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Curriculum Design for the Major of Big Data Management and Application under the New Liberal Arts Paradigm

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Abstract: *This paper delves into curriculum development for the Major of Big Data Management and Application under the New Liberal Arts paradigm, addressing the growing demand for big data professionals in the digital transformation era. The research begins with a review of global and Chinese big data development strategies and talent availability, defining the program's orientation as providing a solid foundational education, broad knowledge, interdisciplinary integration, and strong practical application capabilities. Subsequently, the paper proposes a structured curriculum comprising general education, professional foundational courses, core courses, electives, and extracurricular activities. It emphasizes the importance of layered practical teaching systems, innovative teaching methods, and evaluation reforms, highlighting interdisciplinary faculty teams and university-industry collaboration. Using curriculum reform experiences at University H as a case study, the effectiveness of this system in enhancing students' comprehensive qualities, practical abilities, and innovation skills is validated. Findings suggest that this curriculum not only preserves the strengths of humanities and social sciences but also integrates cutting-edge big data technologies, thus providing theoretical and practical pathways for cultivating interdisciplinary talents for the digital economy and guiding future curriculum updates.*

Keywords: *New Liberal Arts; The Major of Big Data Management and Application; Curriculum Development*

1. Introduction

1.1 Background and Significance of New Liberal Arts Construction

Since the dawn of the 21st century, the digital transformation has profoundly impacted all industries worldwide[1]. Big data, as a crucial element of the digital economy, has become a strategic resource driving high-quality economic and social development. Numerous countries have elevated big data to the level of a national strategy. In 2015, China's State Council issued the Action Plan for Promoting Big Data Development, clearly emphasizing the need for accelerated talent cultivation to support national innovation strategies[2]. However, the current supply of big data professionals significantly lags behind market demand. According to China's first Big Data Talent Report, the country currently has only about 460,000 big data professionals, with a projected shortage of about 1.5 million in the next 3–5 years[3]. A report from Tsinghua University's School of Economics and Management in 2017 similarly highlights the severe shortage of digital economy professionals, particularly in the big data sector[4].

The world is undergoing unprecedented changes, with data becoming as critical as traditional production factors. Technologies such as cloud computing, IoT, and blockchain have significantly accelerated digital transformations, creating unprecedented volumes of data. The value extraction from such massive datasets requires talents with substantial data literacy and analytical skills. Recognizing this, in September 2020, the National Natural Science Foundation of China launched the "Big Data-Driven Management and Decision-Making Research" initiative, aiming to uncover mechanisms and rules of paradigm shifts in management and decision-making, establish comprehensive big data management and decision-making theories, and develop data analytical techniques and computational methods for applications in public management, commerce, finance and healthcare[5].

In this context, higher education institutions bear the historical mission of rapidly developing high-

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quality big data professionals to bridge the talent gap and serve national strategic needs. Chinese higher education is actively promoting the construction of the "New Four Disciplines"—New Engineering, New Medical Science, New Agriculture, and New Liberal Arts—to address emerging technological revolutions and industrial changes. The New Liberal Arts aims to improve the quality and innovation capacity of humanities and social sciences through comprehensive reforms and interdisciplinary integration, focusing on human-centered education. It emphasizes cultivating interdisciplinary talents who combine solid humanities foundations with modern information technologies and data-driven problem-solving capabilities. Since 2019, China's Ministry of Education has initiated research and reform projects in the New Liberal Arts, promoting interdisciplinary integration and transformation.

The emergence of the New Liberal Arts represents not only innovation in traditional liberal arts education but also a breakthrough of the historical division between sciences and humanities. It addresses society's urgent demand for interdisciplinary talents and aligns with the trend of interdisciplinary knowledge fusion. Its core is deeply integrating humanities and social sciences with information technology to cultivate "humanistic scholars of the data era" and "technological experts with humanistic insights".

Research on data science education internationally often emphasizes technical skills grounded in science and engineering backgrounds[6,7], rarely deeply integrating humanities and data technologies[8,9]. While Chinese studies focus on big data management under liberal arts frameworks, most discussions revolve around talent cultivation models[10,11] and specific big data-related courses[12-15]. Comprehensive curriculum development studies for Big Data Management and Application under the New Liberal Arts paradigm are limited.

With expanding big data applications, industry demand has shifted from purely technical skills to interdisciplinary competencies. Data-driven decision-making has become a fundamental paradigm across industries, requiring talents proficient not only in technical aspects such as data collection, cleansing, storage, analysis, and visualization but also in understanding business contexts, data ethics, and decision support. Current surveys indicate a curriculum imbalance, with technical courses heavily outweighing management and humanities courses, diverging from the New Liberal Arts philosophy.

