Comparison and Reflection on Libraries' Participation in Science and Culture Construction: Postprint

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Abstract

Purpose/ Significance: Disseminating scientific culture constitutes one of the missions and responsibilities of libraries. This study systematically analyzes the connotation of scientific culture construction, identifies potential areas for library engagement, and provides references for the Chinese library community' s participation in scientific culture construction. Method/ Process: Through literature research, web-based investigation, and systematic review methods, this study examines the multi-level connotation of scientific culture and corresponding service practices in the international library community, and proposes countermeasures and suggestions based on the existing foundation of Chinese libraries. Results/ Conclusion: Scientific culture construction encompasses a multi-level connotation including the basic literacy perspective, ethical and moral perspective, and workplace culture perspective. Chinese public libraries can participate in scientific culture construction from the basic literacy perspective by enhancing ideological awareness, strengthening connections with the scientific community, increasing the proportion of STEM activities, incorporating information literacy courses related to ethics and morality, and conducting comprehensive science popularization activities such as citizen science. Specialized libraries can provide academic integrity support services through a "trinity" of facilities, resources, and services, and support the construction of ethical and moral perspectives and workplace culture perspectives in scientific culture by establishing norms for specialized library academic evaluation services and practicing responsible scientometrics. This study adopts a macro perspective, and future research will conduct thematic studies at meso and micro levels.

Full Text

Preamble

Library Participation in Scientific Culture Construction: Comparison and Reflection

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Abstract:
[Purpose/Significance] Disseminating scientific culture represents one of the missions and responsibilities of libraries. This study systematically analyzes the connotations of scientific culture construction, identifies potential areas for library engagement, and provides references for Chinese libraries to participate in scientific culture construction.
[Method/Process] Through literature research, web-based investigation, and systematic review, this study examines the multi-layered connotations of scientific culture and corresponding service practices in the international library community. Building upon the existing foundation of Chinese libraries, it proposes countermeasures and recommendations.
[Results/Conclusions] Scientific culture construction encompasses three dimensions: basic literacy perspectives, ethical and moral perspectives, and workplace culture perspectives. Chinese public libraries can participate in basic literacy-oriented scientific culture construction by enhancing ideological awareness, strengthening connections with the scientific community, increasing the proportion of STEM activities, incorporating ethical information literacy curricula, and conducting comprehensive science popularization activities such as citizen science. Academic libraries can provide integrated "trinity" support services for academic integrity covering facilities, resources, and services, and can support ethical and workplace culture-oriented scientific culture construction through the standardization of academic evaluation services and the practice of responsible scientometrics. This study adopts a macro perspective; future research will explore meso- and micro-level topics.

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1 Introduction

Scientific culture, as a subsystem of humanistic culture, reflects and guides scientific research and technological applications. Cultural scholars note that scien-

tific culture exhibits distinct rational characteristics compared to other cultural forms. The "Outline of the National Action Plan for Scientific Literacy (2021-2035)" proposes development goals for significantly enhancing national scientific literacy and soft power by 2035. Sociologists of science view scientific culture as a value system formed around scientific activities. The Nuffield Council on Bioethics in the UK has published reports examining the impact of scientific culture on research ethics and quality, while the success of Bell Labs has been closely linked to its outstanding scientific culture. Whether in policy documents or academic research, the boundaries of scientific culture vary across contexts, encompassing basic literacy perspectives, ethical and moral perspectives, and workplace culture perspectives of the scientific community.

At the metaphysical level, basic literacy-oriented scientific culture is often associated with public scientific awareness and public participation in science and technology. At the practical level, it manifests as scientific knowledge, norms, behavioral standards, and codes of conduct. Ethical and moral-oriented scientific culture emphasizes fundamental norms of the scientific community, including protection of human and animal subjects, proper reporting of scientific findings, and correct citation of sources. It guides the scientific community toward "technology for good" and provides value orientation and institutional safeguards for scientific development. At the metaphysical level, workplace culture-oriented scientific culture reflects researchers' attitudes toward their work environment and career development aspirations; at the practical level, it manifests as the knowledge production modes, thinking patterns, and evaluation models of different disciplines and academic organizations.

2 Research Methods

This study employs systematic review methodology to identify, evaluate, and interpret literature related to the research topic, revealing its developmental trajectory and trends. Based on Chinese academic literature, we extracted Chinese keywords and mapped them to commonly used English terms. Chinese academic literature was primarily searched through CNKI, while English literature was searched through the Web of Science database. The search date was April 30, 2023.

The search strategy covered three dimensions of scientific culture: basic literacy-oriented, ethics and morality-oriented, and workplace culture-oriented. Approximately 80 documents were included for intensive reading after retrieval and classification.

3 International Trends in Library Participation in Scientific Culture Construction

Open science represents the most significant development trend in scientific endeavors, profoundly influencing the evolution of scientific culture and library service practices. Scientific culture and ethical culture are increasingly integrated,

with libraries serving as both important promoters of basic literacy-oriented scientific culture and crucial gatekeepers of scientific culture governance.

