Postprint: Information Science-Oriented Talent Cultivation for Data Science and Big Data Technology

Authors: Chen Mo, Li Guangjian, Chen Congcong

Date: 2023-07-26T00:00:00+00:00

Abstract

[Purpose/Significance] As a humanities and social science discipline with strong computational characteristics, information science embodies features of data science. Big data-related technologies can provide effective means for information science. Therefore, establishing a "Data Science and Big Data Technology" program oriented towards information science, and cultivating interdisciplinary talents equipped with big data thinking, solid foundational knowledge in information science, mastery of big data processing technologies and analytical theories, and the ability to apply these to information science theory and practice, can promote the development of the information science discipline. [Method/Process] This study investigates the training objectives

Full Text

Talent Training for Information Science-Oriented "Data Science and Big Data Technology" Major

Chen Mo, Li Guangjian, Chen Congcong
Department of Information Management, Peking University, Beijing 100871

Abstract

[**Purpose/Significance**] As a computational humanities and social sciences discipline, information science possesses characteristics of data science, and big data-related technologies can provide effective means for information science. Therefore, establishing an information science-oriented "Data Science and Big Data Technology" major to cultivate interdisciplinary talents with big data thinking, solid information science foundations, mastery of big data processing

technologies and analytical theories, and the ability to apply them to information science theory and practice can promote the development of the information science discipline. [**Method/Process**] We investigated the training objectives and curriculum models of big data-related majors at home and abroad, summarized the developmental characteristics of disciplinary education, and designed a talent training plan for an information science-oriented big data major based on domestic teaching resources. [**Result/Conclusion**] Information science and big data are both connected and distinct. Information science provides basic research methods for big data, promotes multi-source data fusion, and broadens the application fields of big data. Big data provides more possibilities for information science research, enriches research methods, improves research efficiency, and expands research scope. The training of information science-oriented big data and data science professionals is both necessary and irreplaceable. The disciplinary system requires further reform and innovation, with more emerging courses that closely integrate big data and information science, such as literature big data analysis and user big data research, to systematically cultivate students' ability to integrate and innovate information science domain knowledge with computer technology and big data technology.

1 Introduction

With the advent of the big data era, data across various industries has experienced rapid growth, and data resources have become important modern strategic resources. Consequently, the construction of data science disciplines and the cultivation of big data talents have attracted widespread attention from academia and educational circles. Since North Carolina State University first established a "Data Analytics" master's program in 2007, numerous universities in the United States have successively launched "Data Analytics" or "Data Science" programs, involving not only traditional computer, mathematics, and statistics departments but also humanities and social sciences departments such as library and information science. For example, the Faculty of Humanities, Archives, and Information Studies at the University of Amsterdam has established the "Information Studies: Data Science" program. Compared with foreign countries, Chinese universities started relatively late in big data and data science education, with Beihang University pioneering the effort by offering a "Data Science" master's program in 2013. In 2016, the Ministry of Education approved Peking University, the University of International Business and Economics, and Central South University to add the "Data Science and Big Data Technology" undergraduate major for the first time. By the end of 2018, a total of 283 domestic universities had been approved to establish this undergraduate major. Among these universities, the departments undertaking this major construction vary, reflecting the educational characteristics and talent features of each school and college.

In recent years, the information science field has increasingly emphasized big data research. The question of whether the talents cultivated by existing disci-

plines can meet social needs has attracted widespread attention in the field. For instance, Su Xinning pointed out that big data has brought opportunities for the development of information science, and the reform of information science teaching systems should focus on leveraging strengths and avoiding weaknesses, concentrating on intelligence technology research [1]. Ba Zhichao et al. argued that information science should promote extensive interdisciplinary integration with various disciplines in multiple ways to build a diversified, open, and interactively coordinated disciplinary ecosystem [2]. Su Rina et al. discussed the positioning of data science within library and information science disciplines, the integration of data science with traditional library and information science courses, and talent training issues, using 15 iSchools universities as research subjects [3].

Against this background, this paper explores issues related to undergraduate education in data science and big data majors. We first conducted extensive investigations into the training objectives, teaching content, and curriculum plans of big data majors at home and abroad, summarizing the characteristics of big data major teaching content. We then combined domestic realities to summarize the necessity of constructing a data science and big data technology major based on information science. Finally, we preliminarily designed the curriculum and training objectives for an information science-oriented big data professional talent training program.

