From Building for Users to Co-constructing with Users: A Study on University Library Resource Construction and Service Pathways in the Open Science Environment

Authors: Wang Fei, Zhao Panyun, Cui Haiyuan, Liu Yuchu, Jia Minghua, Xu Ruxue, Faye Wong

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Abstract

In the open science environment, users have developed novel needs in knowledge acquisition, creation, dissemination, and learning, thereby posing novel requirements for library resource development. This study employs literature review and questionnaire survey methods to investigate the evolution of user information behavior in the open science context and its implications for university library resource development. Building upon this foundation, through examining domestic and international practices in literature resource development, this paper proposes pathways for university library resource development and services. In the open science environment, the scope of university library resource development should expand beyond traditional subscription-based resources to incorporate open resources into the collection and formulate dedicated open resource collection development policies. Philosophically, the approach should transition from an "outside-in" model of resource acquisition to an "inside-out" paradigm of user participation in resource development, shifting from subscription models focused on resource access to frameworks that support open academic communication among users. This transformation would enable user participation in resource development across all stages of research and teaching activities, allowing university libraries to cultivate a user-participatory, dynamically updated ecosystem of collaborative resource development.

Full Text

From "Develop for Users" to "Develop with Users" : Research on Resource Development and Service Pathways of Academic Libraries in the Open Science Environment

WANG Fei*, ZHAO Panyun, CUI Haiyuan, LIU Yuchu, JIA Minghua, XU Ruxue
(Peking University Library, Beijing 100871)

Abstract

In the open science environment, users have developed new demands for knowledge acquisition, creation, dissemination, and learning, which impose new requirements on library resource development. As academic institutions that support scientific research and teaching, academic libraries are significant promoters and participants in open science. This study employs literature review and questionnaire methods to investigate changes in user information behavior in the open science context and their implications for academic library resource development. Based on this analysis, we propose pathways for resource development and services by surveying practices both domestically and internationally.

In the open science environment, the scope of resource development in academic libraries should expand beyond traditional subscription-based resources to include open access resources, accompanied by a formal policy for open collection development. The philosophy of resource development should transition from external resource acquisition to user-participatory internal development, shifting from merely supporting resource access through subscriptions to facilitating user participation in open scholarly communication. This approach will empower libraries to support user involvement in resource development at all stages of research and teaching activities, fostering a user-driven, dynamically updated ecosystem for resource co-development.

Keywords: Open science; User demands; Resource development; Inside-out; Open access
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1. Corresponding Author

*Corresponding author: WANG Fei, Email: wangfei@lib.pku.edu.cn

2. From Open Access to Open Science

2.1 The Evolution from Open Access to Open Science

The open access (OA) movement, also known as the open archiving movement, represents an academic, publishing, and library-led initiative to promote the open utilization of research outputs and broad exchange of humanities information through free dissemination of scholarly information via the internet. Since the late 1990s, the serials crisis caused by dramatic journal price increases, coupled with permissions and access crises resulting from publisher licensing agreements that restricted library use and service rights, constrained traditional scholarly communication models. Simultaneously, internet applications provided opportunities to break the monopoly of traditional publishers and subscription models, making the concept of equitable access and global sharing of academic resources increasingly accepted. Governments, research funding agencies, educational institutions, publishers, and libraries have all joined the effort to promote and participate in open access.

