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Research on the Operational Model of Shenzhen Library Makerspace: Postprint

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Abstract

[Purpose/Significance] This study takes the series of maker activities conducted in the maker space of Shenzhen Library as a case study to explore the operational model of public library maker spaces, aiming to provide theoretical guidance and methodological references for public libraries to develop maker space services. [Method/Process] By investigating the service positioning, target audience, service support, service content, cooperation models, and management mechanisms of Shenzhen Library's maker space, this paper examines the operational model of public library maker spaces. [Results/Conclusion] For public library maker spaces to implement maker education and services, they should clarify service positioning and provide targeted services; integrate STEAM (Science, Technology, Engineering, Art, Mathematics) education to develop an interdisciplinary maker education curriculum system; and introduce social capital to promote the public-private partnership (PPP) model.

Full Text

Preamble

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Research on the Operation Model of Shenzhen Library Maker Space
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Abstract

[Purpose/Significance] This paper examines the series of maker activities conducted at Shenzhen Library's maker space as a case study to explore the

operation model of public library maker spaces, aiming to provide theoretical guidance and methodological reference for public libraries developing maker space services. **[Method/Process]** Through investigating Shenzhen Library's maker space service orientation, target audience, support resources, service content, cooperation models, and management mechanisms, this study explores the operational model of public library maker spaces. **[Result/Conclusion]** To develop maker education and services, public library maker spaces should clearly define their service orientation and provide precise services; integrate STEAM (science, technology, engineering, art, mathematics) education to develop interdisciplinary maker education curriculum systems; and introduce social capital to promote public-private partnership (PPP) models.

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Since the 18th National Congress of the Communist Party of China, the country has emphasized adhering to the path of independent innovation with Chinese characteristics, implementing an innovation-driven development strategy, and building an innovative nation. The 2015 Government Work Report explicitly stated that promoting “mass entrepreneurship and innovation” would become the new normal for economic development. Subsequently, the implementation of guidelines and plans such as the “Guiding Opinions of the General Office of the State Council on Developing Maker Spaces to Promote Mass Entrepreneurship and Innovation,” “Opinions of the State Council on Vigorously Promoting Policies and Measures for Mass Entrepreneurship and Innovation,” “Guidelines for Developing Maker Spaces,” and “Implementation Plan for Deepening Reform of the Science and Technology System” has further stimulated the enthusiasm and potential for mass entrepreneurship and innovation. Various types of maker spaces have been established, with 1,337 maker spaces receiving national certification from the Ministry of Science and Technology by December 2016 [1].

As public cultural service institutions, libraries bear the mission of disseminating knowledge and inheriting human civilization, as well as the historical responsibility of promoting knowledge innovation and social progress. To adapt to the trend of mass entrepreneurship and innovation, public libraries should also attempt to build maker spaces to provide platforms and corresponding services for innovators and entrepreneurs. Shenzhen Library has not only improved service efficiency through technological innovation, such as its independently developed light-pen circulation system, ILAS system, and RFID-based “intelligent document management system,” but has also continuously attempted space reengineering to expand services and lead trends, creating the “South Study Room” classic reading space to promote humanistic, classic, and deep reading, while newly establishing a “maker space” to cultivate imagination, creativity, and collaborative problem-solving abilities. Since its opening on April 23, 2016, Shenzhen Library's maker space has held various maker education activities for two consecutive years, which have been well-received by parents and

young people. This study takes Shenzhen Library's maker space as an example to examine its series of maker activities, analyzing its service orientation, target audience, support resources, service content, cooperation models, and management mechanisms to explore the operation model of public library maker spaces, providing theoretical guidance and methodological reference for public libraries developing maker space services.

1 Theoretical Research and Practical Exploration of Public Library Maker Spaces

1.1 Theoretical Research

Theoretical research on public library maker spaces primarily involves concepts, origins, value and significance, and construction strategies.

