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From Scholarly Communication Support to the Transformation of Library Research Support Services: A Bibliometric Analysis and Scoping Review

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ABSTRACT: Purpose – This study aims to examine the transformation of university library research support services from scholarly communication support to integrated research support services within the context of open science. By combining bibliometric analysis with a scoping review, the study explores the intellectual evolution of the field, identifies major research trends and thematic developments, synthesizes emerging service models and institutional practices, and examines the drivers, barriers, and competencies associated with this transformation. The findings provide a comprehensive understanding of how academic libraries are repositioning their roles and offer practical implications for developing sustainable, research-oriented support services in higher education.

Design/methodology/approach – This study employed a bibliometric analysis combined with a scoping review using data retrieved from the Scopus database. An adapted PRISMA Extension for Scoping Reviews (PRISMA-ScR) framework guided the identification of research trends and knowledge gaps. Bibliometric analyses were performed using the Bibliometrix/Biblioshiny package in R, while VOSviewer was used for network visualization. Furthermore, thematic qualitative content analysis was applied to the selected studies to synthesize research support service models, emerging practices, transformation pathways, and key developments in scholarly communication within the evolving open science and digital research ecosystem.

Findings – The findings indicate that research on the transformation of research support services in relation to scholarly communication has expanded substantially during the period 2016-2026, reflecting a shift from traditional library services toward an open research ecosystem. Bibliometric analysis identified major research themes, including open access, open science, research data management, scholarly communication, and scholarly publishing. It revealed the growing prominence of AI, research visibility, and research impact assessment. The scoping review further demonstrates that scholarly communication has evolved beyond publication support to encompass the entire research lifecycle, driving the transformation of academic libraries from information providers to strategic research partners. Academic libraries are increasingly engaged in research data management, open access publishing, bibliometric services, research capacity building, and digital research infrastructure management. Nevertheless, this transformation continues to face challenges related to institutional policies, digital infrastructure, financial and human resources, professional competencies, and traditional research evaluation systems, highlighting the need for coordinated institutional, technological, and workforce development to establish sustainable open research ecosystems.

Research limitations/implications – This study has several limitations. First, the analysis was limited to Scopus-indexed publications, potentially excluding relevant studies from other databases and grey literature. Second, the bibliometric findings reflect publication patterns rather than the effectiveness of research support services in practice. Despite these limitations, the study provides a comprehensive overview of the evolution of scholarly communication support. It offers evidence to inform the development of research support services, professional competencies, and institutional Open Science strategies in academic libraries.

Practical implications – This study contributes to the systematic integration of research domains that have traditionally been examined separately, including open access, open science, research data management, scholarly communication, and research support services, into a unified analytical framework based on the research ecosystem perspective. The findings not only clarify major developmental trends, areas of consensus, and ongoing debates within the field but also identify important research gaps that warrant further investigation, particularly regarding the evaluation of research support services' effectiveness, the emerging role of Artificial Intelligence and generative Artificial Intelligence (AI/GenAI), and cross-national differences in research support practices.

Originality/value – This study is among the first to integrate bibliometric analysis with a scoping review to provide a comprehensive understanding of the evolution of research support services in academic libraries. It extends existing scholarship by conceptualizing research support services as an integrated research ecosystem rather than a collection of isolated scholarly communication activities. The study synthesizes evidence on the relationships among scholarly communication, open science, digital research infrastructure, research data management, and emerging technologies, offering a unified analytical framework for interpreting service transformation. The findings

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contribute to both theory and practice by informing future research, supporting strategic library planning, and guiding the development of sustainable research support services aligned with institutional research priorities and open science agendas.

KEYWORDS: Scholarly communication, Research support services, Digital transformation, Open science, Academic libraries.

INTRODUCTION

Research and scholarly communication (SC) are undergoing a profound transformation driven by digital transformation, open science (OS), and emerging technologies. Traditionally focused on publishing research findings, SC now encompasses the entire research lifecycle, including data management, dissemination, research assessment, long-term preservation, knowledge sharing, and the reuse of research outputs. The expansion of open access (OA), open research data, open educational resources (Liu & Liu, 2023), digital scholarly platforms, and artificial intelligence (AI) has fundamentally reshaped how scholarly knowledge is created, disseminated, and evaluated.

SC has consequently evolved into a central component of the global research ecosystem by enhancing research visibility, facilitating collaboration, and accelerating knowledge dissemination (Subaveerapandiyan et al., 2025). At the same time, OA and OS have expanded expectations regarding data transparency, research reproducibility, data sharing, and stewardship throughout the research lifecycle. Nevertheless, the implementation of these practices remains uneven because of limitations in technological infrastructure, financial resources, and institutional capacity (A et al., 2024).

These developments have also transformed scholarly communication practices through the increasing adoption of preprints, persistent researcher identifiers, new research evaluation metrics, and diverse OA publishing models. Mullen (2024) argues that OA and OS have substantially reshaped research practices, scholarly publishing, and research data management (RDM), shifting SC from a publication-oriented model toward an open, digitally connected research ecosystem. More broadly, international organizations and funding agencies have promoted reforms in research assessment, data management, research dissemination, and FAIR data practices (Nosek et al., 2015; Wilkinson et al., 2016), reflecting a paradigm in which scholarly knowledge is increasingly regarded as an open and reusable public good.

These transformations have fundamentally redefined the role of academic libraries. Traditionally responsible for collection management and information services, academic libraries are increasingly evolving into providers of research support services (RSS) and strategic partners throughout the research lifecycle. Si et al. (2019) classified RSS into seven major categories: RDM, OA support, scholarly publishing, research impact assessment, research instruction, research consultation, and research tool support. Consequently, services such as institutional repository management, bibliometric and altmetric analysis, copyright support, and compliance with OS policies have become integral components of contemporary RSS (Bourke, 2022). The rapid emergence of AI is further accelerating this transformation.

Accordingly, the transformation of academic libraries has become an important topic in library and information science (LIS). Previous studies have examined individual aspects of RSS, including OA, RDM, bibliometrics, digital libraries, and OS, as well as librarians' competencies in digital research environments. However, these topics have largely been investigated independently, resulting in a fragmented understanding of how they collectively contribute to scholarly communication. Sandy et al. (2020) emphasize that effective research support requires integrating SC-related services into a coherent framework. Furthermore, most existing studies focus on specific countries or individual service domains, leaving a limited understanding of global research trends and the intellectual structure of this evolving field.

Although bibliometric analysis and scoping reviews are widely used in LIS research, studies that integrate these approaches to examine the transformation of RSS within the broader SC ecosystem remain limited. Combining bibliometric analysis with a scoping review enables researchers to identify publication trends while simultaneously synthesizing research themes, developmental trajectories, service models, and knowledge gaps (Imaduddin and Eilks, 2024; Adegoke et al., 2024).

Against this background, this study integrates bibliometric analysis and a scoping review to examine the evolution of research support services within the scholarly communication ecosystem. It aims to synthesize the theoretical foundations linking SC and RSS, identify major research trends and emerging service models, and provide evidence to support the strategic development of academic libraries in the era of digital transformation and OS.

Accordingly, this study addresses the following research questions:

RQ1: How has research on SC-related RSS in academic libraries evolved in terms of scientific productivity, intellectual structure, and research trends?

RQ2: What types of SC-related RSS, organizational models, and implementation practices have been adopted and discussed by academic libraries in the context of digital transformation and OS?

RQ3: How is the transition from SC support to integrated RSS reflected in the existing literature, and what emerging trends and research gaps are shaping this field?

