Research on the Development of Library Science Oriented Toward AI for Science[*]

Zhang Kang¹   Gong Jiaoteng^{1,2}

2026-07-24

ChinaRxiv

Abstract

AI for Science (AI4S) constitutes a new context for the developmental transformation of library science. Based on an analysis of the evolution of scientific research paradigms and their mapping onto library science, this paper examines the possible impacts of AI4S on the development of library science and looks ahead to potential pathways for its future development. AI4S can reshape the connotations, knowledge system, talent cultivation, and research paradigms of library science by shifting the focus of the field, strengthening demand for disciplinary problem-solving, boosting demand in the talent market, and promoting the transformation of disciplinary research paradigms, thereby providing new strategic guidance for the development of library science. Library science should orient itself toward strategic needs, take the initiative in planning, identify growth points in disciplinary knowledge, actively integrate into the transdisciplinary ecosystem of information resource management and data intelligence, build an open collaborative platform for disciplinary innovation, and achieve sustained innovative development.

Full Text

[Theory ·Exploration]

Research on the Development of Library Science Oriented Toward AI for Science*

Zhang Kang1 Gong Jiaoteng1,2

1. School of Public Administration, Xiangtan University, Xiangtan, 411105

2. Xiangtan University Library, Xiangtan, 411105

Abstract AI for Science (AI4S) constitutes an entirely new context for the developmental transformation of library science. On the basis of analyzing the evolution of scientific research paradigms and their mapping onto library science, this paper examines the possible impact of AI4S on the development of library science and looks ahead to possible paths for the future development of the discipline. By shifting the focus of library science, strengthening disciplinary problem demands, boosting demand in the talent market, and promoting the transformation of disciplinary research paradigms, AI4S can reshape the connotations, knowledge system, talent cultivation, and research paradigms of library science, thereby providing new strategic traction for its development. Library science should orient itself toward strategic needs, take the initiative in planning, seek new points of disciplinary knowledge growth, proactively integrate into the transdisciplinary ecosystem of information resource management and data intelligence, build an open and collaborative platform for disciplinary innovation, and realize the long-term innovative development of library science.

[**Keywords**] AI4S; library science; disciplinary development

[**Chinese Library Classification Number**] G250 [**Document Code**] A
[**Article Number**] 1003-7845(2026)01-0028-10

[**Suggested Citation Format**] Zhang Kang, Gong Jiaoteng. Research on the Development of Library Science Oriented Toward AI for Science[J]. *Library Work in Colleges and Universities*, 2026(1): 28–37.

Introduction

As a strategic technology for the intelligent industry and new-quality productive forces, artificial intelligence—jointly driven by the three engines of large-scale computing power, big data, and large models—has exerted a disruptive impact on disciplinary research and educational systems, giving rise to an intelligent form marked by the paradigm of AI-driven scientific research, namely AI for Science (hereinafter "AI4S")[1]. This not only brings new disciplinary growth points for the development of library science, but also provides a wholly new context and starting point for reflection on the future prospects of library science. As a discipline that studies the entire process of information acquisition, organization, storage, retrieval, analysis, development, and utilization, library science attends to the universal needs of human beings to query and obtain information and to the pathways for satisfying those needs. It has always shouldered the mission of establishing and improving information order and ensuring effective human access to and querying of information[2]; it is a safeguarding and developmental enterprise that creates information connections in pursuit of human information well-being. In recent years, whether in knowledge services, data governance, and model development based on AI4S, or in resource construction, academic services, and data-driven work oriented toward AI4S, AI4S—whether appearing as a topic or intervening as a method—has influenced the core problems, methodological tools, talent cultivation, disciplinary boundaries, and research topics of library science.

Library science is inevitably being drawn into the wave of AI4S development; its theoretical system, methodological tools, and even the thinking of its scholars will all be affected, and will change with the deep integration of "intelligence" and "data." Leveraging the momentum of artificial intelligence, AI4S provides library science with new development environments and user needs, research means and tools, research methods and models, research ideas and perspectives, as well as talent demands and educational systems, thereby opening up a new landscape for the theory and practice of library science. At the same time, by virtue of the power of machine "intelligence," AI4S has transformed the entire process of information production, organization, dissemination, and utilization, greatly releasing the value of data and presenting new challenges to the theories and technical methods related to library science. Against this background, an in-depth discussion of the transformation and disciplinary orientation of library science in relation to AI4S may provide highly valuable academic reference for clarifying the theoretical significance of the direction of library science and the practical significance of library work. Accordingly, this paper focuses on the connotations and core capabilities of AI4S, and closely examines the innovative driving role of AI4S in transforming the disciplinary connotations, knowledge system, talent cultivation, and research paradigms of library science, with a view to offering useful reference for anchoring the development direction of library science in the AI4S era.

1 Development of AI4S and the Manifestation of Its Power

1.1 The Evolution of Scientific Research Paradigms and Their Mapping onto Library Science

1.1.1 The Evolution of Scientific Research Paradigms The term "paradigm" first appeared in Aristotle' s *Rhetoric*, and was later taken up by the American philosopher of science Thomas Kuhn in *The [[unclear: title continues beyond the visible page]]*

* This paper is one of the research outcomes of the Major Project of the Hunan Provincial Social Science Fund, "Research on the Construction of Future Learning Centers Driven by Educational Digitalization" (Project No.: 23ZDAJ007), and the Xiangtan University Graduate Research Innovation Project, "Research on the Construction of an Independent Knowledge System for the Discipline of Information Resource Management in China."

Author profiles: Zhang Kang is a doctoral candidate whose research focuses on basic theories of library and information science and issues of the information society. Gong Jiaoteng is a professor and doctoral supervisor whose research focuses on basic theories of library science and library management.

Date received: 2025-10-14 **Responsible editor:** Yang Qianzi.

Structure, and became the basic commitment of the scientific community regarding ontology, epistemology, and methodology[^3]. Scientific research paradigms possess both stability and evolutionary character: although they are relatively stable over short periods, with the evolution of scientific research technologies, methods, and tools, they also evolve from one paradigm to another. In 2007, Turing Award laureate Jim Gray and others classified the development of human scientific research into three paradigms—the empirical science paradigm, the theoretical science paradigm, and the computational science paradigm—and, based on massive amounts of data, proposed the data-intensive science paradigm[^4]. In recent years, with the deep integration of AI and scientific research, scholars have begun to explore a fifth scientific research paradigm that addresses the uncertainty, complexity, and curse of dimensionality of big data in more automated and intelligent ways, promotes the evolution of scientific research toward general model-driven approaches, and proposes the AI4S scientific research paradigm driven centrally by AI[^5]. The evolution of scientific research paradigms is shown in Table 1.

Table 1 Evolution of Scientific Research Paradigms

Scientific research paradigm	Time	Logical starting point	Knowledge activities	Representative figures	Main characteristics	Representative achievements
Empirical science paradigm(first paradigm)	Before the 16th century	Inductive logic	Repeated experiments, observation, recording, induction	Aristotle; Francis Bacon	An experimental research method based on observation and induction, characterized mainly by recording and describing natural phenomena	Galileo's dynamics experiments; Copernican heliocentrism, etc.

Scientific research paradigm	Time	Logical starting point	Knowledge activities	Representative figures	Main characteristics	Representative achievements
Theoretical science paradigm(second paradigm)	16th–19th centuries	Deductive logic	Simplified experiments, analytical comparison, deductive proof, model reasoning	Newton; Galileo	A theoretical research method based on scientific hypotheses, modeling, and logical deduction, capable of providing principled explanations for certain laws of nature	Loop quantum gravity theory; Bradford' s law, etc.