1.1.1 Concept of Maker Space

M. Bretkopf considers maker spaces as innovative spaces that can bring together people with creative inspiration [2]; Li Hongpei [3] defines maker spaces as places that provide makers with materials, tools, and technology to gather and complete projects; Luo Bo [4] points out that maker spaces are creative spaces that bring people together to create and share ideas about making; Tao Lei [5] believes the concept of maker space encompasses three dimensions: environmental, spiritual, and functional; Qu Yun [6] states that maker spaces are gathering and incubation places for “makers” and “maker culture,” providing professional shared, practical, and display spaces for makers to exchange ideas, inspire innovation, realize creativity, and showcase creations.

1.1.2 Origin of Maker Space

D. Dougherty, founder of *Make* magazine, notes that maker spaces originated from maker workshops established in 2006 for readers to exchange ideas and share knowledge [7]; Luo Bo [4] states that the prototype of maker spaces came from Hackerspace, a derivative of DIY that emerged around 2005; Kong Xianghui [8] argues that the world's first maker space was the Chaos Computer Club in Berlin, Germany, established in 1981.

1.1.3 Value and Significance of Public Library Maker Spaces

I. Fouré [9] believes that library maker spaces can effectively stimulate and apply creative ideas, becoming shared spaces for creating and disseminating new knowledge, experiences, and entrepreneurial spirit; Wang Min [10] points out that maker spaces are significant for fully leveraging library functions, innovating library services, promoting library knowledge management, and changing librarian roles; Kong Xianghui [8] believes that public library maker spaces can promote domestic innovation activities and have far-reaching impacts on the national strategy of building an innovative country; Liu Fang [11] notes that maker spaces help public libraries achieve transformation; Du Wenlong et al. [12] believe that maker spaces can generate considerable social and economic benefits.

1.1.4 Strategies and Recommendations for Public Library Maker Space Construction

C. Benton [13] points out that libraries should introduce appropriate resources according to their own needs and positioning, and adjust, supplement, and improve them as maker projects develop; Li Hongpei [3] notes the need to develop comprehensive service strategies, establish sound guarantee mechanisms, and emphasize librarian training; Tang Xiaoyang [14] suggests strengthening multi-party cooperation, reshaping human resources, emphasizing experiential design, and building diversified, multi-level maker space service systems; Wang Peipei [15] believes that cooperation between government and social capital is the future development path for public library maker spaces; Wang Juanjuan [16] proposes that public libraries should combine social forces and conduct cross-border cooperation when developing maker spaces.

1.2 Practical Exploration

Maker spaces have become a hot topic in the library field, with public libraries worldwide building maker spaces and developing maker space services. The Fayetteville Public Library in the United States established a maker space providing 3D printing services, becoming the first public library in the U.S. to create a maker space; the Chicago Public Library's Maker Lab provides equipment such as design software, laser cutters, and CNC lathes for workshops and innovative project development; the Edge maker space at the Queensland State Library in Australia focuses on experiments and projects in programming and development, video and audio production, and design and manufacturing; the Melbourne Docklands Library maker space serves as a place for communication, learning, creation, and exploration; the Victoria Park Public Library has moved toward a maker community through information exchange, discussion meetings, and community participation; the Oslo Public Library in Norway has opened a small maker space for the public called Folkeverkstedet (People's Workshop). Shanghai Library's "Innovation Space" is China's first public library maker space, providing makers with learning tools, information services, and creative innovation platforms; Changsha Library's "New Triangle Maker Space" provides services such as creative production, training, experience, and exhibition; Chengdu Library's "Reading and Creation Space" integrates creative ideas, information retrieval, competitive intelligence provision, and information exchange to serve innovation and entrepreneurship; Shenzhen Library's maker space is a creative reading space that integrates "learning, exploration, and mind expansion."

1.3 Research Review

Overall, since maker spaces originated abroad, foreign public library maker spaces lead in practical exploration, with numerous spaces and relatively mature operation models. In contrast, domestic public library maker spaces started later, with fewer spaces, weaker service capacity, and no well-formed operation

models. Theoretical research on public library maker spaces is limited, focusing mainly on concepts, origins, value significance, and strategies, lacking depth and breadth, and missing systematic studies on operation models including service orientation, target audience, support resources, service content, cooperation models, and management mechanisms. Therefore, this study selects Shenzhen Library's maker space series activities to analyze its operation model, hoping to provide reference for domestic public library maker space practice.