THEORETICAL BACKGROUND

Scholarly communication in the context of open science

Scholarly communication refers to the processes through which scholarly knowledge is created, evaluated, disseminated, preserved, and reused throughout the research lifecycle. Traditionally associated with scholarly publishing, SC has expanded considerably with the emergence of digital technologies and OS. It now encompasses RDM, OA, IRs, research assessment, persistent identifiers, and digital scholarly platforms, reflecting a broader research ecosystem rather than a publication-centered model (Codina et al., 2023).

The global growth of OA and OS has transformed expectations regarding transparency, accessibility, reproducibility, and knowledge reuse. Governments, funding agencies, universities, and academic libraries increasingly promote policies and infrastructures that facilitate open research practices. The SC ecosystem remains influenced by commercial publishing models, creating ongoing challenges related to copyright,

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publishing costs, licensing, and equitable access. Consequently, academic libraries are expected to guide OA publishing, copyright management, institutional policies, and compliance with OS requirements. As research value is increasingly determined by the FAIR principles (Wilkinson et al., 2016), academic libraries play a crucial role in supporting open, transparent, and reproducible research.

Open science and digital research infrastructure

Open science promotes the transparency, accessibility, and reuse of scientific knowledge through practices such as OA publishing, open research data, open-source software, and collaborative research (UNESCO, 2021). Its implementation relies heavily on digital research infrastructures, including IRs, research data repositories, persistent identifier (PID) systems, RDM platforms, and open discovery services.

These infrastructures not only support the storage and dissemination of research outputs but also enhance interoperability, research visibility, and interdisciplinary collaboration (Schmidt et al., 2018; Tapfuma & Hoskins, 2019). Consequently, scholarly value is increasingly determined by discoverability, accessibility, and reuse rather than publication venue alone. Successful OS implementation, therefore, requires coordinated institutional policies, sustainable governance, and integrated RSS involving academic libraries, research institutions, funding agencies, and technology providers.

The transformation of academic libraries within the research ecosystem

The rapid development of SC and OS has fundamentally reshaped the role of academic libraries. Beyond their traditional responsibilities for collection management and information services, libraries now provide RSS such as RDM, OA publishing support, IR management, bibliometric and altmetric analysis, copyright consultation, persistent identifier management, and compliance with OS policies.

Brantley et al. (2017) found that although liaison librarians possess expertise in supporting scholarly publishing and research dissemination, many faculty members remain unaware of these services, underscoring the need for greater promotion and professional development. Accordingly, librarians are increasingly expected to act as research consultants, data stewards, scholarly publishing advisors, and research impact specialists. This transformation reflects a shift from resource-centered libraries to research-centered organizations whose value lies in supporting knowledge creation, research visibility, and research impact throughout the research lifecycle.

Research ecosystem framework

This study adopts the research ecosystem approach proposed by Daga et al. (2023), which conceptualizes research as an interconnected system involving researchers, academic libraries, research institutions, publishers, digital infrastructures, research evaluation systems, and science policies. Within this ecosystem, academic libraries function as knowledge intermediaries by providing digital infrastructure, research data services, scholarly communication expertise, and professional research support.

Building on this perspective, the analytical framework comprises five interrelated components: (1) the SC and OS ecosystem as the primary driver of service transformation; (2) institutional policies and governance, including OA, OS, RDM, and research evaluation; (3) digital research infrastructure and emerging technologies, such as IRs, research data repositories, bibliometric tools, and AI/GenAI; (4) researchers' scholarly communication behaviors, including information seeking, publishing, data sharing, and digital scholarly identity; and (5) the competencies and RSS provided by academic libraries, including RDM, OA support, IR management, bibliometric services, copyright consultation, and AI-enabled research support. This framework provides the theoretical basis for interpreting the findings from the bibliometric and scoping reviews and for explaining the transformation of scholarly communication support into integrated research support services.

METHODOLOGY

This study employed a mixed-review approach by integrating bibliometric analysis with a scoping review. According to Tricco et al. (2018), scoping reviews are particularly suitable for comprehensively mapping broad research areas that encompass diverse types of evidence and study designs. Accordingly, this study adopted an adapted PRISMA Extension for Scoping Reviews (PRISMA-ScR) framework to systematically identify, screen, and synthesize the existing literature, while simultaneously examining the intellectual structure, research trends, and knowledge gaps in the field.

Data source and search strategy

The bibliographic data were retrieved from the Scopus database on 12 May 2026. Scopus was selected because of its broad disciplinary coverage, high-quality bibliographic metadata, and widespread use in bibliometric research. The search strategy was developed around four major conceptual domains: (1) the academic library context, (2) SC, (3) RSS and the transformation of library research support, and (4) emerging technologies and future development trends. These four domains were subsequently combined using Boolean operators to maximize the retrieval of relevant publications while minimizing irrelevant records.

The search expression is used as follows: *(“academic librar*” OR “univerity librar*” OR “Research librar*” OR “Higher education librar*”) AND ("scholarly communication" OR “Scholarly publishing” OR “Open Access” OR “Open Educational Resources” OR “Copyright” OR “Intellectual property” OR “Research integrity”) AND (“Research support services” OR “Research Data Management” OR “Bibliometrics” OR “Scientometrics” OR “Altmetrics” OR “Publishing support services” OR “Institutional Repositorys” OR “Digital curation”) AND (“Open Science” OR “Digital transformation” OR “AI-enhanced library services” OR “Library 4.0”).*

The search strategy was further refined using the following eligibility criteria: (1) document type: Article; (2) language: English; (3) publication period: from 2016 to 12 May 2026; and (4) search field: All Fields. The initial search retrieved 742 records. After removing one duplicate record, a final dataset of 741 articles was retained for bibliometric analysis.

Following data screening and preliminary bibliometric analysis, the retrieved publications were further assessed for inclusion in the scoping review. Study selection was conducted through a manual screening of article titles, abstracts, and keywords, with Microsoft Excel used to organize and manage the screening process. Publications were included if they met one or more of the following criteria: (1) focused on academic or research libraries; (2) explicitly addressed SC-related RSS, such as RDM, scholarly publishing, IRs, bibliometric services, OA, or OS; (3) examined digital transformation, service innovation, or the adoption of emerging technologies in library services related to SC; and (4) presented

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review studies, conceptual frameworks, practical models, or strategic discussions concerning the development of SC services in academic libraries. Based on these criteria, 30 highly relevant studies were selected for qualitative content analysis within the scoping review. The overall study selection process is illustrated in Figure 1.

