

Research on Optimisation Strategies of Data Literacy Education in Higher Education Libraries Shelf of Information Literacy in Chinese Higher Education Libraries

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Abstract: Amidst the epoch of immense data, accompanied by the burgeoning prevalence of investigations into data literacy and the educational aspects thereof, various university libraries have also begun to learn from successful experiences abroad and conduct scientific research on data literacy education. In the realm of information technology, the focal point of research has shifted towards the burgeoning prominence of data literacy education, but the theoretical and practical research on data literacy is relatively weak and insufficient, and more detailed research is needed to address the existing problems. The article reviews the research on data literacy both domestically and internationally, focusing on cultivating readers' data awareness, developing reasonable teaching content, constructing a data literacy teaching system and integrating data literacy resource platforms, and building a professional and efficient data literacy teaching team. The article explores the optimization methods for reader data literacy education.

Keywords: Data Literacy; Data Literacy Education; Library Data Literacy

1. Introduction

Within the epoch of big data, a growing prevalence is witnessed wherein scientific analyses and decision-making processes are grounded in substantial datasets, while the proficiency in acquiring, processing, and citing data has evolved into an indispensable facet of data literacy in contemporary society. In 2015, China formulated an Action Plan to Promote the development of Big Data. The outline highlights the applied significance of big data in contemporary society and delineates the trajectory for the future evolution of big data. At present, in the demand for social talents, big data talents are relatively scarce, and in the

cultivation of societal talents, the significance and necessity of data literacy education within university libraries stand particularly pronounced. which is also an inevitable choice for library innovation services. Therefore, data literacy education has become a hot research field in the field of mapping under the demand of social talents. The research on data literacy education in China started in 2014, but the research level is still in the initial stage. Some key universities draw on the successful experience of foreign data literacy education and carry out research on data literacy education successively, such as Peking University, Tsinghua University, Fudan University, Wuhan University and other brand universities. As forerunners in the research on data literacy education, these university libraries stand at the forefront. And achieved a good research effect for the peer reference. This paper starts from the research situation of data literacy at home and abroad, and analyzes the existing problems of data literacy education in university libraries in our country with a clear concept of data literacy and data literacy education. The optimization strategies of data literacy education are studied from the aspects of readers' data awareness, designing reasonable teaching content, constructing data literacy teaching system, integrating data literacy resource platform, and constructing a professional and efficient teaching team for data literacy, the objective is to offer insights and guidance to university libraries engaged in the implementation of data literacy education..

2. Data Literacy and Data Literacy Education

The concept of data literacy was put forward in 2004, but no unified conclusion has been reached yet. Common industry terms include "Data Literacy", "Data Information Literacy", "Science Data Literacy", and "Data Management literacy" "Research Data Literacy", "Data Visualization Literacy", etc. [1]General views

on data literacy in the industry include Gong Yongqiang's Discussion on Education Model Based on the Connotation of Medical data Literacy, which comprises a comprehensive overview are four categories of literacy perspectives, specifically information literacy, statistical literacy, scientific literacy, and data management. [2]. In the paper "The Practice Exploration of Learning Space for Data Literacy in University Libraries", Yang Min argues that data literacy refers to the ability and quality including data awareness, operation plan, data collection, data analysis, data utilization, data sharing, management and archiving, comprehensive evaluation, basic laws and regulations [3]. In Research on the Construction of Data Literacy Cultivation System for University Librarians, Zhong Qinghong et al defined data literacy as an extension of information literacy, and defined it as the ability to acquire, understand, use, manage and evaluate information data, and use these capabilities to produce data or information of certain value [4]. In her Research on Data Literacy Education of University Libraries in the Era of Big Data, In Jiao Jiao's perspective, the concept of data literacy is construed as the capacity of individuals to gather, sort out, analyze, utilize, manage and share data information and their cognitive level of data ethics and data norms in the era of big data under the premise of establishing "problem" awareness [5]. From the perspective of the subject of education, Chen Mingxing divided data literacy into professional data literacy and civic data literacy in Interdisciplinary, Multi-subject and Multi-Perspective: A Review of the characteristics of Data Literacy research [6]. At present, the definition of data literacy by data literacy researchers can be roughly divided into two categories: one perspective posits that in the era of big data, data literacy constitutes a generalization or extension of information literacy; Another perspective places emphasis on the competence to comprehend and apply data, encompassing aspects such as data processing, data analysis, data sharing, and data reuse, in addition to cultivating awareness of data ethics [7].