2 Operation Model of Shenzhen Library Maker Space

2.1 Shenzhen Library Maker Series Activities

To comprehensively investigate Shenzhen Library's maker series activities and accurately reveal its maker space operation model, we obtained information about Shenzhen Library's maker activities from January to December 2017 through website visits, WeChat public account monitoring, and telephone consultations, as shown in Table 1 .

2.2 Operation Model

2.2.1 Service Orientation

Under the national innovation-driven development strategy, promoting mass entrepreneurship and innovation has become the new economic normal, with maker spaces gradually covering e-commerce, intelligent hardware, finance, healthcare, social networks, and other fields. Public libraries, with their advantages of spacious facilities, rich document resources, professional technical staff, and diverse personalized services, have become favored by makers. Establishing maker spaces in public libraries can both extend and expand services and enhance the library's social image. Facing different maker needs, public library maker spaces should have accurate and clear service positioning. As important social and cultural education institutions, libraries shoulder the task of scientific and cultural education. Therefore, public libraries can integrate education and innovation to conduct creative activities with different themes, stimulating various creative ideas, developing intellectual software and games, practicing gamified education, designing interactive and interesting creative classrooms, and forming innovative education curriculum systems [1]. As an important component of the public cultural service system, public libraries should provide spaces, educational equipment and resources, and educational teams to conduct maker education and services for young people, stimulating their imagination and creativity.

Domestic public libraries have already begun practical explorations of maker education and services for young people. For example, Chengdu Library's Reading and Creation Space has conducted Maker Gatherings and "I Am a Maker" activities for primary and secondary school students aged 4-16; Guangzhou Library regularly holds "Reading and Creation Space • Little Maker" series activities for minors aged 3-18; Yunnan Provincial Library has held "21-Day Little Maker

Growth Show” themed activities for young readers. As shown in Table 1, as a public cultural service institution, Shenzhen Library effectively combines school education with social education, focusing on maker series activities for young people to cultivate innovative thinking and improve hands-on operation abilities. The “Scratch Programming” maker series co-hosted by Shenzhen Library and CodePlay Learning Education Technology Company has certain requirements for computer operation, targeting young people aged 8-14 with basic computer skills; the maker series co-hosted by Shenzhen Library and New Oriental Online has no knowledge prerequisites, allowing young people aged 6-14 to participate.

2.2.3 Support Resources

“Space” is an essential condition for public libraries to provide maker education and services—without “space,” there is no venue for innovation activities. To align with its maker space service positioning, Shenzhen Library has reconfigured its building space, transforming the fourth floor into four distinct areas: creative design and production, creative works display, research and learning, and discussion and exchange. These four areas are both relatively independent and interdependent, meeting the entire process needs of maker education from creative incubation to realization through literature resource searching for creative breakthroughs, creative exchange to form problem solutions, creative display to gain design inspiration, and design production to achieve creative realization.

To guide young people in creative design and product production, public libraries must be equipped with relevant operation tools and equipment, and provide corresponding information resource support. To adapt to maker education curriculum design and overall educational planning, Shenzhen Library has equipped itself with tools such as 3D printers, micro machine tools, Scratch programming software, and Makey Makey kits, providing literature resources on creative production and 3D printing, as well as over 50 databases of electronic resources including Tianwen Children’s Intelligence Audio-Visual Library and Software Guide.

2.2.4 Service Content

The “Action Plan for Revitalizing Education in the 21st Century” requires comprehensively promoting quality education to improve national quality and innovation capabilities. The “Decision of the Central Committee of the Communist Party of China and the State Council on Deepening Education Reform and Comprehensively Promoting Quality Education” clearly states that cultivating students’ innovative spirit and practical abilities is the key focus. The “National Medium- and Long-term Education Reform and Development Plan (2010-2020)” emphasizes improving students’ innovative spirit for exploration and practical abilities to solve problems. Therefore, public libraries fulfilling their social education functions should also implement quality education to cultivate innovative spirit and hands-on practical abilities.