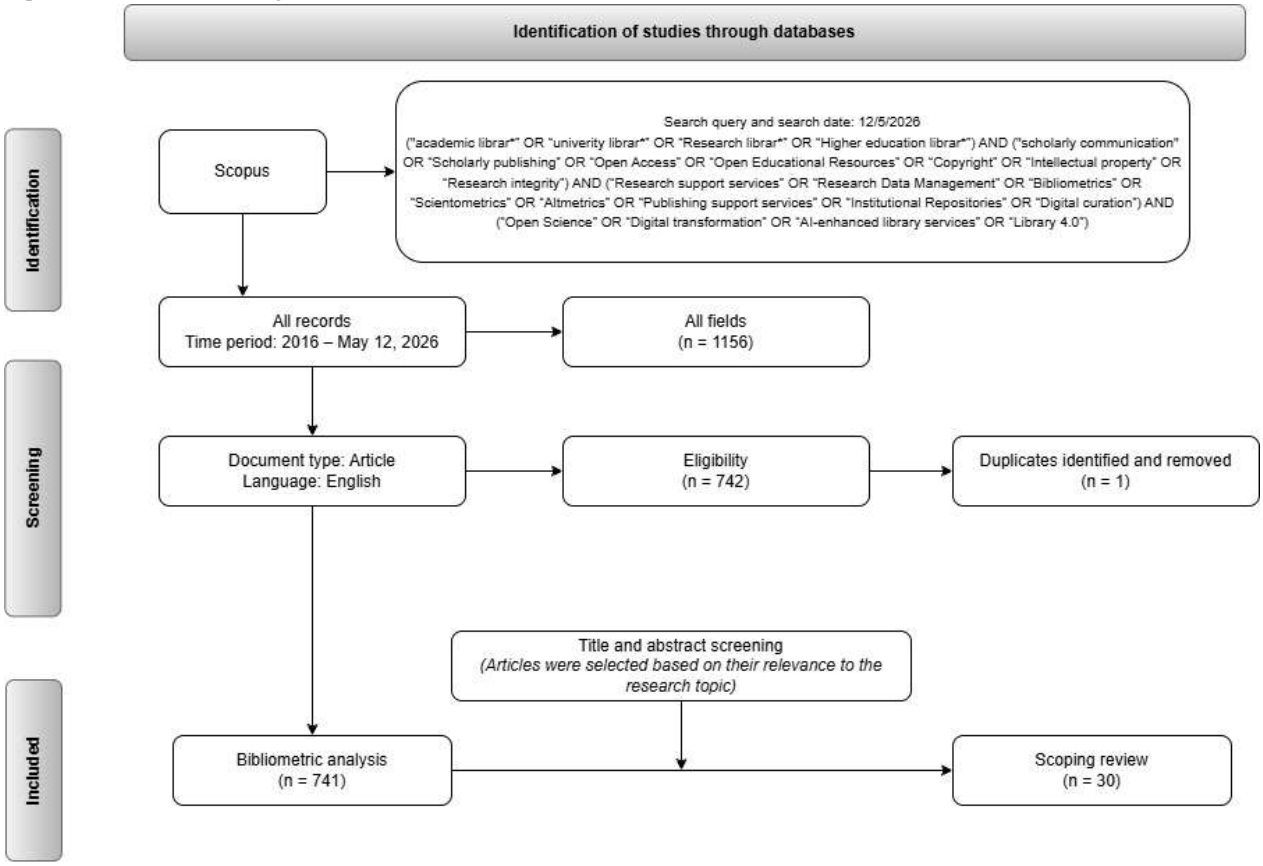


Figure 1. PRISMA-ScR diagram of the results of selecting articles for analysis.
Source: Figure by authors

DATA ANALYSIS

*** Bibliometric Analysis**: The bibliographic records retrieved from Scopus were exported as CSV files and analyzed using the Bibliometrix/Biblioshiny package in R. This platform was used to conduct descriptive bibliometric analyses and visualize the intellectual structure of the research field. The analyses included publication growth, source productivity, country and institutional collaboration, author productivity, keyword co-occurrence, thematic evolution, and conceptual structure. To complement these analyses, VOSviewer was used to generate network visualizations of co-authorship, keyword co-occurrence, and thematic relationships.

*** Scoping Review:** The 30 studies selected for the scoping review underwent qualitative thematic analysis (Braun and Clarke, 2006) to synthesize the evolution of SC-related RSS in academic libraries. Microsoft Excel was used to organize, code, and manage the qualitative data throughout the review process. The analysis followed four sequential stages. First, the full texts of all selected studies were examined to identify their research objectives, study contexts, and the types of RSS investigated. Second, the studies were coded according to major thematic categories, including SC, RDM, scholarly publishing, OS, IRs, bibliometric services, RSS, digital transformation, and the application of AI in libraries. Third, the identified services, organizational models, implementation strategies, and patterns of service transformation were systematically classified and compared across studies. Finally, the synthesized evidence was interpreted to identify the major research themes, developmental trajectories, emerging trends, and existing knowledge gaps regarding the transformation of academic library services from SC support to integrated research support.

RESULTS

The transformation of scholarly communication from scholarly publishing to an open research ecosystem

The thematic evolution analysis across four consecutive periods (2016-2026) reveals the developmental trajectories, convergence patterns, and continuity of the core research themes in this field. During the initial period (2016-2021), the intellectual structure was relatively fragmented, with several independent themes, including reproducibility, OS, OA, developing in parallel. In the subsequent period (2022-2023), these themes began to converge, with most earlier topics becoming increasingly integrated around OA. At the same time, new themes associated with broader societal contexts, such as COVID-19 and citizen science, emerged and became connected to the evolving knowledge structure. A more pronounced thematic reconfiguration occurred during 2024-2025, when the research landscape evolved into two interconnected thematic clusters. One cluster centered on academic libraries, representing the institutional and service infrastructure supporting research. At the same time, the other was organized around OA, reflecting the growing prominence of OS practices and SC policies. This development suggests a closer

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integration between technological infrastructure, library services, and open SC. By 2026, the thematic map indicates further diversification of the field, with the previously established themes of academic libraries and OA extending toward emerging topics such as AI, research visibility, and SC. The emergence of predatory publishing as a new theme highlights growing scholarly concern about research integrity and the quality of scholarly publishing in the digital era. Collectively, these findings indicate that research on SC has evolved from an initial emphasis on OA and reproducibility toward a broader research support ecosystem encompassing digital technologies, research visibility, responsible publishing, and the strategic role of academic libraries (see Figure 2).

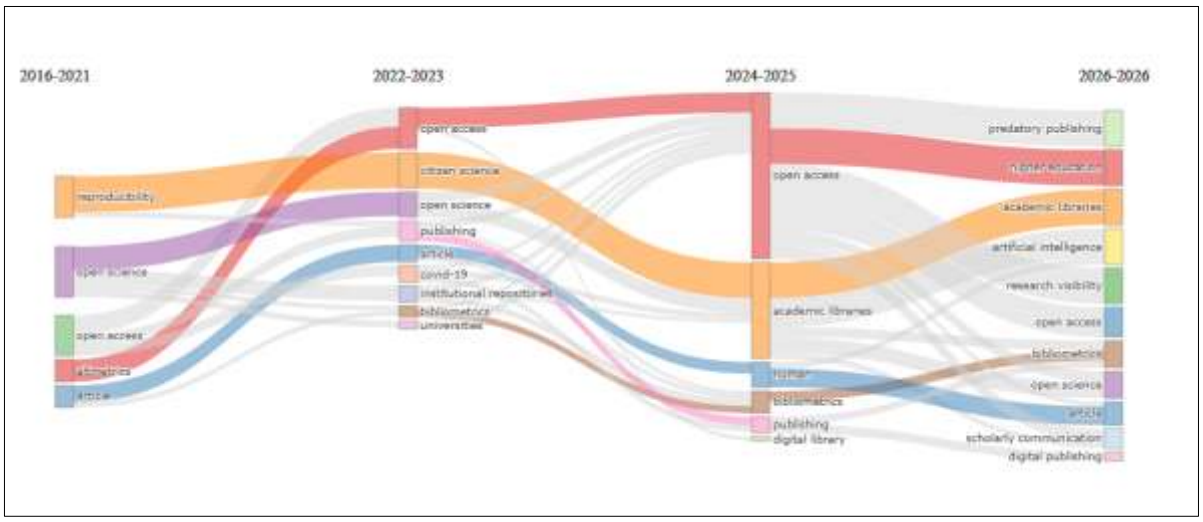


Figure 2. Thematic evolution analysis chart
Source: Bibliometrix

Codina et al. (2023) argue that SC should no longer be understood merely as the publication of research in peer-reviewed journals but rather as an independent field of inquiry concerned with the production, organization, dissemination, evaluation, and preservation of scholarly knowledge. From this perspective, SC integrates multiple components that were previously treated as relatively independent domains, including scholarly publishing, OA, OS, RDM, preprints (Balaji & Dhanamjaya, 2019; Altman et al., 2023), research evaluation metrics, digital SC, scholarly search engine optimization (SEO), IRs, and long-term digital preservation. This transformation reflects a fundamental shift from disseminating research outputs to managing the entire scholarly knowledge lifecycle.

