The Role and Competence Enhancement of Academic Librarians in the Makerspace Environment: Postprint

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Abstract

[Purpose/Significance] By analyzing the supporting and safeguarding roles that university librarians should fulfill in the maker space environment, this study clarifies the innovative service capabilities and requirements they should possess, and proposes corresponding recommendations for effective pathways to enhance their innovative capacities. [Method/Process] Based on an analysis of the support services required of librarians, this study summarizes the essential service capabilities that librarians must possess in meeting maker needs. [Results/Conclusion] In the maker era, the transformation of library service paradigms requires librarians to continuously enhance capabilities such as rapid adaptation to new developments, communication and coordination, information mining, data management, and team collaboration. Only through constant knowledge renewal and improvement of service capabilities can librarians effectively support users' interdisciplinary collaborative learning needs.

Full Text

The Role and Capacity Enhancement of University Librarians in the Maker Space Environment

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Abstract

[**Purpose/Significance**] By analyzing the supporting and ensuring roles that university librarians should play in the maker space environment, this study clarifies the innovative service capabilities and requirements librarians should possess, and proposes corresponding recommendations for effective pathways to enhance librarians' innovative capacities. [**Method/Process**] Based on analyzing the support services librarians need to provide, this paper summarizes the essential service competencies librarians must have in maker demand-based services. [**Result/Conclusion**] In the maker era, the transformation of library service models requires librarians to continuously enhance their service capabilities in rapidly accepting new things, communication and coordination, information mining, data management, and teamwork. Only by constantly updating their knowledge and improving their service abilities can librarians effectively support users' interdisciplinary collaborative learning needs.

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Introduction

With the rise of the maker movement, numerous physical venues and online platforms have emerged to provide makers with spaces for exchanging creative ideas and manufacturing innovative products—namely, maker spaces. In May 2015, the General Office of the State Council issued the "Implementation Opinions on Deepening Innovation and Entrepreneurship Education Reform in Higher Education" (Document No. [2015]36), which comprehensively deployed the deepening of innovation and entrepreneurship education reform in universities. This initiative does not simply encourage a college student entrepreneurship movement, but rather treats innovation and entrepreneurship education as a breakthrough point for deepening comprehensive higher education reform. Various institutions have responded by exploring ways to integrate "double innovation" education with professional education. University libraries have built maker spaces for college students that support thinking, communication, learning, and creativity, and have developed new services based on these spaces—representing an inevitable need for libraries to participate in talent cultivation.

China's library community began paying attention to maker spaces in 2012, with the first practical case being the "Creative Space" at the Chinese Academy of Sciences in 2013 [1]. Since 2013, research and practice on maker spaces in the

library field have gradually increased. Analysis of research literature on library maker spaces collected in CNKI reveals that current attention focuses primarily on maker space construction, service function design, and service model exploration, while discussions on librarians' role transformation and capacity enhancement remain insufficient. A fuzzy search in CNKI using title keywords containing "maker" or "double innovation" or "mass innovation" AND "library" (with no time limit) retrieved 346 documents. A secondary search of these documents using keywords containing "librarian" OR "capacity" yielded only 16 relevant documents. Among these 16 documents, only 4 focused on librarians' roles and capacities in maker services with relatively high relevance. Moreover, these documents mainly discussed specific aspects such as role positioning, development strategies, and continuing education for librarians in maker space services, while holistic consideration of librarians' role positioning, functions to be played, required competencies, and capacity enhancement pathways in maker space services remains inadequate. In the maker space environment, university librarians need to clarify their role positioning, continuously enhance their service capabilities around library development trends such as digitalization, user participation, multicultural integration, and innovation advocacy, achieve library service transformation, and support school talent cultivation [2].

