



Towards AI for science: developing a conceptual basis for transforming research support services in university libraries

Lihong Zhou, Hanyu Miao, Tim Zijlstra, and Zengmin Wang

DOI: <https://doi.org/10.47989/ir31iConf64182>

Abstract

Introduction. This paper reports on an ongoing research project that investigates the development of research support services (RSS) in China's university libraries to facilitate AI for science (AI4S) projects. Specifically, this paper focuses on developing a conceptual model based on a literature review.

Method. A systematic literature review approach was adopted. English and Chinese academic databases were searched.

Analysis. After screening, 67 articles were analysed using a thematic analysis and qualitative coding.

Results. The analysis points to a conceptual model that consists of 21 library RSS and five main themes: promoting AI readiness, formulating research ideas, building collaborative networks, conducting research, and publishing results.

Conclusion(s). Preparing university libraries for AI4S is difficult, facing two primary challenges: (1) the paradigm of AI4S is fast-growing, has not fully emerged; (2) libraries are late and slow in adopting AI technologies. For future studies, the conceptual model can serve as a theoretical basis.

Introduction

Artificial intelligence (AI) is not a singular technology but rather an evolving concept with multiple dimensions (Cox, 2023). As an emerging group of information technologies, AI is one of the important forces reshaping academic culture and practices. At this very moment, AI is pushing forward a paradigm shift in the scientific world. AI for Science (AI4S) has emerged as the most advanced scientific paradigm, which represents the increasing convergence and deep integration of AI and science by widely utilising AI technologies to drive scientific discoveries. AI technologies are quickly changing the operation of university libraries as well as the services they provide to users (Chen et al., 2023; Shah et al., 2025).

In a university library, Research Support Services (RSS) form an important part of the services offered by university libraries and are often seen as a strategic priority. This type of service is defined, according to Hoffman (2018), as *'any action taken by a library that aids the scholarship and research activities of its affiliated institution'*. Traditionally, RSS primarily focused on the development of academic collections and resources, based on which information retrieval and discovery services were offered. However, the traditional RSS is criticised for being overly passive and constrained. Instead, librarians need to move beyond the traditional view and to assume more proactive roles by *'partnering with faculty in the act of creating knowledge'* (Hussain & Rafiq, 2025).

The rapid advancement of AI has provided university libraries with significant growth opportunities while fundamentally transforming library operations and service delivery (Chen et al., 2023; Shah et al., 2025). The core benefit is that, as claimed by Harisanty et al. (2024), libraries can become more agile and dynamic to respond to staff and students' needs for information. AI technology is powering up RSS, making them more intelligent, powerful and efficient (Yeung, 2025). As asserted by Gmiterek & Kotula (2025), AI significantly enhance RSS on at least two fronts. Firstly, information retrieval is improved substantially with intelligent natural language processing and personalised recommendations. Secondly, it positions libraries as central to providing stewardship for AI4S across the organisation.

As the scholarly ecosystem rapidly shifts towards AI4S, to provide continuous support and ensure the central role of libraries within the university's innovation system, RSS offered at university libraries must change and adapt quickly. This paper reports on a research project that aims to study the development of RSS for AI4S projects in university libraries in China. This paper reports on the first step of its research, which is a systematic literature review. Specifically, the review was guided by three review questions:

RQ1. What RSS can be provided by a university library to support AI4S?

RQ2. What RSS conceptual model can be developed by conceptualising findings from RQ1?

RQ3. What implications can be drawn for future research?

Review methods and processes

A systematic literature review is regarded as the most rigorous methodology for literature review that seeks to systematically search, evaluate and synthesise research evidence in relation to the research questions under investigation (Grant & Booth, 2009). For this research, this approach is considered appropriate and effective to answer the three identified review questions.

Furthermore, the systematic review is designed with two incremental stages. A general literature review was performed in the first stage for three specific purposes: (1) to gain an overview of the theoretical development in the scope of this review; (2) to obtain a general view of RSS practice in university libraries around the world; (3) to confirm if the research questions are valid.