This transition has been increasingly realized through the development of digital research infrastructure and the evolution of research practices. Nemati-Anaraki and Tavassoli-Farahi (2018) proposed a SC model centered on IRs, positioning IRs as the core infrastructure for collecting, preserving, disseminating, and enabling the reuse of research outputs. Consequently, the value of scholarly work no longer ends with journal publication but continues to expand through enhanced accessibility, data reuse, metadata interoperability (Kaiser et al., 2021), and broader global dissemination. Similarly, Peña (2025) demonstrates that several Latin American countries are developing OS ecosystems based on integrated components, including OS policies, research data repositories, PIDs, FAIR principles, and library-based RSS. These developments illustrate a transition from providing OA to publications toward enabling openness throughout the entire research process. Furthermore, external drivers such as the COVID-19 pandemic and international OS initiatives, including Plan S, cOAlition S, and national OA policies have accelerated the adoption of transformative agreements and institutional strategies supporting this transition (Laakso & Ayeni, 2025).

The review also highlights a significant transformation in scholarly information infrastructure. Open scholarly infrastructures are gradually challenging the dominance of traditional commercial indexing platforms. Mazov and Gureyev (2023) report that open discovery platforms such as Dimensions and Lens provide increasingly comprehensive coverage of scholarly literature and, in some disciplines, perform comparably to or even surpass traditional commercial databases through flexible DOI-based indexing and continuous metadata enhancement (Kaiser et al., 2021). These developments reflect a broader democratization of scholarly knowledge, reducing dependence on proprietary indexing systems while improving the discoverability and accessibility of research outputs.

Despite this progress, the transition toward an open research ecosystem remains uneven across institutional and national contexts. Studies by Nazim and Ashar (2023), Shehata and Eldakar (2023), Tapfuma and Hoskins (2019), and Siyao et al. (2017) consistently show that although the principles of OA and knowledge sharing are widely recognized, their practical implementation continues to be constrained by traditional research assessment systems, technological capacity, financial resources, and institutional policies. Journal prestige indicators, academic promotion requirements, article processing charges, and disparities in digital infrastructure continue to reinforce centralized models of SC.

The evidence suggests that SC has evolved from a publication-oriented activity into an integrated, open research ecosystem supported by digital infrastructure, research data, and collaboration among multiple stakeholders. Within this ecosystem, the value of scholarly knowledge is increasingly determined by its discoverability, accessibility, interoperability, and reusability rather than by publication alone. This transformation provides the foundation for the evolving role of academic libraries from information providers to strategic partners in research support and facilitators of OS.

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The development of open science and digital research infrastructure

The keyword co-occurrence network reveals the multidimensional intellectual structure of the field and the interrelationships among its major research themes. The network is organized into five closely interconnected thematic clusters. The red and green clusters occupy central positions in the network and are structured around high-frequency keywords, including OA, SC, publishing, and open research. These core themes are closely linked to altmetrics, bibliometric analysis, and article processing charges, reflecting the growing emphasis on scholarly publishing, research evaluation, and publication support in the academic library context. A second major thematic axis is represented by the blue cluster, which comprises RDM, research data, data curation, and big data. The close connections between this cluster and the central SC themes indicate the increasing integration of research data services and digital research infrastructure into the broader open research ecosystem. The yellow cluster, characterized by keywords such as article, humans, and university, represents the general research context and study subjects frequently associated with this field. In contrast, the purple cluster highlights methodological and research quality-related themes, including qualitative analysis and reproducibility. Finally, the orange cluster extends toward topics such as peer review, scientific misconduct, and nursing, suggesting growing scholarly attention to discipline-specific issues concerning research integrity and publication ethics. Overall, the network demonstrates that research on SC has evolved beyond OA and scholarly publishing to encompass RDM, research evaluation, research integrity, and digital research support within an increasingly interconnected research ecosystem (see Figure 3).

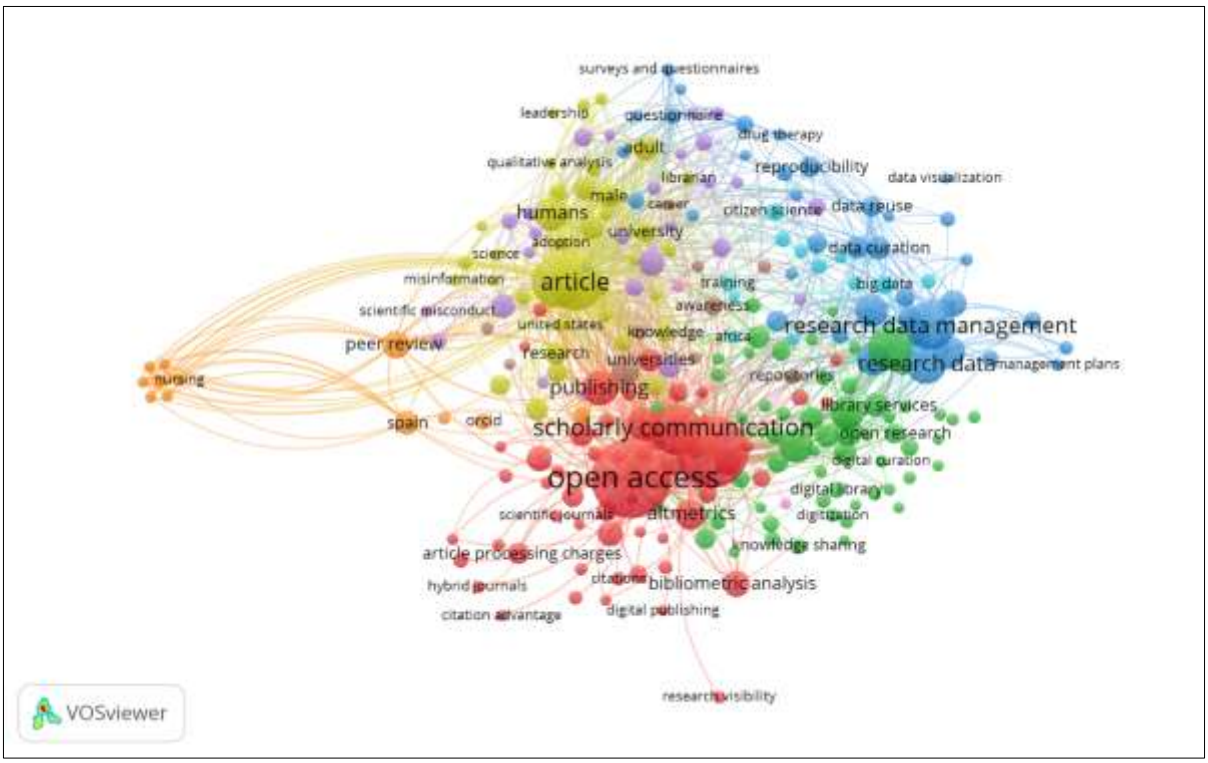


Figure 3. Keyword co-occurrence network
Source: VOSviewer

The scoping review demonstrates that the advancement of OS extends beyond conceptual and policy-level discussions and is increasingly being institutionalized through the development of digital research infrastructure. This infrastructure encompasses OA, IRs, research data repositories, PIDs, standardized metadata (Kaiser et al., 2021), and RDM platforms. Altman et al. (2023) further advocate for establishing a global open data ecosystem to monitor and evaluate interventions in SC. Their framework emphasizes four key priorities: (1) developing standardized evaluation indicators, (2) strengthening data-sharing infrastructure, (3) embedding research evaluation into the implementation of SC initiatives, and (4) advancing theoretical frameworks capable of explaining systemic change.