Under the impact of new technologies and information environments, libraries' traditional service models can no longer meet readers' needs. Libraries are becoming spaces for interpersonal communication and knowledge creation, with their service focus shifting toward knowledge excavation, exchange, and sharing. Based on the maker space environment, university libraries can deeply embed themselves in the school's innovative talent cultivation system by integrating resources, excavating "double innovation" resources, sharing innovative concepts, and conducting "double innovation" training services. This approach promotes college students' innovative thinking, enhances their "double innovation" capabilities, guides entrepreneurial direction, and stimulates their innovation and entrepreneurship vitality, thereby fully realizing the educational and information service functions of university libraries. These innovative service contents also impose new requirements on librarians' service capabilities. In the maker space environment, university librarians are no longer merely managers and providers of document resources; they must play different roles according to makers' needs in maker practice activities, providing comprehensive support and assistance. As Zhu Qiang, Director of Peking University Library, stated in the "Library Makers—Dialogue Between Chinese and Foreign Experts" forum: in the process of maker services, librarians need to play multiple roles including promoters of innovative thinking, guides of knowledge exchange, providers of "double innovation" information, organizers of maker activities, promoters of maker culture, and managers of intellectual property [2].

1. The Role of Librarians in the Maker Space Environment

1.1 Stimulating Readers' Innovative Thinking

Creativity derives from accumulated knowledge and reflection. University library maker spaces not only provide users with abundant information resources and diverse services, but also offer spaces for ideological exchange and collision. In maker spaces, libraries' primary function is not merely to provide resources, equipment, and facilities for realizing and transforming users' ideas, but rather to provide technical support for innovation practice and organize deep knowledge service activities such as lectures, salons, and competitions. Through the space, venues, equipment, and technical support provided by librarians, libraries create an atmosphere for practical exploration and innovation that stimulates readers' innovative thinking.

1.2 Guiding Readers' Knowledge Exchange

Maker spaces are practice bases that fully embody maker education philosophy—places where readers can gather for communication, thinking, learning, and creation. Maker education activities should focus on creating problem-exploration scenarios for students, enabling them to independently explore and collaboratively solve problems. In the maker space environment, librarians need to play their role by helping college students establish maker clubs, build project teams, provide abundant online and offline learning resources, and coordinate team members from different disciplinary backgrounds to cooperate in problem-solving. These processes enable broader and more frequent exchanges among readers, which not only broadens their knowledge but also cultivates their communication skills and cooperative awareness [3].

1.3 Cultivating Makers' Innovation Literacy

Cultivating and enhancing college students' maker literacy has become one of the core contents of library quality education. Although domestic researchers have not yet formed a unified definition of "maker literacy," scholars generally believe that maker literacy is the innovative ability and quality through which learners, based on spontaneous creativity and common interests, use mastered science and technology and means to continuously experiment and attempt, ultimately discovering, analyzing, and solving problems, and are willing to share. University library maker spaces are not only creation venues but also practice bases that fully embody inquiry-based, experiential, and project-based education concepts based on extensive learning resources. In addition to traditional information literacy education, maker spaces focus on practical application and innovation, which not only improves college students' basic literacy as makers but also enhances their entrepreneurial awareness, innovative spirit, and creative abilities, thereby helping students improve their innovation literacy [4].

1.4 Enhancing Makers' Information Literacy

Innovation activities require consulting large amounts of literature, including topic analysis, literature investigation, feasibility analysis, data surveys, and patent searches. Rapidly obtaining large amounts of accurate research information and data and applying it in a timely manner can greatly improve the efficiency of makers' academic research and innovation practice. Faced with increasing information resources, readers are troubled by questions of how to excavate reliable information sources, evaluate resource quality, and effectively organize obtained information. To address these issues, librarians need to help makers in different disciplines enhance their information literacy and improve their ability to obtain effective information according to their specific needs.

1.5 Curating Innovation and Entrepreneurship Information

With the rapid growth of information, readers need more than just indirect information resources—they need precise knowledge that can directly solve problems. In the "double innovation" education environment, readers need to understand large amounts of relevant policies, regulations, business information, and technical information. As the school's literature and information center, libraries have resource and talent advantages and can integrate multi-party resources around the theme of innovation and entrepreneurship, organize thematic information exhibitions, help readers quickly master relevant information, accurately grasp opportunities, and enhance the bidirectional transformation of technology and achievements in the innovation and entrepreneurship process.