Scientific research paradigm	Time	Logical starting point	Knowledge activities	Representative figures	Main characteristics	Representative achievements
Computational science paradigm(third paradigm)	Mid-20th century-21st century	Computer simulation	Hypothesis-driven work, simulation computation, practical application	Alan Turing and other founders of computer science	Centered on electronic computers and based on mathematical methods, computer technology, and information science, it improves experimental efficiency and accuracy through quantitative analysis and computational analysis.	Computational simulation in fluid mechanics and prediction of aircraft aerodynamic performance; nuclear explosion simulation, etc.

Scientific research paradigm	Time	Logical starting point	Knowledge activities	Representative figures	Main characteristics	Representative achievements
Data-intensive scientific paradigm(fourth paradigm)	Early 21st century to the present	Emergent analysis based on massive data	Data-driven work, computation as support, massive-data mining and services	Jim Gray	Scientific research shifts from hypothesis-driven to data-driven, using data-management and statistical methods to analyze data so as to reveal internal correlations among things	Discovery of gravitational waves; release of the first human image of a black hole, etc.

Scientific research paradigm	Time	Logical starting point	Knowledge activities	Representative figures	Main characteristics	Representative achievements
AI4S paradigm(fifth paradigm)	2018 to the present	AI-driven human-machine interaction	Machine learning, deep learning, etc.	Weinan E; John Hopfield	AI is comprehensively integrated into scientific research, emphasizing human-machine integration, complex-systems research, interdisciplinary collaboration, and support from large-model platforms	AlphaFold2 protein structure prediction; the drug-design engine drugAI, etc.

1.1.2 Relationships among Scientific Research Paradigms

The various scientific research paradigms are not mutually independent or mutually exclusive; rather, there is an evident relationship of inheritance and development among them, and in scientific research practice they move toward integrated development. The empirical science paradigm can provide a practical foundation and empirical data for other paradigms, and can be verified through theory and computation[^6]. The theoretical science paradigm is the core of scientific research paradigms, playing a goal-oriented and teleological guiding role for other scientific research paradigms, while the other scientific research paradigms shoulder the mission of constructing new theories and verifying, revising, and extending existing ones. The computational science paradigm can not only provide empirical verification for theory and experience, but also offer computational-thinking inspiration and data support for the data-intensive scientific paradigm and the AI4S paradigm; it embodies scientific research' s pursuit of refined computation of data. The data-intensive scientific paradigm takes data-driven research as its core: it uses data-analysis techniques as tools for understanding, discovering, and exploring theory, while also providing support for experimentation and computation. The AI4S paradigm inherits the advantages of other paradigms and introduces interdisciplinary knowledge integration and AI empowerment, enabling it to enhance the automation and intelligentization capabilities of other paradigms and promote the integrated development of scientific research paradigms[^7-^8]. At the same time, other scientific research paradigms can also make use of the intelligent theories and meth-

methodological tools, thereby promoting optimization of research methods and processes [9]. In addition, the essence of the transformation of scientific research paradigms is related to data [10]. The empirical-science paradigm is the pre-data stage, which relies on practice and observation for empirical description; the theoretical-science paradigm is the small-data stage, which emphasizes induction and modeling; the computational-science paradigm is a transitional big-data stage in which complex phenomena are simulated to drive research toward data refinement; the data-intensive science paradigm is the big-data stage in which the intrinsic associations within massive data are discovered; and the AI4S paradigm is the stage in which the meaning and value of data are released for the collective wisdom of humanity. The relationships among the research paradigms are shown in Figure 1.

Figure 1. Relationships among research paradigms

Visible text in the figure:

- Axes: "machine intelligence" and "human intelligence."
- Paradigms: empirical-science paradigm; theoretical-science paradigm; computational-science paradigm; data-intensive science paradigm; AI4S paradigm.
- Relationship labels include: "AI empowerment," "validation," "guidance," "tool-and-method support," "generate data," "technical implementation," "explanation," "data support," "assist computation," "guide AI optimization," and "the computational-science paradigm provides a basis for the empirical-science paradigm; the empirical-science paradigm can improve the computational-science paradigm."

1.1.3 Disciplinary Mapping of Library Science

Scientific research is an important way to explain and understand the world, and the essence of revolutions in human knowledge lies in the replacement of old paradigms by new ones. Each revolution in scientific research paradigms expands the breadth and depth of humanity' s understanding of the world and innovates pathways for knowledge production. To date, the impacts brought about by the five paradigm revolutions in the development of human science have, to varying degrees, been projected onto the field of libraries, reflecting the path of transformation in library science, as shown in Figure 2.

Figure 2. Evolution of Scientific Research Paradigms and Their Mapping onto Library Science

Visible text in the figure:

- Research paradigms and characteristics:
  - Empirical-science paradigm: "describe natural phenomena."
  - Theoretical-science paradigm: "models, mechanism induction, universal laws."
  - Computational-science paradigm: "computer simulation."
  - Data-intensive science paradigm: "data-based."
  - AI4S paradigm: "AI-driven; intelligent scientific research."
- Corresponding mappings in library science:
  - Professionalization of library science: "awakening of professional occupational consciousness and disciplinary consciousness."
  - Scientization of library science: "establishing library science as a modern scientific branch."
  - Informatization of library science: "moving toward information and information-resource management."
  - Datafication of library science: "data-based integration."
  - Intelligentization of library science.
- Other visible label: "impact of data intelligence."

Before the emergence of computers, scientific computing activities relied mainly on human intelligence and remained within the stages of the empirical-science paradigm and the theoretical-science paradigm. The empirical-science paradigm constructs deterministic knowledge through empirical observation and logical inference, and developed within library science in the form of scientific induction. Library scholars summarized library work experience through empirical observation and treated library science as a form of social practice to be studied scientifically, thereby forming a library science grounded in empirical knowledge. For example, Schrettinger defined library science as "the generalization of the theoretical principles required for the purposeful organization implemented by libraries." Its essence lies in its foundation in the competencies suited to the library profession and in its emphasis on the professionalism of the core knowledge of library science. It represents both the awakening of professional occupational consciousness and of disciplinary consciousness; in education, this was reflected in an emphasis on practical education and the transmission of librarians' experience, so as to establish the status of librarianship as a professional occupation. The theoretical-science paradigm adopts rigorous mathematical logic and theoretical deduction to construct new theories, aiming to use logical deduction and theoretical generalization to summarize the commonalities of phenomena and derive principles and laws with relatively strong universality. To a certain extent, the theoretical-science paradigm catalyzed library scholars' reflection on the scientization, standardization, and theorization of library science, promoting the formation of modern scientific characteristics in library science: taking the exploration of verifiable universal laws as its goal, and pursuing scientific discovery theories that are formed by analyzing and generalizing empirical data and are tested by empirical data according to certain procedures. This was precisely what library science had previously lacked. For example, the Graduate Library School of the University of Chicago introduced standardized social-science research methods and encouraged the use of positivist methods to accelerate the process by which library science became a branch of modern science.