The paper resources and electronic resources of library provide important resource guarantee for data literacy education. If readers want to have higher data literacy, they should accept perfect data literacy education. In her article "Data

Literacy Education for High-quality Development", Huang Ruhua posits that in the era of big data, data literacy education represents an expansion and deepening of information literacy education, a response to better play of library education functions in the new era, and the need for high-quality development of library science majors, as well as the need for libraries to better serve the society and enhance social influence [8]. In his master's thesis Research on the Content Framework of Data Literacy Education for Graduate Students, It has been emphasized by Chen Mingxing that both domestic and international data literacy education should center around the cultivation of data awareness, proficiency in data management skills, and comprehensive knowledge of data management [9]. This includes cultivating readers' computer use ability, network application ability, information management and processing ability, etc.

3. Research on Data Literacy at Home and Abroad

3.1 Foreign Data Literacy Education Research

The advent of big data has ushered in a paradigm shift, propelling mankind into a realm of unprecedented advancement, and there is obviously a shortage of big data talents in society. The competition in today's society is mainly reflected in talent competition. It is very necessary for every social citizen to master basic big data knowledge and improve data literacy. Some foreign higher education schools have long begun to train big data technical talents, and their main units are university libraries, which organize and implement data literacy education for undergraduate readers and scientific researchers. Some university libraries focus on cultivating undergraduate data literacy, while some universities focus on cultivating data literacy for scientific researchers. The data literacy education in foreign university libraries has distinct cultivation objects, diversified education methods, rich teaching content and clear teaching objectives, and its research level is relatively mature so far. Data literacy education in foreign countries mainly targets undergraduates and researchers, but also gradually targets members of society. The main body of data literacy education in foreign countries presents the characteristics of

diversification, and its main teaching tasks are undertaken by professional librarians in libraries, or professional teachers in research institutions on campus, or external data analysts are invited to do short-term training, so as to optimize the organization of data literacy teaching activities. Foreign data literacy education mainly teaches theoretical knowledge of data management for undergraduate readers, and more in-depth professional knowledge such as data analysis and processing and data reuse for readers with a master's degree or above. The education methods of data literacy education in foreign countries generally adopt reference service, short-term training courses, seminars, embedded classrooms, data management resource navigation, special lectures, symposia, elective courses, online courses, etc. Foreign data literacy education mainly involves basic cognition of data, digital tools, data quality assessment, data analysis and data visualization, and attaches importance to the training of readers' basic, advanced and practical abilities in data literacy at different levels [10]. The 2013 White Paper on Information Literacy in the United States defines the content framework of data literacy. According to the White Paper on Information Literacy, Purdue University Library has developed data literacy education content suitable for the university, which is mainly designed based on scientific research. The teaching content is divided into research project initiation stage, research project research stage and research project completion stage, with different teaching emphasis in each stage. According to the characteristics of the students, the foreign university library formulates the corresponding teaching objectives, and designs the corresponding teaching contents according to the teaching objectives. It can be seen that the data literacy education in foreign university libraries has the characteristics of diverse education methods, rich teaching content, clear education levels and diversified education subjects.