1.6 Organizing Maker Practice Activities

Library maker spaces can provide tools and platforms for readers to enhance their professional capabilities and innovative skills. Librarians can serve as organizers to plan maker practice projects, helping college students transition from classroom knowledge to maker projects; provide venues for maker practice activities; help readers gather like-minded makers with different specialties to become partners; provide software, hardware equipment, and technical support; and cooperate with enterprises to develop school-enterprise collaboration, characterized by service outsourcing and highlighted by complementary advantages, forming a new ecology of production, learning, and cooperation [5].

1.7 Managing Information Intellectual Property

College student makers' innovation and entrepreneurship paths mostly involve technological innovation and transformation, where "exchanging intelligence for capital" is the characteristic and necessity of college student entrepreneurship. Therefore, the popularization of intellectual property protection knowledge is particularly important for student makers [6]. Currently, many Chinese universities have established innovation and entrepreneurship courses, but the teaching content emphasizes national innovation and entrepreneurship policies, team

building, project selection, risk control, financing cooperation, and enterprise application, while neglecting intellectual property education. This causes many college students to infringe upon others' intellectual property rights during innovation and entrepreneurship, not knowing how to protect and operate their own intellectual property, which greatly reduces the success rate of college student innovation and entrepreneurship [7]. Through training on intellectual property and its protection, librarians can help readers understand the basic rights and obligations of intellectual property. On the one hand, they guide readers to use information rationally, follow academic norms, and reasonably utilize others' achievements; on the other hand, they can provide patent consultation for college student makers, help them protect their achievements using intellectual property law (such as applying for patents), and learn to use legal means to combat infringement and suppress harmful violations.

1.8 Promoting Maker Culture

In maker spaces, librarians' work objective is to guide college students to master problem-based learning methods, improve problem-solving abilities, help them pursue the origin of things, explore fundamental truths, learn new things in practice, and temper their will through continuous exploration and practice. Through salons, forums, and practice projects, librarians gather makers with different interests and specialties. When they gather around issues of interest, they generate tremendous innovative vitality. Makers share resources and knowledge, exchange ideas, and share research results or works in maker spaces. With passion and persistence, they aggregate, communicate, share, cooperate, and continuously explore, demonstrating the unique charm of maker culture and attracting more readers to join.

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2. Essential Competencies for University Librarians in the Maker Space Environment

As maker services become a new service form in libraries, librarians are endowed with multiple new roles beyond traditional resource providers, which imposes newer and higher requirements on librarians' qualities [8]. The DeLaMare Science and Engineering Library, the first library in the United States to practice maker spaces, believes that one of the key factors for its success is the deployment of highly professional librarians who must have solid fundamentals in certain fields and certain foresight [9].

2.1 Capacity for Rapidly Accepting New Things

The core of university libraries' innovation services based on maker spaces is guiding and assisting college students' innovation activities. Librarians in maker spaces must not only maintain new equipment but also correctly guide users in tool usage and guide them to apply new knowledge, technologies, and tools in

the innovation process. Compared with traditional services, services based on maker spaces require librarians to continuously update concepts and learn new knowledge and technologies to provide effective help to users. Therefore, in the maker space environment, librarians must have an open consciousness, keen perception and understanding of new things, be willing to accept and learn fresh things, and have the ability to rapidly accept them.

2.2 Communication and Coordination Ability

University library maker spaces are built against the backdrop of school "double innovation" education, serving as platforms for spreading maker concepts and cultivating "double innovation" literacy and skills for college student readers. In this platform, librarians are the bridge between the library and the outside world [10]. On the one hand, in the process of embedding support for innovative research services, librarians need to communicate deeply with makers to accurately understand user needs and provide precise services. On the other hand, librarians' knowledge reserves and professional capabilities have limitations, and services such as lectures, salons, training, and information consultation need to invite industry experts for help and guidance, which also requires librarians' communication and coordination with makers. Good communication and coordination abilities help maker spaces play a more effective role in college students' "double innovation" practice.