Over the past two decades, open access has developed extensively across multiple dimensions including content types, opening methods, timeframes, and participating entities. In terms of content, it has expanded from open journals to include open books/textbooks/monographs, open data, open courseware, and open educational resources. Regarding opening methods, it has evolved beyond open journals and repositories to encompass open data repositories, institutional repository consortia, institutional repository registration systems, and open data journals. In terms of timing, delayed open access coexists with immediate open access. Regarding participants, the ecosystem now includes not only researchers, educators, and librarians, but also relevant institutions, government organizations, and national-level stakeholders. As various open resources have been disseminated and utilized, the foundational environment for open access to research data has taken shape globally. In November 2021, UNESCO' s 41st General Conference adopted the *Recommendation on Open Science* [6], marking a new stage of global consensus on open science. The Recommendation defines open science as an inclusive construct combining various movements and practices aimed at enabling open browsing, access, and use of multilingual knowledge. Open science encompasses all scientific disciplines and aspects of scholarly practice, including basic and applied sciences, natural and social sciences, and humanities, and is built upon four main pillars: open scientific knowledge, open science infrastructure, science communication, open engagement of social actors, and open dialogue with other knowledge systems.

2.2 Impact of Open Science on User Information Behaviors

2.2.1 Impact on Knowledge Acquisition Open resources have become crucial sources for users to acquire knowledge in the open science environment. Compared to traditional subscription resources, open resources enable immediate access due to their free availability and convenience, significantly accel-

erating scholarly communication. Research indicates that open access articles receive more views and citations than paywalled articles, with greater diversity in users' disciplinary backgrounds and community origins [7]. For instance, a 2020 bibliometric study on citation counts and thematic diversity of open access articles revealed that open access articles exhibit 36% higher citation diversity (interdisciplinary) than non-open access articles [8]. At Peking University, the most frequently accessed open platforms include the *Yongle Encyclopedia* High-Resolution Image Database, Late Qing and Republican Chinese Newspaper Collection, ChinaXiv Preprint Platform, SCOAP3, eLibrary Russian Academic Database, and DOAB, with some platforms receiving annual usage exceeding that of many subscription resources, reflecting strong user demand for various open resources.

2.2.2 Impact on Knowledge Creation First, the open science environment has generated vast amounts of user-generated content (UGC), transforming the traditional unidirectional information transmission model of knowledge repositories. With the development of E-learning and E-science concepts and digital research environments, users extensively utilize web publishing, personal homepages or blogs, and academic social networks to disseminate their research outputs, producing substantial user-created open scholarly resources such as science blogs, academic forums, academic communities, and scholar personal homepages. Second, open science emphasizes the reusability of research outputs, providing users with open data, tools, and software for reuse and derivation, thereby promoting sharing, collaboration, and exchange in scientific research. Consequently, researchers require infrastructure for data acquisition and storage, as well as institutions that foster collaboration, reproducibility, and equity. As of December 2024, Peking University' s Open Research Data Platform has collected interdisciplinary open data from 149 data spaces and 431 datasets, including the China Family Panel Studies, China Health and Retirement Longitudinal Study, Beijing Social and Economic Development Annual Survey, and data from research centers such as the Center for Healthy Aging and Development, the Visual Computing and Visual Analytics Research Group, and the Bioinformatics Center of the School of Life Sciences. Third, open science emphasizes research transparency, enabling researchers not only to make their outputs openly accessible but also to share their research processes, thereby achieving full-cycle openness of scientific research. This approach helps reduce low-level repetitive research at its source, requiring researchers to have infrastructure for opening their research designs, methods, and conclusions, while ensuring the openness and security of research outcomes at all stages.

2.2.3 Impact on Knowledge Dissemination Traditional academic publishing involves lengthy publication cycles, resulting in significant lag times for research dissemination. Open science emphasizes efficient dissemination of research outputs, encouraging researchers to publish open access papers for immediate and instantaneous openness, thereby accelerating knowledge propagation

and advancing research progress in relevant fields. A 2018 survey on Chinese researchers' perceptions and use of open access journals (OAJ) [9] investigated 381 Chinese researchers, revealing that most were familiar with OA journals, with three-quarters having published in OA journals, particularly among STEM researchers. At Peking University, as of December 2024, a search of the Web of Science Core Collection for articles with "Peking University" as the affiliation (including co-authorship) yielded 225,791 articles, of which 87,249 (38.6%) were open access. Among these, 44,674 OA articles were published between 2020-2024, with an annual average of 8,934 OA articles. The annual distribution is shown in Figure 1 [Figure 1: see original paper]. The disciplines with the highest number of OA publications are interdisciplinary studies, astrophysics, oncology, particle physics, and cell biology.