3.2 Research on Data Literacy Education in China

China's data literacy education has been attached importance by the government level, and a number of data-related policies such as the "Action Outline for Promoting the Development of Big Data" and "Scientific Data Management Measures" have been introduced successively,

providing the development direction for data literacy education. From a national perspective, the current status of data literacy education in our country is at its nascent stage, necessitating exploration of diverse forms of data literacy education. University libraries that have begun to implement data literacy education have set up different levels of data literacy education courses for undergraduates, postgraduate students, doctoral students and scientific research teachers to cultivate readers' data awareness, basic data knowledge, data skills and data ethics [11]. The content of data literacy education is mainly data awareness, ethics and evaluation, data acquisition, data processing, data exchange, etc., so that readers can master the practical skills of data literacy. The substance of data literacy education at Tsinghua University and Peking University, which are the most representative of data literacy education in China, is mainly designed and formulated from the aspects of novice guide, resource recommendation, scientific research assistant, software tools and so on. The forms of data literacy education in China are also gradually diversified, mainly in the form of special lectures, seminars, workshops, online courses, resource recommendations, competitions, etc., which provide readers with learning opportunities and platforms for actual practice of data literacy. For example, Wuhan University Library offers the course "Data Literacy and Utilization of Data Literacy", Beijing Institute of Technology Library offers the course "Network Information Data Mining and Knowledge Management" and Nanjing Institute of Information Management offers the course "Data Thinking" to improve readers' data literacy. The main body of data literacy education also presents diversified development. For example, university libraries use the advantages of existing resources to carry out data literacy education activities; The secondary colleges in universities will also make use of the existing strong teachers to set up data literacy education courses, such as the School of library and information, the School of mathematics and statistics, the School of Computer science, the school of information engineering, etc. Various events and training conditions will be leveraged by data-related organizations in society to conduct activities related to data literacy education, such as Library and information society and data management organizations are

actively engaged in the implementation of data literacy education and training [12]. In order to expand business and carry out business activities, Internet companies also organize data literacy education activities, such as the MOOC platform of Chinese universities; In order for more people to use and purchase databases, database merchants organize data literacy education lectures, such as CNKI, Super Star merchants, etc.

4. The Existing Problems of Data Literacy in Chinese University Libraries

China lacks data literacy awareness from the government level, enterprise level, society level, school level and individual level, etc. Data literacy education for readers in most Chinese university libraries has not received adequate attention, and the educational focus on cultivating data literacy is comparatively rudimentary, and the number of courses and lectures offered is very limited. Their main awareness is still at the level of information literacy education, and the content involved in data literacy education is relatively small. Basically, it is the use of some common software tools, such as Excel, CiteSpace, SPSS, Python and other software, and these software teaching contents can be accessed at the advanced stage of information literacy education. At present, only some key universities in China have carried out data literacy education, and there has been an integration of data literacy education into information literacy programs, permeating the essence of data literacy throughout the educational content. The constraints of faculty and resources hinder ordinary university libraries from effectively conducting data literacy education. Presently, the embryonic stage characterizes the research depth of data literacy education in China, and there are still many shortcomings, which are mainly manifested in the object, content and form of data literacy education. The recipients of data literacy education in colleges and universities are primarily categorized into junior college students, undergraduates, master's students, doctoral students and scientific research teachers, etc. The focal point of data literacy education in numerous schools predominantly on undergraduate students, who have a large proportion of personnel and are the main objects of social talent demand. Junior college students, due to their relatively weak foundation, are

difficult to digest the content of data literacy education. Due to the high requirements on the content of data literacy education for master students, doctoral students and scientific research teachers, the general data literacy teaching staff can not bear the depth of education, resulting in the inability to carry out data literacy education activities. Data literacy education content in China lacks systematicity, and the instructional material regarding data awareness, data ethics and data evaluation is relatively weak. Most courses are set up in data analysis, but the depth of data mining is not enough to reflect the training of data application ability of readers. In certain pivotal university libraries, the emphasis of data literacy education content is directed towards data analysis and data management, and lacks the breadth of data literacy education content. The simplicity characterizing the form of data literacy education in China is evident, mainly sporadic lectures and training, lack of systematic and coherent, and the data literacy education for readers is not strong enough, deep enough, and widespread enough. At present, some university libraries publish courseware and videos related to data literacy education on the library homepage. Most university libraries have not yet released courseware and videos related to data literacy education. In summary, the varied educational needs of readers have not been fully met by the data literacy education offered in Chinese university libraries.