2.3 Information Mining Ability

As the literature and information center of universities, the main function of university libraries is to provide information services for teaching and research, making information resource guarantee the foundation of library services. With the rapid development of digital technology, information types and forms are increasingly abundant, and information resources are growing exponentially. Faced with massive data, traditional management models and means are powerless. The need for deep-level information services requires librarians to have strong information mining abilities to help users conduct deep-level mining among large amounts of disordered information in various forms and formats, analyze the relationships between various types of information, and obtain the most effective information. Therefore, besides mastering data mining theories and principles, librarians should also understand or even be familiar with the properties and characteristics of data analysis software and tools such as SPSS, EXCEL, STATA, and EVIEWS, provide suggestions for data storage and analysis for different categories and scales of data, and help users select appropriate tools. Only with strong information mining abilities can librarians discover, organize, and integrate relevant information resources according to user needs in makers' innovation practices, provide convenient one-stop information access, and provide strong information resource guarantees for users' "double innovation" practice.

2.4 Data Management Ability

With the rise of the "fourth research paradigm" known as "data-intensive science" [11], scientific data has become the most important academic information resource. Researchers need to collect, analyze, and store large amounts of scientific data during research, while also processing, sharing, and disseminating scientific data generated in their own research. Innovative research is an important component of "double innovation" education in universities, and library maker services need to face and integrate into the entire process of innovative research. With the in-depth development of big data utilization technology, new challenges have emerged for librarians, making data management ability one of the essential competencies for librarians.

In the process of innovation services, librarians need to master knowledge about data formats, metadata, management strategies, data lifecycle, data citation, and data publishing [12]. In services, on the one hand, they need to help makers complete data collection, analyze and evaluate obtained data, and assist makers in discriminating and preserving effective data. On the other hand, they must help makers store, manage, and reveal various resources generated in the practice process from creativity to reality, including project records, experimental data, courseware, secondary literature, social records, and achievement displays. They also need to analyze and evaluate the project process based on records and data [13], propose metadata outlines for various research projects, and help users extract and organize important information from text, images, audio, video, and digital information objects generated in projects, establishing relationships to make information storage, publishing, and sharing more efficient, thereby promoting academic exchange and dissemination.

2.5 Team Collaboration Ability

In the library transformation service environment, individual or small team activities can no longer meet user service needs. Library maker space services require the establishment of innovation service teams that emphasize complementary advantages on the basis of relatively concentrated work objectives, absorbing talents from multiple departments and disciplines to complement each other in knowledge acquisition, technical support, hardware maintenance, teaching cooperation, organizational planning, and age structure, enabling the team to achieve a synergistic effect of 1+1>2 [14]. Librarians in the maker space environment should have innovative consciousness and professional skills, integrate into innovation groups, and participate in innovation processes. They should not only guide users to improve scientific literacy but also serve as team coordinators with the ability to coordinate team internals, fully mobilize various advantages, and bring out each person's strengths; the ability to explore external cooperation resources and facilitate cooperation; and the ability to provide suggestions on team structure, mechanism establishment, and the selection and application of collaborative tools to enhance team efficiency.

3. Pathways for Enhancing University Librarians' Innovative Capacities

In the maker space environment, libraries provide makers with not only resources and space but, more importantly, librarian support for innovation services. The transformation from document services to knowledge services and the change in service models require librarians to continuously update their knowledge and skills. The enhancement of librarians' innovative capacities is both an external requirement to meet user needs and an internal need for librarians' self-improvement. Libraries must provide learning conditions for librarians and, based on systematic, practical, and collaborative principles, help librarians rapidly improve their innovative capacities through various methods such as training, on-site observation, self-directed learning, and case experience.

3.1 Skills Training

In the maker era, librarians cannot provide satisfactory services based solely on their original library and information science foundation knowledge. Librarians in maker space environments are like "general practitioners" who need to understand multiple disciplines including information technology, network technology, cutting-edge science and technology, intellectual property protection law, and management. Regarding the skills and technologies librarians need to master and the problems encountered in service processes, libraries can invite experts and scholars for specialized training, which is highly professional and targeted and can help librarians quickly master relevant knowledge and solve problems.