At the institutional and national levels, the implementation of OS has progressed from isolated initiatives to more comprehensive and coordinated infrastructures. Peña (2025) reports that several Latin American countries have moved beyond the pilot stage by establishing integrated OS ecosystems comprising national OS policies, research data repositories, digital preservation platforms, and expanding library involvement in RDM (Chen et al., 2023). Countries such as Argentina, Brazil, Colombia, and Mexico have adopted open-source platforms, including DSpace, Dataverse, and EPrints, while incorporating the FAIR principles into RDM and sharing practices. These developments indicate that the focus of OS has shifted from providing OA to publications toward building sustainable infrastructure that ensures the long-term accessibility, interoperability, and reuse of research data (Bourke, 2022).

The review also suggests that digital research infrastructure represents more than a technological innovation; it is reshaping the governance of scholarly knowledge. Peña (2025) argues that research repositories, standardized metadata, and PIDs are transforming the ways scholarly outputs are organized, evaluated, disseminated, and preserved (Kaiser et al., 2021). Within this evolving ecosystem, academic libraries are no longer primarily custodians of information resources but have assumed strategic roles in coordinating research data, supporting metadata standardization, and maintaining interoperability across digital research platforms.

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Evidence from Africa highlights another important dimension of open research infrastructure its contribution to reducing inequalities in global access to knowledge. Siyao et al. (2017) found that, in many African countries where subscription costs for commercial databases remain prohibitively high and digital infrastructure is still developing, IRs have become strategic mechanisms for preserving and disseminating locally produced scholarship. Beyond journal articles, these repositories increasingly host theses and dissertations, research datasets, cultural heritage collections, and preprint and postprint versions of scholarly works.

Similar findings were reported by Tapfuma and Hoskins (2019) in Zimbabwe, where IRs have evolved from supplementary library services into core components of SC infrastructure. In the context of declining library budgets and rising costs of international scholarly resources, open repositories provide universities with greater control over the dissemination and preservation of their own research outputs. Nevertheless, the effectiveness of these repositories depends heavily on institutional deposit mandates, cross-sector collaboration, and the technical expertise available within academic libraries.

Alongside the expansion of IRs, the review identifies the emergence of open scholarly discovery and indexing platforms as another important driver of the open research ecosystem. Mazov and Gureyev (2023) demonstrate that platforms such as Dimensions and Lens are reshaping access to scholarly information through DOI-based indexing, extensive metadata integration, and continuously updated research records (Kaiser et al., 2021). These platforms now provide coverage comparable to that of traditional commercial databases while offering freely accessible tools for literature discovery, citation tracking, and data export. Their growing adoption reflects a broader transition from dependence on proprietary indexing systems toward interconnected open scholarly infrastructures.

Despite these advances, the review indicates that OS is not replacing existing scholarly information systems but is instead giving rise to a hybrid research infrastructure. The reviewed studies consistently conclude that no single platform currently satisfies all requirements regarding literature coverage, metadata quality, RDM, and research assessment. Instead, the prevailing trend is the integration of multiple infrastructures, combining commercial databases (Scopus, Web of Science), open discovery platforms (Dimensions, Lens), IRs, and persistent identifier systems to establish a more connected, interoperable, and sustainable research ecosystem (Tapfuma & Hoskins, 2019; Mazov & Gureyev, 2023; Peña, 2025).

Changing scholarly communication practices of researchers in the digital environment

Studies focusing on early career researchers demonstrate substantial changes in scholarly information-seeking behaviors. Shehata (2019), Bordons et al. (2024), Abutayeh et al. (2021), Nicholas, Jamali, et al. (2020), A et al. (2024), and Nicholas, Watkinson, et al. (2020) consistently report that platforms such as Google Scholar, Google, Scopus, Web of Science, ResearchGate, Academia.edu, Mendeley, ORCID, LinkedIn, X (formerly Twitter), arXiv, and PubMed have become the primary entry points for scholarly information discovery. In contrast, academic libraries are no longer the starting point for most literature searches. These findings indicate a transition from library-mediated information retrieval toward researcher-driven discovery, in which speed, ease of access, real-time searching, and platform integration are increasingly prioritized over traditional bibliographic control. Consequently, academic libraries are evolving from being the primary gateway to scholarly information into an underlying research infrastructure that provides data, digital tools, and value-added services throughout the research process.

Alongside changes in information-seeking behavior, digital scholarly environments are also reshaping how researchers establish academic identity and build scholarly social capital. Academic social networking platforms including ResearchGate, X (formerly Twitter), LinkedIn, WeChat, and Academia.edu are increasingly used to disseminate research findings, monitor emerging developments, maintain professional networks, and foster international research collaboration (Shehata, 2019; Nicholas, Jamali, et al., 2020; Nicholas, Watkinson, et al., 2020; Abutayeh et al., 2021; Subaveerapandiyan et al., 2025; Shehata and Eldakar, 2023). These developments suggest that SC has expanded beyond conventional publication, reading, and citation practices to encompass multidimensional digital networks in which research visibility is increasingly shaped by online engagement, community interaction, and dissemination across multiple platforms. Furthermore, the growing use of smartphones and other mobile devices to access scholarly literature indicates the emergence of mobile scholarship, in which research activities are increasingly integrated into flexible, continuously connected digital environments (Nicholas, Jamali et al., 2020).

Despite these technological advances, the review consistently indicates that traditional research assessment systems continue to exert a dominant influence on researchers' publishing and communication practices. Decisions regarding both literature selection and publication venues remain driven primarily by journal reputation, impact factors, indexing in Scopus or Web of Science, and their contribution to career advancement, rather than by the openness or societal reach of research outputs (Nicholas, Jamali, et al., 2020; Nicholas, Watkinson, et al., 2020; Shehata and Eldakar, 2023). This finding suggests that contemporary SC operates within a hybrid environment, characterized by increasing openness in technological infrastructure while remaining largely constrained by conventional evaluation mechanisms.

This tension is particularly evident in developing countries. Studies conducted in India, Egypt, the Middle East, and Zambia consistently report that researchers generally hold positive attitudes toward OA, recognizing its potential to enhance research visibility, accessibility, and impact. Nevertheless, actual publishing practices continue to favor high-prestige journals and internationally recognized indexing systems because of promotion requirements, institutional regulations, and performance evaluation systems that remain heavily dependent on bibliometric indicators (Nazim and Ashar, 2023; Shehata and Eldakar, 2023; Subaveerapandiyan et al., 2025). At the same time, article processing charges (APCs) continue to create inequalities in participation in OS, particularly for researchers from low- and middle-income countries, a challenge that Codina et al. (2023) identify as one of the major barriers to equitable SC.