Thus, achieving deep integration of humanities and data technology in curriculum structure, teaching content, practical training, and evaluation remains an urgent research topic. Future curriculum designs should balance technology with critical thought, professional specialization with general education, and theoretical learning with practical application. This perspective underlines the significance and practical value of this study.

1.2 Research Objectives and Framework

The Major of Big Data Management and Application emerged under the New Liberal Arts paradigm, requiring curricula that fully embody interdisciplinary integration and innovative practices. This study tackles two primary challenges: firstly, transcending traditional disciplinary barriers to deeply integrate management, computer science, and social sciences; secondly, establishing a layered practical teaching system to enhance students' technical application capabilities and foster innovation.

The research framework involves clearly defining professional objectives based on the New Liberal Arts and market needs, proposing systematic curriculum modules, practical teaching systems, and reforming teaching methodologies. Finally, the effectiveness of this curriculum structure is validated through a detailed case study at University H. The findings aim to provide theoretical and practical guidance for similar programs, fostering interdisciplinary talents essential for digital economy development.

2. Positioning of the Major of Big Data Management and Application under the New Liberal Arts Paradigm

2.1 Background of Program Establishment and Talent Demand Analysis

The Major of Big Data Management and Application is a newly established interdisciplinary undergraduate program tailored to address the demands of the digital economy and intelligent society. The Ministry of Education officially included this major in the undergraduate catalog in 2019, and numerous universities have launched the program since 2020. Its goal is to cultivate interdisciplinary talents proficient in data science methodologies and possessing management decision-making abilities

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and industry-specific knowledge, thus addressing the urgent industry demands for "Big Data + X" professionals.

As big data applications have penetrated various sectors, including finance, healthcare, governance, and commerce, industry requirements for big data talents have become increasingly diverse. Therefore, higher education institutions must ensure both general and specialized skills. For instance, healthcare sectors require professionals versed in medical knowledge and data analytics, while the financial industry needs specialists knowledgeable in economic theory and skilled in big data technologies. Thus, the Major of Big Data Management and Application emphasizes cultivating students with a robust theoretical foundation and broad interdisciplinary knowledge, enabling them to apply big data techniques to complex industry-specific issues effectively.

2.2 Significance of New Liberal Arts for Professional Development

Under the New Liberal Arts paradigm, the Major of Big Data Management and Application fulfills an interdisciplinary role bridging traditional liberal arts and engineering disciplines. Unlike traditional engineering-oriented big data programs focusing on technical implementation, this program stresses integration between humanities, social sciences, and data technologies[16]. Research reveals that the curriculum of this major exhibits distinct interdisciplinary attributes within the New Liberal Arts framework, incorporating disciplines such as management, economics, statistics, computer science, information science, as well as legal and ethical studies. It aims to foster students' data literacy, critical thinking, and social responsibility.

This approach aligns with the "preserving core values while innovating" principle of the New Liberal Arts paradigm—maintaining the human-centered educational philosophy emphasizing ethical awareness and humanistic care, and integrating innovative big data technologies to enhance educational relevance. Consequently, the curriculum design combines traditional liberal arts strengths (theoretical reasoning and humanistic principles) and engineering methods (practical training and project-based learning), aiming to develop a new educational model blending humanities, sciences, theory, and practice effectively.

3. Curriculum Construction Plan for Major of Big Data Management and Application

3.1 Overall Curriculum Structure

Developing a high-quality curriculum for the Major of Big Data Management and Application necessitates an integrated design covering general education, professional education, and practical instruction, forming a clear, coherent, and interconnected curriculum structure.

General Education Module: This module serves to establish a foundation in humanities, social sciences, and scientific literacy for students. It includes courses such as Marxist theory, elective courses in humanities and social sciences, mathematics, statistics, and introductory computer science. This module fosters students' correct values, communication and writing skills, and strong quantitative reasoning. Under the New Liberal Arts paradigm, general education emphasizes comprehensive student development, providing a broad intellectual foundation for subsequent specialized learning.

Professional Foundation Module: This includes courses such as principles of management, economics, management information systems, programming fundamentals, data structures, database principles, and statistics and probability theory. These foundational courses equip students with essential theories and technical skills in "Big Data + Management," enabling deep understanding of business management frameworks and systematic proficiency in data collection, storage, and processing.

Professional Core Module: The core curriculum, aligned with the program’s objectives, includes courses such as Introduction to Big Data, Data Mining and Machine Learning, Big Data Storage and Management, Data Analysis and Visualization, Introduction to Artificial Intelligence, Business Intelligence and Decision Support, and Data Governance and Security. These courses emphasize practical big data technology applications, combining theoretical knowledge with case studies, thereby enhancing students' comprehensive understanding and practical capabilities in managing the complete lifecycle of big data. Depending on institutional strengths, courses related to specific industries such as healthcare, finance, or government data can be incorporated, highlighting the professional uniqueness of "Big Data + X."

