers received the majority of APC payments in the United Kingdom between 2007 and 2014, highlighting how, despite being framed as a means to support open access, the APC model has intensified the commercialization of scholarly communication, making it even more profitable for some publishers.

The United Kingdom's scenario mirrors those of other countries, including Brazil, in the Global South. According to Alencar and Barbosa (2021), between 2012 and 2019, Brazilian researchers paid over USD 40 million in APCs, with costs increasing year after year. We must add this expenditure to the over 5 billion Brazilian reais spent on the CAPES Portal of Journals over the past 20 years. The Portal is a national provider of access to a wide range of academic publications, particularly subscription-based ones. A national agency mediates the Portal, ensuring access to numerous higher education and research institutions in Brazil.

The emergence of hybrid journals further complicates the cumulative costs, raising concerns about double-dipping, where institutions pay twice for the same publication, first through APCs paid by researchers and then through subscriptions to access restricted articles. Mittermaier (2015) highlighted the lack of sufficient transparency to audit this process, despite publishers' claims that licensing costs adjust based on journals' licensing status. In this context, transformative agreements, such as "Read and Publish" models, have gained traction. Based on analyses of such agreements in Germany and Colombia, Alencar and Barbosa (2022) proposed guidelines for Brazil. According to the authors, these proposals must include both hybrid and open access journals to finance APCs for high-impact publications by researchers in Brazilian graduate programs.

Two key points summarize the significant controversy surrounding high-impact journals and APCs. First, paying APCs does not guarantee publication quality and has, in some cases, contributed to the proliferation of predatory journals, as emphasized by Björk and Solomon (2014) and Shamseer et al. (2017). Second, issues arise around quality evaluation criteria, which prioritize journals indexed in specific databases, often controlled by commercial publishers and aligned with their interests. Addressing this issue, Torres-Salinas et al. (2018) revealed that, between 2007 and 2016, open access journals represented only about 10% of the Web of Knowledge database. Despite the existence of top-end open access journals, they constitute a small fraction of commercial journal databases, where traditional evaluation models often serve to perpetuate inequalities.

An alternative to the APC is the diamond open access model, where neither access nor publication incur charges. However, diamond open access requires funding to operate. How can we ensure the sustainability of this model over time, and who funds it? Addressing these questions, Yoon et al. (2024) analyzed over 1,330 diamond open access journals. It was found that those funded by government agencies from the Global North exhibited greater sustainability. This data underscores the challenges of implementing open science projects in diverse global contexts, where countries and institutions face varying realities.

According to Bosman et al. (2021), Brazil boasts one of the highest numbers of diamond open access journals globally, particularly among countries with fewer than one full-time professional dedicated to journal operations. While Brazil stands out, the study revealed that, globally, 60% of diamond open access journals rely on volunteer efforts. In Brazil, these journals are closely tied to public universities and the unpaid work of professors, researchers, and graduate students. This highlights the indirect public funding of the diamond open access model in Brazil, frequently without explicit recognition.

Although the maintenance of diamond open access journals in Brazil predominantly relies on voluntary efforts by academics, there has been a growing trend of academic libraries offering support to such journals. As reported by Santillán-Aldana and Mueller (2016), the editorial services offered by academic libraries have evolved as a pragmatic response to the need for low-cost publishing in a digital environment, without profit expectations.

The role of academic libraries in the context of open science

Discussions and practices regarding academic libraries as publishers have long been part of the literature on library services, particularly driven by electronic journals. In 1984, Cronin and Martyn published a study highlighting the opportunities and challenges for libraries in the face of electronic journals, which had the potential to transform the role of these institutions in scholarly communication. The authors emphasized the importance of partnerships between libraries and publishers, as exemplified by the Adonis consortium project launched in 1981 (Bradbury, 1988). In that direction, Cronin and Martyn (1984) initiated a significant discussion that continues today in academic library services about their roles and how they can contribute to the growing use of electronic documents in scholarly communication.