2.2.4 Impact on Knowledge Learning The advancement of open science has transformed education and teaching from print textbook-dependent models to digital, open content, and open access approaches, thereby exerting broader impacts on teaching activities. On one hand, it expands the content and traditional methods of student learning; on the other, it signals the transformation of textbooks and the future development of educational publishing. Open Educational Resources (OER) originated at MIT with the OpenCourseWare (OCW) project in 2001, which made MIT' s teaching resources—including lecture notes, lab reports, homework assignments, bibliographies, lab manuals, and exam questions—freely available globally via the internet. In recent years, Chinese universities have actively joined the OER movement. For example, the Hong Kong Polytechnic University developed an OER portal that indexes and categorizes high-quality public domain teaching and learning materials from around the world to facilitate discovery and integration into curricula. Peking University' s "Teaching Online" platform, built on the Blackboard system, integrates network teaching, digital resource management, online video classrooms, and campus community functions, currently supporting blended learning for nearly 2,000 courses. Additionally, Peking University' s "Chinese MOOC" platform, a non-profit open sharing platform, has offered nearly 200 courses with over 5,000 daily learners. Beyond free learning, the platform supports faculty in conducting blended teaching, with some courses incorporating online grades into final scores and providing features for class management, flexible grading, and grade statistics. In the open teaching environment, students not only use resources but also actively participate in designing and creating OER learning materials, contributing to knowledge production and dissemination through activities such as creating research toolkits, online courses, e-books, and webpage maintenance.

3. Impact of Changing User Information Behaviors on Library Resource Development

Library services ultimately serve users, so changes in research and learning methods directly impact library resource development. The transformation of user

information behaviors in acquiring, creating, disseminating, and learning knowledge under open science may trigger the second major resource development transformation since the shift from print to digital resources. In July 2020, OCLC' s Global Council and OCLC Research published a survey report on global libraries' open resource development and service activities [10], investigating 705 libraries and information institutions across 82 countries. Among them, 511 institutions (97%) from 69 countries conducted open resource-related activities. The report categorized research and academic libraries' open resource activities into three types: (1) building institutional repositories for open resources, (2) digitizing public domain collections for open online access, and (3) managing open resource collections. The most common activity was "building institutional repositories" (71%). Regarding future plans for open resources, "data services" and "deep interaction with open content" ranked highest (both at 18%), followed by resource evaluation, digital libraries, open content publishing, promoting open content discovery, born-digital collections/web archiving, bibliometric services, and open content promotion.

3.1 Users Require Diverse Open Resources Beyond Subscription Publications

The flourishing development of various open resources in the open science environment makes open content an important supplement to commercial academic resources. The OCLC report [10] broadly defines "open resources" as "all types of freely accessible, unrestricted online resources," including "scientific open access journal articles, monographs, and preprints, as well as other types of open materials, open educational courses, government documents, grey literature, datasets, digitized special collections and other heritage collections, freely accessible videos, software, tools, or other types of born-digital resources." The library' s mission is to provide users with comprehensive, timely, and reliable information resources and further process and reveal them. In the open science environment, users' utilization needs for these open resources in teaching and research impose higher requirements on the scope of academic library resource development. If libraries continue to focus primarily on providing subscription-based (paid) resources, a considerable portion of open resources will not be effectively discovered or utilized, hindering libraries' ability to provide one-stop comprehensive information services.

