The Current Situation and a Review of Chinese Library and Information Science from the Perspective of the Teaching System*

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The evolution of information science education in China has changed over time. This paper studies library and information science education from the perspective of bibliometrics. Following a literature review, this research discusses the stages of library and information science education in China and concludes that China has increasingly paid more attention to library and information science education in recent years.

Keywords: bibliometrics, iSchool, library and information science education, reform

Education is not only the process of facilitating learning but also the acquisition of knowledge, skills, values, beliefs, and habits. With the development of science and technology and the arrival of the information age, we are increasingly aware that information is significant for our work, life, and social development. As a consequence, the degree of attention being paid to information science education is also increasing. Information has been used for a long time in China, although information was relatively closed to the public until the end of the nineteenth century. It was not until 1900 that China had its first public library, which allowed information to be more open and shared. In 1920, Mary Elizabeth Wood and Shen Zurong

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KEY POINTS:

- Library and information science in China has developed in the years covered in this study.
- Strengthing the construction of the talent team has become an important part of library and information science in the teaching system.
- The addition of practical courses is another important component of the teaching system of library and information science.

founded the Boone Library School, which was the first information education institution. After a long period of depression, China's information science education began to increase in momentum and to undergo a period of vigorous development in the late 1970s. This reached a climax in the mid-1980s and maintained a steady trend of development in the 1990s. This development in information science education went alongside the trend of overall reform and opening up. Now, in the twenty-first century, with the rapid development of data and information technologies, information science education is also facing unprecedented challenges and opportunities (Aman & Sharma, 2005).

With the 60th anniversary of the founding of China in 2009, the advent of science and technology information education became an important part of library and information science. Therefore, it is necessary to look retrospectively at the development of library and information science education. Many research directions have been taken by library and information science master's dissertations. The cultivation units pay more and more attention to the perfection and establishment of the evaluation index system of dissertations. They also pay more attention to the much-discussed mentor's project (Min & Liu, 2010). The research directions and curricula setting for information science for doctoral students vary across different universities, with each university being distinctive in this respect. This paper reviews and summarizes the development of information science in three stages since the period of reform and opening up.

A review of the development of information science education in China

The development stage of science and technology information: 1978–92

Wuhan University established science and technology information as a major in 1978, followed by Jilin University, Peking University, Xi'an University, Nanjing University, and others that established and restructured characteristics of the information science discipline. Different universities developed their own strategies in terms of recruitment models, training methods, and curriculum setting. Professional education in the field of information science in China entered a period of great development that centred on science and technology information studies. At this time, a more formal structure and a comprehensive and complete information

science education system was forming and developing. This made a great contribution to the development of science and technology information studies. In 1983, the Ministry of Education held a symposium on library and information science education at Wuhan University at which the educational plan for library and information science was discussed. Strengthening the discipline and professional education in this field was also emphasized. According to Qiu (2011), the State Scientific and Technological Commission set up the National Science and Technology Information Training Center in Wuhan University in 1983 to undertake the nationwide training of intelligence staff. Wuhan University founded its College of Library and Information Science in 1984 (Hu, Jiao, Qiu, & Ma, 1990), which, in turn, established the Department of Information Science. This department began to recruit graduate students of information science and added a number of professional core courses, such as information economics, literature metrology, information user research, and others. The education system improved gradually and initially formed a multi-level system that included undergraduates, junior college students, master's-level graduate students, a variety of short-term training courses, and correspondence classes. In addition, the method of running schools continued to develop from a single-school education format to a combined education model format. The area of specialization changed from scientific and technological information to become two branches: information management and research and information systems engineering. The rapid development of information science education in China at that time can be illustrated by considering the development of the department at Wuhan University. This continuously expanded in size, strengthened the structure of the discipline, and improved the overall teaching conditions. There were more than 30 undergraduate teaching administrations and 10 authorized Master's degrees (Qin, 1990). The Center established a wide range of contacts with the domestic intelligence sector and also academic circles at home and abroad.

In general, this period of information science education had the following characteristic: information science was conducted independently from library science, which offered professional education and developed specialists in the field of scientific and technological information.

In order to study the main courses covering information science education throughout the world and to explore the position of information science education, teaching patterns, and the cultivation of information talent in higher learning institutions, the *Journal of the China Society for Scientific and Technical Information*, regarded as the principal Chinese periodical in this field, included many articles on information science education. The Committee on Science and Information Science Technology, which held four seminars on information science education and related issues, came to the conclusion that the undergraduate level of information science education was divided into four types: comprehensive information education, library and information science education, management information science education, and science and medical information science education.