The first stage of review was carried out between October and December 2024. It was found that there is a general acceptance that AI4S will soon become a dominating research paradigm, under which researchers' information needs and behaviours are likely to undergo radical changes. This indicates that RSS offered by university libraries need to embrace the emergence of AI4S. However, the review informed that although the library community have accepted that adopting AI is inevitable, there is a lack of holistic visions and long-term strategies. Some libraries even actively resist the emergence of AI technology (Harisanty et al., 2024). There is an absence of research on how to develop RSS to facilitate AI4S research projects.

The second stage of review aimed to respond to the research questions. Therefore, a structured and rigorous review was performed. Academic works in English and Chinese were retrieved, collected and analysed. Three academic databases were selected and systematically searched. Web of Science and Scopus were used and searched for the retrieval of English articles. Chinese works are collected from China National Knowledge Infrastructure (CNKI), the most popular and inclusive database of Chinese academic publications. The database search was performed from January to March 2025 using the search strategy presented below: ('AI' or 'AI for Science' or 'AI4S' or 'artificial intelligence' or 'machine learning' or 'data mining') and ('research support' or 'data management' or 'digital scholarship' or 'digital humanities') and librar*

The search strategy was designed to be as inclusive as possible, with the purpose of including as many relevant and useful articles as possible. Although this strategy might return a substantial number of irrelevant articles, these articles would later be screened out manually using the following four exclusion criteria.

- Duplicate articles from different databases would be identified and removed.
- Documents that are not retrievable in full text or do not meet the eligibility criteria would be excluded.
- Articles not specifically focused on RSS in university libraries would be excluded.
- Position papers and subjective opinion papers lacking adequate and justifiable theoretical support would also be discarded.

The workload of article screening was divided and carried out by the four authors. The results were cross-examined, collated and confirmed. The database search and article screening are shown in the Preferred Reporting Items for Systematic Reviews and Meta-analysis (PRISMA) flow diagram in Figure 1.

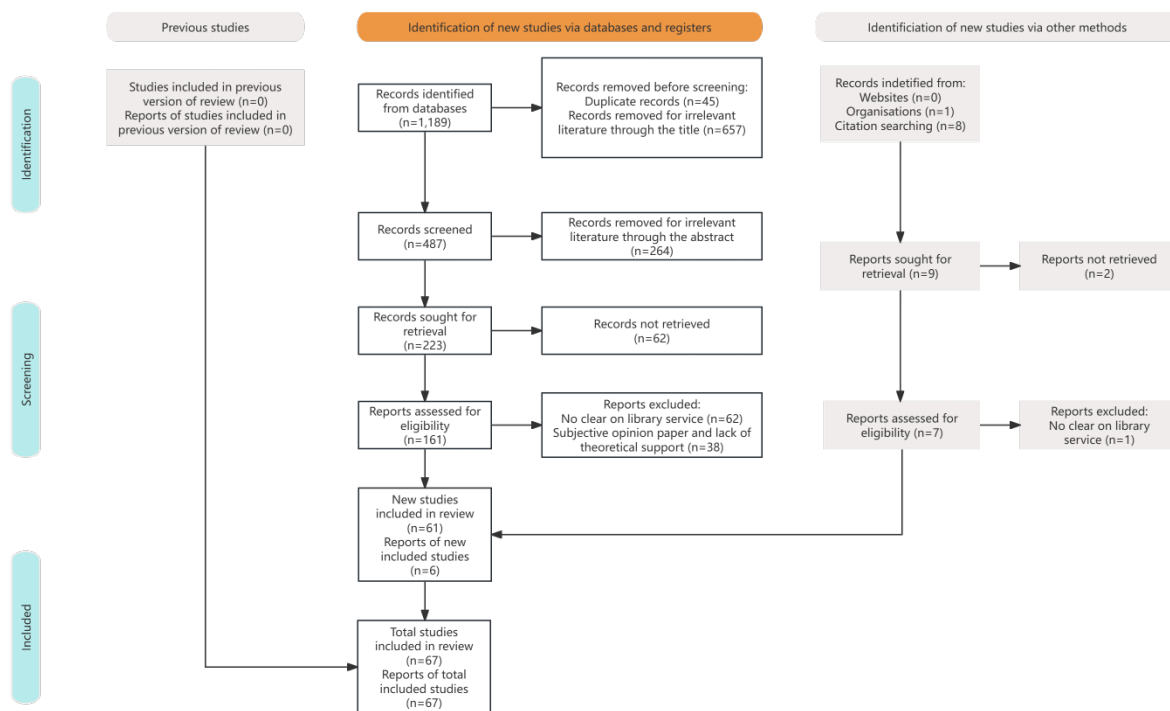


Figure 1. Process of literature inclusion and exclusion using a PRISMA flow diagram.