5. Improve the Optimization Path of Data Literacy Education for Readers

The university library has a unique resource advantage for the data literacy education of readers because it collects all kinds of data resources. The learning environment and learning atmosphere in the library play a certain role in driving readers' active learning. At present, more and more colleges and universities gradually begin to invest in data literacy education, and make reference to the data literacy education model of experienced university libraries. Data literacy education in libraries can be optimized by cultivating readers' data awareness, designing reasonable teaching content, constructing data literacy teaching system, integrating data literacy resource platform, and building professional and efficient data literacy teaching team.

5.1 Cultivate Readers' Awareness of Data

Data awareness runs through the whole data life cycle and dominates the whole process of data literacy education [13]. Data awareness is the sensitivity of data and the judgment of data value, including data value awareness and data security awareness. In the process of data literacy education, attention should be paid to the training of readers' data consciousness. Based on the needs of readers for data, readers are guided to search, sort, judge and analyze data until they learn to apply data, which can stimulate readers' awareness of data, promote their data exchange, increase their knowledge of data and cultivate their data ability. University libraries make use of their own resource characteristics and actual conditions to carry out extensive publicity and education activities related to data literacy, infiltrate more relevant content of data literacy education in activities, and publicize the importance of data literacy to readers through competition activities. For example, Shanghai International Studies University Library has held many library data analysis competitions with the theme of "Bring Python to Mining", providing readers with in-depth data mining and practical application opportunities, with the aim of augmenting readers' comprehension of the pivotal role played by big data in scientific research and daily life; The academic training of "Data Joy Reading" in Fudan University carries out data mining in actual scenarios [14]. Relevant publicity brochures, videos and books can also be made to deepen the data awareness of teachers and readers through case analysis, and new media means of libraries can also be used to infiltrate data awareness ethics education into the daily data literacy education [15]. The object of data literacy education can not be limited to the scope of universities, but also spread to the public, which is the social responsibility of university libraries. The Platform for Action to Enhance Digital Literacy and Skills for All, which will be issued in 2021, specifies that data literacy education should be accessible to the general public. Therefore, the cultivation of readers' data awareness should also take into account the public. Only by making readers improve their data awareness can they take the initiative to accept data literacy education and achieve a state of coordination between data literacy awareness and data literacy ability.

5.2 Design Reasonable Data Literacy Teaching Content

To carry out data literacy education in university libraries is inseparable from curriculum optimization design. In an Analysis of the Construction of Data Literacy Education System in University Libraries Based on the 5W Model, It was proposed by Wan Wenjuan that there should be a systematization of the content of data literacy education, which should be rationally designed from three aspects. The first is the combination of professionalism and general knowledge. The basic knowledge of data literacy education and data management theories and methods related to the subject field are the main, the second facet involves the fusion of theory and practice, with a primary focus on amalgamating theoretical knowledge of data and practical operational skills, the third is the content level progressive, which means that the design of each educational content should have a gradient and spiral structure, forming a logical and rigorous system. Depending on the data needs of our readers, we can divide the course into beginner, intermediate and advanced stages, each with a different level of content. Elementary courses are offered for general readers to understand basic data types and formats, access to and sources of data, and methods of data analysis and processing [16]. The courses mainly focus on improving data literacy awareness and data collection ability, such as "Data Acquisition and Rational Utilization" and "Excel Examples and Applications"; Intermediate level courses are offered for professional readers, focusing on cultivating students' ability of data discovery, acquisition and evaluation, focusing on improving data organization and data analysis skills, such as: Introduction to EPS Data Analysis Platform, From Excel to MySQL: Data Analysis, EndNote software, NoteExpress software, etc. Advanced level courses for research-level readers, focusing on the development of higher level of data literacy, data collection, data archiving and preservation, data management tools and the use of data repositories. Courses to improve the ability of data processing and data evaluation, such as: "Data processing and data utilization", SPSS statistical analysis courses, Python series of courses, etc. University libraries with insufficient conditions can penetrate data literacy education through special lectures, such

as special lectures, "embedded" lectures, third-party training, etc. And the relevant courseware or teaching video form a series on the library website, to provide online education for readers with data literacy needs.