Electives and Extracurricular Module: Elective offerings such as blockchain technology, cloud

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computing fundamentals, data law and regulations, alongside extracurricular activities including competitions, innovation projects, and industry internships, are designed to broaden students' knowledge base and practical capabilities. These extracurricular engagements serve as valuable supplements to formal curricula, fostering students' innovation and practical skills by providing opportunities to apply theoretical knowledge to complex real-world scenarios.

3.2 Practical Teaching System Design

Considering the emphasis placed on practical skills within the big data domain, a tiered, progressively sophisticated practical teaching system is imperative. Practical education spans the entire undergraduate experience, structured across four incremental stages:

Basic Practical Stage: Through laboratory experiments and course assignments, students develop proficiency with basic software tools and programming. For example, Python programming assignments in introductory courses and SQL database projects provide foundational technical skills.

Cognitive Practical Stage: Internships, corporate visits, and field studies expose students to real-world big data applications, fostering problem awareness and industry insights. Activities may include visiting data companies or smart-city projects and compiling analytical reports to enhance practical industry understanding.

Integrated Practical Stage: Comprehensive laboratory projects, case studies, and big data competitions encourage students to solve complex real-world problems collaboratively, strengthening teamwork and project management skills. For instance, data analytics projects require student teams to execute end-to-end processes—from data acquisition and cleansing to analysis and visualization.

Innovative Practical Stage: Students engage in research projects supervised by faculty or independent entrepreneurial projects culminating in graduation theses or designs. Here, students propose innovative big data solutions tailored to specific industry challenges, exemplifying interdisciplinary integration.

Each stage builds upon the previous, systematically enhancing students' practical abilities and innovation capacity. Universities should foster close partnerships with enterprises and research institutions, establishing practical training bases, employing industry experts as instructors, and continuously aligning teaching content with industry developments. Such university-industry collaborations significantly improve students' practical skills and employability.

Supplementary extracurricular practical activities, including technology forums, comprehensive open experiments, skill competitions, and big data simulations, further enhance classroom practical training. Research indicates that this progressive and tiered practical teaching approach substantially elevates student practical capabilities and innovation levels.

3.3 Teaching Methods and Evaluation Reform

Effective curriculum implementation requires innovation in teaching methods and evaluation.

Teaching Method Innovation: Utilize a variety of methods, including case studies, project-driven learning, flipped classrooms, and blended teaching approaches. Real-world problems introduced in courses such as Business Intelligence and Big Data Analytics, involving analyses of authentic corporate datasets and decision-making exercises, enhance student engagement and application of theoretical knowledge. Courses like Data Governance use case discussions to explore ethical and privacy issues, nurturing social responsibility and critical thinking.

Evaluation Reform: Transition from traditional exam-centric assessments to a comprehensive evaluation combining formative and summative approaches. This new model emphasizes practical skills, teamwork, and innovation, assessing performance through lab reports, data competitions, and innovation project outcomes. Such multi-dimensional evaluations accurately reflect students' growth in knowledge, competencies, and character, motivating greater student engagement in practical learning and continuously improving instructional quality.

3.4 Faculty Development and Resource Assurance

The successful implementation of a high-quality curriculum relies on qualified faculty and robust instructional resources.

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Interdisciplinary Faculty Teams: Establish cross-disciplinary teaching teams comprising experts from management, computer science, statistics, and other pertinent fields. Collaborations among faculties across departments and external industry experts ensure courses remain cutting-edge and practically relevant. Data analysis courses, for instance, could involve experienced industry data scientists, while legal and regulatory courses could feature legal experts, enhancing teaching depth and industry alignment. Educational Resources and Platforms: Universities should substantially invest in instructional resources and laboratories, creating comprehensive big data, cloud computing, and data analytics platforms equipped with necessary software and hardware for student projects. Digital educational resources, including online courses, case libraries, and datasets, should be developed to support teaching and student learning.

Faculty Training and Teaching Research Mechanism: Establish comprehensive faculty training and regular pedagogical seminars, encouraging faculty to continually update their knowledge and grasp the latest technological developments in big data. Regularly scheduled teaching forums facilitate sharing experiences and improving instructional quality. With these comprehensive supports, the curriculum can be effectively implemented and continuously improved, thereby enhancing overall educational effectiveness.