2 Investigation of Big Data Education at Home and Abroad

As early as the late 20th century, foreign universities attempted to offer data science-related majors and courses. To date, the disciplinary fields of foreign big data education have shown diversified characteristics, with big data majors offered in computer science, mathematics and statistics, economics and management, biology and medicine, science and technology, journalism and media, and other disciplinary fields, each with distinctive curricula and research directions. Ruan Jing et al. [4] summarized seven main directions for foreign big data-related master's talent training: information systems, data science, health care, business analytics, applied statistics, business intelligence, and MBA big data direction. Among the iSchool alliance of over 60 information schools in the United States, many library and information science departments have established data science and big data technology majors [5].

Unlike foreign countries where most big data-related majors target master's students, Chinese higher education focuses more on undergraduate education. In 2016, the Ministry of Education's "2015 Undergraduate Major Filing and Approval Results" [6] first added the "Data Science and Big Data Technology" undergraduate major, approving three universities—Peking University, the University of International Business and Economics, and Central South University—to establish this major. Subsequently, 32 universities were added in 2017 [7] and 248 in 2018 [8], as shown in Figure 1 [Figure 1: see original paper]. By 2018, a total of 283 domestic universities had been approved for the "Data Science

and Big Data Technology" major, including 36 "985" and "211" universities (accounting for 13%). The major has a four-year duration and grants engineering or science degrees. Peking University, Renmin University, Shanghai University of Finance and Economics, and other institutions have established this major in multiple departments. However, no library and information science or other humanities and social science departments have yet offered this major in China.

Our investigation of training objectives, teaching content, and curriculum plans for big data-related majors at home and abroad reveals two notable characteristics: first, a hierarchical curriculum system has been formed; second, specialized orientations integrated with the host discipline have emerged.

2.1 Hierarchical Curriculum System Data science is an interdisciplinary discipline that takes big data as its research object. Its theoretical foundation primarily comes from computer science, applied mathematics, and information management and information systems, among other related disciplines. Moreover, since big data itself exists only within various fields and industries—not as simple data accumulation independent of any industry or discipline—processing big data also requires specialized knowledge of the field or industry to which the big data belongs, such as economics, law, biology, medicine, and other disciplinary knowledge. In practice, domestic and international big data majors have developed a relatively clear three-level curriculum system, as shown in Table 1 . The top level is the application layer, which involves application scenarios using big data and data science concepts and methods to solve problems, essentially the core and key knowledge of disciplines that generate big data, such as biomedicine, business management, science and technology management, and e-commerce. The middle level is the methodology layer, consisting of big data and data science concepts, methods, and technologies. Courses at this level provide students with basic concepts, methods, techniques, and tools for processing big data, and when combined with application layer knowledge, provide models and algorithms for big data processing in specific fields, training students to understand, abstract, and model application data for processing and analysis on underlying computing platforms. The bottom level is the foundation layer, mainly including basic disciplinary courses in statistics, mathematics, and computing theory and technology, which are currently recognized as the foundational disciplines for big data and data science.

For example, the curriculum of the "Data Science and Big Data" major at the School of Information, University of International Business and Economics [9] clearly demonstrates hierarchical characteristics. Its curriculum system is divided into four modules: mathematics foundation, computer foundation, big data technology and methods, and economics, management, and law, corresponding to the foundation, methodology, and application layers, as shown in Table 2 . The mathematics and computer foundation modules primarily cultivate students' basic capabilities in traditional information technology industries and provide foundational knowledge for methodology layer courses related to

data science and big data technology. Big data technology and methods courses aim to equip students with data analysis and modeling capabilities, big data processing technologies, and the ability to understand, abstract, analyze, model, and develop solutions to data science problems. The economics, management, and law module involves courses related to economics, management, and law, enabling students to understand knowledge of specific data industries and supporting their literacy and knowledge reserves for data analysis work in economic, financial, management, logistics, and business fields.

2.2 Specialized Orientations The second characteristic of big data major education is the formation of distinctive specialized orientations. Currently, big data majors at domestic and international universities are all developed based on existing majors, usually combined with the original research fields and directions, with certain emphases in talent training objectives. The training models can basically be summarized into three categories: technology-oriented, computation-oriented, and professional field-oriented.