From that point onward, the topic consistently appeared in discussions within the field until it gained new prominence in the 2000s with the rise of open access. In 2003, Prat warned of the changes in scholarly communication processes driven by electronic journals, which were influenced by both the technologies available and the provocations stemming from what he defined as free and open access to peer-reviewed academic literature. The author highlighted the potential of open access to democratize access to academic knowledge but noted that it had not yet succeeded in reducing costs. So, it was thought that scholarly communication stakeholders, like libraries, needed to be involved in coming up with alternatives that could effectively increase and make available to everyone academic knowledge that was produced.

Prat's (2003) observations contributed to ongoing discussions about the potential and challenges of open access over the following two decades. Proposed strategies emphasized the role of libraries as facilitators of content publication. Notably, the Scholarly Publishing and Academic Resources Coalition (SPARC) proposed in 2019 the development of funding structures for open scholarly communication infrastructures, where libraries operate under the "library as publisher" model. This involves hosting journal portals, publishing books and open educational resources, and broadly promoting open science frameworks within their communities (Dewey, 2020).

Dewey (2020) highlighted the library as the publisher model, which Lippincott's (2017) book further elaborated on. Lippincott provided guidelines for practice, addressing the changing academic publishing ecosystem and the growing involvement of academic libraries in innovating informational products and services for science. Open access to publications was emphasized not only as an indicator of shifts in publishing models but also as a call for knowledge-producing institutions, through their libraries, to foster more equitable and democratic access to academic outputs.

Atwood et al. (2021) cited examples such as incubators for open journal portals, repositories for gray literature, and digital humanities projects to argue for the integration of research data repositories into library services. The authors argued that promoting local content through institutional repositories, whether for publications or data, enhances the visibility and impact of local research. This impact extends not only to improved evaluation rankings but, more importantly, to the relevance of locally developed themes and perspectives, enhancing engagement with local communities.

Library-supported initiatives in this context are known by various terms, including Library Publishing Service, Library-Based Publishing, and Campus-Based Publishing, as noted by Santillán-Aldana and Mueller (2016). According to the authors, these services provide guidance on digital publishing, which may include training for platform use, understanding editorial policies, and technical support. A common feature is their alignment with the open access context and their integration with other library services and university presses.

In the Brazilian context, Silva (2023) investigated the offerings of Library Publishing Services at universities and categorized their experiences into eight groups: open access promotion and training, copyright, research data, author identifiers, research impact, metrics, publishing, and repositories. Although the study did not specifically target open access, the phenomenon appeared as the most prominent context among the services.

Other studies, such as those by Liu and Liu (2023), Giustini et al. (2021), and Ogungbeni et al. (2018), conducted meta-syntheses to identify the emerging roles of academic libraries in the context of open access using the academic literature. Liu and Liu (2023) performed a systematic review of 65 articles in Library and Information Science (LIS). Similarly, Ogungbeni et al. (2018) reviewed 34 LIS articles. Giustini et al. (2021) expanded their analysis to include 54 articles from both LIS and health sciences. Figure 2 organizes a synthesis of these studies and the categories they presented.

	Liu & Liu, 2023	Giustini et al., 2021	Ogungbeni et al., 2018
Type of research	Systematic review	Scoping reviews	Comprehensive review
Scope	LIS literature – 65 papers	LIS and HSL literature - 54 papers	LIS literature – 34 papers
Role of academic libraries in open science			
Service providers			
Advocates and educators			
Collaborator			
Policy makers			
Publisher			

Figure 2: Meta-synthesis about the role of academic libraries in open science

A common element across the three studies (Liu & Liu, 2023; Giustini et al., 2021; Ogungbeni et al., 2018) was the effort to identify the dimensions of open science. Using the taxonomy proposed by Pontika et al. (2015) as a framework, the authors identified open access and research data as the most prominent dimensions under investigation. Less frequently discussed were topics related to open educational resources, open source, and citizen science. The data indicated that discussions around research data are expanding and aligning with the development of more mature categories, such as open access, as highlighted by Santillán-Aldana and Mueller (2016). Based on the findings of these three studies on how academic libraries support open science, five theoretical groups have been established and will be presented below.