The structure of professional courses and teaching materials is important in the development of information science education, and a number of professional courses were gradually established to improve the curriculum. From 1978 to 1983, there were eight textbooks, including the Selected Program of Liberal Arts Teaching Materials for Higher Education (Huang, 1991). These books introduced information science, science and technology information retrieval, science and technology literature, and other subjects that are widely used in domestic colleges and universities. The corresponding teaching materials have greatly enriched the teaching content of information science and have established the basic paradigm for information science education. Taking Wuhan University as an example (Tu, 1992), as well as basic courses (including courses on political theory, foreign languages, science and technology, and computer applications), it also set up a number of specialized courses, such as "Introduction to Scientific and Technological Information Work," "Scientific and Technological Information Work," "Analysis and Research of Scientific and Technological Information," "Scientific and Technological Information Retrieval," "Information Retrieval Language," and other courses. These were offered according to scientific and technological information practices, all of which constituted the framework for specialized courses for the newly established major in science and technology information.

The scientific organization of professional teaching depends on the curriculum, which requires the construction of the curriculum to be comprehensively strengthened. So, from 1980 to 1983, the title "Introduction to Scientific and Technological Information Work" was changed to "Introduction to Information Science," "Scientific and Technical Information Work" became "Science and Technology Literature Management," and "Analysis and Research of Scientific and Technological Information" was changed to "Information Research"; the systems and contents of other courses were adjusted accordingly (Wu, 1986; Zhao, 1999). Shi (1999) explained that, from 1981, many courses were introduced: for instance, "Science and Technology Literature," "Fundamentals of Patents," "Research on Intelligence Users," "Bibliometrics," "Information Systems Management," "Compiling and Reporting," "Science of Science," "Information Economics," "Information Retrieval Systems," and "Science and Technology Forecasting." At the same time, computer application courses were gradually improved to adapt to professional levels in information science.

It was very important to recruit and train competent teaching staff. However, in order to alleviate the shortage of teachers, the teaching unit initially recruited a number of non-information specialists, but with science, engineering, agriculture, medicine, and arts backgrounds, to supplement the teaching staff. At the same time, some universities held training courses to improve the quality of information education and to infuse the teaching body with fresh blood.

The professional stage of science and technology information: 1993–98

At the beginning of the 1990s, with the establishment of the College of Library and Information Science in the United States as a model, information science education met new challenges and problems around the world. One of the reasons for these problems was that information science education had not paid sufficient attention to the rapidly changing social environment and rising demand. The progress made in information technology in the 1980s was largely due to multidisciplinary efforts in different fields involving traditional literature information management with information science education at its centre. Interdisciplinary research became the primary way to carry out information science research because the information market, and its interdependent social and internet environments, is so complex. In this environment, information science education began to accelerate in terms of the pace of its reform, while the professional field and the scope of adaptation to cover information and information management broadened.

In September 1992, the State of Science and Technology Commission decided to change the name "Chinese Science and Technology Intelligence Research" to "Chinese Science and Technology Information Research" (Zi, 1992); this had widespread consequences. It was previously known as "Scientific and Technological Intelligence" because, on the one hand, the word "information" was barely used between the 1950s and the 1970s and, on the other, from the perspective of demand, China used to utilize the System of Planned Economy. In this system, production for all economic activities was determined by planning, so it did not reflect the information demands of the market. Instead, it needed only scientific and technological intelligence in the fields of scientific research, manufacturing techniques, and the research and development of products. However, considering the international environment of China at that time, a comprehensive system of scientific and technological intelligence was established from state to local levels. This was named the scientific and technological intelligence major and was the origin of the early informatics major. In 1993, the state education commission issued an article entitled "Undergraduate Professional Directory of Ordinary Colleges and Universities" (Shu & Wen, 1994), in which the title "intelligence of science and technology" was changed to become the "information of science and technology." The development of Chinese information science education thus changed with the times, as these examples show:

1. The "information view theory" was put forward. This showed that information should be combined with social, economic, and management fields to meet the growing demand for information.
2. It was decided that there should be an emphasis in information science education to cultivate interdisciplinary talent with a deeper foundation, a broader range of skills, and extended capability. In

addition to professional courses, and foreign language and computer courses, the majority of colleges and universities created economics, management, and other related courses. One example was the University of Science and Technology of China (Yi, 1996), which recruited two-year students from other majors. These students then studied the information science curriculum for three years to meet the needs of society. Some departments of medical information offered medicine courses in the first three years, and then information courses for two years, in order to develop specialist students who would be engaged in medical information work.