All included articles were uploaded in the form of PDF files into a qualitative data analysis software, MAXQDA 2022, for analysis. The article analysis adopted an inductive, qualitative approach. A thematic analysis strategy was used for coding and developing theoretical themes. Coding means identifying, labelling and verifying data fragments related to RSS as reported in the articles. Three coding techniques were operationalised: open coding, axial coding, and selective coding. Theoretical themes were identified and confirmed by interrelating open codes through axial and selective coding. The research lifecycle model proposed by Zhou et al. (2019) was employed as a preliminary framework to guide the operations of coding and RSS identification. Finally, the research findings were reported as a theoretical narrative that presents, describes, and discusses RSS for AI4S research.

Review results

The systematic literature review pointed to a total of 21 library RSS, which can be used to support AI4S research. Also, in the literature review, these RSS emerged into five main themes. The themes and RSS are shown in Table 1.

Themes	Library RSS for AI4S Research	Supporting Citations
Promoting AI4S Readiness	Training and tutorial on AI4S tools	(Çakmak & Eroglu, 2025; Michalak et al., 2025)
	Access to a full range of AI4S systems and tools	(Michalak et al., 2025; Zhao, 2024)
	Digital and physical spaces for AI4S research collaboration	(Massis, 2018; Osbourne et al., 2024)
	AI4S literacy promotion	(J. Chigwada, 2024; Cox & Mazumdar, 2024)
	Technological infrastructure and computing power for AI4S research	(Josiline Chigwada, 2024; Cox et al., 2019)
Formulating Research Ideas	Literature and review support	(Asemi et al., 2021; Gupta et al., 2022; Lappalainen & Narayanan, 2023)
	Validation of research ideas/hypothesis	(Garbuio & Lin, 2021; Kulkanjanapiban et al., 2025)
	Bibliometric analysis of the research field	(Cox et al., 2019; Yao et al., 2019)
	Grant seeking and proposal development	(Hussain & Rafiq, 2025; Singh et al., 2024)
Building Collaborative Network	Identifying potential research partners	(Howlett et al., 2024; Huang, 2018; Wu & Wang, 2018)
	Team building and management	(Dong & Ma, 2019)
	Negotiation of roles and tasks	(Kulkanjanapiban et al., 2025; Monyela & Tella, 2024; Siemon, 2022)
	Research progress coordination	(Gupta, 2025; Jabeen et al., 2016)
Conducting Research	Data collection, visualisation and analysis	(Cox et al., 2019; Hussain & Rafiq, 2025)
	Research data storage and management	(Cox et al., 2019; Koltay, 2019; Öztemiz & Sahin, 2024)
	Ethics and compliance review	(Çakmak & Eroglu, 2025; Mishra, 2023)
	Digital project management	(Cox, 2023; Nenni et al., 2025; Vergara et al., 2025)
Publishing Results	Academic editing and review support	(Cox, 2023; Hosier & Cantwell-Jurkovic, 2025; Misra & Chandwar, 2023; Razack et al., 2021)
	Journal recommendation and submission compliance	(Kousha & Thelwall, 2024; Ortega et al., 2018)
	Publishing and open access support	(Jimenez et al., 2024)
	Research impact tracking and promotion	(Gutzman et al., 2018; Ye, 2019)

Table 1. An overview of RSS identified from the literature analysis.

University libraries, as an interdisciplinary space for research and learning, are the ideal place for researchers from all disciplines to learn about AI (Massis, 2018). Libraries hold an important role in promoting the AI4S readiness of researchers by designing and delivering AI4S literacy training programs, lectures, and tutorials that cover some of the most critical areas of AI4S: ethical considerations, research integrity, information access, equity, knowledge innovation and protection (Chigwada, 2024; Cox & Mazumdar, 2024). Moreover, university libraries should lead, or at least be one of the major stakeholders, in the development of the university's AI4S technological infrastructure and computing capability (Cox et al., 2019). *'Libraries might have a place in helping to design the whole infrastructure based on their understanding of user needs, and to protect users' privacy and interests with their data'* (Cox et al., 2019).