Although open research data has become a fundamental component of OS, data-sharing practices remain relatively limited. Nicholas, Jamali, et al. (2020) and Nicholas, Watkinson, et al. (2020) found that only slightly more than one-third of researchers publicly share their research data, despite generating research datasets routinely during the research process. The principal barriers include concerns over losing competitive advantage, unintended data reuse, the substantial effort required for data preparation and curation, the absence of mandatory institutional policies, and the limited recognition of data sharing within existing research evaluation systems. These findings suggest that the transition toward OS is not

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solely a technological or infrastructural challenge but also requires fundamental changes in research culture, incentive structures, and academic reward systems.

The transformation of academic libraries from scholarly communication support to integrated research support services

The trend topic analysis illustrates the temporal evolution of research interests in SC and RSS between 2016 and 2026 (Figure 4). Few publications were identified during the initial period (2016-2017), suggesting that the field was still in its formative stage. From 2018 onward, however, the thematic landscape expanded considerably, reflecting the gradual transition from traditional library services toward a broader SC and research support ecosystem. During the early stage (2018-2021), research primarily focused on foundational topics, with frequent occurrences of keywords such as librarian, library, information science, and social media. These themes emphasize the traditional functions of academic libraries and their initial engagement with digital SC. A marked shift toward digital research infrastructure and open knowledge practices characterized the middle period (2022-2023). This transition is evidenced by the increased prominence of keywords such as OA, OS, IRs, and data sharing, indicating growing scholarly interest in the infrastructure, policies, and practices supporting open research. The emergence of these themes coincides with the expanding role of academic libraries in facilitating access to, preserving, and disseminating scholarly outputs. During the most recent period (2024-2026), research trends further evolved toward scholarly publishing, research evaluation, and research analytics. Keywords including academic publishing, OA publishing, bibliometric analysis, and bibliometrics analysis became increasingly prominent, reflecting growing attention to publication support, research assessment, and evidence-based research management. Overall, the temporal evolution of research topics suggests a progressive expansion of SC from traditional information services toward integrated research support encompassing scholarly publishing, digital research infrastructure, research evaluation, and OS practices (see Figure 4).

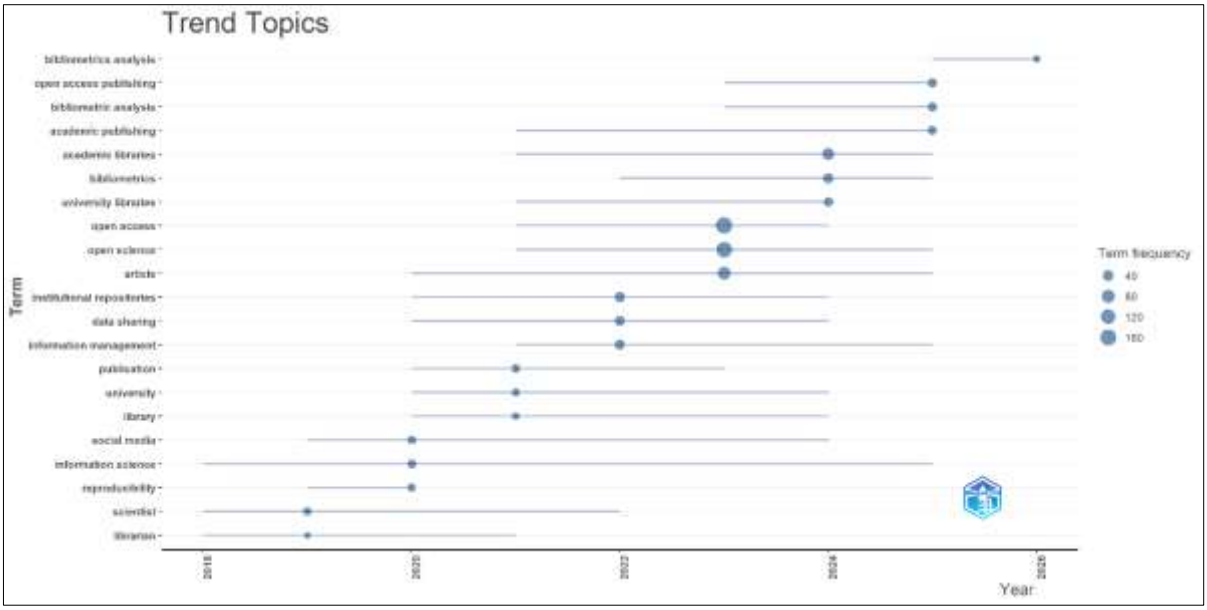


Figure 4. Research Trends
Source: Bibliometrix

The scoping review demonstrates that academic libraries are undergoing a fundamental transformation from collection-centered service providers to strategic partners in the research ecosystem. Whereas libraries traditionally focused on collection development, resource management, and information access, the expansion of digital scholarship and OS has driven a transition toward integrated RSS that span the entire research lifecycle. This shift represents not merely the addition of new services but a fundamental redefinition of the library's institutional role and value within research-intensive universities (Sandy et al., 2020; Codina et al., 2023).

The reviewed literature indicates that libraries are becoming increasingly involved in all stages of the research process. During the pre-research phase, they assist researchers in developing literature search strategies, strengthening information literacy, providing RDM consultation, preparing Data Management Plans (DMPs), and implementing metadata standards and the FAIR principles to improve the discoverability, interoperability, and reusability of research data (Nemati-Anaraki & Tavassoli-Farahi, 2018; Chen et al., 2023; Peña, 2025). Throughout the research process, libraries extend their services to include RDM, researcher identity management through ORCID, Digital Object Identifiers (DOIs), and other PIDs, while also guiding copyright, open licensing, and compliance with funder and institutional OS policies (Féret and Cros, 2019; Sandy et al., 2020; Tapfuma and Hoskins, 2019). Following publication, libraries increasingly manage IRs, support OA publishing, enhance research visibility through scholarly SEO, and evaluate research impact using both traditional citation indicators and alternative metrics (altmetrics), thereby improving the dissemination, accessibility, and societal reach of scholarly outputs (Wilson et al., 2019; Codina et al., 2023).

The expansion of bibliometric services further illustrates this transformation. Marijanović et al. (2023) found that although most surveyed academic libraries were relatively small and operated with limited human resources, nearly all (95.8%) had introduced bibliometric services. These services primarily supported academic promotion and tenure processes while also contributing to institutional accreditation, research performance assessment, and grant reporting. Most libraries offered these services free of charge to internal users and had established them within the previous 1 to 5 years. Notably, none employed dedicated bibliometric specialists; instead, existing librarians assumed these responsibilities alongside their traditional duties. Essential competencies included knowledge of research evaluation policies, scholarly databases, bibliometric indicators,

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statistical analysis, and data analytics. However, professional preparation remained largely dependent on self-directed learning and short-term training, revealing a significant gap between emerging service demands and formal professional education. The study also identified persistent challenges, including staffing shortages, fragmented scholarly data infrastructures, disciplinary differences in research evaluation, and uneven workloads across institutions. Collectively, these findings suggest that bibliometric support is becoming a core library function, highlighting the need for formal education programs and competency frameworks to prepare future research support specialists.

The review further suggests that the institutionalization of SC positions reflects broader organizational transformation within academic libraries. Sandy et al. (2020) argue that the emergence of dedicated SC roles has been driven by increasing institutional demand for research support, particularly in RDM. As a result, academic librarians are no longer viewed solely as custodians of collections or intermediaries facilitating access to information. Instead, they are increasingly assuming specialized roles as research data specialists, SC experts, publishing advisors, OS coordinators, research infrastructure managers, and collaborative research partners (Sandy et al., 2020; Peña, 2025). Evidence from Association of College and Research Libraries (ACRL) institutions indicates that the number of dedicated SC and digital scholarship positions increased steadily between 2012 and 2017, reflecting the formal integration of research support into library organizational structures. Similarly, Tapfuma and Hoskins (2019) demonstrate that implementing IRs in Zimbabwe required establishing interdisciplinary teams comprising librarians, information technology specialists, academic staff, and legal experts to coordinate the management, preservation, and dissemination of institutional research outputs.