In 1946, the first computer came into being, and the tasks of data computation, modeling, and simulation began to be undertaken by computers; scientific research thus entered the computational-science paradigm. If the empirical-science paradigm and the theoretical-science paradigm promoted the professionalization, disciplinarization, standardization, and scientization of library science, then the computational-science paradigm more often opened, through informatization, the prelude to library science' s movement toward an information-oriented professional landscape and disciplinary differentiation. The computational-science paradigm strengthened, to an unprecedented degree, the importance of information and information technology, expanding the research objects of library science from documents, spaces, and institutions to the domains of information and platforms. The development of fields such as information retrieval, information organization, and information storage not only led to the departure of information science—with its emphasis on technical methods—from library science, but also enabled library science continuously to shed the centrality of library institutions and occupational routines, moving toward information and knowledge management and shaping talent-cultivation goals in response to the broader needs of the information-profession landscape. For example, most iSchool members in Europe and the United States emphasize interdisciplinary diversification centered on the iField, moving toward information and information disciplines; in China, the cultivation of library-science talent has shifted from "specialized vocational education" to "taking library vocational education as the main line, and thereby driving talent cultivation across the entire field of information and knowledge management."

The data-intensive science paradigm emphasizes the use of technologies such as big-data analysis to conduct inference and computational simulation on massive data, promoting a shift in scientific research from traditional hypothesis-driven approaches to data-based natural emergence. The data-intensive science paradigm has not only enabled library-science research to shift from traditional speculation, empirical observation, and small-sample verification toward being driven by discoveries from massive data.

a new model of activity, and further strengthened the emphasis in library science on "data" as both a resource and a factor of production, broadened disciplinary boundaries, and promoted the integration of library science, information science, and computer science into data science. Meanwhile, China has replaced the first-level disciplinary title "Library, Information, and Archives Management" with "Information Resources Management," thereby weakening disciplinary boundaries and incorporating technologies and theories such as data mining, data governance, data elements, and data management into the library science curriculum system, advancing the integration of library science education with education in other information sciences[^11]. All of these developments have given library science practice, research, and education a data-oriented tendency.

1.2 The Connotation and Main Characteristics of AI4S

1.2.1 The Connotation of AI4S

AI4S is the product of the deep integration of AI, data, and scientific research, and its connotation can be understood in both broad and narrow senses. In the broad sense, AI4S refers to the application of AI in a wide range of scenarios such as scientific research processes, technological innovation, and the transformation of research outcomes[^12]. In the narrow sense, AI4S focuses on embedding AI into the scientific research process and promoting the intelligent and automated development of scientific activities; that is, using AI and data-driven approaches to reveal and predict the laws behind natural and social phenomena, thereby advancing scientific discovery and knowledge innovation[^13]. The essential core of AI4S lies in empowering the efficient solution of scientific problems through data-driven and general-model-driven methods. It has a distinctive logic oriented toward scientific problems[^14], and is a methodological system aimed at knowledge discovery[^15]. Its purpose is, in a research environment where research problems are becoming increasingly complex and data are exploding, to use AI technologies and methods to overcome the bottlenecks of traditional scientific research paradigms in areas such as data management, academic vision, and the implementation of outcomes[^12], thereby obtaining insights that cannot be achieved using traditional scientific research methods and tools alone.

In summary, AI4S—namely, intelligent science—is a new scientific research model in which researchers, on the basis of integrating prior knowledge and interdisciplinary knowledge, use AI-related technologies to analyze structured and unstructured multimodal data, so as to achieve more efficient and intelligent model construction, experimental verification, knowledge discovery, and trend prediction.

1.2.2 Characteristics of AI4S

AI4S has triggered profound transformations, including accelerated interdisciplinary integration, improved efficiency in knowledge production, systematic solutions to complex problems, and the upgrading of scientific research infrastructure. It mainly has the following five characteristics:

(1) The research object is multimodal data. The data processed by AI4S are datasets formed through the integration of multisource heterogeneous multi-

modal data, including speech, images, videos, and text. Data are the foundation for the emergence of knowledge. With the help of AI, researchers discover scientific knowledge from full-sample datasets, achieve deep learning and reasoning across domains, and promote a shift in data analysis from the sampling-probability logic of "samples reflecting the whole" to the full-sample logic of "the sample is the whole."

(2) The research form emphasizes human–machine interaction. AI4S emphasizes the interaction between human intelligence and machine intelligence. In essence, it highlights close collaboration between researchers and AI, treating machine intelligence as a partner of researchers, and even treating digital-intelligent human scientists as core members. Researchers provide guidance and judgment for AI; AI serves as a reasoning engine and participates in the entire process of scientific research, including idea generation, experimental design, data collection, data analysis, model construction, results interpretation, and theoretical verification, providing researchers with a "second opinion" for knowledge emergence.

(3) Research fields emphasize sharing and integration. If the computational science paradigm and the data-intensive science paradigm have promoted the cross-integration of disciplinary knowledge, then AI4S will realize unprecedented sharing and integration of knowledge across different fields. AI4S promotes the cross-application of scientific research paradigms and research methods, requiring collaboration among multidisciplinary teams and drawing on the totality of human knowledge as nourishment for knowledge innovation.

(4) Research methods achieve intelligent synthesis. Technologies such as intelligent algorithms, optimization of general models, and multi-agent systems are increasingly becoming fundamental tools for data collection and analysis, providing support for the integrated innovation of different research methods. For example, the combined application of content analysis and machine learning is becoming increasingly common.

(5) Research infrastructure exhibits platform-based characteristics. Scientific research activities under AI4S rely more heavily on large-model-driven research knowledge platforms, shifting from individual creative-thinking-driven approaches to platform-resource-driven approaches. Such platforms aggregate massive scientific data and research resources, and possess functions such as virtual simulation and remote experimentation, data sharing and research collaboration, high-performance computing, and data analysis. Knowledge emergence can be effectively achieved simply by fine-tuning model algorithms.

1.3 Development Stages of AI4S

In 2018, Professor E Weinan first proposed AI4S[^16]. Its development as a whole shows an evolutionary pattern from the initial emergence of incremental scientific innovation to machine-enabled innovation, as shown in Table 2.

1.3.1 Stage of the Initial Emergence of Incremental Scientific Innovation (2018–2022)

Incremental innovation in science refers to using scientific and technological literature as the domain data source for AI4S, mining domain knowledge around scientific research problems, and improving the interpretability of AI regarding domain knowledge by training domain knowledge-mining and deep-learning algorithmic models, thereby promoting the automation of research tasks and further improving research efficiency. This stage is devoted to solving the problem of the "machine presentation of scientific activities," that is, proving that scientific problem-solving activities can be expressed and realized by machines.

1.3.2 Stage of Machine-Enabled Innovation (2022 to Present)

At present, the role of AI is no longer limited to retrospectively proving known laws or acting as an assistant. Instead, it has been endowed with the "discovery" capability to promote knowledge innovation, pushing AI4S into the stage of machine-enabled innovation. This stage takes as its corpus foundation high-quality scientific research datasets composed of multisource heterogeneous scientific data, scientific and technological literature, and other multimodal data. With the help of AI's perceptual intelligence, cognitive intelligence, and decision-making intelligence, it constructs general scientific foundation large language models, promotes autonomous decision-making and intelligent development in highly complex and high-workload scientific research processes, and enables AI to play a guiding role throughout the entire chain of knowledge innovation.