3.2 Users Require Support for Publishing and Archiving Beyond Resource Access

In the open science environment, traditional commercial publishing is no longer the sole avenue for users to publish and archive research outputs. Users are increasingly leveraging open access journals and institutional repositories to disseminate and archive their achievements. Libraries should incorporate institutionally generated scholarly outputs into their resource development scope and provide financial or infrastructural support for users' open publishing from

the source. For instance, the preprint platform arXiv has become a frontier exchange platform for disseminating research outputs in mathematics, physics, computer science, and quantitative biology. As of September 2024, the total number of papers submitted to arXiv reached 2,577,590, with 21,794 submissions in July 2024 alone [11], setting a new milestone and reflecting researchers' demand for immediate, open knowledge dissemination and the need for open resource publishing and archiving infrastructure.

3.3 Users Require Academic Record Management Throughout Research and Teaching Project Lifecycles

Open science heralds the arrival of an era of data-intensive scientific discovery, where the fundamental unit of knowledge production and reproduction shifts from research outcomes (journal articles) to scientific data and preprints as research process outputs. Research data management encompasses how to organize, structure, store, and maintain information used or generated in research projects, including how to collect, store, and process data throughout the project lifecycle—before, during, and after research [12]. Many foreign research libraries have strategically positioned themselves in research data management (RDM). A July 2013 survey by Primary Group on RDM services at renowned university libraries worldwide indicated that approximately 63.33% of university libraries provide data management services. Research based on user needs surveys after 2011 demonstrated that researchers have strong demand for data management services, which are essential for both STEM and non-STEM disciplines [13]. To better meet user needs, academic libraries should incorporate data resource management into their resource development scope and provide campus researchers with data storage and management services throughout the entire research lifecycle.

4. Pathways for Open Resource Development in Academic Libraries Based on User Needs in the Open Science Environment

4.1 Incorporating Open Resources into Collections and Developing Policies and User Guidelines

(1) Integrating Open Access Resources into Discovery Services and Developing Open Access Collection Development Policies

Given users' demand for open access resources in the open science environment, libraries must incorporate open access publications into their collection development scope. Currently, most Chinese university libraries have added various open resource repositories to their resource lists. For example, Peking University Library' s database navigation integrates high-quality domestic and international open resource platforms alongside conventional subscription and self-built databases, totaling 416 open platforms covering humanities and social sciences, biology, medicine, chemistry, and natural sciences. These include

open access platforms such as DOAB (Directory of Open Access Books) and SCOAP3 high-energy physics open access resources, as well as free public data platforms like the *Yongle Encyclopedia* High-Resolution Image Database and the Chinese Ancient Books Resource Library. Each database entry provides resource type, language, description, volume information, valid access URLs, and regular maintenance. The navigation system allows users to search and discover resources by discipline, content type, language, and subject. By integrating open resource platforms with purchased and self-built databases for unified searching, the library enhances the discoverability and usage of open resources. In addition to librarians regularly selecting high-quality open resource repositories with significant academic and research value for inclusion, the platform also accepts recommendations from faculty and students, incorporating frequently used open resource platforms for broader discovery and use.

In selecting open access resources, libraries typically identify suitable resources from the vast open access landscape and add them to local discovery systems, often relying on user and peer recommendations but lacking standardized selection criteria. To better leverage user participation in resource co-development, libraries should formulate collection development policies tailored to open access resource characteristics. Such policies provide guiding principles for user participation in development and establish a basis for long-term resource management. In a September 2024 OCLC report on improving open access resource discovery for academic library users [14], seven Dutch libraries were surveyed on their open access collection development, with five providing collection development policies that guide open access resource development.

The University of North Texas Library' s *Collection Development Strategy for Open Access and Born-Digital Resources* [15] comprehensively specifies principles and scope for open access resource development. Following general collection development policy principles, it is structured into sections including overview, objectives and definitions, selection and responsibilities, selection guidelines, access, copyright compliance, collection maintenance, and collaboration with digital library departments. The "Selection Guidelines" stipulate that web-based open access resources should meet the same standards as purchased resources, while also considering additional evaluation criteria including quality, authority, objectivity, timeliness, and functionality, as detailed in Table 1 .