3.1 Major Actions in Basic Literacy-Oriented Scientific Culture Construction

Benefiting from close community connections, public libraries play important roles in basic literacy-oriented scientific culture construction. The Institute of Museum and Library Services (IMLS) provides grants to support AI literacy education for disadvantaged youth populations. The New York City Mayor' s Office of the Chief Technology Officer released an AI strategy in 2021, guiding citizens in AI use and management. Public libraries and New York University jointly launched a 5-week "We Are AI" program. The American Library Association and the Association for Information Science & Technology (ASIS&T) formulated thematic initiatives to train library staff on AI, incorporating AI literacy into MLIS curricula. The International Federation of Library Associations and Institutions (IFLA) issued a statement on libraries and artificial intelligence, emphasizing public education on privacy, bias, and transparency.

3.2 Major Actions in Ethics and Morality-Oriented Scientific Culture Construction

Under open science influences, scientific and technological resources are increasingly open, including open literature resources, open government data, and open laboratories. As publication barriers lower, interactions between professional and citizen scientists have evolved beyond brief knowledge transmission. In citizen science projects, librarians often serve as assistants to professional scientists, conducting full-process rehearsals to enhance research reliability and validity. However, citizen science also brings negative impacts—citizens face risks of misinformation and exposure to unrigorous academic viewpoints, necessitating knowledge and tools for critical evaluation.

Since the U.S. National Science Foundation mandated data management plans, libraries have actively responded to emerging needs for research misconduct prevention. The University of Michigan Library led the development of the institutional repository Deep Blue and data repository Deep Blue Data. The University of Illinois at Urbana-Champaign Library established the Illinois Data Bank. The University of Florida Health Science Center, Oregon State University Library, and Ryerson University Library created specialized positions serving research reproducibility. Master' s and doctoral programs at the University of Illinois School of Information Sciences added research reproducibility courses for talent development.

The Association of College and Research Libraries (ACRL) updated and expanded information literacy courses covering knowledge of data/code/method sharing, intellectual property protection, and data management ethics. The League of European Research Libraries (LIBER) issued recommendations on

metric usage, promoting responsible metrics practices. These actions represent libraries' primary engagement in ethics and morality-oriented scientific culture construction.

3.3 Major Actions in Workplace Culture-Oriented Scientific Culture Construction

Open science has reshaped knowledge production models, enhancing openness and inclusivity. Multilateral, multi-node, and multi-level collaborative innovation among diverse social entities has become increasingly important. The British Academy' s "Crossing Paths" report emphasized the value of cross-disciplinary and cross-organizational experience for career development and research. With only 4% of UK science PhD graduates securing permanent academic positions, standards for respect and recognition in academic workplaces have diversified.

The San Francisco Declaration on Research Assessment (DORA), launched in December 2012, has been adopted by numerous global research institutions advocating responsible use of quantitative research evaluation metrics. The University of Nottingham implemented responsible research metrics policies, while the University of Michigan Library' s evaluation reports prominently note the limitations of index-based metrics. Libraries have inclusively incorporated non-academic impactful performances into assessment objects, keeping pace with evolving academic evaluation standards and benefiting workplace culture-oriented scientific culture construction.

4 Chinese Libraries' Actions and Existing Problems

4.1 Basic Literacy-Oriented Scientific Culture Construction

China has approximately 6,000 public libraries and thousands of provincial-level science popularization education bases, yet only 88 provincial-level library science education bases exist. Science popularization remains sporadic and decorative rather than normalized. Among the first batch of 140 "Scientist Spirit Education Bases" designated by the China Association for Science and Technology, only three were libraries. While public libraries conduct exhibitions and lectures, STEM-related activities account for merely 8.4% of total programs—for instance, Guangzhou Children' s Library' s "Yangcheng Youth Academy" brand held 420 sessions by September 2022, with STEM topics representing only a small fraction.

Maker spaces represent an innovative response to open science development. A national survey of 58 public libraries found only 15 had established maker spaces, with sustainability concerns due to funding instability and talent shortages. Information literacy education and misinformation governance remain two sides of the same coin, yet Chinese public libraries continue to struggle with disorganization and insufficient community influence. Most libraries focus on information

tools and skills like software programming, rarely addressing information ethics, evaluation, or legal-moral dimensions. Public libraries demonstrate insufficient participation in basic literacy-oriented scientific culture construction, with low recognition of their science popularization responsibilities and inadequate grasp of trends in science-culture integration.

4.2 Ethics and Morality-Oriented Scientific Culture Construction

University libraries are the primary actors in ethics and morality-oriented scientific culture construction. Most provide academic norm detection services, with some participating in technology development. The Chinese Academy of Sciences Documentation and Information Center established a Research Integrity Research Center in January 2023, focusing on technology and service research. Peking University Library built an open research data platform, while Fudan University Library led development of a social science data platform. However, research data management services remain inactive, with few reproducibility services and ongoing exploration of librarian training.

