Research on Cooperation between the Academic Library and Research Team: Taking the Life & Medical Sciences Subject Team of Shanghai Jiao Tong University Library as an Example

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Abstract:

Under the ubiquitous knowledge environment, academic libraries are developing cooperation in the entire knowledge creation lifecycle. The Life & Medical Sciences subject team of Shanghai Jiao Tong University Library (LMSST) has extensively executed its subject services since 2008 and built a good relationship with the research teams. This paper deeply expounds three cooperation modes driven by needs as follows: 1) Micro level: Subject librarians focus on individual information literacy (IL) capacity and provide information literacy improvement supports, students, teachers and researcher's partners-enterprise employee were included as the training targets; Case 1: Cooperate to hold the "Big Data Training" summer camp, combine the research direction, cultivate research teams data awareness, data usage skills and data mining ability; Case 2: Provide information literacy supports for Innovation Alliance of Nano-medical Diagnostic Technology. 2) Meso level: Subject librarians embedded information service in the research project as the role of "information worker". Case 3: Subject team integrated into Metabolic Science Discipline Development Strategy Research Group, assist the researchers that study in the new discipline to fully grasp the discipline situation. 3) Macro-level: Subject librarians support managers of research team to make decision based on scientific intelligence analysis. Case 4: Pharmacological and Toxicological Contribution Analysis Report of

ESI in the school of Pharmacy. This paper aims to provide a reference for the cooperation between academic libraries and research teams.

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1. Introduction

In the ubiquitous knowledge environment, the emergence of large amounts of open access resources has changed behavior and expectation users acquire information during teaching, research and learning process. The traditional role of libraries as physical books and journal repositories is rapidly disappearing. Libraries gradually shift their strategic emphasis from collections to services (or collections as one service), and provide a diversity of services to support teaching, learning and research, and even become user partners (Attis & Koproske, 2013; Pinfield, Cox, & Rutter, 2017).

The Life & Medical Sciences subject team(LMSST) develops subject services with a cooperative concept. Since 2008, it has established a diversified partnership with the department. LMSST is one of the twelves subject teams of Shanghai Jiao Tong University Library, which provide subject services for the School of Life Science and Technology/Pharmacy/Biomedical Engineering, Shanghai Center for Systems Biomedicine and Bio-X Institutes. The team consists of a subject librarian (master of microbiology, with more than 8 years of experience in subject services) and two subject counselling librarians (master of library information and master of pharmacy). In addition to basic faculty contact, reference consultation, and subject resource construction, LMSST has also carried out extensive information literacy education, including rolling training, credit courses, embedded instruction, special workshops, information specialist training, etc. In addition, the subject service team provides service for the whole research lifecycle: 1) In the project application stage, provide literature research, project novelty retrieval and other services as needed; 2) In the research stage, provide information retrieval, document push, project tracking, and situation analysis in the field of scientific research on demand; 3) In the output stage, provide assistance in the production of results through IL training such as academic paper writing and submission guidelines. Besides, LMSST provides the service for decision support, including subject orientation analysis, talent evaluation, and discipline situation analysis.

LMSST has carried out multi-level and multi-angle cooperation with research teams in the process of providing user-oriented services. Regarding the cooperation objects and contents, the cooperation modes can be divided into three levels: micro, meso and macro (see Figure 1). Firstly, at the micro level, LMSST pays attention to individuals in the research team, including students, teachers, and enterprise partners, and aims to enhance team members' ability to solve information problems in research. Secondly, at the meso level, LMSST directly participates in the research lifecycle by embedding services into a specific research project, and supports research through professional information knowledge management. Thirdly, at the macro level, from the perspective of research team overall development, LMSST supports management decision-making with various types of intelligence services, and supports the research team in research cooperation, talent team construction and other services as needed. Through multi-level, multi-angle and all-round service and cooperation, LMSST and the research team have built trust and strengthened the cooperation relationship.

