



# Development of a Data Literacy Education System for the New Generation of Librarians Based on the Mutation of Progression

Hui Liu<sup>1</sup>(✉) and Na Kang<sup>2</sup>

<sup>1</sup> Information Management, Jiangnan University, Wuhan, Hubei, China  
1743915381@qq.com

<sup>2</sup> Bioinformatics, Jiangnan University, Wuhan, Hubei, China

**Abstract.** As an important carrier of data literacy education, the university library is faced up with the big data age, from the university library talent structural crisis to the appearance of the new generation of librarians. This paper puts forward the concept of the new generation of librarians and analyses the present situation of the data literacy education among the new generation of librarians in university libraries. This paper also introduces the way to cultivate data literacy of the new generation of librarians and shows the important role that the new generation of librarians play in the data literacy education.

**Keywords:** Structural Crisis of talent · University Library · New generation Librarian · Data literacy education

## 1 Introduction

The era of big data has given libraries a new mission of data literacy education, and there is a lack of data literacy education talents in the existing personnel structure of Libraries in China. Therefore, it is important to actively cultivate a new generation of librarians to make them competent for this job.

## 2 The Structural Crisis of Library Human Resources and the Emergence of New Generation Librarians

### 2.1 Library Human Resource Crisis

At the beginning of this century, Huang Lianqing points out that there is a structural crisis of human resources in libraries in China. Specifically, there is a serious shortage of technical talents who can cope with the requirements of digitalization and networking in the library talent team of our country. Librarians with single skill structure account for the majority, and various types of composite talents who carry out high-level and high-quality information services cannot be timely satisfied [2].

The reasons for these phenomena are the “error” of the education department’s recognition of the professional nature of library science. At the same time, the professional ability of library practitioners in China is uneven, the fundamental reason is the lack of a unified entry threshold: library professional qualification certification system [6]. In the United States, it is unthinkable for a master of Library and Information Science without ALA accreditation to enter a library, that is, to get on the bus before buying a ticket.

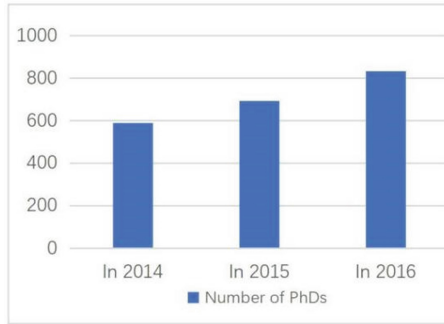
## 2.2 The Emergence of a New Generation of Librarians

The decision-making power of university library personnel lies not in the library director but in the president, who, considering the overall talent introduction plan of the university, arranges most of the personnel to the library to be relocated. From the beginning of this century, university library directors began to actively suggest and strive for the introduction of some master’s and doctor’s graduates to the various departments of the library. According to the Development Report of Chinese University Libraries (2014) (EB/OL 2015), the self-reported human resources of 644 university libraries were collected. There are 12,373 people with bachelor’s degree, 6,396 people with master’s degree and 596 people with doctor’s degree, the average number of doctor’s degree is 0.93 per museum, and the ratio of bachelor’s degree to master’s degree is 1.93 times. According to the general situation of the development of university Library in 2015 [9], the statistics of the human resources of 741 university libraries submitted data, the total number of librarians with doctorates is 695, but 488 university libraries have no librarians with doctorates. Although the total number increased by 99 from 2014, PhD librarians are still scarce in university libraries. The data also showed that the number of people with master’s degrees was 7,163, an increase of 767 compared with 2014. The ratio of the number of people with bachelor’s degrees and master’s degrees was 1.87 times, indicating that the number of people with bachelor’s degrees decreased while the number of people with master’s degrees increased [8].

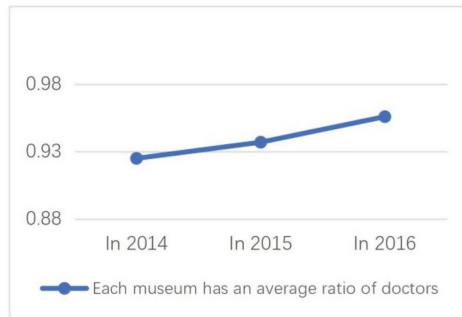
Then according to the general situation of the development of university library in 2016 [10], the statistics of the human resources of 872 university libraries which submitted data, the total number of librarians with doctoral degrees is 834, 139 more than that in 2015, the number of librarians with bachelor’s degrees is 16,101, and the number of librarians with master’s degrees is 8,687, a significant increase compared with last year. The total number of librarians with bachelor’s degrees is 1.85 times that of the total number of librarians with master’s degrees, and the ratio continues to decline. According to the above data, we use several intuitive charts to describe the trend of educational background change of university library staff from 2014 to 2016 (Figs. 1, 2, 3, and 4).