3. Attention was paid to modern information technology education. Starting with the development of information infrastructure projects in the 1990s, the digital and network information environment became a new social environment (Bump, 2004). The colleges and universities tracked the development of information technology in time to add some new courses, such as information networks, multimedia technology, data communications, development and utilization of network and digital information resources, and so on, to update and optimize computer courses in order to reflect changing environments and advancing technology.
4. The hierarchical structure was improved and high-level talent was cultivated. Wuhan University established the first information science doctoral degree to recruit PhD students in China after gaining the approval of the Academic Degrees Committee of the State Council in 1990 (Wang, Liu, &Yuan, 1999). Nanjing University and Peking University (Ni, 1992) followed and were allowed to set up doctoral degree programs in information science. These brought information science education in China to a new level, while the hierarchical structure was completed after the set-up of doctoral degree authorization centres that promoted the development and structure of information science education. These were important steps in developing advanced professional talent in the field of information science education in China. The teaching body actively explored the rules of doctoral student education in order to emphasize the cultivation of students' innovative consciousness and scientific research ability.

The stage of information management and information systems: 1999 to the present

As previously mentioned, intelligence education was extended and developed to become "information" and "information management" beginning in the 1990s; this was recognized by the community and the relevant education and management departments. The main sign of this was the establishment of professional "information management and information systems." In July 1998, the Ministry of Education published "A Brief Introduction to the Catalogue and Specialty of Undergraduate

Major in Colleges and Universities" (Gray, Diamond, & Adam, 1996), which combined the five majors of information economic management, information, information technology,information management systems, and information management and systems. This combination belongs to the category of information management together with the professions of library science and archival science.

This was different from the previous professional name of "information management" and not only specified the direction of intelligence education but also had certain characteristics of a wide subject range in accordance with information management. There was wide professional integration with other disciplines, and this integration reflected the internal features and essential characteristics of information management, considering the efficient allocation of professional resources, the requirement to conform to the needs of society, and the need for high-quality talent in the field of information. Thus, information science education reinvented itself with a new vision and was, in addition, a starting point for developing talent in the area of knowledge and the organization of information in order to adapt to the information age.

At present, information management is at the stage of integration and reconstruction. On the whole, information science education currently tends to focus on information management, which means it has been targeted to aim for the wider cultivation of information management talent (Dai, Chen, & Zhang, 2017). Thus, the traditional information science curriculum has been changed in an attempt to expand the scope of education. Currently, this trend occupies the mainstream.

Analysis of the present situation of information science education in China

Information science and related research has been a hotspot both at home and abroad; it is interdisciplinary (Sapa, 2007) due to the advanced nature and creativity of the discipline. The rapid development of information technology and the continuous progress being made in emerging disciplines is injecting more vitality into the field, as well as new ideas and methods. After experiencing two major shifts in information science, many of the scholarly studies in the field are still based on specific content while still not forming a theoretical and practical system. Recently, at the Fourth International Symposium and Workshop on Library and Information Science Education in the Digital Age (Perushek, 2000), scholars from all around the world gathered at Wuhan University to talk about the development of information science in the light of considering big data. However, we believe that any further developments in information science need to start from the basics. Therefore, this article aims to analyze the current situation of information science education in terms of five aspects: the structure of the degree, the cultivation of an objective educational model, the curriculum, faculty and enrolment, and the level and ability of teachers.

Structure of the academic degree

Table 1 provides statistics on information science in Chinese colleges and universities, taken from the *Chinese Graduate Education Evaluation Report 2014—2015* (Qiu, 2011).

Table 1: Statistics on graduate programs in information science in Chinese colleges and universities

NO.	Institution	Region
1	Peking University *	North China
2	Renmin University of China *	North China
3	Beijing University of Aeronautics	North China
4	Beijing Institute of Technology	North China
5	China Agricultural University	North China
6	Beijing Normal University	North China
7	Nankai University *	North China
8	Tianjin University	North China
9	Tianjin Normal University	North China
10	Hebei University	North China
11	Shanxi University	North China
12	Shanxi Finance and Economics University	North China
13	Chinese Medical Sciences University	North-eastern China
14	Jinlin University *	North-eastern China
15	Northeast Normal University	North-eastern China
16	Heilongjiang University	North-eastern China
17	Tongji University	East China
18	Shanghai Jiao Tong University	East China
19	East China University of Science	East China
20	East China Normal University	East China
21	Shanghai University	East China
22	Nanjing University *	East China
23	Suzhou University	East China
24	Southeastern University	East China
25	Nanjing University of Aeronautics and Astronautics	East China
26	Nanjing University of Science and Technology	East China
27	Hohai University	East China
28	Jiangsu University	East China
29	Nanjing Agricultural University	East China

(Continued)