These developments have profound implications for librarians' professional competencies. Beyond traditional expertise in information organization and user services, research support librarians increasingly require advanced capabilities in RDM, metadata design, persistent identifier management, data visualization, scholarly publishing, digital technologies, research impact assessment, OS policy, and intellectual property regulation (Sandy et al., 2020; Bourke, 2022; Kaiser et al., 2021; Chen et al., 2023; Peña, 2025; Codina et al., 2023). Consequently, the transformation of academic libraries extends beyond service innovation to encompass a comprehensive reconfiguration of professional identity, organizational capacity, and institutional strategy, positioning libraries as indispensable partners in developing sustainable, open, and data-intensive research ecosystems.

Barriers to and enabling conditions for the transformation of research support services in scholarly communication

The scoping review identifies multiple, interrelated barriers that continue to constrain the transformation of RSS within the SC ecosystem. Economic constraints remain among the most significant challenges. Article Processing Charges (APCs) for OA publishing, together with the high cost of subscriptions to commercial scholarly databases, impose substantial financial burdens on universities and researchers, particularly in developing countries (Wilson et al., 2019; Maryl et al., 2020; Nazim and Ashar, 2023; Altman et al., 2023; Laakso and Ayeni, 2025; Ezema, 2021). A et al. (2024) further highlight that inadequate technological infrastructure, expensive access to digital resources, licensing restrictions, limited awareness, linguistic and cultural differences, insufficient technical expertise, inadequate professional support, and constrained research funding collectively reduce access to up-to-date scholarly resources, specialized databases, and institutional research support.

Technological barriers are equally important. The literature consistently reports fragmented digital infrastructures, limited interoperability among research management systems, and substantial disparities in the implementation of IRs and research data repositories across countries and regions (Siyao et al., 2017; Tapfuma and Hoskins, 2019; Mazov & Gureyev, 2023; Peña, 2025). At the institutional level, the absence of comprehensive policies governing OA, IRs, and research data sharing weakens the implementation of OS initiatives and limits researchers' participation in open scholarly practices (Wilson et al., 2019; Hey, 2022; Kingsley et al., 2022; Nazim & Ashar, 2023; Marijanović et al., 2023; Tapfuma & Hoskins, 2019; Bordons et al., 2024; Subaveerapandiyan et al., 2025). Professional capacity also remains a persistent challenge, as both researchers and librarians must acquire new competencies in RDM, metadata standards, digital SC, and research infrastructure management to support increasingly data-intensive and technology-driven research environments (Sandy et al., 2020; Kaiser et al., 2021; Kingsley et al., 2022; Marijanović et al., 2023).

Beyond these structural constraints, the greatest obstacle to transformation may lie in the persistence of traditional academic reward systems. Although digital technologies and OS have substantially expanded opportunities for knowledge sharing, research evaluation continues to rely heavily on journal prestige, citation counts, and Journal Impact Factors. These conventional performance indicators reinforce established publishing practices and discourage broader adoption of open SC models (Maryl et al., 2020; Chen et al., 2023; Nicholas, Jamali, et al., 2020; Nicholas, Watkinson, et al., 2020; Shehata & Eldakar, 2023; Tapfuma & Hoskins, 2019). Evidence from Zambia further demonstrates that researchers' adoption of SC platforms depends primarily on perceived ease of use, content relevance, and the availability of user support services (A et al., 2024), underscoring the importance of user-centered service design alongside technological innovation.

The synthesis of the reviewed studies indicates that the successful transformation of RSS requires a coordinated and systemic approach rather than isolated institutional initiatives (Maryati et al., 2024). Four enabling conditions emerge consistently across the literature. (1) Universities should establish and institutionalize comprehensive OS and RDM policies to provide a coherent governance framework and strategic direction for implementation (Peña, 2025; Wilson et al., 2019). (2) Sustained investment in digital research infrastructure including IRs, research data repositories, persistent identifier systems, and interoperable platforms is essential to ensure the long-term preservation, sharing, and reuse of research outputs in accordance with the FAIR principles (Siyao et al., 2017; Nemati-Anaraki & Tavassoli-Farahi, 2018; Tapfuma & Hoskins, 2019; Wilson et al., 2019; Balaji & Dhanamjaya, 2019; Kaiser et al., 2021; Bourke, 2022; Kingsley et al., 2022; Mazov & Gureyev, 2023; Peña, 2025; Subaveerapandiyan et al., 2025). (3) Academic libraries must strengthen their professional capacity by expanding librarians' expertise beyond traditional information services to include RDM, scholarly publishing, copyright consultation, research assessment, and lifecycle research support (Sandy et al., 2020; Tapfuma & Hoskins, 2019). (4) Effective transformation depends on cross-sector collaboration among libraries, researchers, information technology units, research administrators, funding agencies, and institutional leadership. Such collaborative governance is fundamental to building sustainable research support ecosystems and repositioning academic libraries from information providers to strategic research partners (Féret & Cros, 2019; Siyao et al., 2017; Sandy et al., 2020; Peña, 2025).

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DISCUSSION

The bibliometric findings provide robust quantitative evidence for the rapid development of research on SC, OS, and the transformation of academic library services. The substantial increase in publications between 2016 and 2026, together with the emergence of themes such as OA, OS, RDM, SC, research visibility, and, more recently, AI, indicates that this field has evolved into a mature and rapidly expanding area of research. Collectively, these trends confirm that the transformation of academic libraries toward integrated research support has become an established direction within the international scholarly community.

The scoping review further demonstrates that SC is evolving from a publication-centered model into an open research ecosystem supported by digital infrastructures, research data, and multi-stakeholder collaboration (Féret & Cros, 2019). Codina et al. (2023) argue that SC should be regarded as an independent field of inquiry concerned with the production, organization, dissemination, evaluation, and preservation of scholarly knowledge. This broader conceptualization reflects a fundamental shift from viewing SC as the dissemination of research outputs to understanding it as the governance of the entire research lifecycle. Consistent with this perspective, Nemati-Anaraki and Tavassoli-Farahi (2018), Peña (2025) demonstrate that the value of scholarly knowledge is increasingly determined by its accessibility, interoperability, visibility, and reusability rather than by publication alone. Nevertheless, the implementation of OS remains uneven across national contexts. While several Latin American countries have developed relatively comprehensive OS infrastructures (Peña, 2025), studies in Africa and other developing regions continue to report substantial constraints in financial resources, digital infrastructure, and institutional governance (Siyao et al., 2017; Tapfuma & Hoskins, 2019). These findings suggest that the transition toward OS is shaped not only by technological advancement but also by broader institutional, economic, and policy environments.

Open science is widely recognized as the future direction of SC, but the review suggests it is unlikely to replace traditional SC systems entirely. Mazov and Gureyev (2023) show that open scholarly platforms such as Dimensions and Lens have significantly narrowed the gap with commercial databases by expanding metadata coverage and improving discoverability. However, current evidence does not indicate that these platforms can fully substitute established indexing services such as Scopus or Web of Science. Instead, the literature consistently points toward the emergence of a hybrid scholarly infrastructure in which commercial databases, open discovery platforms, IRs, and persistent identifier systems coexist and complement one another (Tapfuma & Hoskins, 2019; Mazov and Gureyev, 2023; Peña, 2025). This suggests that the future of SC will be characterized by interoperability rather than replacement.