This paper analyzes the modes and process of cooperation between academic librarians and research teams under current circumstances through the multi-case study method.
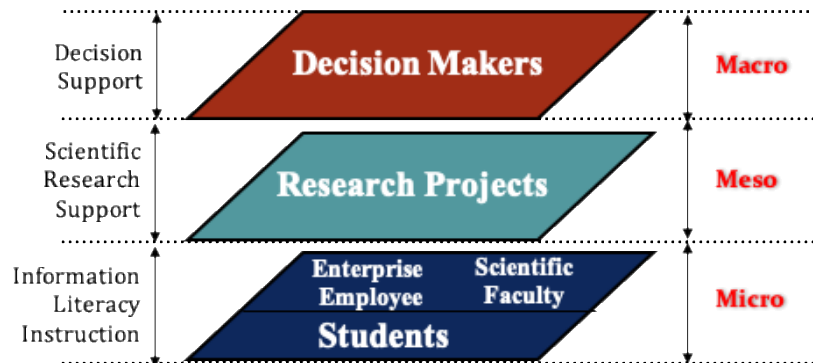

Figure 1 Multiple Dimensions Cooperation with Research Teams

2. Literature Review

In the rapidly changing environment, one strategy for libraries to remain vibrant is to establish a good partnership with users and embed their expertise into the teaching, learning and research process. Academic librarians are developing cooperation in the entire knowledge creation lifecycle, including academic communication, copyright protection, open access, data management, information literacy (IL), etc.

Academic librarians' cooperation with faculty to embed the IL skills into the curriculum has been well developed. This approach has been encouraged by regional accreditation agencies in the United States. Those agencies pointed out that academic librarians need to change the established teaching model from teaching students the way of locating specific resources to integrating library instruction and research methods into course syllabi and content in cooperation with faculty (Thompson, 2002). A great deal of literature in the field covers English composition instruction and a series of "one-shot" or individual lectures (Mounce, 2009). Gradually, the teaching form has developed into different forms like stand-alone credit course, course-related instruction and course-integrated instruction. Among them, course-integrated instruction is generally considered to be the most effective way to achieve the course objectives (LaGuardia, 2012; O'Connor, Bowles-Terry, Davis, & Holliday, 2010), which enables students to acquire IL while accepting resource-based, problem-driven and inquiry-based learning through the full participation in professional courses of librarians. In addition to personally entering physical classroom and participating the course design and teaching (Manus, 2009), many librarians focus on cooperating with faculty to embed information support services in the teaching environment through virtual platforms. For example, the library from college of Staten Island, the City University of New York, makes use of *Blackboard* to embed IL components and course-specific library resources into *NRS 110: Medical, Surgical Nursing* course (Xiao, 2010).

In addition, libraries of research institutions are actively seeking opportunities to cooperate in research with faculty. It can be found that more and more librarians work directly with researchers as research team members or partners. For example, academic librarians of

Purdue University identify the specific needs of teachers for data management, then apply information science to teachers' research projects to develop relationships with teachers (Brandt, 2007; Carlson & Kneale, 2011). The University of British Columbia librarian joins the NewGIT team to provide professional services throughout the knowledge development and dissemination process, including dealing with issues related to copyright agencies and open access policies for funding agencies (Janke & Rush, 2014). An information specialist at the Louise M. Darling Biomedical Library at the University of California–Los Angeles (UCLA) embedded into the research process, providing data management, repository, and other information guidance to improve the team's research output (Federer, 2013). Librarians keep creating value for the team by using their own expertise and skills.

While academic librarians are playing new roles, there is a lag in the perceptions of disciplinary faculty on how librarians can become research partners as well as service providers. Typically, disciplinary faculty view librarians as professionals who provide resource support for their research and teaching. Under the unbalanced perceptions inside and outside the library, how to set the role and future development of academic librarians is an issue that libraries are actively exploring.

3. Research design and method

3.1 Research methods

This paper adopts the method of multi-case study. Case study is a commonly used qualitative research method, which combines practice to study one or several typical cases, reveal their attributes and discover the general law. This method can comprehensively and systematically explain the research questions, and is especially appropriate for answering the questions of how academic librarians and research teams cooperate in the real-life. It has been used in library and information science research (Federer, 2013; Janke & Rush, 2014). Compared with single case study, multi-case study can collect valuable information from multiple perspectives and dimensions by comparative analysis. Therefore, this paper attempts to use multi-case study method to explore how academic librarians cooperate with research teams according to different cooperation objects and contents.

3.2 Case Selection

This paper studied four cases from LMSST which has established a diversified partnership with the research teams or institutions. One or two typical cases were selected from each cooperation modes of micro, meso and macro. Considering that there are research team members with different characteristics and demands, this paper selected two cases at the micro level in particular. Table 1 describes the case object, cooperation content and cooperation modes.

Table 1 Cases of LMSST Collaboration with Research Teams

Case	Modes	Objects	Content
1	Micro-level	Master/Doctoral Students	Data literacy
2	Micro-level	Members of the Industry-University-Research alliance (including students, teachers and enterprise employee)	Information literacy
3	Meso-level	Research Project	Information service
4	Macro-level	Managers	Discipline analysis, decision support

3.3 Case collection and analysis

Four cases were summarized from the subject service practice of LMSST. The qualitative analysis was conducted through reflective description and analysis of cross-case content. We identified cooperation pattern and process in the cooperation cases.