NO.	Institution	Region
30	Zhejiang University▲	East China
31	Anhui University	East China
32	Anhui University of Finance and Economics	East China
33	Fuzhou University	East China
34	Fujian Normal University	East China
35	Nanchang University	East China
36	Shangdong University	East China
37	Shangdong University of Science and Technology	East China
38	Qingdao Science and Technology University	East China
39	Jinan University	East China
40	Shangdong University of Technology	East China
41	Zhengzhou University	South Central China
42	Xinxiang Medical College	South Central China
43	Zhengzhou University of Aeronautics	South Central China
44	Wuhan University *	South Central China
45	Huazhong University of Science and Technology *	South Central China
46	Central China Normal University	South Central China
47	Xiangtan University	South Central China
48	Central South University	South Central China
49	Sun Yat-sen University	South Central China
50	South China Normal University	South Central China
51	Guangxi University for Nationalities	South Central China
52	Sichuan University	South-west China
53	Chongqing University	South-west China
54	Southwest University of Science and Technology	South-west China
55	Southwest University	South-west China
56	Yunnan University	South-west China
57	Xi'an Electronic Technology University	North-west China
58	Lanzhou University	North-west China

Note: * shows that the institution authorizes a doctorate degree.

From Table 1 it can be seen that only seven universities offer a doctoral degree in information science education. These are marked *: Peking University, Renmin University of China, Nankai University, Jinlin University, Wuhan University, Huazhong University of Science and Technology, and

Nanjing University. Fifty-eight universities offer a master's degree, compared to 15 universities in the last century. The number of professional information science education study courses increased greatly, which underlines the status of information science as a relatively new and rapidly developing discipline. Information science education still has great potential for development, as most universities in China have yet to offer any degree in information science. In addition, the availability of information science education is uneven in its geographical distribution, with more than 60% of the relevant universities being distributed in east and north China, the second largest number being in the south central region, while the northeast and northwest have the lowest provision. (See Figure 1.)

It can be easily seen that eastern China accounts for a relatively high proportion of library and information science education, followed by northern China. This has a relationship with the rapid economic development of eastern China, whose economic foundation promotes the development of education. The distribution of programs in northeastern and northwestern China is relatively small, at less than 10%. This shows that education in library and information science is developing slowly. The eastern China programs are driving the development of LIS.

Training goals

Just as theory guides practice, the cultivation of information science professionals is an important premise for information science education, which is coupled with courses and training programs to lay a solid foundation. The information technology industry in China was given "eyes and ears, pioneers and staff" at the very beginning. The so-called "eyes

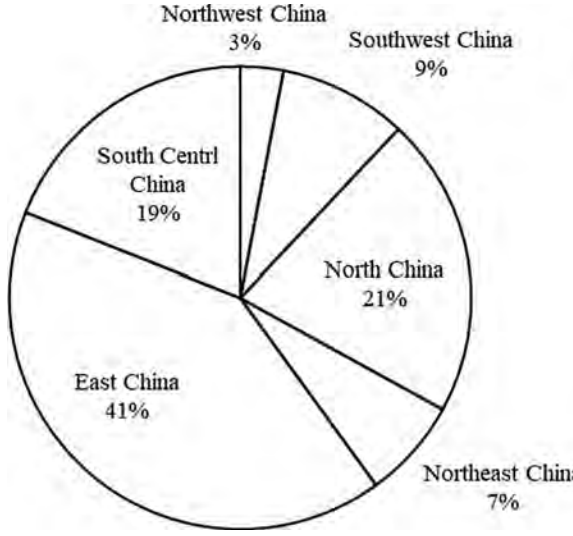

Figure 1: Geographical distribution of information science education in China.

and ears" refers to the timely communication of information, while the so-called "pioneers and staff" refers to enquiring about the current and future state of the field and integrating all kinds of information for decision making. The most important factor for information science education is to identify the professional objectives; this becomes more and more critical as the field progresses (Yeap & Kiran, 2017). Current professional training in information science in Chinese colleges and universities is determined by its specific historical background, which will clearly support scientific decision making rather than relying on books and materials. However, information science and library science in China developed simultaneously. According to Hjørland (2000), experiences from the development of foreign library and information science (LIS) were absorbed and drawn together by changing the name from "intelligence" to "information." In this way, information science education gradually lost its original features and initial direction. For various reasons, the methods of cultivating professionals in colleges and universities became different and the main training objectives became blurred. At present, information science is most criticized for its fuzzy orientation, the changing research objectives in disciplinary research, and the lack of solid core research aims, as well as a lack of stable research directions. This has led to a certain fickleness in the development of the whole discipline.