Researchers' SC practices are also undergoing a significant transformation under the influence of digital platforms. Nicholas, Jamali, et al. (2020) and Nicholas, Watkinson, et al. (2020) report that researchers increasingly begin their information seeking through Google Scholar, multidisciplinary databases, and academic social networking platforms rather than library-managed discovery systems. Similarly, Shehata and Eldakar (2023) and Subaveerapandiyan et al. (2025) demonstrate that digital platforms have become central to establishing scholarly identity, increasing research visibility, and fostering international collaboration (Féret & Cros, 2019). Nevertheless, publication decisions continue to be dominated by journal prestige, impact factors, and international indexing systems. This paradox illustrates a SC system that is technologically open but institutionally conservative, in which digital innovations have transformed research workflows without fundamentally altering the mechanisms by which academic reputation is allocated. Likewise, although researchers generally express positive attitudes toward OA, publishing behaviour remains strongly influenced by traditional research evaluation systems (Nazim & Ashar, 2023; Shehata and Eldakar, 2023; Subaveerapandiyan et al., 2025). Furthermore, Article Processing Charges (APCs) remain a significant barrier to broader participation in OS, particularly in resource-constrained research environments (Codina et al., 2023; Ezema, 2021; Laakso & Ayeni, 2025).

Regarding the role of academic libraries, the reviewed studies demonstrate a remarkable degree of consensus on their transition from collection-oriented institutions to comprehensive research-support partners (Sandy et al., 2020; Codina et al., 2023). Contemporary libraries increasingly manage critical components of research infrastructure, including IRs, RDM services, and digital preservation systems (Nemati-Anaraki & Tavassoli-Farahi, 2018; Tapfuma & Hoskins, 2019; Chen et al., 2023). Their responsibilities have expanded further to encompass scholarly publishing support, research impact assessment, researcher identity management, and institutional coordination of OS initiatives (Wilson et al., 2019; Peña, 2025). However, the maturity and scope of these RSS vary substantially across universities, reflecting differences in institutional priorities, available resources, and organizational capacity.

Among emerging research support functions, bibliometric services have become particularly prominent. Marijanović et al. (2023) identify bibliometric support as one of the fastest-growing services provided by academic libraries. At the same time, their findings reveal a substantial gap between professional expectations and existing workforce capacity, as most librarians deliver bibliometric services alongside their traditional responsibilities and rely primarily on self-directed learning rather than formal professional education. Similar observations are reported by Sandy et al. (2020) and Peña (2025), who emphasize that human capital has become the critical determinant of successful library transformation. Consequently, the principal challenge facing academic libraries is no longer defining their emerging roles but developing the professional competencies necessary to sustain increasingly sophisticated RSS.

The review also indicates that library transformation is influenced by a complex interaction of financial constraints, technological capacity, institutional governance, professional expertise, and entrenched research evaluation cultures (Wilson et al., 2019; Maryl et al., 2020; Nazim & Ashar, 2023; Shehata and Eldakar, 2023; Marijanović et al., 2023; Peña, 2025). However, existing studies have largely examined these factors independently rather than investigating their dynamic interrelationships. This fragmented perspective limits a comprehensive understanding of how institutional, technological, and cultural factors collectively shape the transformation of RSS.

Taken together, these findings suggest that the transformation of university library RSS extends far beyond the expansion of traditional SC activities. Instead, it represents a fundamental repositioning of academic libraries within the contemporary research ecosystem. Libraries are increasingly evolving from providers of information resources into strategic research partners that contribute throughout the research lifecycle by supporting OS, RDM, scholarly publishing, research assessment, and digital research infrastructures. This transformation reflects a broader paradigm shift from service-oriented library models toward research-centered, data-intensive, and ecosystem-based models, in which the value of

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academic libraries is increasingly assessed by their contributions to research quality, visibility, integrity, collaboration, and societal impact, rather than solely by their ability to provide access to information. From this perspective, SC should be understood not as an isolated service domain but as an integral component of a broader research support ecosystem that requires strategic alignment with institutional research agendas, OS policies, digital infrastructures, and evolving research evaluation frameworks.

Despite substantial progress, several important research gaps remain. Most studies focus on implementing RSS rather than evaluating its long-term impacts on research productivity, visibility, and quality. Evidence from developing countries, particularly Southeast Asia, remains limited. Research continues to examine individual components of the SC ecosystem, while integrated perspectives on the ecosystem remain scarce. Although AI has emerged as a major research topic, issues such as AI governance, data stewardship, intellectual property, and the role of academic libraries in responsible AI use remain underexplored. Future research should evaluate the impacts of RSS, expand the evidence base across diverse contexts, and develop integrated frameworks that explain the interactions among SC, OS, AI, and academic libraries.

CONCLUSION

By integrating bibliometric analysis with a scoping review, this study provides a comprehensive overview of the evolution of SC and the transformation of RSS between 2016 and 2026. The bibliometric findings reveal rapid growth in this research field, accompanied by the consolidation of key themes, including OA, OS, RDM, scholarly communication, academic libraries, bibliometrics, and, more recently, AI.

The scoping review demonstrates that SC has evolved from a publication-centered model into an open research ecosystem in which digital infrastructure, research data, and collaborative practices underpin the creation, dissemination, and reuse of scholarly knowledge. Within this ecosystem, academic libraries have expanded beyond traditional information services to become strategic research partners supporting the entire research lifecycle through RDM, OA publishing, institutional repositories, researcher identity management, research assessment, and OS implementation. This transformation is shaped by the interaction of technological, institutional, policy, and human factors, particularly the development of digital infrastructures, changes in researcher behavior, and the evolving competencies of librarians.

Theoretically, this study contributes by integrating previously fragmented research areas, including OA, OS, RDM, SC, and RSS, into a unified analytical framework from a research ecosystem perspective. This framework clarifies the relationships among these components while identifying important research gaps, particularly concerning the long-term effectiveness of RSS, the integration of AI, GenAI, and differences across institutional and national contexts.

In practical terms, the findings highlight the need for universities to reposition academic libraries as strategic components of institutional research ecosystems. This requires sustained investment in digital research infrastructure, OS policies, and professional development for librarians, together with stronger collaboration among libraries, researchers, information technology units, research administrators, and funding agencies. Such efforts are essential for developing sustainable RSS that enhances research quality, visibility, integrity, and societal impact.

Overall, the study demonstrates that the transformation of academic libraries represents a fundamental restructuring of their role within the contemporary research ecosystem rather than merely an expansion of traditional library services. As OS, open research data, AI, and GenAI continue to reshape scholarly communication, academic libraries are expected to play an increasingly important role in knowledge governance, research support, and research innovation.

INTRODUCE: Mr Phan Truong Nhat holds both a Bachelor's and a master's degree in Library and Information Science. He is currently a PhD candidate in Library and Information Science at the University of Social Sciences and Humanities, Vietnam National University Ho Chi Minh City, Vietnam. He has more than ten years of professional experience working at the Library of the University of Information Technology, Vietnam National University Ho Chi Minh City, Vietnam, where he serves as a librarian specializing in information services and research support services. His research interests focus on research support services in academic libraries and the application of emerging technologies in the field of Library and Information Science. He is particularly interested in innovative service models, digital transformation in libraries, and strategies to enhance research productivity and scholarly communication. By integrating academic inquiry with extensive practical experience, he aims to contribute to the development of researchoriented library services in Vietnam as well as in the broader international academic community.

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