Public libraries establishing maker spaces conduct project-based inquiry learning maker education, with students’ independent inquiry and hands-on creation

at the core, striving to cultivate innovative spirit and problem-solving abilities, gradually becoming a new approach for cultivating innovative practical abilities and quality education reform. Under the background of the national innovation-driven development strategy and building an innovative country, STEAM education focusing on science, technology, engineering, art, and mathematics, which emphasizes connections between the real world and learning and hands-on experience in the learning process, has gradually gained popularity in maker education and integrates with it. As shown in Table 1, Shenzhen Library's maker series activities for young people continuously integrate STEAM curriculum content. Activities such as "Electronic Magic Hundred-Pieces - Caterpillar," "3D Projection Lamp," "3D Popsicle," "Infinite Creativity - Mysterious Code," and "Basic Electronics - Escape from Danger" allow young people to learn robotics, 3D printing, physical electronic components, and artificial intelligence, cultivating their basic scientific literacy and experiencing the charm of high-tech and new technologies. Activities like "Scratch Programming - Electronic Band DIY," "Machine Tool - Cool Car Alliance," "Scratch Programming - Magic Brush," and "Machine Tool - Self-made Cabin" integrate music, engineering, art, and architecture into maker education, enabling young people to strengthen cultural and artistic literacy while learning simple programming and micro machine tools, achieving the integration of humanities and engineering, and art design with engineering technology.

2.2.5 Cooperation Model

The "Opinions on Accelerating the Construction of a Modern Public Cultural Service System" encourages and supports social forces to participate in public cultural service system construction through investment or donation of facilities and equipment, and provision of products and services. The "Public Cultural Service Guarantee Law of the People's Republic of China" encourages and supports citizens, legal persons, and other organizations to participate in public cultural services. The "Guiding Opinions on Promoting Public-Private Partnership Models in Public Service Fields" requires promoting PPP models in public service fields to attract social capital participation in public product and service project investment and operation management, improving the supply capacity and efficiency of public products and services. The "Notice on Further Promoting Public-Private Partnership in Public Service Fields" requires further promoting the transformation of public services from government supply to cooperative supply and from single investment to diversified investment, practicing supply-side structural reform in public service fields.

Public libraries conducting maker education and services for young people face problems such as shortage of educational personnel, unreasonable teaching process design, and non-systematic curriculum content, urgently needing active participation from maker groups, social organizations, or individuals to implement government-social capital cooperation models. As shown in Table 1, all maker series activities held by Shenzhen Library in 2017 were co-hosted with social organizations such as CodePlay Learning Education Technology Company and New Oriental Online, relying on their professional education teams, online

and offline educational resources, and rich educational training experience to provide maker training teachers, design curriculum content systems, and complete training for hands-on practical abilities and innovative thinking. This can not only improve public library service efficiency and meet the maker training needs of young people but also enhance the visibility and influence of social organizations.

2.2.6 Management Mechanism

Standardized management of activities helps reduce operational costs, improve activity efficiency, and ensure the achievement of established goals. Shenzhen Library has established standardized service management mechanisms to ensure the normal conduct and steady progress of maker series activities, mainly including: Clear activity themes and content: According to the overall planning of maker education and services, different themed maker series activities are formulated, such as “3D Projection Lamp” to learn physics knowledge like light and shadow, and “Printing Pen - Various Forms of Bridges” to reflect bridge architectural styles; Flexible session arrangements: Since each activity has different curriculum designs, equipment and venue requirements, and participant scheduling considerations, different sessions are arranged for the same theme; Internet + registration method: To adapt to mobile Internet, all maker series activities use online registration through library website login and WeChat public account subscription; Strict management system: Adhering to the principle of maximizing benefits while ensuring fairness, participants who register but accumulate two violations will be disqualified from activities.

3 Recommendations for Public Library Maker Space Operation Model

3.1 Clarify Service Orientation and Provide Precise Services

The national innovation-driven development strategy encourages everyone to innovate, making mass entrepreneurship and innovation the new economic normal. To adapt to this new normal, public libraries should build maker spaces and develop maker space services. Based on overall planning, construction models, and target audiences, public library maker spaces can be positioned to support entrepreneurship, project development, and maker education.

To alleviate employment pressure and support college student entrepreneurship, public library maker spaces should provide college students and graduates with services such as entrepreneurship experience sharing, market prospect forecasting, financing channel expansion, and intellectual property protection to solve problems from creative incubation to project development and product creation, realizing the transformation from creativity to entrepreneurship.