Table 2 Stage Characteristics of AI4S

Development stage	Core objective	Data characteristics	Algorithmic characteristics	Representative achievements
Initial emergence of incremental scientific innovation	Automation of research tasks; improvement of research efficiency	Structured, scenario-based scientific and technological literature; small data; specialized data	Supervised learning	ChemDataExtractor; AlphaFold 2

Development stage	Core objective	Data characteristics	Algorithmic characteristics	Representative achievements
Machine-enabled empowerment stage of innovation	Natural emergence of the discovery of scientific laws and knowledge innovation	Multimodal, cross-domain scientific research datasets; big data; general-purpose data	Generative large models; large-scale pretraining	DARWIN; the "Fengniao" large model

1.4 Core Capabilities of AI4S

AI4S possesses broad innovation-empowering capacity and disciplinary permeability, and can improve research efficiency and innovation capability. This advantage stems mainly from its capacity for data-intensive scientific discovery, complex-system modeling and simulation, cross-domain knowledge-association reasoning, and generative human–machine interaction in scientific research.

1.4.1 Data-Intensive Scientific Discovery Capability Data are an important foundation of scientific research, and scientific research is increasingly facing the challenges of the two "dark clouds" of data explosion and the curse of dimensionality. AI4S can, by leveraging AI's capabilities in data extraction, structural-rule generalization and prediction, and high-dimensional parameter fitting, complete semantic parsing and knowledge extraction from multimodal, multi-source heterogeneous, and unstructured research data[17]. At the same time, AI4S can integrate with the data-intensive scientific paradigm, promote a shift in scientific research from a large-sample paradigm to an all-sample paradigm, provide new tools, methods, and ideas for addressing data explosion and the curse of dimensionality, reduce researchers' data burden, enhance researchers' high-dimensional representation capabilities and high-throughput data-processing capabilities, and drive research from labor-intensive data analysis toward intellect-intensive discovery of scientific laws.

1.4.2 Complex-System Modeling and Simulation Capability In the AI era, the development of complex-system modeling and simulation exhibits the characteristics of technological convergence and is undergoing a transformation from "tool assistance" to "intelligent symbiosis." AI4S makes it possible to use larger-scale artificial systems to carry out complex-system modeling and virtual-simulation parallel experiments, and its effects and benefits will far exceed those of traditional complex-system modeling and computer simulation[18]. AI4S carries the thinking of complex-system modeling and simulation through the entire process of scientific research. It can not only, in virtual space, use technologies such as digital twins, Agent modeling, and DAO to construct digital mappings of researchers, equipment, and sites, but also use methods such as parallel learning and data mining to evaluate and optimize research processes and decision-making plans, thereby realizing the parallel operation and co-evolution of real research scenarios and digital-twin scenarios. In addition, AI4S can simulate creative activities such as human computation, reasoning, and thinking. Through integrations such as "intelligent modeling + data-driven" and "intelligent sampling + generative models" [19], it promotes the evolution of technologies for numerical collection, generation, analysis, and statistics in traditional system modeling and simulation toward intelligence, automation, and dynamic self-adaptation, and gives rise to new paradigms such as generative real-time modeling and simulation based on large models, as well as agent-collaborative interactive modeling and simulation.

1.4.3 Cross-Domain Knowledge-Association Reasoning Capability AI4S is the product of the continuous integration of AI technology into scientific research, promoting and strengthening the evolution of traditional domain knowledge toward interdisciplinary and cross-domain knowledge. It requires not only empowerment from disciplines such as computer science and data science, but also support from foundational disciplines such as mathematics. The essence of AI4S is to aggregate massive global human literature, terminological systems, and modes of thought through pretraining mechanisms, compress human collective intelligence, and embed it into the parameter space of large models. This process involves the mutual intersection and penetration of the knowledge and skills of human collective intelligence, and has cross-domain and transdisciplinary characteristics[20]. At the same time, AI' s cross-domain and multimodal integration capabilities can delve into semantic associations and integrate fragmented data, thereby helping to break down barriers between domain knowledge, create new research tools and application scenarios[21], generate interdisciplinary knowledge graphs and knowledge maps, and support cross-disciplinary and cross-domain knowledge association and collaborative innovation.

1.4.4 Generative Human-Machine Interaction Capability for Scientific Research Data-driven descriptive intelligence, experiment-driven predictive intelligence, and interaction-feedback-based interactive intelligence are the basic conditions for AI4S. This requires scientific research to shift from an expert-system model to a general human–machine interactive symbiosis model. Benefiting from the development of general-purpose artificial-intelligence large models, alignment technologies and prompt engineering have been widely applied in such links as automatic literature generation, assurance of data usability, expansion of scientific simulation, complex causal solving, emergence of frontier conjectures, and experimental automation[22], meaning that AI can participate in and even lead certain parts of the research process. In the future, some research tasks will fall under the work of "alignment" and "prompting," thereby forming a collaborative loop of bidirectional human–machine understanding, continuous tuning, and joint knowledge generation. This human-machine hybrid model, which integrates human experts' intuition and creativity with AI' s high-speed computation and pattern-recognition capabilities, achieves a leap from simple command execution to the co-creation of value between humans and machines, and helps break through the cognitive limitations of individual researchers.

2 The Impact of AI4S on Library Science

AI4S will not only shift the focus of library science, give rise to new research questions, and enrich research tools; it will also change the library profession' s demand for talent, prompting new development trends in the connotations, knowledge system, training model, and research paradigm of the library science discipline.

2.1 A Shift in Focus Triggers a Turn in Connotation

From advocating that "library science is the learning concerned with libraries" or "[[unclear: sentence continues beyond the visible page]]

Library science is "the study of a functional body for the ordering of knowledge" ; from linking library science with librarianship and strengthening, through institutional attributes, the exclusivity of the core knowledge of library science, to the fact that many operations for guaranteeing human access to and acquisition of information are now completed by institutions or platforms outside libraries, library science has begun to truly focus on the proposition of ensuring the effective querying and acquisition of information—a universal human need—and on its satisfaction[23]. It has even been incorporated into the discipline of information resource management and defined as a discipline devoted to studying the entire process of information acquisition, organization, retrieval, analysis, creation, and utilization, as well as the satisfaction of user needs[24]. Thus, the focus of library science has undergone profound change. Yet the scope of library science has always remained within a three-dimensional space formed by the horizontal dimension constituted by the information life cycle, the vertical depth determined by the "data-information-knowledge-wisdom" model (hereinafter "DIKW"), and the mutually constitutive evolution of the two. It has consistently focused on analyzing the transformation mechanisms and progressive processes among information resources at different levels; on the basis of information generation and acquisition, organization and retrieval, and presentation and exchange, it orders disordered information into structured knowledge, enabling it to form wisdom that changes users' cognitive structures and creates information well-being for humanity[25].

However, AI4S has broken this state of affairs. Driven by the pursuit of efficiency in information acquisition and querying, humans will use technologies such as AI and large models to continue innovating libraries as functional bodies that guarantee information querying and acquisition. The information technologies supporting AI4S give libraries new changes in form and modality; they hand over such processes as information organization, retrieval, analysis, and development to machine parameters, and transform the process from information to wisdom into AI-tool-based deconstruction and reorganization. As a result, the position of library science centered on the "library institution" in the chain of information use is further marginalized. All this will change the relative weight of the various stages of the information life cycle, break the previous progressive route by which libraries intervened in the DIKW model, and force the focus of the library science discipline to shift from the entire process of information acquisition to utilization toward greater attention to the application of knowledge and the presentation of knowledge terminals, realizing a transformation from the "use" of information resource management to "empowerment." This will promote a shift in library science from institutionally oriented theories and technologies based on the idea that "library science is the study of libraries" toward the universal problem of guaranteeing human information acquisition and querying; from the attributes of libraries as "places + institutions + platforms" toward building, on platforms for the production, dissemination, and accumulation of human information and data, a "superstructure for human information needs and their satisfaction"; and toward greater attention to the intelligentization of information and data in the digital-intelligence era, as well as the adaptation between application scenarios and user needs.