2.2.1 Technology-Oriented Big Data Education Technology-oriented big data education is currently the mainstream orientation for domestic and international big data and data science-related majors, primarily cultivating talents oriented toward big data technology research and application. It emphasizes students' computer development capabilities to design new big data-related systems, technologies, or programs, with greater emphasis on mastering the cutting-edge status and trends of big data technology and practical abilities in big data platform and tool development and data processing system construction. The curriculum system of such majors is more closely integrated with computer technology and theory, usually established in computer science or information schools. Examples include the Data Analytics major at the University of Warwick's Computer Science Department, the Data Science and Big Data Technology major at the University of Electronic Science and Technology of China's School of Computer Science and Engineering, and the Data Science and Big Data Technology major at Beijing University of Posts and Telecommunications' School of Computer Science. Table 3 shows the technology-oriented curriculum using Beijing University of Posts and Telecommunications as an example.

2.2.2 Computation-Oriented Big Data Education Computation-oriented big data education focuses more on cultivating talents in big data algorithms and general modeling, developing students' abilities to create new big data-related algorithms, models, or methods. It requires students to be proficient in data analysis theories and methods and capable of solving large-scale or complex data processing problems. The curriculum system of such majors often includes numerous mathematics and statistics courses with deeper study in computation and modeling, usually established in mathematics or statistics schools. Examples include the Operational Research with Data Science major at the University of Edinburgh and the Data Science master's

program at New York University's Courant Institute of Mathematical Sciences [10]. Table 4 shows New York University's specific curriculum.

New York University was the first university in the world to create a "Data Science" master's program, recruiting students with backgrounds in mathematics, computer science, and applied statistics, focusing on developing new methods for data science. Compared with undergraduate curricula, the master's program has fewer courses. In addition to foundational courses such as Introduction to Data Science, Big Data, and Machine Learning, the curriculum includes more computation and algorithm courses such as Optimization-based Data Analysis, Optimization and Computational Linear Algebra, and Probability and Statistics for Data Science.

2.2.3 Professional Field-Oriented Big Data Education Professional field-oriented big data education typically cultivates big data professionals in specific industry fields, requiring students to master big data technologies and methods while having sufficient understanding of professional knowledge in specific fields such as finance, biology, and medicine. This type of major education has lower requirements for students' big data technology or modeling capabilities, only requiring them to be able to use relevant methods and technologies in specific fields. Currently, such majors are usually established in discipline-specific schools corresponding to the field, such as King's College London's Big Data in Culture and Society major in the Digital Humanities Department [11], which links big data to culture, law and ethics, geography, public health, and social life, aiming to solve theoretical and practical problems of big data from arts and humanities perspectives. The specific curriculum is shown in Table 5 .

In China, professional field-oriented data science and big data technology majors are mostly combined with management and economic-finance fields, such as Fudan University's School of Management, Peking University's Yuanpei College, and Peking University's School of Mathematical Sciences [12]. Table 6 shows the curriculum of Peking University's School of Mathematical Sciences as an example.

Peking University was one of the first three universities to establish the "Data Science and Big Data Technology" major, currently offered by the School of Electronics Engineering and Computer Science, Yuanpei College, and the School of Mathematical Sciences. The major in the School of Mathematical Sciences focuses on internet finance analysis, with a curriculum system that includes numerous mathematics and statistics foundation courses as well as applied courses in economics and finance, cultivating students' ability to apply big data theories and methods to economic and financial fields.

In summary, compared with the mature environment of foreign data science-related majors, domestic "Data Science and Big Data Technology" major education is still in its initial exploration stage, with many shortcomings. Foreign-

related majors have developed over a long period, while domestic undergraduate education has only formally existed for about three years, and master's education is mostly in the exploratory stage, with the entire disciplinary education environment still immature. Abroad, this discipline field shows diversified characteristics, widely involving multiple disciplines beyond computer science, while domestically, the major is mostly established in computer technology or economics and management-related schools, with a few in mathematics, medical care, and other related schools, but rarely in other fields, resulting in insufficient diversification of development directions. Although most domestic institutions' major curriculum systems show clear hierarchy, at the application level, they mostly simply retain characteristic courses from original majors, with few curricula that closely integrate big data with the original major, showing insufficient innovation in curriculum design.

However, although domestic "Data Science and Big Data Technology" majors started late and lack diversified coverage of professional fields and specialized curriculum design, the initial stage of domestic discipline establishment covered a broad range of undergraduate institutions, with "985" and "211" universities accounting for only about 13%, which is conducive to the comprehensive cultivation of big data-related talents.