The most prominent problem with regard to information science is that it lacks a substantial "theoretical core," since most of its theories have been transplanted from other areas. So far, there is no clear agreement among the information science community on basic questions of information science theory such as the connotations and denotations of the subject. The changeability in information science education and its tendency to emphasize doctoral research have shown that information science's theoretical system is unstable. Taking information science education as an example, different universities have slightly different focuses. For example, Nanjing University (Wang & Sun, 2006) pays attention to competitive intelligence, knowledge management, electronic affairs, and so on; Jilin University focuses on grid and information resource allocation, as well as the related content of digital libraries; the Information and Documentation Center of the Chinese Academy of Science concentrates on bibliometrics, knowledge discovery, data digging, and individualized services (Yi, 1981); Wuhan University pays special attention to ontology, e-business/government, evaluation, and knowledge management (Ren, 2006); Peking University is concerned with knowledge services, information services, companies, and so on. After decades of change, information science education has undergone innovation, stagnation, development, adjustment, and progression; these have resulted in some degree of educational and professional formation. All the colleges and universities have to create training programs to emphasize talent training based on social developments.

Curriculum setting

At present, dozens of colleges and universities offer information science, but the field can be divided into three aspects—theory, technology, and practice—by analyzing the main courses offered by these institutions. Such analysis shows that there is variation in the number of courses offered by each institution, although each school can set the number of courses to suit its professional education according to its respective conditions. Theoretical courses are concerned mainly with introducing the basic concepts of information science, management, research, and related contents, such as the "Information Management and Information Law" course at the Wuhan School of Information Management (Qiao, 1989). This course combines the relevant theory of management science and information management education. "The Modern Management of Reading" offered by Lanzhou University explores how to conserve and use intelligence, data, and knowledge of information science through further research (Ni, 1998).

The technology courses in information science are meant to supplement the theoretical ones, and these involve a large range of specific technology, such as SPSS, Access, VFP, C++, Python, cloud computing, and so on. Shandong University of Technology offers more technical courses, such as Java and Applied Visual Basic, which have a strong applicability and practicability with regard to big data (Qin, 1990). This course also satisfies the urgent need for talent required due to the rapid developments in internet technologies in recent years. The application curriculum, such as the "Principle and Application of Databases" course at Southwest University (Yi, 1992), refers to the technology involved in terminal equipment, social networks, the internet, and other specific domains that are used to obtain effective information. It also considers methods of dealing with problems for technical analysis and model construction of specific domains. Although the course examines the principles of databases, the focus is still on applications.

In order to study whether the teacher's basic situation is reasonable, Wuhan University was selected as a concrete example in order to analyze the structure of the ages, professional titles, academic experience, and backgrounds of teachers (Huang, Xia, Zhou, & Cai, 2009). Wuhan University was chosen as an example for the following reasons: (1) it has been recognized as the principal institution for information science education in China, and many colleges and universities look to it for experience and wisdom; and (2) it is at the forefront in leading the domestic development of information science. By learning about the development of information education of Wuhan University, we can gain clear insights into the details and the frontier of the development of information science education in China. At the same time, it can provide a reference for the development of information science education. The detailed statistical results are shown in Table 2.

As shown in Table 2, the number of faculty is a reflection of the strength of the sustainable development of information science.

Table 2: Detailed statistics on teachers of information science at Wuhan University (*N*=17)

Item	Specific item	Number of faculty	Proportion
Gender	Male	11	64.71%
	Female	6	35.29%
Age	<35	2	11.76%
	35–45	6	35.29%
	>45	9	52.94%
Title	Chair	10	58.82%
	Associate professor	7	41.18%
Degree	PhD.	15	88.24%
	Master's	0	0
	Bachelor's	0	0
	Others	2	11.76%
Background	Information technology	5	22.73%
	Computer science	2	9.10%
	Chemistry	1	4.55%
	Management	9	40.91%
	Engineering	5	22.73%

Note: Teachers who have a multidisciplinary background are counted more than once in their respective disciplines.

A complete team of teachers should be composed of experienced older teachers, middle-aged, and younger faculty. In particular, the latter category plays a key role in information science education. Information science is a highly integrated cross-disciplinary field that requires students not only to gain informatics, theoretical, and technical knowledge but also to obtain more extensive and comprehensive multidisciplinary expertise. Therefore, the backgrounds of the teaching staff can reflect the characteristics of diversity. With regarding to Wuhan University, there are 17 teachers with an information technology and management background, while the rest have backgrounds in computer science, chemistry, or physics, having entered late into the field of information science for research. In sum, the professional backgrounds of information science teachers in China have multiple characteristics because of their different scientific backgrounds.