2.2 Increased Problem Demands Transform the Knowledge System

A knowledge system is a knowledge structure jointly composed of disciplinary foundations, theories, and practices; it reflects the internal knowledge associations and laws of a discipline. For a long time, in order to adapt to the development and challenges of emerging information technologies, the knowledge system of library science, while inheriting the historical mission of "transmitting civilization and serving society," has continuously absorbed new theories, new methods, and new technologies, forming relatively stable basic principles, a constantly renewed knowledge system, and laws of integrated development[26]. The technological expectations represented by AI4S will exert a new impact on the core knowledge system of library science, generate new problem demands in the knowledge practice of library science, promote the expansion of the research boundaries of traditional library science—which takes the "library institution" as its research object—in response to new problem demands, and continually generate new knowledge amid new forms of business and social needs.

2.2.1 Integration of the Information Service Knowledge Cluster into the Smart Knowledge Service Knowledge Cluster

AI4S supports the extraction of knowledge from massive amounts of information, realizes the automated organization and association of knowledge, and promotes the transformation of the traditional single-modal information output model toward multimodal knowledge perception and interactive integration, thereby enhancing the precision and efficiency of knowledge services as well as the capacity for knowledge discovery. Against this background, existing library information services will take smart knowledge services as their goal and be unified into the knowledge service knowledge cluster. In response to new social-development needs and users' new demands for library literature and information services, the focus will shift toward the integrated development of multimodal information and data resources, the generation of visualized decision-making solutions, and intelligent knowledge services; the service scope will also be further extended to personalized and precise scenarios for users' information acquisition and querying.

2.2.2 Integration of the Information Technology Knowledge Cluster into the Information System Utilization Knowledge Cluster

The development of AI4S requires the coordinated construction of large-scale scientific infrastructure, laying the foundation for in-depth analysis and personalized use of scientific data, so that researchers can acquire and share the overall wisdom of humanity and use advanced technological tools to achieve efficient integration of the research process and research resources. As a discipline of information-resource infrastructure focused on supporting scientific research and development, library science needs to actively build the "super brain" of AI4S, integrate high-performance data resources and research tools, form powerful data-analysis capabilities and convenient reuse capabilities, and support high-performance computing for multiple types and modalities of data. Under the AI4S paradigm, library science needs to integrate related knowledge such as information technology, information retrieval, smart libraries, digital libraries, and databases, forming an information system utilization knowledge cluster centered on knowledge representation, information evaluation, and information ethics, with attention to how to advance natural-language human-computer interactive question answering to replace traditional mechanical retrieval, and how to realize an upgrade in the supporting capacity of information systems from information retrieval to knowledge production.

2.2.3 Integration of the Information Resource Construction Knowledge Cluster into the Knowledge Base Knowledge Cluster

At present, information resource construction in the field of library science is dominated by structured literature resources. It faces problems such as insufficient ubiquity of strategic information-resource systems oriented toward major complex national scientific issues, difficulty in universalizing the knowledge ordering of vertical research-scenario-oriented information-resource systems, and weakness in AIGC and high-quality dataset construction. These problems make it difficult to meet the needs of smart knowledge services for high-level scientific and technological self-reliance and self-strengthening, as well as scientific and technological innovation. Therefore, it is necessary to promote the integration of AI and information resources and to build systems capable of efficiently serving

AI4S requires a high-quality knowledge-resource foundation to provide personalized and scenario-based knowledge. The level of AI4S development depends to a large extent on the quality and availability of the knowledge-resource system. The authority, feasibility, comprehensiveness, and granularity of that system not only directly affect the developmental level of AI4S, but also bear on the fulfillment of libraries' role in ensuring access to information resources. AI4S has expanded the scope and types of research information resources. Library science therefore needs to pursue theoretical and technological innovation oriented toward building a high-quality knowledge-resource foundation for AI4S, and to overcome technical challenges such as the effective aggregation of multimodal and big-data resources, knowledge organization, value alignment, and semantic association. In this way, it can address the supply of trustworthy data resources and information resources for knowledge reasoning, knowledge prediction, and knowledge generation, enabling diverse information resources to be input across multiple dimensions and to support scientific research innovation.

2.2.4 Deep Exploration of the Construction of Data Resources and Data-Intelligence Knowledge Clusters

The knowledge cluster of data resources and data intelligence centers on theories and technologies for using data intelligence to acquire and synthesize knowledge, transforming data into resources, mining data for knowledge, refining data into wisdom, and ensuring secure control across the entire data-and-intelligence process[27]. It is a key point through which library science can obtain more development resources in the AI4S era. As AI4S becomes increasingly dependent on massive volumes of data, library science needs to orient itself toward realizing the resourceization, knowledge-based transformation, and intelligentization of data; to take systematic management of data resources as its core foundation; and to use frontier data-intelligence technologies as enabling tools, thereby responding to societal demand for releasing the value of data elements[28]. In particular, attention should be paid to full-lifecycle management of data resources, with emphasis on using intelligent technologies such as large language models, embodied intelligence, and agents to mine data value; to meet needs such as scenario-based and domain-specific data-resource development and data empowerment; and to integrate knowledge concerning data governance, data openness, data integration, and data annotation into a knowledge cluster of data resources and data intelligence.

2.3 Market Transformation Drives Optimization of the Training System

The development of AI4S will inject contemporary meaning into the cultivation of library science talent, promoting the renewal of training objectives, the restructuring of curriculum systems, the expansion of industry-university-research scenarios, and innovation in talent-training models.

2.3.1 An Interdisciplinary Digital-Intelligence Turn in Talent-Training Objectives

For a long time, China' s library science programs have focused on the organization, preservation, and service of documentary information resources, emphasizing cultural inheritance and the construction of public cultural service systems, and training personnel for information service and management work in libraries and information institutions[29]. AI4S will strengthen coordination between the orientation of social demand and the talent-training system, promote a shift in training objectives from information professionals to data-intelligence talent, and emphasize the cultivation of compound talent with both professional competence in library science and interdisciplinary backgrounds. To this end, it is necessary to consider the compatibility between human intelligence and artificial intelligence within the knowledge and skills system of professional education, focus on updating and iterating the training system for information service and management personnel, and examine the continuing value and development direction of traditional library science talent training in the context of AI4S. The focus of talent training should shift toward cultivating high-level compound talent who possess strategic thinking in data-resource management, master advanced data-intelligence technologies, and adhere to ethical and moral norms in the digital-intelligence era, as well as interdisciplinary digital-intelligence talent suited to the development of digital-intelligence undertakings and capable of integrating data elements, extracting data in scenario-based forms, and realizing data intelligence.