Table 1. University of North Texas Library OA Resource Selection Criteria

OA Resource Selection Criteria	Description
Same standards as purchased resources	Meet learning, research, and teaching needs of students and faculty; resources should be scholarly or likely to advance research or support university curricula.
Quality	Resources should be relevant to the repository' s subject; information should be reliable, accurate, reasonably comprehensive or complete. Quality indicators include peer review or librarian review of websites/content; author or publisher authority; professional website design and functionality; continuous updating of archives; provision of author and publisher contact information.
Authority	Provide author and publisher credentials; legitimacy of publishing domain (e.g., .edu, .gov, .org, or .net); publisher reputation and operational status.
Objectivity	Provide verifiable and confirmable information without unnecessary advertisements or other distractions.

OA Resource Selection Criteria	Description
Timeliness	Provide publication dates with clear update statements and/or regular updates as indicated on the resource.
Functionality	Accuracy of citations and links; no additional software required to view resources; no access fees or registration required.

Additionally, Emory University, a private research university in Georgia, adopts a different approach in its *Open Access Collection Development Policy* [16], structuring the policy according to open resource characteristics. It enumerates sections including purpose, support for open access collections, support for open educational resources, support for researchers and faculty, requirements for open access resource development and cataloging, and support for transformative agreements, providing strong specificity for open resource development and service activities (Table 2).

Table 2. Emory University Library Open Access Collection Development Policy

Policy Component	Description
Support for open access collections	Advance the open access movement by helping users discover open access collections and supporting institutional authors' open access publishing.
Support for open educational resources	Enhance discovery of OER in the university library' s discovery system.
Support for researchers and faculty	Support individual authors in publishing open access monographs or journal articles; provide open access publishing funds for authors.

Policy Component	Description
Requirements for open access resource development and cataloging	Allocate staff to catalog and manage OA resources; subject librarians add titles to the resource directory based on user needs.
Support for transformative agreements	General principles for signing TA: prioritize waiving APCs over providing discounted APCs; prefer multi-year agreements when possible to lock in price increases.

(2) Strengthening Open Educational Resource Development and Providing User Guidelines

To address the needs of faculty and students for open educational resources, libraries should enhance the collection and centralized discovery of open courseware (OCW), open textbooks, and interactive learning modules, facilitating user access and utilization while providing guidelines for institutional users to use, create, and disseminate OER.

4.2 From "Outside-In" Resource Acquisition to "Inside-Out" User-Participatory Resource Development

(1) "Inside-Out" User-Participatory Resource Development

A significant component of academic library resource development involves collecting, managing, and providing access to scholarly records. In the open science environment, the scope of scholarly records has expanded to include all activity records throughout the research process, including research data, research processes, research tools, and other relevant materials, varying by discipline. All such knowledge content is incorporated into academic library collections as scholarly records. According to Lorcan Dempsey' s framework proposed by the University of Washington Libraries, library resource development should shift from "outside-in" to "inside-out." Under this framework, libraries act not only as agents that procure external resources based on user needs but also as custodians and disseminators of user-generated content.

Traditional library collection development emphasizes external resource acquisition ("outside-in")—providing local users with access through purchasing or licensing external resources. In response to users' needs for publishing and archiving support beyond resource access, library resource development should complement external acquisition with "inside-out" development, strengthening the integration of knowledge resources generated within the institution (digital special collections, research and learning materials, scholar homepages) to

promote both internal scholarly communication and open knowledge sharing.