4. Case Study of Curriculum Reform at University H

To validate the effectiveness of the proposed curriculum framework, several Chinese universities have actively explored and implemented related reforms. Taking the School of Digital Economy at University H as an example, which launched its undergraduate program in Big Data Management and Application in 2019 under the New Liberal Arts framework, significant curriculum innovations were introduced:

Interdepartmental Collaboration in Course Modules: University H surpassed traditional departmental boundaries, with the School of Digital Economy spearheading collaborations with the School of Computer Science, the School of Mathematics and Statistics, among others, to devise a comprehensive educational blueprint. Core teachers from each school formed interdisciplinary teams to design course modules covering diverse disciplinary content. For instance, the "Data Mining and Machine Learning" course was jointly taught by faculty from Computer Science and Digital Economy schools, while "Business Data Analysis" was co-taught by faculties from Statistics and Business schools, effectively integrating computing technology with business management insights. This interdepartmental collaboration not only optimized educational resources but also created a multidimensional learning environment, allowing students to understand and apply big data technologies from multiple disciplinary perspectives.

Implementation of Layered Practical Teaching System: University H established a four-tier practical education system integrated into the overall talent development strategy. At the freshman level, a university-wide seminar titled "The Data Era and Society" was introduced to foster students' broad understanding of big data applications. Sophomore students participated in industry observation internships to gain practical insights into real-world big data operations. In their junior year, students undertook comprehensive practical courses, involving complete big data projects from data acquisition and analysis to visualization. Senior-year students were required to engage in at least one innovative project or produce a thesis based on data analysis, incorporating practical achievements into graduationcriteria. After several years, students from University H consistently excelled in national competitions, many participated early in faculty research projects, publishing academic papers and significantly enhancing their practical skills and innovation capabilities.

Continuous Feedback and Dynamic Optimization: Through graduate surveys and employer feedback, University H continuously gathered insights into curriculum effectiveness. Data indicated strong market demand and positive employer recognition for graduates' skills in data analysis, business comprehension, and teamwork. This feedback drove further curriculum improvements, such as increasing advanced technology electives and emphasizing industry case studies, while addressing reported overlaps in course content to enhance curriculum efficiency and relevance.

This practical example from University H demonstrates the feasibility and effectiveness of curriculum reform for Big Data Management and Application under the New Liberal Arts paradigm. Through interdisciplinary collaboration and innovative practices, students' overall abilities significantly improved, aligning educational objectives closely with industry demands. Universities can adapt these reform strategies based on their specific contexts and regional industry characteristics, consistently aiming to

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cultivate high-quality big data professionals for contemporary societal needs.

5. Conclusion and Future Prospects

5.1 Research Conclusion

The curriculum development for the Major of Big Data Management and Application under the New Liberal Arts paradigm constitutes a comprehensive undertaking that necessitates strategic planning at the macro level and meticulous execution at the micro level. Through an in-depth analysis of the New Liberal Arts philosophy and industry demands for big data talent, this study proposes systematic measures, including clearly defined educational objectives, optimized curriculum modules, enhanced practical teaching, innovative teaching methodologies, and improved evaluation mechanisms. Empirical practices indicate these reforms effectively integrate the strengths of liberal arts and sciences, emphasize practical applications of big data, and cultivate talents possessing both humanistic insight and data intelligence. Consequently, this contributes significantly to the national big data strategy and digital economic development by ensuring an adequate supply of qualified professionals.

5.2 Directions for Future Development

Curriculum development must continuously adapt to evolving technological advancements and societal needs. Regular educational research and evaluation are essential for timely curriculum optimization, including updating content to reflect current industrial demands and phasing out obsolete knowledge. Emerging themes, such as Data Governance and Artificial Intelligence-Generated Content (AIGC), present new opportunities to enrich the curriculum. Strengthening data governance ensures data quality and security, forming the foundation for deeper big data analytics. Incorporating AIGC topics equips students with skills in cutting-edge applications like natural language generation, image synthesis, and intelligent content recommendations, enhancing their innovative and practical competencies.

Additionally, universities should actively learn from leading domestic and international institutions in data science and management to maintain the curriculum's academic rigor and relevance. Future research could focus on areas such as specialized curriculum design for "Big Data + Industry," Outcome-Based Education (OBE) curriculum assessment frameworks, and innovative teaching models combined with digital educational resources.

Ultimately, adhering to student-centered educational philosophies, demand-oriented curriculum design, and innovation-driven teaching reforms will enable higher education institutions to develop robust curricula aligned with the New Liberal Arts paradigm. Continuous curriculum refinement and iteration will effectively prepare interdisciplinary talents with cross-disciplinary thinking, innovation capabilities, and practical skills, significantly supporting the growth of a data-driven digital economy and fostering positive societal progress.

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