Training programs

A few colleges or universities do admit undergraduates; information science exists only at the postgraduate stage, which involves three years for a professional Master's degree or two years for a regular Master's degree. The one extra year is for students to complete field work. In addition to

Table 3: Statistical account of graduate practice in the top 11 Chinese universities

Name of school	Total credits	Practice credits	Proportion of credits
Beijing Normal University	36	1	2.78%
Wuhan University	32	2	6.25%
Heilongjiang University	38	4	10.53%
Northeast Normal University	32	5	15.63%
Shanghai University	42	0	0
Hohai University	28	0	0
Fuzhou University	32	2	6.25%
China Agriculture University	28	4	14.29%
Shanxi University	31–34	0	0
Hebei University	30	8	26.67%
Shanghai Jiaotong University	32	0	0

the necessary theoretical learning with discussions, the programs also include practical courses. In their final year, students must complete their graduation practice within a 3–6-month period. At present, China's colleges and universities place more emphasis on practical aspects (to varying degrees) and have different internship arrangements.

In order to illustrate the practices in China more thoroughly, a plan of the requirements for graduation are listed in Table 3 (Qiu & Jiao, 2015).

As shown in Table 3, most colleges and universities in China have stages to graduation and give credits to urge students to practice, with only the proportion of internship credits being different. Some schools attach great importance to practice, such as Hebei University, with 26.67% of the total credits being awarded for practice. However, some schools pay little attention to practice. For example, Beijing University awards credits for practice which account for less than 1%. If schools do not require any practice, or very little, this will affect the enthusiasm of students for practicing in the field. At the same time, colleges and universities share a common drawback: Most universities have no fixed practice base, yet there are many links between information science and library science, so the libraries of universities could be utilized as a place to practice (Virkus & Harbo, 2002). Colleges and universities generally recommend practice, but most of the experiences offered in internships are not comparable with professional ones. The vast majority of internship positions comprise simple labour and ignore the more complex aspects of information science. This makes the situation unsatisfactory for both the students and the schools.

In most cases, there is a lack of uniform rules among universities. However, information science education in China attaches great importance to the students' scientific research ability, and the graduate student stage is the best time to cultivate an ability for critical thinking. Therefore, most schools have issued publishing requirements for students in China during that stage. Wuhan University requires students to publish at least one paper in a periodical during their postgraduate study, and Northeast Normal University requires at least one more in a provincial publication. The rest of the colleges and universities also have publishing requirements for papers, and they strictly investigate and deal with plagiarism to cultivate students' scientific, critical, and analytical thinking. It is not sensible to assess the enthusiasm and initiative of a student's learning by blindly attaching importance to their scientific research ability (Limberg & Sundin, 2006) while ignoring their practical abilities. In addition, it is not easy for those students who have not undertaken an internship to fit into a work environment as soon as possible after graduation.

Educational model

In order to adapt to the trend of internationalization in education, information science education has continued to absorb new elements, such as digital libraries, the Internet, e-commerce, knowledge management, Web2.0, library 2.0, and so on. This has changed the form of teaching and learning in information science, as it embodies the application of ICT technology and tools since the application of ICT technology has reshaped traditional teaching and distance learning institutions. This can form a globalized and unlimited learning environment that can speed up information science courses to keep up with the pace of internationalization.

In the early 1990s, information science education began to take advantage of e-learning. However, although most of the institutes of information science have published a number of high-quality courses on the web, there is still no systematic and complete construction for information science e-learning. The network teaching platform of Peking University released only one high-quality course on information science: "The retrieval and utilization of electronic resources" (Xiao, 1993). Wuhan University, on the other hand, has a website for an experimental teaching centre for information science under construction (Yi, 2000). There are seven items: curriculum website navigation, curriculum construction, a network classroom, practice innovation, databases, rules, and a teaching forum. Compared with foreign countries, however, the research aspects of information science education are still in the initial stages in China.

The development trend of information science education in China

In general, information science education in China has begun to take shape in the form of a relatively complete, multi-level, varied system of

educational institutions, which is entering a rapid, healthy, and comprehensive development phase (Wang, 2001). At present, the central task is to find ways to strengthen the structure of the discipline, to handle various related structures correctly, and to improve the quality of talent training (Huang, Li, & Zhou, 2016). The trends of development of information science education in China can be seen in the following five aspects, starting from the current situation in the twenty-first century.