The following is analyzed by the data of the in-service librarians of Jiangnan University Library, and the total number of librarians in the library is 81, including 52 people below the undergraduate level, 26 masters and 3 doctors. Librarians who can undertake data literacy education work, 4 people below the undergraduate level account for 4.9% of the total number 22 masters accounted for 7.1% of the total number of people, accounting for 3.7% of the total number of doctors.

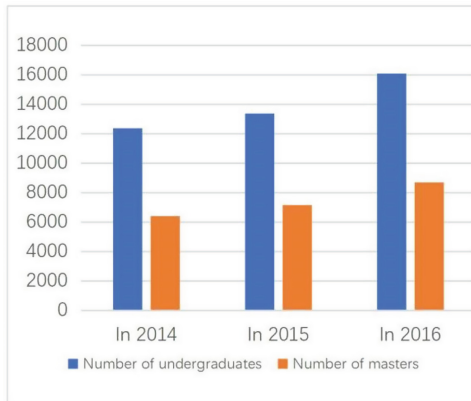
It can be seen that the master is the subject of the mutation of the new generation of librarians. However, in terms of job titles, 7.6% of those who can be qualified for data



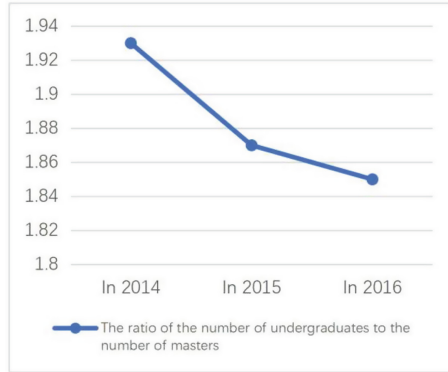
**Fig. 1.** Number of PhDs



**Fig. 2.** Each museum has an average ratio of doctors



**Fig. 3.** Number of undergraduates and masters



**Fig. 4.** The ratio of the number of undergraduates to the number of masters

literacy educators below bachelor’s degree, 15.3% of masters, and 100% of doctoral degrees. It shows that doctors are the most prone to mutations in the new generation of librarians.

The theory of mutation was proposed by the French mathematician Rene Thom in the 1960s. The potential function of mutation theory consists of two types of variables, namely state variables and control variables, which are two aspects of the problem of contradiction [12]. The data on the change of librarian’s academic qualifications is substituted into the swallowtail formula:

$$v(x) = x5 + ax3 + bx2 + c$$

is calculated as follows:

Objective function matrix

$$\begin{Bmatrix} x_{11}x_{12} \dots\dots\dots x_{1y_2} \\ x_{21}x_{22} \dots\dots\dots x_{2y_1} \\ \{ \dots\dots\dots \} \\ x_{i1}x_{iz} \dots\dots\dots x_{ij} \end{Bmatrix}$$

It was concluded that the librarian’s academic qualifications developed to a high level, and the possibility of mutation was strong.

Apply the control variable coefficients to determine the mutation level:

Grading	Mutation series regular value	New rating values
Not fragile	0.5 0.7 0.9	0.89 0.9 0.97
More fragile	0.3 0.5 0.7	0.34 0.5 0.62
Medium fragility	0.4 0.6 0.8	0.5 0.61 0.72
Very fragile	0.1 0.3 0.5	0.3 0.42 0.55

The above data is substituted into the swallowtail normalization formula

$$v(x) = x^6 + ax^4 + bx^3 + cx^2 + dx$$

It is concluded that China's highly educated young librarians are prone to mutations to the new generation of librarians.