Service providers

The studies closely tie initiatives related to open access and research data to two key responsibilities. The first is the provision of services to various stakeholders in scholarly communication, such as researchers, students, and journal editors. These services include the development and maintenance of essential infrastructure, such as publication repositories, research data repositories, and repositories for educational resources. They also extend to supporting open access journals, digitization, and aspects of research data management. Broadening the scope to other dimensions of open science, Liu and Liu (2023) also highlighted activities such as curating collections of open educational resources and promoting makerspaces for citizen science.

Advocates and educators

The role of academic libraries as advocates and educators involves raising awareness and building skills within the academic community to understand and operate within the open science framework. Along with regular training, Liu and Liu (2023) and Giustini et al. (2021) stressed the importance of helping researchers understand the rules of funding agencies, the needs of academic publishers, and other outside services that deal with managing research data. Training on educational resources includes identifying and understanding licensing, discovery systems, and other tools. In the context of citizen science, libraries were noted for their responsibility to promote information literacy and provide tools to support projects within the institution.

Collaborators

The collaborative role of academic libraries was discussed in two main contexts. One is the institutional partnerships, when Ogungbeni et al. (2018) explored partnerships established with other institutions, particularly with other libraries. Another one is the regional and national collaboration, where Giustini et al. (2021) emphasized collaboration on a national and European regional level, highlighting the need to adhere to national and regional principles and standards to build communities that transcend institutional boundaries. In both cases, the significance of collaboration lies in the expectation of expanding and optimizing the structures necessary for the implementation of open science initiatives.

Policy makers

The role regarding policies highlights academic libraries as responsible for both formulating policies within the library itself and promoting and advising on policy development at the institutional level. Giustini et al. (2021) emphasize that the areas of open access and research data, which are the most developed categories of open science overall, clearly establish policies. In the studies reviewed by Liu and Liu (2023), policies are also considered at operational levels, such as IT services and guidance documents.

Less prominently, some studies also pointed to the responsibility of academic libraries in assisting with the management and monitoring of universities' APC costs and supporting copyright management.

Publishers

Libraries' involvement in open science initiatives are closely tied to their role as publishers. The studies identified a growing trend of libraries producing knowledge or publishing digital content, alongside their existing support services for open access journals. Library publishing services include providing tools and hosting platforms, as well as offering guidance on best practices for publishing content and scholarly communication.

A further dimension of this role involves promoting local and diversity-oriented content. Although not directly addressed by the studies mentioned earlier, this theme was explored by Tzanova (2020), as cited by Liu and Liu (2023) and Giustini et al. (2021). This dimension emphasizes the political power of libraries in promoting locally relevant content. The perspective seems to align with the idea that libraries are not neutral agents in the systems of knowledge production and promotion. Their role goes beyond merely providing materials, as their curation imparts meaning and context to the knowledge system they foster (Ameen et al., 2020).

LIS education

Understanding the importance of academic libraries' role in addressing the demands of open science requires considering the professionals who plan, execute, and evaluate these actions, namely, librarians. Santos-Hermosa and Atenas (2022) regard the training of information professionals as a strategic component for advancing the various dimensions of open science. This training aims not only to enhance skills but also to raise awareness.

To look into how librarians are trained for open science, Santos-Hermosa and Atenas (2022) looked at the programs of 36 LIS schools in Europe. They did this by using guidelines from Varlejs et al. (2016), which were made as part of the IFLA framework for continuous professional development, and Audunson and Shuva's (2016) ideas about how education works in Europe. Their study included an analysis of undergraduate and graduate curricula, as well as training programs offered by academic libraries in the context of open science.

The macro and meso levels contextualized the discussion of micro-level professional training. At the macro level, the study addressed international declarations and recommendations, while the meso level focused on national frameworks and the micro level on institutional contexts. This multi-tiered approach underscores the influence of national and international

political contexts in fostering broader awareness and providing the structures necessary for implementing open science initiatives.

At the international level, the study highlighted UNESCO's 2017 Recommendation on Open Educational Resources as the first document to explicitly address librarians' roles. The study identified training materials at the institutional level that cover broad topics such as open science, open access, research data, and open publishing. Additionally, nine institutions were noted for organizing workshops and seminars. However, only four out of the 36 analyzed institutions had formal librarian training programs. Based on their findings, Santos-Hermosa and Atenas (2022) recommend that LIS programs incorporate open science content transversally into curricula through both formal and informal education initiatives.