3.2 Immersive Experience

Maker spaces are places where makers use new technologies and tools to transform creativity into reality. Only through close contact with these new technologies and tools can intuitive understanding and deeper knowledge be gained. Therefore, guiding librarians should be provided with more opportunities to "go out," such as attending new technology release conferences, new product exhibitions, and visiting commercial maker spaces or maker spaces in other universities to experience service characteristics, broaden horizons, enhance concepts, access broader technologies, and improve librarians' innovative service capabilities.

3.3 Self-Directed Learning

While organizing librarians to learn new technologies, libraries should also emphasize librarians' self-directed learning. Libraries can establish corresponding incentive mechanisms, encourage librarians to participate in short-term training during spare time, take MOOC courses, follow information on maker space websites, relevant technology forums, blogs, and WeChat platforms, understand the

latest technology trends through multiple channels, continuously update their knowledge reserves, and contribute ideas for library maker space services.

3.4 Innovation Practice

Libraries can establish research projects targeting the content and objectives of skill enhancement for maker space service librarians, encouraging librarians to use practice to drive theoretical learning. Project research involves establishing research objectives, analyzing, researching, and solving problems. In the process of researching and solving practical problems, librarians can deeply understand core principles, experience the application of key technologies, accumulate experience, and put it into practice. Theory exploration based on practice undoubtedly promotes librarians' digestion and absorption of new knowledge and helps them master new skills.

3.5 Team Collaboration

Libraries can form different interest groups or teams based on librarians' interests and hobbies. When planning and implementing maker service projects and activities, team members can brainstorm, divide labor, cooperate, and jointly participate in solving various problems. This method can effectively mobilize team members' enthusiasm, stimulate innovative service passion, and provide opportunities for team members to develop personalized service capabilities. At the same time, the learning effects generated from team discussions, salons, and brainstorming activities far exceed individual learning effects.

3.6 Practical Exercises

Librarians' personal participation in practical service activities is one of the effective ways to rapidly improve innovative service capabilities. The user-facing service process tests the effectiveness of librarians' professional skill learning and examines their comprehensive application abilities of various business skills in maker activity services. Maker space service cases can be considered real-world training. Only when facing users and makers' needs can librarians' professional skills be more clearly tested in terms of their role in meeting user needs and satisfaction levels, clarifying their own deficiencies and improvement directions in professional knowledge, skills, and service abilities, thereby achieving self-training and enhancement.

Conclusion

The New Media Consortium's *Horizon Report: 2016 Higher Education Edition* lists maker space construction as a mid-term technology among six educational technology development directions that will significantly impact education in the next five years [15]. Maker space construction is not just about possessing

high-tech equipment but about supporting students' personalized inquiry and promoting collaborative learning, knowledge sharing, practical problem-solving, and creative idea implementation. Simultaneously, maker spaces have become a new hot topic in library innovation development. In future development, university librarians must continuously learn new knowledge and skills, enhance their innovative service capabilities in the maker environment, and transform themselves into new roles such as knowledge providers, technical supporters, hardware maintainers, and teaching partners. Only then can they provide satisfactory services for users' innovation and entrepreneurship practice and offer effective support for library transformation and space services.

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The Function and Ability Improvement of University Librarians Under the Environment of Maker Space

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Abstract: [Purpose/significance] By analyzing the supporting and ensuring roles university librarians should play in the maker space environment, we clarify the innovative service capabilities and requirements librarians should possess, and propose corresponding suggestions for effective ways to improve librarians' innovative ability. [Method/process] Based on analyzing the support services librarians need to provide, we summarize the necessary service abilities of librarians based on maker demand. [Result/conclusion] In the maker era, the change of library service mode requires librarians to constantly enhance service abilities such as quickly accepting new things, communication and coordination, information mining, data management, and teamwork. Only when librarians constantly update their knowledge and improve their service ability can we effectively protect users' interdisciplinary collaborative learning needs.

Keywords: maker space; librarian; ability improvement

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