Systematic information literacy courses remain rare—only Fudan University, Shanghai Jiao Tong University, and Wuhan University libraries offer comprehensive programs. Most focus on information retrieval, with outdated courseware lacking ethics content. Some university libraries have established scientist memorial libraries (e.g., Wu Jianxiong Library at Nanjing University, Qian Xuesen Library at Xi' an Jiaotong University), but educational activities around these collections remain limited. While Chinese university libraries actively engage in ethics and morality-oriented scientific culture construction, practical effectiveness requires improvement.

4.3 Workplace Culture-Oriented Scientific Culture Construction

China has issued guidelines such as "Opinions on Deepening Reform of Professional Title Systems" and "Guidelines for Breaking 'Five Only' in Talent Evaluation." Libraries remain important in talent recruitment, promotion, and university development evaluation. Peking University developed the "仔 Index" for evaluating life sciences and basic medical research institutions. The Shanghai Information Center for Life Sciences creatively proposed the "仔 Index" combining expert review with paper impact metrics. He Xiaoqing proposed an improved z-index based on co-author contribution allocation algorithms. Pang Hongsen et al. explored talent evaluation indicator systems for "Double First-Class" universities, attempting to address domain-specific evaluation needs.

Some scholars use Altmetrics to evaluate social impact through social media data. The representative work evaluation system represents an important reform measure, with libraries providing methodological support and quantitative data for selecting representative academic works. However, controversies surrounding evaluation indicator systems persist. While Chinese libraries actively respond to academic evaluation needs, unified standards remain unresolved. Evaluation

reports from different libraries vary significantly in metric selection, calculation transparency, and stability.

5 Deepening Chinese Libraries' Participation in Scientific Culture Construction

Drawing on international leading libraries' experiences and Chinese libraries' current situation, this study proposes that Chinese libraries can deepen participation according to their positioning across different levels of scientific culture construction.

5.1 Guiding Public Libraries to Fulfill Science Popularization Responsibilities in Basic Literacy-Oriented Construction

To enhance public libraries' participation, efforts must address awareness, services, and multiple dimensions. First, initiate industry-wide thematic forums on scientific culture to raise ideological awareness and mobilize proactive engagement. Second, strengthen connections with the scientific community, particularly establishing links with science and technology associations and participating in regional science popularization alliances to expand resource bases. Third, enhance exhibition design and planning, increasing the proportion of STEM-themed exhibitions and expert lectures. Fourth, update information literacy curricula to strengthen information ethics and moral awareness, developing critical thinking for the digital world. Fifth, leverage opportunities from culture-tourism integration and urban open resources to conduct innovative science popularization activities.

5.2 Guiding Academic Libraries to Provide "Trinity" Academic Integrity Support Services in Ethics-Oriented Construction

Preventing research ethics risks requires infrastructure, technology, and service guarantees. At the infrastructure level, academic libraries should actively participate in big research data construction and governance, including developing databases for retracted papers, research integrity cases, and academic misconduct. At the technology level, libraries can develop or apply new technologies to curb emerging forms of academic misconduct. At the service level, libraries should update academic norm training content, expand research ethics education audiences, and participate in collecting scientist spirit-themed materials. Notably, current staffing levels may struggle to meet high-quality service demands—professional libraries should strengthen human resource development, improve technical capabilities, and enhance adaptability to evolving scientific paradigms.

5.3 Developing and Promoting Academic Evaluation Service Standards for Academic Libraries

Responsible scientometrics is crucial for maintaining academic workplace fairness. Qiu Junping et al. discussed China' s library standardization process, noting that service standard research has yet to address fundamental theoretical issues regarding mechanisms and effectiveness measurement. Li Jian proposed a theoretical framework for library service standard systems encompassing six themes and 58 elements. Academic evaluation has permeated all aspects of university assessment, from organizational to individual levels, necessitating standardized practices.

Drawing on international experience, university library consortia or associations should organize theoretical and practical discussions on academic evaluation service standards, distilling guidelines for research evaluation metric usage and promoting standardized toolkits. This would ensure metric selection and application follow clear protocols for specific scenarios. Concurrently, professional development should enhance librarians' understanding of their mission, ensuring neutrality in academic evaluation work and responding to the demands of responsible scientometrics.

6 Conclusion

This study analyzed the connotations of scientific culture construction and reviewed domestic and international library practices across its different dimensions. Compared with international libraries, Chinese libraries show more significant gaps in public library domains. While university libraries actively engage in ethics and workplace culture-oriented construction, effectiveness remains suboptimal.

This research adopts a macro perspective; future work will explore meso- and micro-level topics, including standards for responsible scientometrics, practical cases of libraries using new media to disseminate scientific culture, and transformation and upgrading of public library science popularization.

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