5.3 Build Data Literacy Teaching System and Integrate Data Literacy Resource Platform

Information literacy was proposed as early as 1974. So far, information literacy education has formed a relatively complete education and teaching system in teaching content, curriculum design, practical application and other links, while data literacy education has developed relatively late, and there is no relatively complete education and teaching system at present. On the basis of the information literacy education system, the data literacy education in university libraries should make use of the existing educational concepts and methods to cultivate the data literacy ability of readers, and build a sustainable data literacy education system that includes all aspects of course content, teaching methods and practical guidance [17].

The data literacy education of university library should not only build a complete education and teaching system, but also a complete resource integration platform. First of all, the existing digital resources and paper resources of the library should be integrated to lay down the basic resources of data literacy education, and then the data analysis and collection of practical cases should be integrated. Data literacy education cannot be separated from a large number of cases for practical exercises, and then the integration should be carried out from the practical operation platform to contact social units with applied data environment. Provide readers with a practical platform for applying data practices. Data literacy education requires multi-party integration of data resources. Not only university libraries, but also library and information communities, as well as both inside and outside the industry, need to join forces to establish a multi-party cooperative data literacy education system [18], so as to create a broader education platform for data literacy education.

5.4 Build A Professional and Efficient Data Literacy Teaching Team

For the implementation of data literacy education in university libraries, we must first build a data literacy education team, and build an excellent data literacy teaching team. In data

literacy education, give play to the multidisciplinary advantages of team members. The members of the data literacy teaching team should have the basic ability of data service and related basic knowledge, involve in multi-field knowledge, and have high academic qualifications and professional titles to complete the course content of data literacy education and teaching. Data literacy has a strong interdisciplinarity, strengthens the connection between disciplines, and realizes the integration of multidisciplinary research [19], such as statistics, mathematics, physics, biology, sociology, computer science and economics. Therefore, the construction of data literacy teaching team can attract teaching staff from various aspects, and select and train professional librarians with data literacy from the subject librarians in the library. Teachers who teach data literacy related software are selected from a team of professional teachers, such as Python teachers, SPSS teachers, EndNote teachers and NoteExpress teachers [20]. Select personnel with teaching ability from database vendors of electronic resources; Select special talents with data literacy ability from all walks of life. Members of the data literacy teaching team should often carry out group discussions and learning activities, organize targeted training and communication for members of the teaching team, understand the progress of data literacy education development, learn from successful experiences, lay a solid educational foundation for data literacy education, and provide readers with better data literacy services. It is also helpful to improve the teaching level of the teaching team. Foreign university libraries also attach great importance to the training of data literacy librarians. Harvard University Library offers the "Data Scientist" course training for data librarians, with the purpose of continuously improving the data level and data literacy of data librarians and providing service reserve for the development of data literacy education. In China, the domain of data literacy education is still at an early stage of development, and there exists a need to construct an exceptional data literacy teaching team through comprehensive training, actual combat and communication in order to better train students with higher levels.

6. Conclusion

Data literacy education is both an opportunity and a challenge for university libraries, which

can improve readers' data literacy, but at the same time there are certain difficulties. At present, domestic research on data literacy education focuses on skills rather than consciousness, and readers' demands for data use should be fully understood under existing conditions. To facilitate the execution of data literacy education within library settings, the data consciousness and related contents of data literacy education should be permeated into the personalized service of library. The use of data analysis methods and data processing tools by university students needs to be improved, thus constituting a focal point for research in the realm of data literacy education within university libraries. In this process, the library gives full play to its own advantages, combines the characteristics of data literacy education, actively responds to difficulties and challenges, and timely rectifying deficiencies in the education process to achieve the optimization of data literacy education effects. We should also take the construction of first-class disciplines as an opportunity to customize special data literacy education courses for superior disciplines and develop deep services for library data literacy education.

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