2.3.2 A Competency-Based and Differentiated Transformation of Talent-Training Models

AI4S has accelerated the substitution by AI of some functions of library science professionals in such areas as literature retrieval, reference consultation, and novelty searches for science and technology, driving talent training toward education in digital-intelligence leadership[30] and requiring students to form a compound competency structure of "theory–technology–capability–practice–compliance." AI4S has expanded the application scenarios of library science knowledge, requiring professional education to strengthen the integration of industry and education, attach importance to data-intelligence training and practice that support AI4S, and transform the traditional training model and philosophy of "professional knowledge–skills improvement." In this process, it is necessary to closely align with the characteristics of the era marked by disciplinary intersection and technological integration, respond to the social demand of "data elements × modernization of national governance," and explore pathways for improving the quality of talent training through digital-intelligence empowerment. Based on actual industry needs and talent positioning at different levels, a series of distinctive micro-specialization directions should be established in fields such as digital humanities, data elements, data governance, digitization of ancient books, artificial intelligence, and data intelligence, so as to cultivate students' ability to solve theoretical and practical problems related to the discipline. Only in this way can a differentiated, practice-capability-oriented talent-training model for the innovative development of AI4S be reconstructed around "social demand–digital-intelligence empowerment–literacy cultivation–problem solving–innovation capability," promoting the transformation of library science education from qualification-based education to capability-empowering education.

2.3.3 Practice-Oriented and Contextualized Adjustment of the Curriculum Content System

AI4S expands the employment horizons of library science talent to a broad professional landscape dedicated to ensuring human access to and retrieval of information. It requires curriculum design and teaching content to keep pace with industry developments, pay attention to the impact and restructuring of knowledge systems brought about by new technologies, and offer distinctive course modules closely aligned with AI4S needs. This requires taking core courses as the foundation and data-intelligence technologies as the carrier, systematically incorporating frontier knowledge such as large language models, agents, and data security into professional training in documentary information services, information resource development, information analysis and prediction, and other areas, while adding related courses such as Introduction to Artificial Intelligence, Introduction to Data Elements, Data Resource Management, Large-Model Theory and Methods, Data Organization and Agents, and Data-Intelligence Governance. At the same time, relying on practice-oriented teaching in areas such as data-resource organization and retrieval, user behavior and service design, human–machine intelligent interaction, and applications of data analysis and intelligent decision-making systems, students' innovative ability to solve problems in specific scenarios such as data-resource acquisition, annotation, cleaning, organization, analysis, and mining should be cultivated, so as to adapt to the increasingly diversified and intelligent development trend of information inquiry and acquisition methods[31] and enable students to truly apply professional knowledge in the information service industry.

2.4 Research Paradigm Transformation Driving Research Change

AI4S imposes new requirements on the process of library science research—"problem posing—mechanism exploration—research verification—knowledge generation." By influencing research concepts, research practice, and organizational ecology, it promotes the transformation of the research paradigm in library science.

2.4.1 Strengthening the Research Concept of Intelligent Computing

In the digital-intelligent era, library science has gradually focused on the computability, mechanization, and modeling of research problems, as well as the quantification, automation, and intelligentization of research methods. AI4S has accelerated the progress of intelligent computational thinking and methods in the intelligent innovation of library science. It can not only understand library science theory in a more intelligent and automated manner and, during computation, establish connections between researchers' descriptive explanations of information acquisition and query phenomena, but can also expand the data processing and representation methods used in empirical research, thereby providing intelligent computing conditions for the quantitative and mechanistic transformation of human information acquisition and its satisfaction systems

32

. AI4S has changed the mindset of library science research, injecting intelligent computational thinking and digital-intelligent technological genes into disciplinary research. For example, collaboration between large models and agents can transform complex information phenomena into mathematical models and assist in revealing the internal relationships among various elements in information acquisition and query systems, thereby enabling the concept of "intelligent computing" to serve practical exploration and empirical research in library science.

2.4.2 Innovating Research Practice in Human-Machine Interaction

AI4S emphasizes a research ecology of knowledge innovation based on collaboration between human wisdom and machine intelligence, aiming to use artificial intelligence to augment human wisdom. AI4S possesses the capacity for autonomous judgment and learning with respect to data and environments; it is a prescient enabler of research design and hypothesis generation, an intelligent agent for simulating and generating synthetic data, and a core vehicle for realizing the autonomous transformation and emergence of scientific research data into knowledge

33

. It can promote the transition of machine intelligence from a scientific research tool to an intelligent scientist, and push AI tools closer to the core processes of knowledge innovation. In library science research, AI4S can automatically handle repetitive and mechanical research tasks, assist in exploring research directions and forming research hypotheses, support experimental design, and monitor experimental processes. This enables researchers to focus more on more innovative and higher-level research tasks. At the same time, AI4S can also provide researchers with hardware acceleration support, promote the shift of scientific decision-making models from "data + learning" to "knowledge + reasoning"

34

, and exhibit significant substitution, enhancement, and autonomy effects.

2.4.3 Fostering an Integrated Research Organizational Ecology

AI4S is an emerging interdisciplinary collaboration mechanism, representing an organized model of scientific research innovation that is oriented toward solving real problems and supported by intelligent large-model platforms. It provides researchers with a knowledge platform for more equal and effective interdisciplinary sharing, and promotes a profound transformation of knowledge production from stock mining to incremental creation

35

. At present, the value orientation of library science research is undergoing a transformation from positivism oriented toward the pursuit of deterministic and explanatory knowledge to pragmatism oriented toward exploring uncertainty understanding and solutions to complex problems. This requires changing the logic of scientific discovery that is dominated by researchers' experience and relies on theoretical hypotheses, promoting mutual nourishment of knowledge between library science and disciplines such as computer science, data science, and artificial intelligence, as well as the cross-application of datasets and analytical methods from various disciplinary fields. Meanwhile, knowledge discovery based on AI4S can be widely applied to library science research scenarios, realizing the organic integration and systematic consolidation of different paradigms. More importantly, the research environment and collaborative research system created by AI4S can help researchers share research resources across fields, disciplines, and regions, and promote the transformation of scientific research organization models from traditional individual-driven models to platform collaboration and human–machine interaction. This is conducive to constructing a scientific community that includes library science researchers and machine-intelligence entities, promoting research practice that covers the entire knowledge domain, and thereby accelerating the development of the library science research organization system toward cross-integration and boundarylessness.

3 Development Pathways for Library Science under AI4S

AI4S provides new strategic guidance for the transformation and development of library science. Library science should actively adapt to and integrate with AI4S, innovate theories as well as technical methods related to the effective querying and acquisition of human information, reconstruct a digital-intelligent disciplinary ecology, and achieve leapfrog development of the discipline.

3.1 Proactively Planning and Seeking New Disciplinary Growth Points

AI4S has had a profound impact on human information needs and will also deeply affect the paradigm by which library science explains new information phenomena. Library science should assume responsibility for constructing, in response to AI4S, new theories and technical methods concerning human information needs and their satisfaction. First, it should scan the application environment of the library science knowledge system, take major scientific research projects as the starting point, and sort out the social needs, research problems, knowledge connotations, and development laws of the discipline under the transformation brought about by AI4S. Through the profound impact of AI4S on the proposition of "ensuring human information acquisition and querying," it should promote the dynamic updating of library science knowledge. Second, centering on the transformations brought by AI4S in intelligent knowledge services, information system utilization, knowledge bases, and knowledge clusters of data resources and data intelligence, it should redefine the knowledge system of library science, carry out forward-looking integrative research, form original theoretical frameworks with explanatory power, and promote the transformation of library science from information management toward supporting knowledge creation. At the same time, library science should take knowledge association and inclusive services as its foundation. By leveraging its leading role in public scientific databases and scientific research toolchains, it should construct an open scientific research ecosystem, build an independently controllable intelligent scientific research data platform, and form a scientific research intelligent data center; develop intelligent knowledge service engines and provide intelligent data products for scenario-based intelligence services; construct frameworks for large models and data ethics as well as ethical review mechanisms, ensure AI value alignment, improve researchers' AI literacy, and thereby promote the transformation of libraries and library science from guardians of knowledge into enablers and partners of intelligent scientific research.