Meeting the needs of technological, economic, and social developments

Education is important in ensuring the development of productive forces in society. A prominent trend in the contemporary social development of the information society is accelerating the processes surrounding knowledge, since information and knowledge have become the most important resources and the key elements of social and economic development. The knowledge economy, as a new social economic form, has begun to emerge (Qiu, Sha, & Chen, 2002), with information science being a key to understanding how to provide and use knowledge and information. The important mission of education is to develop the science of information management to meet the needs of society.

Chinese information science education has its own training objectives, structure, professional direction, teaching management, school conditions, and talent training, all of which are becoming increasingly adapted for the information society. After years of effort, talent training has now become a requirement, especially in recent years. "Information Management and Systems" and "Information Science" were classified as a category of "Management" in order to stabilize the discipline of information science, but it is now time for information science education to broaden its professional scope by cultivating students, thus improving both their comprehensive quality and their social adaptability. Then, graduates in the competitive information market will be able to find their own position and, in turn, gain competitive advantage. It can be expected that information science education will retain innovative impulses and its dynamic development, reinventing itself to keep up with the needs of the knowledge economy and the information era.

Sticking to the three principles

"Internationalisation, modernisation and sustainable development" are the basic educational principles for development in China (Li & Li, 2006). In the era of big data, education in information science can only grow and prosper in accordance with this principle. With the accelerating process of globalization, information science education can and will cooperate and exchange expertise with foreign counterparts through visiting scholars studying for a degree and information exchange at academic conferences. The scope of cooperation and communication has become more and more extensive, and, in the modernized structure of China, information management talents have been fostered.

At present, the employment of graduates of information science in China is not limited to library and information departments but exists throughout state administration departments at all levels, in businesses, financial institutes, research institutes, and the information industry at large. Information science education is oriented to take on board future societal developments through the prospect of education reform and talent training (Qiu & Yu, 2007). The new educational goal of information science in the era of big data is the concrete manifestation of this orientation.

Strengthening the structure of the curriculum and teaching content updates based on the digital and network environment

The organization and application of knowledge have become a huge industry. In the new information environment, the main competencies needed in information management are to be proficient in using computer technology, network technology, and other technical means to obtain relevant information in order to analyze, evaluate, organize, develop, manage, and deliver knowledge and information. Therefore, a major trend within information science education is to reform the traditional curriculum and information technology in order to modernize it sensibly. The future task of information science education is to integrate course content with training objectives to form a whole; this will lay a solid foundation for professional work for students in the future.

Distinguishing between various structural relations, and improving the quality of the cultivation of talent

The development of information science education in China should deal mainly with the following aspects:

1. Quantity and quality. Information science education in China has developed to a considerable degree. The emphasis in the future is to strengthen this innovative construction and improve the quality of education. Education quality is reflected mainly in the structure of the discipline, scientific research, and the cultivation of high-quality talent.
2. Hierarchical relationship. For a long time, the focus of development of information science education in China has been the cultivation of undergraduates in China. For future development, and the needs of the information society and the knowledge economy, it is important to improve the quality of education and expand the scale of postgraduate enrolment. It is equally important to strengthen postgraduate institutions, from the School of Information Management to the Graduate School of Library and Information Science.
3. Relationship between the supply and demand of professionals. This is closely related to the educational hierarchy mentioned

above. The supply and demand for information science graduates is balanced, but there is an apparent shortage of postgraduates. Therefore, cultivating postgraduates is a major focus for information science education in the twenty-first century.

Analysis of the plight of information science education in China

The teachers of information science

Whether or not to reform information science education to achieve the desired purpose will be determined by the quality and level of teachers. However, China's current situation with regard to teachers is not satisfactory, for the following reasons:

1. Knowledge requires a gradual rationalization. Most teachers have had systematic training in computer skills and related information technology. Since technological progress has been especially rapid in the era of information technology, this requires teachers to update their knowledge all their lives in order to stay competitive.
2. The shortage and limited sources of teachers. Most teachers delivering information science education in China originally graduated in library and information science, which results in the teachers having limited educational backgrounds.
3. The proportion of teachers with a doctoral degree is low. Most Chinese teachers hold a Bachelor's and a Master's degree. The teachers who have obtained a doctoral degree account for only about 1% of the total number. Obviously, the current situation with regard to teachers does not meet the need for high quality education in the digital age. The reorganization and renewal of teaching staff has become the most important aspect of information science education which requires reform.

The specialty orientation and subject assignment in information science

The theoretical foundation of information science has been weakened in various new disciplines and has therefore lost its own characteristics. In the process of merging with computer science, software engineering, library science, and archival science, it has become more difficult to choose and clarify the research direction. In the process of expanding the discipline of information science, its content has gone far beyond the basic business of intelligence, and it is easy, therefore, for research to become generalized.