For supporting AI4S research, libraries need to maintain trusting, interactive and collaborative relationships with research teams from various disciplines. The literature analysis showed that AI4S RSS should be offered at four research stages along the AI4S research lifecycle: formulating research ideas, building collaborative network, conducting research, and publishing results.

At the stage of formulating research ideas, librarians serve as review assistants, efficiently identifying relevant studies from large collections of articles gathered from various databases and bibliographic searches, thereby significantly reducing the time and effort required for comprehensive literature analysis (Gupta, 2025). Singh et al. (2024) state that librarians' involvement in the processes of research grant application is highly appreciated. AI tools such as ChatGPT and other LLM chatbots have exhibited great potential at this stage of research, e.g., in systematic literature review, bibliometrics and text analysis. As claimed by Lappalainen and Narayanan (2023), library chatbots are useful for maintaining interaction between libraries and their users. There is an increasing use of AI chatbots to answer basic reference questions, so that librarians can be freed to dedicate themselves to more complex research support. Garbuio and Lin point out that AI applications can be used to spark ideas, help brainstorm topics, and synthesise observations into hypotheses and insights (Garbuio & Lin, 2021).

Effective RSS should be provided for building AI4S collaborative networks. Libraries can use AI tools for identifying potential colleagues, suggesting specific research areas for collaboration, and facilitating real-time interpersonal and human-AI interaction throughout processes of AI4S research (Dong & Ma, 2019; Huang, 2018; Wu & Wang, 2018). Librarians must understand how to compose a functioning human-AI team based on analysing individual researchers' background, skills, experiences and research experience, as well as how to fully utilise the power of AI (Siemon, 2022).

When conducting research, librarians play a crucial role in providing RSS at the core of knowledge innovation. Hussain and Rafiq (2025) show that data collection and analysis is one of the most popular service areas. Cox et al. (2019) propose that librarians work side by side with the research team to ensure the proper handling of research data, which involves data organisation, processing, analysis, storage, access, maintaining data security and formulating a data management plan. Also, working with researchers, librarians can help with applying ethics frameworks and principles, and with ensuring ethics principles such as transparency, honesty, and accountability are compatible with AI4S requirements (Çakmak & Eroglu, 2025; Mishra, 2023).

The use of AI and machine learning in libraries and information centres raises significant ethical challenges, such as the risk of bias and discrimination, privacy concerns, job displacement, and the loss of human interaction in service delivery. [...] Applying these ethical frameworks and principles, libraries and information centres can ensure that their AI and machine learning systems are used in a responsible and ethical manner that prioritizes the needs and interests of their users and the broader community (Mishra, 2023).

At the stage of publishing results, there is a wide debate over how to use AI appropriately and ethically. Nevertheless, AI is highly useful not only for ‘help with choosing keywords, [...] crafting outlines, brainstorming, improving grammar and syntax, and improving writing for new or early-career researchers and for non-native English speakers’ (Hosier & Cantwell-Jurkovic, 2025), but also for editors and reviewers ‘to screen the language and the appropriateness of the methodology or statistics of submitted articles’ (Misra & Chandwar, 2023).

Discussion and conclusions

As the systematic literature review aims to develop a conceptual model, the research team attempted to build a model by correlating and contrasting the review results with existing RSS models, e.g., Zhou et al. (2019)’s model of digital scholarship services, Nie et al (2024)’ model of entire lifecycle of scientific data, and Sendra et al (2025)’s model of data lifecycle to research activity. This exercise led to a conceptual model of RSS for AI4S, as shown in Figure 2.