3 Data Science and Big Data Major Based on Information Science

3.1 Significance of Discipline Construction Information science refers to a humanities and social sciences discipline that uses modern information technology and soft science research methods as primary means, with the series of processes of information collection, selection, evaluation, analysis, and synthesis as basic procedures, to form new or value-added intelligence products to meet users' different specific needs and serve scientific decision-making at different levels [13]. In recent years, with the development of big data technology, the talent market in the library and information science field has gradually demanded mastery of data science and big data technology-related skills. For example, the 2018 autumn recruitment season for university graduates showed that among over 100 information science-related positions nationwide, many explicitly mentioned hoping candidates would master big data-related skills or have relevant experience. Guangdong Shuding Technology Co., Ltd. required data analysis capabilities and proficiency in statistical software such as SAS in its recruitment information for intelligence information analysts [14]. Changsha Library in Hunan Province also emphasized that candidates should have strong big data analysis capabilities and good qualitative analysis abilities when recruiting operations specialists [15].

Information science emerged after World War II and, through long-term development, has formed a unique set of research methods and theoretical systems. The concept of big data emerged in the late 20th century, and in its development process, it has integrated theories and methods from multiple disciplines, including information science. Many methods in information science can enrich the

big data methodology system and help improve the efficiency of big data technology. For example, citation analysis methods in information science can help filter key information sources, thereby improving the efficiency of text analysis and mining and serving as pre-processing assistance for big data mining.

The so-called "big data" is composed of specific data; there is no abstract "big data." Whether it is "big data" studied in the computer field or "big data" studied in statistics and mathematics fields, it is all combined with its research field to solve specific problems in the corresponding field, not pure "big data" problems. The value of big data depends on domain knowledge and experience, and the value of big data is exerted and diffused through domain disciplines. Library and information institutions are also members of the big data industry and are closely related to big data. For example, hospitals or medical research institutions apply big data technology to the medical field, using medical big data to help improve medical services; commercial consulting companies, banks, and other institutions analyze business big data to help with rating and decision-making; transportation and public management departments process urban traffic big data to help with vehicle scheduling and reduce traffic pressure. Library and information institutions such as libraries, CNKI, and SCI also provide book and literature information services to the public through literature big data analysis.

Establishing information science-based big data major education belongs to the third type of professional field-oriented big data education model mentioned above. This type of professional education needs to solve two main problems: first, whether the relevant major needs big data education, or whether there is a necessary connection between the existing major and big data; second, the relationship between the established big data education and existing professional education, that is, whether there are differences between the two. The following attempts to answer these two questions based on the characteristics of information science itself.

3.1.1 The Relevance Between Information Science and Big Data Big Data Analytics (BDA) is the core of big data concepts and methods, referring to the process of analyzing massive, diverse, rapidly growing, and authentic data (i.e., big data) to identify hidden patterns, unknown correlations, and other useful information that can aid decision-making [16]. Compared with the definition of information science mentioned earlier, both take information and data as basic resources and research objects. Data originally came from measurement—the so-called "well-founded numbers"—as records of measurement results of the objective world, not randomly generated. Nowadays, the content of data has expanded to include not only well-founded numbers but also all information stored in computers, which are no longer measurement data but records of the objective world [17]. Big data includes not only structured data but also unstructured data. Literature, text, and behavioral data traditionally studied in information science can all become a form of big data. Both information sci-

ence and big data technology require data collection and processing to utilize the value brought by data. For example, Min Song et al. used citation analysis on large-scale biomedical literature data to discover hidden connections between drugs and diseases, contributing to clinical experiments in biomedical research [18]. Feng Yuanwei [19] proposed building knowledge graphs of character relationships to help query basic information such as life trajectories and social relationships, bringing convenience to public security intelligence work.

Moreover, with the development of the information science discipline and society, intelligence analysis has presented new characteristics, gradually focusing on computational methods, multi-source data fusion [20], and in-depth content analysis, requiring the construction of large-scale knowledge graphs and social networks based on massive data. These are tasks that traditional information science cannot complete and require new concepts and methods for support. This necessitates the combination of information science and big data technology, which can not only deepen the research depth and improve research efficiency of information science but also promote the development of big data methods and technology, achieving common progress in both disciplines.