### 3 Definition and Significance of New Generation Librarians

#### 3.1 The Definition of the New Generation Librarians

The term "New generation" is a term borrowed from geological time, that is, the most recent geological epoch, from which the world of life gradually took on a modern aspect. The "New generation" is being borrowed into various fields, such as the new generation of employees, entrepreneurs, knowledge workers. Our librarian is a little bit similar to this type, which was introduced in 1959 by Peter Drucker, the world famous management master who believed that knowledge workers were people who mastered using symbols and concepts, working with knowledge or information [5]. Domestic scholars generally believe that the new generation is a group of people born after the 1980s. They were born synchronously with the computer and the Internet and grow into mental workers with strong learning ability and innovation ability and who can make full use of professional modern scientific and technological knowledge to improve work efficiency. Western scholars began to study the new Generation of employees in the 1990s. They are called Generation Y in English. They were born in the 1980s and have entered the work force, injecting new blood into all walks of life.

There is no such term as the new generation librarian in our libraries, but the regulations of libraries in colleges and universities issued on December 31, 2015 have found the basis for us to put forward the concept of the new generation librarian. The new regulations states that librarians and auxiliary librarians should generally have a master's degree or higher, and that the number of professional librarians should not be less than 50% of the total number of librarians (EB/OL 2015).

Therefore, this paper defines the new generation of librarians as professional librarians who were born after the 1980s, have a master's degree or above, have worked in the library for more than three years, and have obtained intermediate or above titles. The reason why this definition does not include the undergraduate librarians who occupy a large proportion in the library is that the undergraduate librarians have a wide range of ages and different working abilities, especially their inability to cope with the new mission of data literacy education given to the library in the big data age.

#### 3.2 The Significance of Defining the New Generation of Librarian

The significance of the definition of the new generation librarian includes two aspects: one is timeliness and the other is necessity. Timeliness means that with the advent of the era of big data, scientific research has entered the fourth paradigm stage of data-intensive research. As an important carrier of data literacy education, libraries have no time to improve the proportion of well-educated young librarians. According to Wu Hanhua and

Zhang Fang's survey [11] on the human resource data of University libraries in China in 2013, the proportion of librarians over the age of 40 is 64.7%, the proportion of those with a bachelor's degree or less is over 50%, Master's degree or above accounted for only 21.6%. It shows that the problem of low educational background and old age of university librarians is quite serious. The new regulations have made clear provisions on the entry threshold of university library staff with the unprecedented high starting point and strict provisions. Necessity means that there has been a serious misjudgement of library in academic circles and even in various units. Some schools think that libraries are teaching auxiliary units, some schools think that librarians are technical personnel, and some schools put libraries into the management of logistics support center. In short, they have not realized that libraries are departments that provide information guarantee for teaching and scientific research. At the same time, the library itself did not launch its own expert celebrities in time, especially did not launch its own young and middle-aged research team. Therefore, article 13 of the new regulation points out that professional librarians should be included in the talent training plan of the school, and attention should be paid to the training of high-level experts and academic leaders (EB/OL 2015). Therefore, it is of great significance to define the new generation of librarians in time, strengthen the training of high-level young and middle-aged librarians, and make it an indispensable link in the process of school teaching and scientific research, so as to change the old idea that librarians do nothing [3].

## **4 The Connotation and Content of Data Literacy Education**

### **4.1 The Connotation of Data Literacy Education**

Scholars at home and abroad have different understandings of data literacy. Zhang Qun sorted out relevant data at home and abroad, summarized relevant concepts and inclined to Professor Huang's explanation of data literacy: data awareness, data ability and data ethics basically cover the content of data literacy [14].

Data awareness includes data discrimination, data acquisition and processing, and data capability includes data acquisition, processing, application and evaluation.

Data ethics includes data regulation, safety and standards [7].

### **4.2 The Content of Data Literacy Education**

The data literacy education for librarians is basically carried out by the education and training organized by the library itself, and the strong key university libraries carry out theme training and lectures with their own courses [1]. For example, the introduction of data literacy and statistical data resources in Peking University Library, the introduction of data literacy in information literacy in Shanghai Jiaotong University library, and the search and acquisition of statistical data in statistics and data resources network in Zhejiang University library and the like. These teaching and training are carried out independently, and have not yet formed alliance and standardized education. However, libraries in general colleges and universities mainly attend data knowledge training courses and lectures organized by Library Society of China or provincial library societies,

and the content of education is mainly data literacy knowledge and skills. For example, the library Advanced Knowledge Service Tools and Application, SPSS data Processing and application courses held by Library Society of China from 2013 to 2016 [13]. All of these training courses are in the form of voluntary payment and registration. Many school libraries do not participate in these training courses because they are busy or unwilling to pay for other reasons. Therefore, the data literacy ability of university librarians is uneven and the level is not high.