3.2 Ecological Reconstruction and Integration into Transdisciplinary Unified Development

Facing the "transdisciplinary" research form spawned by AI4S—one oriented toward complex problems and transcending traditional disciplinary barriers—library science must from

a closed or semi-closed "literature-resource system" into an open and dynamically evolving "intelligent knowledge ecology," and become deeply integrated into a supra-disciplinary ecosystem centered on information-resource management. Specifically, first, library science needs to re-examine its distinctive disciplinary positioning in the digital-intelligence era, attend to the impact of AI4S in breaking through the DIKW transformation chain and thereby challenging the disciplinary foundations, distill core knowledge, identify new points of knowledge growth, and integrate them into new course clusters, injecting sustained developmental momentum into the disciplinary ecosystem. Second, on the basis of strengthening dialogue between library science and adjacent disciplines such as information science and archival science, it should examine the impact of AI4S on the entire discipline of information-resource management and proactively integrate itself into information-resource management as a first-level discipline. By participating in the construction of a supra-disciplinary ecosystem of data intelligence and information-resource management, library science can promote its organic growth as a discipline, proactively enter the broader landscape of cross-domain and interdisciplinary AI4S-integrated talent cultivation, and expand its overall influence.

3.3 Coordinated Development and Diverse Interdisciplinary Cooperation

AI4S is driving scientific research away from the traditional model of closed disciplinary divisions and toward an open, integrated collaborative-platform model; the value orientation of scientific research is also shifting from the pursuit of objectivity to an emphasis on transparency. This trend requires the construction of cross-departmental and interdisciplinary mechanisms for coordinated research development, the formation of a community for the development of library science, the joint cultivation of a diverse, mutually reinforcing, and mutually illuminating ecosystem of interdisciplinary integration, and the creation of an open collaborative-innovation platform oriented toward the development of library science. First, a catalytic platform for interdisciplinary dialogue should be built to transform research paradigms. The development of library science requires platforms for interdisciplinary knowledge exchange; especially in the context of new liberal arts and broad-disciplinary construction, only through the cross-integration of theoretical knowledge, research methods, technical tools, and platforms from multiple disciplines can the innovative development of knowledge in library science be promoted. Second, social forces should be coordinated to build a platform for leapfrog development. As the wave of AI4S continues to surge forward, library science will shift toward broader fields of information and data, the application scenarios of disciplinary knowledge will continue to expand, and the traditional role of knowledge management as "gatekeeper" will tend to weaken. This means that its educational system and knowledge system face challenges of transformation. Yet library science cannot, by its own efforts alone, resist the impact of AI4S on knowledge systems and educational systems. It is therefore necessary to establish cooperative networks among government agencies, enterprises and public institutions, and other stakeholders, form a model of organized scientific research, and promote knowledge flow and organizational exchange through collaborative platforms.

3.4 Responding to Needs and Enhancing the Competitiveness of Talent Cultivation

Talent cultivation is the core issue in library-science education. On the one hand, China has not yet fully formed an autonomous system and mechanism for cultivating outstanding industry-leading talents in library science; the coordination mechanism between talent cultivation and industry demand remains relatively weak; the curriculum system has not adapted to technological transformation; and insufficient attention has been paid to cultivating compound, innovative and entrepreneurial, and intelligent talents for the new era[36]. On the other hand, the impact of AI on librarianship and information professions requires educational actors in library science to plan and adjust educational content and positioning so as to improve the competitiveness and adaptability of library-science talent cultivation.

However, the existing layout and structure of education are still unable to respond comprehensively to the developmental requirements of new quality productive forces, nor can they match the knowledge and skill demands arising from changes in the landscape of information professions. The rise of AI4S further highlights the importance of cultivating practical abilities and orienting training toward high-level compound talents. Library science should proactively connect with national strategic needs such as data elements, public cultural services, and "AI+," actively respond to practical development needs, and enhance the discipline' s social influence and recognition[37]. To this end, comprehensive educational reform should be advanced: the curriculum system and teaching-material content should be optimized; talent-cultivation programs should be innovated; and the education chain, professional-service chain, and talent chain of library science should be deeply integrated. Efforts should be made to build a high-quality collaborative cultivation system that comprehensively enhances talent competitiveness, with a focus on the implementation of professional scenarios, the pooling of industry-expert resources, the development of teaching teams with diverse practical capabilities, the strengthening of the design of data-resource and data-intelligence training as well as practical-teaching platforms, and the establishment of interdisciplinary, practical, comprehensive, and innovative talent-cultivation models, thereby highlighting students' competitive capacity for innovative practice in the field of information professions.

4 Conclusion

AI4S is becoming a key productive element for disciplinary knowledge innovation, bringing unprecedented opportunities and challenges to library science and opening up new dimensions of thought and practical pathways. This impact is comprehensive, long-term, and profound. Library science should actively embrace the changes brought by AI4S; respond to AI4S-related demands for large-scale scientific infrastructure, interdisciplinary knowledge-sharing platforms, high-quality data-resource systems, intelligent knowledge-service foundations, the mitigation of algorithmic bias and data risks, methods and regulatory pathways for responsible ethical value alignment, high AI literacy, and practicable AI capabilities; deepen theoretical innovation, technological application, and multidisciplinary integration; and, on this basis, incorporate these as points of knowledge growth into the supra-disciplinary ecosystem of information-resource management and data intelligence. At the same time, disciplinary development should always remain oriented toward national strategies and social needs, expand the scope and application scenarios of the discipline, promote the organic growth of the disciplinary knowledge system, and enlarge the overall influence of library science.

References

[1] Wang Yanli, Xie Lijiao, Gong Xi, et al. Research on the development process and evolutionary laws of AI for Sciences [J]. *Social Sciences Front*, 2025(3): 50–63.

[2] Yu Liangzhi. The mission and horizon of library and information science (LIS) [J]. *Library and Information Service*, 2009(9): 5–9.

[3] Kuhn. *The Structure of Scientific Revolutions: 4th Edition* [M]. Translated by Jin Wulun and Hu Xinhe. 2nd edition. Beijing: Peking University Press, 2012: 7–11.

[4] Tolle K M, Tansley D S W, Hey A J G. The fourth paradigm: data-intensive scientific discovery [J]. *Proceedings of the IEEE*, 2011(8): 1334–1337.

[5] Zhang X, Wang L, Helwig J, et al. Artificial intelligence for science in quantum, atomistic, and continuum systems [J/OL]. arXiv, 2023 [2025-09-23]. https://arxiv.org/pdf/2307.08423.

[6] Leng C, Tang Z, Zhou Y G, et al. Fifth paradigm in science: a case study of an intelligence-driven material design [J]. *Engineering*, 2023: 126–137.

[7] Li Guojie. Intelligent Scientific Research (AI4R): The Fifth Research Paradigm [J]. *Bulletin of the Chinese Academy of Sciences*, 2024(1): 1–9.

[8] Chen Zhimin, Wu Libo. *The Future Has Arrived: 2025 Blue Book on the Intelligent Development of Humanities and Social Sciences* [R]. Shanghai: Fudan University Press, 2025: 14–17.

[9] Zhou Daishu, Wei Shanhe. The Fifth Paradigm of Scientific Research Driven by Artificial Intelligence: Evolution, Mechanisms, and Impacts [J]. *Forum on Science and Technology in China*, 2024(12): 97–107.