3.1.2 The Irreplaceability of Information Science-Oriented Data Science and Big Data Major Information science-oriented big data analysis is both connected to and different from other fields of big data analysis. Although both study data as their research object, information science-related big data mainly studies literature big data, text big data, and behavioral big data. Information science places greater emphasis on resource collection and organization services, with clear task orientation and established patterns when conducting data analysis, while other discipline-oriented big data analyses focus more on analyzing the data itself to discover new patterns.

Information science has also accumulated a set of theories and methods for processing such data, including classification and subject ideas and methods, authority files, metadata, bibliometrics, citation analysis, and intelligence analysis theories and methods. The combination of information science and big data concepts and methods will enrich the content of information science, improve the accuracy and efficiency of intelligence work. For example, previous research mostly analyzed literature external features represented by metadata, such as keywords, abstracts, and subject terms. Relying on data science and big data technology enables more fine-grained research within literature, such as word vector analysis and text mining, thereby opening new horizons for literature research and enriching research content.

Therefore, the information science-oriented data science and big data major cannot replace or be replaced by other discipline-oriented majors, as each has its specific research content and focus that other disciplinary fields cannot accomplish. Additionally, information science-oriented big data education is not simply an expansion or extension of information science education and cannot be replaced by information science education. The establishment of an informa-

tion science-oriented data science and big data major aims to fill current gaps in disciplinary professional education, enriching the disciplinary applications of big data and data science majors while conforming to contemporary characteristics and promoting the cultivation of big data and data science professionals in library and information science disciplines.

3.2 Training Objectives The information science-oriented "Data Science and Big Data Technology" major aims to cultivate high-level interdisciplinary talents with big data thinking and solid information science foundations, mastery of big data processing technologies and analytical theories, familiarity with big data technologies and methods, and the ability to use statistical vector analysis, machine learning, text mining, and other technologies to extract meaningful information for information science research and practice from massive data, and to display it using social networks and knowledge graphs. The program systematically cultivates students' ability to solve typical problems in information science within big data applications, practically improving students' ability to solve real-world problems and cultivating their ability to integrate and innovate information science domain knowledge with computer technology and big data technology. Students who meet the major training and graduation requirements will be awarded a Bachelor of Management degree.

3.3 Curriculum Design Combining the above four modules and based on the "foundation layer-methodology layer-application layer" hierarchical system, the curriculum system for the information science-oriented data science and big data technology major is designed as shown in Figure 2 [Figure 2: see original paper].

The bottom layer is the foundation layer courses, representing basic courses in statistics, mathematics, and computer application technology. The middle layer is the methodology layer, representing data science methodology courses that provide theories and technologies for understanding, abstracting, and modeling big data and implementing them on underlying computing platforms. The top layer is the application layer, representing application scenarios that need to use data science to solve information science problems, including basic information science courses and frontier characteristic courses that integrate information science and big data.

4 Conclusion

Facing the multi-level talent demands for data science in the big data era, the data science and big data technology major requires not only computer, mathematics, and statistics backgrounds but also needs humanities and social sciences fields such as information science that are based on data to jointly promote development. Information science and big data are both connected and distinct. The research objects of both include data, and the value of big data depends on the integration of various disciplines. Meanwhile, library and information

institutions are also members of the big data industry. Information science provides basic research methods for big data, promotes multi-source data fusion, and broadens the application fields of big data. Big data provides more possibilities for information science research, enriches research methods, improves research efficiency, and expands research scope. The training of information science-oriented big data and data science professionals is both necessary and irreplaceable, filling the gap in this professional education in China.

Although domestic big data-related major education is still in the initial exploration stage with a short development time and many shortcomings, the covered disciplinary fields need to be continuously enriched according to market and social development demands. The participation of library and information science disciplines such as information science can also promote the development of big data technology, enrich the disciplinary system, and facilitate interdisciplinary integration, helping to cultivate more interdisciplinary application and research talents. Furthermore, the disciplinary system requires further reform and innovation to promote the establishment of more emerging courses that closely integrate big data with original majors, thereby enriching the curriculum system and improving teaching quality and effectiveness.

References

[1] Su Xinning. Reflections on the Rise of Information Science in the Big Data Era [J]. Journal of the China Society for Scientific and Technical Information, 2018, 37(5): 451-459.