4. Cooperative practices with the research teams

4.1 Case 1: Embedded instruction in the "Big Data Training" summer camp

As a vibrant group in the research team, doctoral postgraduates have high-level needs in improving personal information quality and research ability. In 2012, the American Research Library Association (ARL) published a report titled "New Roles for New Times: Research Library Service for Graduate Students", pointing out that, unlike undergraduates' basic information literacy training, post graduate students should pay more attention to the training of scientific research methods and using special tools, including data analysis and processing.

In the current context of data-intensive scientific research, the demand for data literacy is increasing. Especially in the field of life sciences, biological pathway analysis, metabolomics, genomics, proteomics and other research processes are constantly combined with big data. In this context, the library cooperated with Graduate Union of School of Life Science and Technology to organize the "Big Data Training" summer camp.

Before the training camp started, LMSST had communicated with the head of the Graduate Union of School about the needs of students. After weighing the matching degree between their abilities and users' needs, the subject librarians contacted two librarians with big data analysis background in the library and designed a summer training camp plan. The course content has two aspects: data awareness and data processing and utilization. In data awareness, it helps students to establish a correct understanding of data and concepts based on the background of big data, applications in the field and data mining in the literature. In data processing and application, two data processing software Excel and Matlab are introduced in detail through a dozen of lectures. SimBiolog and Bioinformatics related to life sciences, as well as statistical and machine learning toolboxes, are introduced with examples. The training

not only provided special analysis for the field of life science, but also provided general solutions for broad scientific research.

The summer camp lasted for two weeks. In addition to the School of Life Science and Technology, it also attracted more than 100 students from the faculties of Pharmacy, Agriculture and Environment, etc. The training camp combines bioinformatics with data statistics, which provides a good learning opportunity for the students in the training camp. Through the big data training camp, the students not only realized the importance and value of data, but also got the ability to effectively use data processing software for study or participate in scientific research.

4.2 Case 2: Embedded instruction in Innovation Alliance of Nano-medical Diagnostic Technology

In addition to providing research support to research team of university, LMSST also extends its patron to the cooperative institutions both inside and outside the university. The Innovation Alliance of Nano-medical Diagnostic Technology is a university-enterprise alliance organization dedicated to the research and development of nanomedical diagnostic technology. In order to improve the information ability of the alliance members then promote scientific research and output, the librarians were asked to provide information literacy training.

The needs of alliance members are as follows: enterprise employee's need of the knowledge the relevant technical route, market, competitors and other information of a product design; students' and teachers' need of professional information retrieval, analysis and document management. Based on the needs above, subject librarians and team teachers designed a training plan, including biomedical resource guidance, Pubmed database, Endnote tool application, Innography database and cooperation mode with enterprises. Members attended relevant courses according to their needs. In terms of course content setting, according to the main research directions of students, teachers and enterprise employee, librarians customized search keywords and embedded case demonstration, such as selecting vitro diagnostic related topics for enterprise cases, selecting nano-materials related topics for students and teachers, deepening team understanding through examples, and improving training effectiveness. In terms of training employee arrangement, according to training needs, LMSST specifically invited librarians from other subject teams specialized in patent and Innography to form a training team.

The implementation of information literacy education embedded in research teams and their partners has achieved good results. According to the feedback of the participating researchers, they have acquired the information retrieval and information utilization skills, and accumulated experience for future research activities; from the feedback of the participating enterprise employees, they have not only learned the skills of obtaining medical information, but also mastered patent-related knowledge. Through Incopat database searching, LMSST found that 25 patents were applied by the research team after the training programs from 2014 to 2018, and 5 patents were transferred or transformed. Although this result is not the direct output of subject librarians, there is no doubt that the embedded training of information literacy of League members benefits team members on the scientific research output. This cooperation is not only the cooperation of subject librarians and research teams, but also the communication and cooperation between research teams and enterprise partners, and promote the industry-university-research cooperation.

4.3 Case 3: Integrated into Metabolic Science Discipline Development Strategy Research Group (MSRG)

The role of LMSST is not just the transmitter of products produced at the end of the research lifecycle, but also the co-operator working with researchers more "upstream" in the process.