(2) Pathways for "Inside-Out" User-Participatory Resource Development

Table 3 outlines the pathways for user participation in resource development:

Table 3. "Inside-Out"User-Participatory Resource Development Pathways

User-Coordinated Resources	Participants	Resource Types	Collection Methods	Access Scope
Theses and dissertations	Students, faculty	Bachelor' s, master' s, and doctoral theses; post-doctoral reports	User self-submission; batch import metadata model	Authorized access for institutional users
Research outputs	Students, faculty	Monographs, journal articles, conference papers, research reports, courseware	User self-submission; batch import	Authorized access for institutional users
Research data	Students, faculty	Research data, datasets, data spaces, data tools	User self-deposit; unified harvesting; user self-storage and batch import	Authorized access for internet users
Personal academic websites	Students, faculty	Personal academic homepages or blogs, academic forums, academic communities	User self-submission; unified import	Authorized access for internet users

User-Coordinated Resources	Participants	Resource Types	Collection Methods	Access Scope
Personal collections	Students, faculty, public donors	Ancient books, calligraphy, rare manuscripts	User self-submission; batch import; digitization import	Authorized access for internet users

For academic libraries, "inside-out" resource development should include institutional users' theses and dissertations, research outputs, research data, personal academic websites, and personal collections. Among these, the theses and dissertations database is a typical characteristic resource built through user self-deposit. As unique institutional resources with high academic and research value, theses and dissertations represent a priority in academic library resource development [17]. Peking University Library has collected electronic theses and dissertations through student self-submission since 2003, reviewing and publishing them upon submission. To date, the library has collected over 140,000 entries. For metadata collection, users complete submission forms according to system requirements, including selecting discipline codes, Chinese Library Classification numbers, and thesis languages, and filling in author information before uploading electronic files. This process enables user self-deposit at both metadata and object data levels, enhancing collection efficiency and resource discovery accuracy.

For other research output resources, academic libraries should provide appropriate infrastructure for dissemination and storage. Providing an institutional repository is essential for modern research universities and represents a fundamental step toward achieving green open access on campus. Its primary purpose is to collect and preserve the academic and intellectual outputs of institutional users, including monographs, journal articles, conference papers, theses, and research reports, enabling archiving, management, publication, discovery, and open sharing, with free and permanent global access. Repositories can be locally developed platforms (e.g., UC' s eScholarship), open-source software (DSpace), or commercial platforms (bepress). However, repositories alone do not satisfy open access requirements; institutions must also establish policies ensuring authors' rights and incentives encouraging user self-deposit.

Regarding research data, academic libraries should provide research data management (RDM) services enabling users to create, share, use, and organize data, ensuring data security, providing access when necessary, and archiving data with long-term preservation value. The Chinese University of Hong Kong (CUHK) has developed *Research Data Management Guidelines* [18] to provide general guidance and support for researchers and students in managing, preserving, and sharing current or future research data.

Additionally, centrally discovering academic websites built or provided by in-

stitutional users and donated literature resources can further promote resource discovery and open access, benefiting more users. For example, Peking University Library has recently developed special collection databases from renowned donor resources, including the Chen Hansheng Archive Database, Duan Baolin Gift Collection, Ren Zhi-Wei Ying Collection, and Su Bai Book Collection, forming distinctive resource databases aligned with donors' disciplinary characteristics. The Su Bai Book Collection Database, for instance, primarily contains humanities and social science publications, particularly distinctive in archaeology and history. The database also includes biographical information, academic achievements, teaching ethics, gift book displays, and media coverage, setting a positive example for other scholars' donations while enabling open utilization of resources.

4.3 From Supporting Resource Access via Subscriptions to Supporting User Open Publishing

In recent years, academic libraries have committed to promoting transformative agreements to facilitate convenient open publishing for users. Transformative agreements involve libraries paying publishers certain fees to secure resource access while simultaneously supporting institutional researchers in publishing open access articles in those publishers' journals. Over time, the traditional subscription payment model will gradually transition to a model supporting open publishing, achieving a comprehensive shift from one fee structure to another. Under transformative agreements, all journals in a publisher' s subscription list will support full open access for institutional users.