[2] Ba Zhichao, Li Gang, Zhou Liqin, et al. Data Science and Its Impact on the Transformation of Information Science [J]. Journal of the China Society for Scientific and Technical Information, 2018, 37(7): 653-667.

[3] Su Rina, Yang Qin. Research on Data Science Curriculum System Setting in LIS Disciplines: Centered on Curriculum Investigation of iSchools Universities [EB/OL]. [2019-03-19]. http://kns.cnki.net/kcms/detail/44.1306.G2.20181009.0828.002.html.

[4] Ruan Jing, Liu Hongjing, Ji Hong. Experience and Enlightenment of Foreign Big Data Master's Talent Training: Based on Big Data Text Mining [J]. Statistics & Information Forum, 2017, 32(9): 29-36.

[5] Zeng Yueliang. Characteristics and Enlightenment of Foreign iSchools Data Science Program Talent Training Models [J]. Knowledge, Learning and Management, 2018, 184(4): 109-118.

[6] Ministry of Education of the People's Republic of China. Notice on the Announcement of 2015 Undergraduate Major Filing and Approval Results [EB/OL]. [2018-07-01]. http://www.moe.edu.cn/srcsite/A08/moe_{1034}/s4930/201603/t20160304_{231794

[7] Ministry of Education of the People's Republic of China. Notice on the Announcement of 2016 Undergraduate Major Filing and Approval Results [EB/OL]. [2018-07-01]. http://www.moe.gov.cn/srcsite/A08/moe_{1034}/s4930/201703/t20170317_{299960}

[8] Ministry of Education of the People's Republic of China. Notice on the Announcement of 2017 Undergraduate Major Filing and Approval Results [EB/OL]. [2018-07-01]. http://www.moe.gov.cn/srcsite/A08/moe_{1034}/s4930/201803/t20180321_{330874}

[9] University of International Business and Economics. Training Program for Data Science and Big Data Technology Major, School of Information [EB/OL]. [2018-07-01]. http://jwc.uibe.edu.cn:82/ADMINUI/UploadFiles/files/1_{linjingtan}/20171020154008394.pd

[10] New York University. MS in Data Science Curriculum [EB/OL]. [2018-07-01]. https://cds.nyu.edu/academics/ms-in-data-science/curriculum.

[11] King's College London. Big Data in Culture & Society [EB/OL]. [2018-07-01]. https://www.kcl.ac.uk/study/postgraduate/taught-courses/digital-humanities-ma.aspx.

[12] Peking University. Peking University Undergraduate Teaching Plan (2016 Edition) (Science Volume) [EB/OL]. [2018-07-01]. http://www.dean.pku.edu.cn/userfiles/upload/download/20

[13] Bao Changhuo. Methodology of Intelligence Research [M]. Beijing: Scientific and Technical Documentation Press, 1990.

[14] Guangdong Shuding Technology Co., Ltd. Recruitment Information [EB/OL]. [2019-02-02]. http://www.yingjiesheng.com/job-003-813-711.html.

[15] Changsha Library, Hunan Province. Recruitment Information [EB/OL]. [2019-02-02]. http://www.yingjiesheng.com/job-003-850-173.html.

[16] Whitehouse. Big Data Across the Federal Government [EB/OL]. [2018-07-01]. http://www.Whitehouse.gov/sites/default/files/microsites/ostp/big_{{{data}}}*{{fact}}*{{{sheet}}}_{{fi

[17] Tu Zipei. Big Data and Its Causes [J]. Science and Society, 2014, 4(1): 14-26.

[18] Song M, Kang K, Ju Y. Investigating Drug-Disease Interactions in Drug-Symptom-Disease Triples via Citation Relations [J]. Journal of the Association for Information Science and Technology, 2018, 69(11): 1355-1368.

[19] Feng Yuanwei. Design and Implementation of Character Relationship Based on Knowledge Graph [D]. Chongqing: Chongqing University, 2016.

[20] Li Guangjian, Hua Bolin. Analysis of the Relationship Between Big Data Analysis and Intelligence Analysis [J]. Journal of Library Science in China, 2014, 40(5): 14-22.

Author Contributions

Chen Mo: Responsible for data collection, investigation and analysis, and article writing and revision.
Li Guangjian: Provided research themes, research ideas, and article review and revision.
Chen Congcong: Responsible for investigation and analysis of domestic university majors and article writing.