Education and training system of information science

From the view of postgraduate training programs, there are detailed arrangements and explicit teaching requirements for theoretical teaching and scientific research papers. However, the practice is not clear, and some educational institutions have even failed to include the teaching of practice. The main reason for this phenomenon is the backwards-looking

notion that restricts, to a certain degree, the limiting of practice for students of library and information science, resulting in the practical ability of graduate students being no better than that of undergraduates.

Teaching the content and form of information science

At present, the teaching of library and information science is still at the development stage, as it is based on the theory of teacher teaching in many educational institutions in China. The curriculum is too rigid, the degree of students' choice is small, and there is a lack of interaction between teachers and students. Without the combination of theory and practice, and since existing practices largely repeat and continue the content and form of undergraduate teaching, the developments and characteristics of information science will not be reflected. In addition, practice does not play a role for many graduates and cooperation is limited to a single entity with little useful interaction between the two sides. As a result, the role of practice is reflected only in occasional student visits or in small, low-level internships.

Conclusion

In 2005, several North American colleges announced that they would promote information science in the twenty-first century. This marked the birth of the iSchool union, which was established in 2005 and has since been committed to the development of international cooperation with institutions in information science education (Hsieh-Yee et al., 2015). ISchool attracted information colleges from abroad, such as computer, multimedia, and other colleges, to join and find ways to cope with the challenges of the new information environment for information science education. At the same time, the arrival of the information age brought new opportunities for information science education. Against the background of reforming higher education, how to adapt to the new requirements of the times in terms of information science education is becoming more and more important.

Researchers are therefore giving close attention to, and discussing ways to clarify, the direction of Chinese information science education and consider its development in the future. It was found that, from 2007 to 2011, 2,213 extracts in the literature focused on educational research in information science when, in contrast, 4,062 literature studies were produced from 2012 to 2016 (data from Web of Science), showing an increase of 83.55%. The research on information science education focuses mostly on empirical research methods, which include both quantitative and qualitative methods. From the research point of view, information science education relates to the theme of diversity and shows the following characteristics:

1. Technology plays an important role in the education of information science, and its influence is becoming more prominent. Technology is integrated into the teaching content not only to promote the reform of the curriculum but also as an important medium for

the dissemination and promotion of information science education, so that the different groups of people can gain conveniently greater knowledge about information science. The main concept of Ischool is the integration of information, technology and people to guide educational activities.

2. The development of information science education is ever more diversified. On the one hand, it absorbs excellent ideas or methods from other disciplines and fields to carry out interdisciplinary and integrated research. Then, it combines this with its own reality to transform and promote information science education's ideological and theoretical structure. On the other hand, the object of information education is diverse, including not only students and employees, but also society as a whole. This reflects the openness of education and the information services.
3. Information science originates from work practices and has therefore always attached great importance to practical issues. This not only refers to industry practitioners involved in teaching, who strive to improve the usefulness of the courses, but also considers the needs of both the students and the community in terms of student training and encouraging students to participate in practice in order to develop their skills to better adapt to the needs of actual work.

In the future, the reform of information science education in China should pay attention to and strengthen the following aspects, moving alongside a comprehensive reform of information science education over the coming years.

These aspects include fostering cooperation with international information science institutes and different disciplines, as well as including a focus on research, teaching, practice, and other aspects of dialogue and communication. At present, there are three information management colleges that have joined iSchool in order to speed up the process of the internationalization of China's information science education. While countries have different national conditions, education in the field is similar, so international cooperation can allow information science education in China to understand and learn from the advanced experience of foreign countries in order to promote the beneficial reform of information science education in the country. At the same time, international cooperation could also focus on the strength of research and education to explore ways in which they can be reformed. Cooperation among different disciplines could extend the research methods used in information science education, improving research content and objectives to explore the development of a new educational paradigm. This, in turn, could lead to interdisciplinary and integrated research to address complex phenomena and real-life problems.

Those reforming information science education in China should also listen to the views of different parties, such as students, academics,

libraries, and other information agencies, to gain a variety of perspectives. Views from the applied side of the field are especially important so that the education can be more in line with the social status quo and meet social demands, as well as achieve a balance between the related subjects. Attention needs to be paid to the role of technology in the curriculum to achieve the integration of people, information, and technology. Information science education needs to integrate such technology and optimize the professional curriculum. At the same time, it should adhere to the concept of intelligence and service, strengthen students' cultural consciousness and sense of social responsibility, and remain people-oriented to meet the needs of modern society. At the same time, it should maintaining professional characteristics and advance with the times, understanding how science and technology penetrated the whole of society. In short, the reform of Chinese information science education has a long way to go and, as such, requires constant exploration and innovation.

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