On June 26, 2015, the Ministry of Life Sciences and Medical Sciences of the Chinese Academy of Sciences officially launched the research project of "Metabolic Science" discipline development strategy which is a project of the National Natural Science Foundation of China. Seven experts from Shanghai Jiao Tong University (SJTU) participated in this project and committed to putting forward a pioneering subject "Metabolic Science", and pointed out the future development direction of this subject. In July 2017, the School of Life Science and Technology proposed the need for situation analysis of the new discipline at the "College as Entity" demand research and exchange meeting. Since then, subject librarian of LMSST has joined the research team as information worker.

At the very beginning, the subject librarian communicated with the scientific research secretary on the needs of the project. The main issues included: the project background, the composition, and form of the analysis report content, and the keyword selection scheme. Afterward, subject librarians participated in research meetings and joined the discussion with research group members in the form of group reference consultation. At the same time, members of the research group provided detailed research materials to subject librarians and raised questions about information retrieval. Subject librarians answered specific problems on the spot. Then, subject librarians began to develop and test search strategies and make recommendations, regarding its sensitivity and specificity. For the project, this stage was critical as the concept of a newly "Metabolic Science" is somewhat amorphous. Therefore, the librarian and the expert members of the research group had a deep discussion on the related directions and fields. The subject librarian has microbiology background, which played a significant role. The whole process was the iterative process of developing inclusion and exclusion criteria. Also, subject librarians took the data acquisition and analysis in the direction of "metabonomics" as an example to demonstrate the process to team members.

The cooperation is the service customized for specific project research needs of users, and aims to solve practical problems of users. Though quantitative data of the value added to the research team by the librarian have not yet been collected, research members consider the librarian's involvement with the research team to be worthwhile.

4.4 Case 4: Pharmacological and Toxicological Contribution Analysis Report of ESI for the School of Pharmacy

In the process of scientific research, it is of great significance for librarians to support team managers to make decision for team development based on scientific intelligence analysis methods. LMSST is actively practicing in this field.

ESI is one of the important indicators to evaluate the development level of disciplines or universities. Under the circumstance that "World-class Disciplines and World-class Universities" construction has become China's national strategy, it is of great significance to monitor the development data of ESI disciplines in time and analyze the critical state disciplines. In March 2018, ESI released data showing that pharmacology and toxicology of SJTU entered the top 1/10th of 1 percent. In order to understand the current situation of the

development of the faculties and research teams in SJTU, the School of Pharmacy proposed the need for the discipline contribution analysis report.

Before carrying out intelligence analysis, members of LMSST first discussed the needs from the dean, the assistant dean and the head of the related research team. At the meeting, they discussed the research methods and data sources, reporting indicators, the criteria and responsibilities of the research team determination. After the meeting, the librarians worked out a reporting framework to further clarify the objective. After that, the librarians began to collect and clean the data. Cluster analysis method was adopted to study the contribution of the discipline with the two levels of the college and the research team. According to previous discussion, the scientific research secretary of the institute and LMSST jointly completed the determination of the research team. By using the academy's familiarity with the scientific research team and the ability of librarians in collecting information, the two sides jointly checked and improved the accuracy of research team division.

On July 19, 2018, LMSST completed the *ESI Pharmacological and Toxicological Contribution Analysis Report of Shanghai Jiao Tong University (2007-2017)*. The report mainly analyses the contribution of secondary institutions and research teams of SJTU in ESI pharmacology and toxicology from two aspects of academic output and academic influence, and might provide reference for disciplinary development, talent team building and institutional cooperation research.

5. Discussion

In examining research support conducted by LMSST, we saw three elements in the process of cooperation. First, every cooperation with research teams starts from the direct needs of users, which is attributed to the active role of liaison. LMSST has established a good relationship with the research team through constructing "department bases", visiting professor and training information specialists. It is necessary to mention the information specialists who are voluntarily selected from the research team to attend intensive short-term training programs from library so as to get information skills. They serve as bridges between research teams and libraries to make library services match the needs of research team. Second, to establish a service team that can meet the needs of users, LMSST members have professional backgrounds in discipline and information science, which facilitate the subject services, especially when embedding a specific research project. The discipline knowledge is conducive to reducing the gap between the librarian and the research team members and help to understand real needs. In addition, the cooperation with the research team requires high capability of librarian, however the strength of a person or a subject service team is limited. When the demand exceeds the scope of competence, the members of the subject service team must make full use of the strength of other librarians in the library, and even cooperate with experts in disciplines (e.g. data experts, multimedia production experts and experts in other fields), to form a team to improve the effectiveness of cooperation, such as the data training librarian in case 1 and the combination of patent knowledge experts and subject service teams in case 2. Third, collaboration varies in micro, meso or macro dimensions depending on the objects and contents to form a research support pattern that is fully spread from the individual-project-team development. In the case studies, we can observe the multi-dimensional cooperation of LMSST with the research team. At the micro level, we pay attention to the individual literacy needs of research teams, such as case 1 for data literacy training of doctoral students, and case 2 for medical and patent-related information literacy training of a cross-university-enterprise alliance. At the meso level, we focus on specific research projects, to assist research teams to complete research projects through professional