## **5 Data Literacy Training Approach for New Generation Librarians**

### **5.1 Stratified Training of the New Generation of Librarians**

The new generation of librarians includes doctoral and master librarians. For doctoral librarians, they can be recommended to be included in the overall talent training plan of the university, or even participate in the election for overseas exchange, laying a good foundation for high-level talent training. For master librarians, they should focus on the study of combining theory with practice, pay attention to playing the role of team and improve themselves in practice.

### **5.2 The Cultivation of New Generation Librarians Has Dual Characteristics**

Duality refers to that the new generation of librarians are both data literacy learners and data literacy educators. In the training process, attention should be paid to the training of both data ability and educational ability. For example, it is better to participate in the study and acquisition of teacher qualification certificate for the improvement of educational psychology learning, professional standards of educators, language communication, expression and communication skills, because at present, no university has required the librarians who teach literature retrieval courses and information literacy courses to have teacher qualification certificate. Compared with teaching by teachers, teaching by librarians lacks a little taste. This taste is the professional teachers' unique professional abilities, such as the ability of infectivity, persuasiveness, communication, psychological analysis and comprehensive coping ability. The formation of this ability cannot be accomplished overnight and needs to be cultivated as soon as possible.

### **5.3 Participate in MOOC Courses and Study Online**

The MOOC courses originated in the United States. At first, famous universities such as Stanford and Harvard took the initiative to make videos of their courses and upload them to specific network platforms for free learning. In May 2014, The MOE and NetEase jointly launched China University MOOC, a MOOC platform with independent intellectual property rights in China. On the MOOC platform of Chinese universities, Harbin Institute of Technology opened a course on big data algorithm, and Zhejiang University opened a data structure to help students understand why some classical data exist and under what circumstances can best solve the problem [4]. The new generation of librarians are particularly suitable for this approach because of their high education, young age and the seamless connection between computer network and the big data age in the information society.

## 5.4 Sign Personnel Training Contracts with Database Operators

A proverb says, “Jade can be polished by stones from other hills.” The engineers of the database company come from the first line of practice and have rich practical experience and experience. Listening to their training classes can closely combine theory and practice and get twice the result with half the effort. At the same time, signing the after-sales training contract can also promote the development of after-sales service. For example, Jiangnan University Library invited Mr. Lei Bin, regional manager of Clarivate Traverse, to give a web of Science lecture, which received good results.

## 6 The Value Embodiment of the New Generation Librarians in the Data Literacy Education – Takes Jiangnan University Library as an Example

### 6.1 Embedded in the Whole Process of Scientific Research Services

On December 14, 2017, the Library of Jiangnan University played a team role. ESI and INCITES, the international authoritative platforms, were used for the first time to analyze and evaluate the influence of scientific research output of key construction disciplines of Jiangnan University, and analyzed the influence of materials science of Jiangnan University in the past decade. The report selected 7 universities as the benchmark, from the number of papers Cited frequency, discipline standardization influence and other indicators were analyzed and compared. The research report has attracted great attention of The College of Chemistry and Environment, and many excellent young teachers with doctoral degrees have been selected to establish cooperative relations with the new generation librarians in the hope of receiving the whole-process service of scientific research project life cycle. Such as data collection in the application process of scientific research projects, data production, storage and management in the middle of research, data storage and achievement transformation in the process of project conclusion.

### 6.2 Technology Development of the Education System for the New Generation of Librarians

Front-end technology uses Java Script, an interpreted scripting language that can be applied independently to programming. The data implementation is to establish a database.cs page to implement the link to the database to complete the query, update, delete, insert, statistics, etc. of the data, and the control code is as follows:

```
<WPY TOOIKIT:Data Grid X:Uid
Style={static Resource data Grid}
Ltem Style=“Static resource LLtem Contstyle”
X:Name=“Dgbills” margin =“6,8,18,28,68,88”
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```



## 7 Conclusions

Value is the sublimation of function, and timely definition of the new generation of librarians adds strength to the embodiment of their ability. The development and transformation of any enterprise must choose a breakthrough, and the library chooses to train young librarians with high education as the breakthrough, which is very necessary to meet the new mission of the big data age.

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