The strategy of analyzing European curricula provides valuable insights by systematically linking global contexts with evidence of practices in Europe. However, such analyses must be contextualized within their specific historical and territorial frameworks. It is essential to integrate not only data from diverse realities but also theoretical perspectives with intersections in the field of education.

Education as a practice of subject formation and reality transformation: by way of conclusion

To ground this reflection on scholarly communication and open science in LIS education from a Brazilian perspective, it is essential to illuminate the conception of education and professional training itself. Guided by the teachings of Brazilian educator Paulo Freire, this discussion explores the process of forming individuals capable of actively engaging with and transforming scholarly communication based on the principles of open science.

Freirean pedagogy asserts that education is a means of mediating knowledge and engaging with the world. Freire (2024) proposes educational practice as a strategy that fosters critical consciousness, empowering individuals to actively participate in transforming their reality. Critical consciousness involves understanding facts as they are, with all their complexities and contradictions. Unlike naive or magical consciousness, this form of awareness views reality externally, entangled in fatalism and passivity.

The development of critical consciousness is crucial for understanding open science as a contemporary phenomenon in scholarly communication, a project rooted in inclusion and social justice. But the project also has real problems. It pits different interests against each other and, in some cases, could make long-standing differences in academic knowledge systems worse.

Critical consciousness necessitates an educational process for individuals who act upon reality. In the promotion of open science, librarians are essential agents, as argued in this text. The formative process for librarians must include the development of skills and competencies, as outlined in the studies by Liu and Liu (2023). These studies include Giustini et al. (2023), Ogungbeni et al. (2018), and Santos-Hermosa and Atenas (2022). These skills include:

- Knowledge of information systems, particularly different types of repositories, academic publishing platforms, and digital preservation mechanisms.
- Promotion and dissemination of content within and beyond the academic community through marketing activities, event organization, and production of outreach materials.
- Informational policy development at both micro and macro levels.
- Data literacy and best practices for opening research data and educational resources.
- Development of local, regional, and international networks and partnerships.
- Understanding of academic knowledge financing and evaluation systems.
- Expertise in scholarly publishing practices and open licensing.

Beyond acquiring the skills necessary for project implementation, librarians must develop critical consciousness to influence the conception of open science. For this purpose, librarians should understand:

- Their local reality.
- The interests of their community, both academic and non-academic.
- The contradictions and challenges within scholarly communication systems.

Reflections on librarian education must also consider the role of educators in training programs. On this relationship, Freire (1996) teaches that:

- Educators must also engage in a dialogical process of teaching and learning. This circular process enables individuals to develop epistemological curiosity, critically exercising their ability to learn and teach.
- Teaching is not the transfer of knowledge. All individuals in the educational process should also view themselves as knowledge producers. Education should create opportunities for the genuine production of knowledge, rather than merely consuming it.
- Teaching is a human activity. As a human action, it requires an understanding of the world and its ideals. Humanity demands freedom, consciousness, and agency. Teaching demands professional competence, dialogue, openness, and generosity.

The relevance of Paulo Freire's teachings extends beyond the proven efficacy of his method for teaching literacy to workers, encompassing writing and technical mastery. His ideas reach the transformative essence of education: empowering professionals to understand their role in creating a more just and inclusive reality. This theoretical foundation presents the Freirean perspective on education as the basis for training new librarians, not just as technical specialists in organizing and disseminating knowledge, but also as agents of social transformation.

In conclusion, open science is not merely a technological or administrative advancement in scholarly communication, but a political and social project requiring critical engagement. Drawing on Paulo Freire's pedagogy, it emphasizes the need for librarian education to extend beyond technical training, fostering critical consciousness to reflect and act on contradictions in scholarly communication and advocate for inclusive knowledge-sharing practices. Librarians play a dual role as technical experts and social agents, necessitating an education that promotes reflection, dialogue and justice in knowledge production. The Freirian perspective thus provides a transformative framework for LIS education, positioning libraries as active participants in building a more open, inclusive, and democratic scholarly communication system.

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