knowledge of librarians. For example, case 3, we embedded information worker into the MSRG as to assist the situation analysis of new disciplines. At the macro level, we focus on the overall development of the research team, such as case 4. Through the analysis of ESI discipline contribution and distribution by cluster analysis method, we provide development strategy suggestions for pharmacy institutes and relevant research teams. Figure 2 maps the understanding and experience with cooperation of LMSST and research teams. Finally, the process of cooperation is applying the expertise of both sides, librarians mainly making use of the collections and information science capabilities to provide services, not being an expert in disciplines. We present our ability and win the trust of the research team.
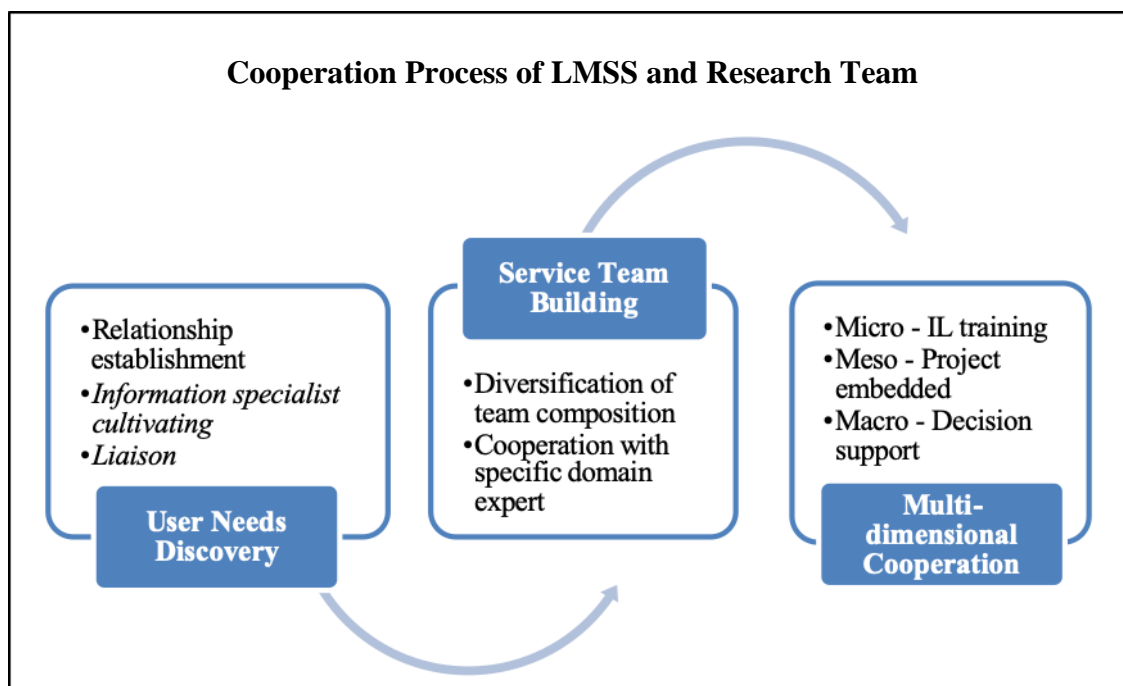

Figure 2 Cooperation Process of LMSS and Research Team

Future work of LMSST will be based on three dimensions of cooperation, trying to expand the scope of research support beyond our case studies, such as exploring the support of interdisciplinary research, introducing interactive teaching mode such as "flipped classroom" in the process of IL education, and strengthening the cooperation with research teams.

6. Conclusion

Under the ubiquitous knowledge environment, the role of academic librarians is rapidly evolving. LMSST has transferred its pattern from collection-centered to user-centered, focusing on need-driven service, and actively explores the appropriate method of supporting research. This paper puts forward a multiple dimensions cooperation model, which includes micro-level focusing on the individual accomplishment of the research team, meso-level embedding specific projects, and macro-level focusing on team development, and analyzes the cooperation process. We hope our framework of research support will provide some inspiration or reference for academic libraries to cooperate with research teams.

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