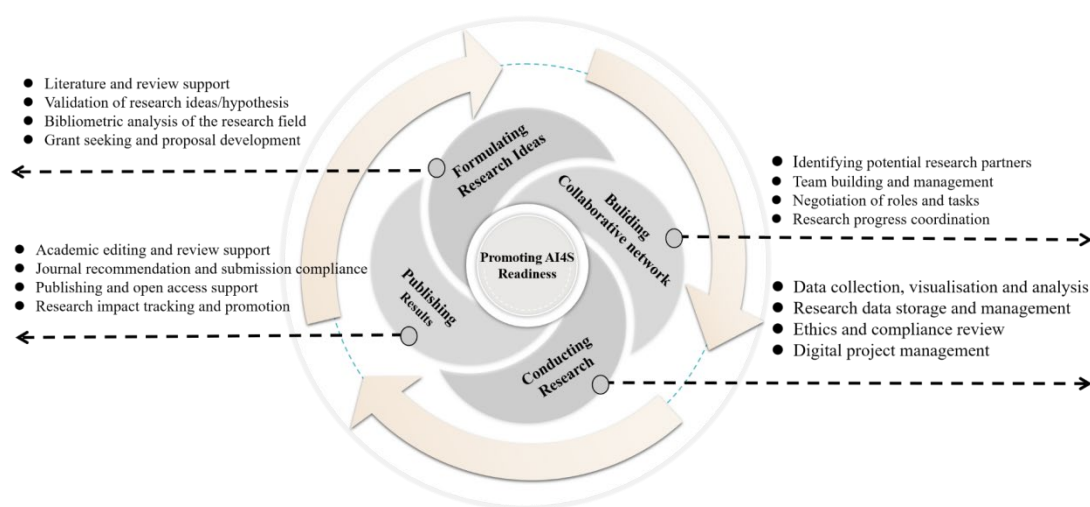


Figure 2. A conceptual model of RSS for AI4S at university libraries.

This model reveals three indications that are important for future research. Firstly, ‘promoting AI4S readiness’ is likely to become a new and core theme in the provision of RSS. However, the AI4S readiness, literacy, and capabilities of researchers are not sufficiently studied. As reflected in this review, the provision of this type of RSS can be very challenging for university libraries. A huge number of libraries, as observed around the world, are struggling to keep up with the digital transformation and are overwhelmed by everyday RSS demands.

Secondly, the conceptual model of RSS for AI4S was conceptualised along the research life cycle, which may not be entirely suitable for AI4S projects. As claimed, for instance, by Zou et al. (2024), in AI4S research with the support of AI, researchers move quickly from one research process to another or work simultaneously on different tasks. This is greatly different from the traditional paradigm, in which researchers are expected to follow the research lifecycle. Nevertheless, the paradigm of AI4S has not fully emerged, making it impossible to definitively classify which is an AI4S research, or which one is not. Therefore, for future research, it would be useful to participate in AI4S research projects and observe new approaches, processes, patterns, and behaviours.

Furthermore, in the proposed model, RSS along the research life cycle are not substantially different from those traditional ones, such as the digital scholarship services raised by Zhou et al. (2019). However, the provision of RSS for AI4S research necessitates a strong reliance on AI

platforms and systems. As evidenced by the literature review, libraries are generally late and slow in adopting AI technologies.

RSS for AI4S can be seen as a natural extension and development of the traditional RSS. However, the two types of RSS are quite different. The core difference lies in the use of AI technologies in the library's provision of RSS. As AI has become indispensable in many research processes in various scientific disciplines, university libraries need to explore deeper and wider utilisation of AI in their RSS provision.

The conceptual model presented in this paper can serve as a theoretical basis for future studies. The model requires further development, revision and validation through the study of RSS provision in university libraries, as well as the collection and analysis of empirical data.

Acknowledgements

This work is supported by Key Project of the National Social Science Fund of China (2024), titled 'Research on Research Support Services of University Libraries for AI for Science (AI4S)' (Grant No. 24ATQ008).

About the authors

Lihong Zhou is a Professor in School of Information Management, Wuhan University, People's Republic of China. His research interests include the library services, interorganisational data sharing, and medical information. He can be contacted at l.zhou@whu.edu.cn

Hanyu Miao is a master student in School of Information Management, Wuhan University, People's Republic of China. Her research interests include the AI4S, library services, and data sharing. She can be contacted at Miaohyeah@163.com

Tim Zijlstra is a Librarian of National Health Service. His research interests include Artificial Intelligence implementation, health information, patient experience, and person-centred care. He can be contacted at timotheus.zijlstra@nhs.scot

Zengmin Wang is a doctoral student in School of Information Management, Wuhan University, People's Republic of China. Her research interests including AI4S, library services, data sharing, and AI ethics. She can be contacted at celinewong_0913@yeah.com

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