[10] Gong Jiaoteng, Zhang Kang, Wang Fengjiao. Research on the Demonstration and Academic Influence of Methodological Paradigms in Library and Information Science: An Empirical Analysis Based on 18 CSSCI Source Journals in Library and Information Science [J]. *Library and Information Service*, 2025(21): 52–69.

[11] Jin Shengyong, Zhang Qi. On the Datafication Trend in the Development of Library Science in China [J]. *Information and Documentation Services*, 2021(1): 42–49.

[12] Mao Jin, Zhou Fanqing, Wang Zhuohao. AI for Science Promoting the Transformation of Scientific Research Paradigms: The "Platform-Based Scientific Research" Paradigm from the Perspective of Knowledge Services [J]. *Journal of the China Society for Scientific and Technical Information*, 2025(2): 132–142.

[13] Xinhua News Agency. The Ministry of Science and Technology Launches the Special Deployment of "AI-Driven Scientific Research"[EB/OL]. [2025-09-27]. https://www.gov.cn/xinwen/2023-03/27/content_5748495.htm.

[14] Wu Wenjun, Ma Yujing, Gao Yajun, et al. A Review of the New Paradigm of AI-Driven Scientific Research: Models, Applications, and Cases [J]. *Artificial Intelligence*, 2023(3): 1–17.

[15] Wang H, Fu T, Du Y, et al. Scientific discovery in the age of artificial intelligence [J]. *Nature*, 2023(7972): 47–60.

[16] *Global Development Observation and Outlook of Scientific Intelligence (AI4S) (2023 Edition)* [EB/OL]. [2025-09-27]. http://www.news.cn/tech/download/2023AI4SBG.pdf.

[17] Zhao Lijuan. Research on Library Services and Transformation Driven by Artificial Intelligence Science (AI4S) [J]. *Library & Information*, 2024(6): 131–135.

[18] Fan Wenhui, Jiang Yuan. Simulation Science and Engineering Thinking in the Era of Artificial Intelligence [J]. *Journal of System Simulation*, 2025(7): 1607–1623.

[19] Shi N. Deep surrogate models for parameter space exploration of ensemble simulations [D]. Columbus: The Ohio State University, 2024.

[20] Li Shengyang, Liu Kang, Liu Yunfei, et al. Digitally Intelligent-Driven Space Science Experimental Research: New Explorations under the AI4S Paradigm [J]. *Bulletin of the Chinese Academy of Sciences*, 2025(2): 371–379.

[21] Matl' a I, González-Camacho F, Marco R, et al. Nucleolar structure and proliferation activity of Arabidopsis root cells from seedlings germinated on the International Space Station [J]. *Advances in Space Research*, 2005(7): 1244–1253.

[22] Qin Rui, Liang Xiaolong, Li Juanjuan, et al. Parallel Research Institutes: From Digital Transformation to Intelligent Transformation [J]. *Journal of Intelligence Science and Technology*, 2023(2): 212–221.

[23] Yu Liangzhi. What Is Legitimate? How to Innovate? Reflections on the Concept of the Library and the Legitimate Innovation of Library Science in China [J]. *Library & Information*, 2022(5): 63–70.

[24] Ge Zimeng, Lu Kequan, Li Gang. Research on Generative Artificial Intelligence Anxiety among Students in the Discipline of Information Resource Management and Its Influencing Factors [J]. *Library and Information Service*, 2025(6): 72–84.

[25] Zhou Wenjie, Zhou Xiaoying, Yan Hui. The "Dual-Chain Interaction" Theoretical Framework of Information Resource Management: Interpretive Induction and Application Scenarios [J/OL]. *Journal of Library Science in China*, 1–24 [2025-10-12]. https://link.cnki.net/urlid/11.2746.G2.20250821.1522.002.

[26] Yan Hui. Development Directions of the Discipline of Information Resource Management in the Era of General Artificial Intelligence [J]. *Journal of Information Resources Management*, 2024(2): 21-28, 53.

[27] Zhou Wenjie. The "Third Wave" of Transformation in Library, Information and Archives Science: Data Management [J]. *Library Development*, 2023(4): 4-10.

[28] Ran Congjing, Liu Yan. The Establishment of the National Data Administration and the Expansion of the Discipline of Information Resource Management [J]. *Journal of Information Resources Management*, 2023(4): 6-9.

[29] Wu Dan, Zhou Lihong, He Xiaoyang, et al. Intelligence Studies Opens a New Era: Theoretical Innovation and Value Reconstruction in Chinese Library Science [J]. *Journal of Library Science in China*, 2025(2): 6-21.

[30] Chen Chuanda, Jiang Ziyu, Wu Gang, et al. Research on the Transformation of Talent-Cultivation Models in Library Science in the Practice of New Liberal Arts [J]. *Documentation, Information & Knowledge*, 2024(2): 50-59.

[31] Li Shuai, Chen Dingquan. Data as the Foundation: A Strategy for Reconstructing the Disciplinary Knowledge System of Information Resource Management [J]. *Library Tribune*, 2024(12): 1-7.

[32] Ye Jianhua, Qi Qi, Feng Chengyan, et al. Research on the Construction of the Information Resource Management Discipline from the Perspective of the Fourth Paradigm of Scientific Research [J]. *Library and Information Service*, 2023(1): 57-64.

[33] Liu Zemin, Chen Xiangdong. Paradigm Change Triggered by Artificial Intelligence Science (AI4S): Issues, Methods, and Processes in Educational Research from the Perspective of Large Language Models [J]. *Distance Education Journal*, 2024(5): 23-34.

[34] Sun Haoling, Han Tao. Research Intelligence and Knowledge Services: Connotations, Implementation, and Opportunities [J]. *Information Studies: Theory & Application*, 2021(10): 41-49.

[35] Burger B, Maffettone P M, Gusev V V, et al. A mobile robotic chemist [J]. *Nature*, 2020(7815): 237-241.

[36] Zhu Manna, Gong Jiaoteng. An Exploration of Graduate Education in Library Science from the Perspective of New Liberal Arts [J]. *Library*, 2021(7): 39-45.

[37] Yi Ling, Wang Fengjiao, Gong Jiaoteng. A Review of the Construction of the Library Science Discipline under the Background of "Double First-Class" : 2015-2020 [J]. *Journal of Academic Libraries*, 2021(2): 81-91.

ChinaRxiv 中X

Research on the Development of Library Science for AI for Science

Zhang Kang1 **Gong Jiaoteng**1,2

1. School of Public Administration of Xiangtan University, Xiangtan, 411105
2. Xiangtan University Library, Xiangtan, 411105

Abstract AI for Science (AI4S) constitutes a new context for the development and transformation of library science. Based on an analysis of the evolution of scientific research paradigms and their implications for library science, this paper examines the potential influence of AI4S on the discipline' s development and explores possible future pathways. AI4S may reshape the connotation, knowledge system, talent cultivation, and research paradigms of library science by shifting its disciplinary focus, intensifying problem-driven demands, elevating talent-market needs, and promoting research-paradigm transformation, thereby providing new strategic momentum for the advancement of the discipline. Library science should align with strategic needs, proactively plan for growth points in disciplinary knowledge, actively integrate into the interdisciplinary ecosystem of information resource management and data intelligence, build open collaborative platforms for disciplinary innovation, and achieve sustained innovative development.

Keywords AI4S; Library science; Discipline development

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