To address project innovation and development, public library maker spaces should provide space resources, software and hardware resources, and information resources for individual, group, and organizational maker enthusiasts to

facilitate information exchange and sharing of innovative experiences, and conduct cooperative development for specific projects.

To fulfill social education functions and conduct maker education, public library maker spaces aim to cultivate innovative thinking and improve hands-on practical abilities and problem-solving skills. The cultivation of innovative thinking and abilities should start from childhood—that is, from young people. Therefore, public library maker spaces should target young people, equip professional teaching teams, formulate maker education curriculum systems, develop maker education courses, and conduct maker education series activities. Shenzhen Library’s maker space is positioned to provide maker education and services for young people, conducting maker series activities.

3.2 Integrate STEAM Education and Develop Interdisciplinary Maker Education Curriculum Systems

Building an innovative country requires promoting educational innovation and integrating scientific spirit, innovative thinking, and creative abilities throughout the entire education process. STEAM education encompasses multidisciplinary knowledge of science, technology, engineering, art, and mathematics, integrating the spiritual connotations, values, and practical activities contained in different disciplines to meet the requirements of educational innovation. Therefore, public libraries building maker spaces and conducting maker education and services for young people should strive to integrate STEAM education and develop interdisciplinary maker education curriculum systems.

The integration of maker education and STEAM education involves two aspects: first, cultivating young people’s STEAM literacy through maker education, with the goal of cultivating interdisciplinary application talents by solving practical problems; second, conducting maker education with the help of STEAM concepts, with the goal of cultivating innovative individuals through creation [17]. Maker education in public library maker spaces should utilize the project-based education model to integrate knowledge content from different disciplines, design project-based or problem-based learning curricula, develop interactive and interesting classrooms, and encourage young people to design, operate, “learn through play,” and “create through play” activities through hands-on practice, stimulating their imagination and creativity, improving practical abilities and problem-solving skills, while simultaneously enhancing comprehensive STEAM literacy in science, technology, engineering, art, and mathematics. Through designing a series of project-based training activities focusing on Scratch programming and 3D printing, covering knowledge content from different disciplines such as physics, engineering, music, art, and mathematics, Shenzhen Library’s maker space improves young people’s hands-on abilities and innovative capabilities.

3.3 Introduce Social Capital and Promote PPP Models

As public cultural service institutions, public libraries should actively respond to national policy requirements, introduce social capital, promote PPP models, achieve transformation from single supply to multi-party supply and from single investment to diversified investment in public cultural services, promote supply-side reform in the public cultural service field, and form a new normal of social capital assisting public library development.

Public libraries building maker spaces can solve funding shortages by introducing social capital investment or donations of facilities and equipment; they can improve maker space service supply and operational efficiency by providing products and services. Public libraries should consider the positioning of maker spaces, carefully select social capital, and develop maker space services that adapt to the development of both maker spaces and social capital to achieve refined, diversified, and specialized service methods. When reengineering its space, Shenzhen Library introduced social forces to jointly build multiple new service spaces [18], accumulating successful experience in government-social capital cooperation models. The construction of Shenzhen Library's maker space also introduced social capital such as CodePlay Learning Education Technology Company and New Oriental Online, relying on them to provide products and services, conduct maker education series activities, and improve maker education levels and operational efficiency of maker spaces.

To build an innovative country and respond to the call of “mass entrepreneurship and innovation,” public libraries should consider institutional reorganization and space transformation, build maker spaces, provide equipment and tools resources based on clear service positioning, introduce social forces to jointly establish maker service teams, provide services and activities such as maker training, creative product exhibitions, and maker competitions for innovators and entrepreneurs, improve innovation capabilities, and further promote social progress. The successful operation of Shenzhen Library's maker space can provide reference and lessons for public library maker space construction and services. Future research will continue to track maker education and services in public library maker spaces, using qualitative and quantitative methods to conduct empirical performance evaluations.

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Xie Shoumei: Responsible for paper conception, writing, and revision;
Nie Wen: Responsible for literature collection and organization;
Zhao Wenjun: Proposed research direction and paper structure formulation.

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Keywords: maker; maker space; operation mode

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