(1) Identifying Publishers for Transformative Agreements

For academic libraries, determining priority publishers for transformative agreement negotiations requires evaluating institutional research output volume, publisher cooperation opportunities, and whether publishers are commercial, nonprofit, or scholarly societies. First, institutional research output should be assessed quantitatively. For example, the University of California evaluates institutional authors' publishing output as a quantitative metric, using commercial statistical tools to determine annual publication volumes and journal distributions of UC authors, prioritizing publishers with the highest institutional author publication rates for transformative agreements to maximize open publishing impact.

Second, cooperation opportunities should be evaluated. For publishers with relatively low institutional research output but significant cooperation potential, qualitative indicators should be assessed. The University of California has developed a series of qualitative metrics to measure publishers' potential for advancing open access, including: whether the publisher' s values and mission align with the institution; the publisher' s commitment to transitioning to full open access and willingness to cooperate; whether the publisher has a compatible business model or is willing to co-create new models; whether the publisher

provides strong support for researchers; whether the publisher collaborates with other institutions; and whether an agreement with the publisher would establish a positive precedent and influence the broader scholarly publishing system.

(2) Signing Open Access Transformative Agreements

In international practice, the University of California has signed transformative agreements with 25 major global publishers, including the American Chemical Society, covering over 8,000 academic journals as of 2024. Under these agreements, UC authors or co-authors receive automatic waivers of $1,000 article processing charges (APCs) for open publishing; authors without open publishing research funding receive full APC waivers, while funded researchers receive APC discounts (partial discount scenarios shown in Table 4).

Table 4. University of California Open Publishing Agreement APC Discounts

Publisher	APC Discount	Applicable Journals
Cambridge University Press	15% discount (10% for Cell Press, The Lancet)	Most CUP journals (except 少数还未提供开放出版的期刊)
Elsevier	Automatic $1,000 APC waiver; full APC waiver for authors without open publishing funding	All Elsevier journals (except 少数社科期刊)
Springer Nature	20% discount for hybrid OA journals; 15% discount for fully OA journals	All Springer journals under agreement
Taylor & Francis	Full APC waiver	All SAGE journals (except 少数社科期刊)
Wiley	15% discount	All Wiley journals

In domestic practice, the Chinese Academy of Sciences launched the *Guidelines for Chinese Academy of Sciences Authors Publishing OA Papers* in October 2024, providing information on APC payment models, discounts, and journal selection to advise institutional authors on publishing open access papers and applying for open publishing funding. The guidelines include publishers offering unlimited full APC waivers for all corresponding authors from the Academy, such as the Association for Computing Machinery (ACM), publishers offering limited APC waivers allocated on a "first-come, first-served" basis or according to institutional subscription amounts, such as Oxford University Press, and publishers offering APC discounts, such as the Institute of Electrical and Electronics Engineers (IEEE).

5. Conclusion

Open resource development has evolved from a "for users" approach to a "with users" paradigm. Researchers are the principal force in the open access movement, and academic libraries should collaborate with faculty and users to jointly build and share open resources. By partnering with researchers and educators to incorporate the most academically valuable open resources across disciplines into collections, and by supporting researchers' open research practices, libraries can enhance researchers' enthusiasm for participating in open access, strengthen local open resource development, and ultimately achieve comprehensive open access to all types of resources, including scholarly resources, thereby facilitating scientific research development and technological innovation. Chinese academic libraries can learn from foreign libraries' experiences in operating open access journals and actively participate in the open scholarly communication process. In developing and serving open resources, libraries should raise awareness of open access among Chinese library and research communities, provide training and guidance to readers on using and publishing open access resources, and promote open access information literacy education. Furthermore, libraries should actively construct secure, transparent, and trustworthy open science governance systems, particularly by participating in global open science governance processes to effectively prevent and address related risks. As academic institutions serving university scientific research and teaching, academic libraries are crucial promoters and participants in open science and should explore new pathways for literature resource development and services based on user needs in the open science environment, positioning themselves as vital platforms for users to create, acquire, disseminate, and learn knowledge.

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