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Exploration on the Development of the Big Data Major in Local Colleges and Universities with a Focus on Enhancing Regional Service Capability

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Abstract: We investigate the development of the Data Science and Big Data Technology major in local colleges and universities in China, with a focus on enhancing regional service capabilities. The rapid growth of big data technologies has reshaped the demands placed on higher education, necessitating curriculum innovation and competency-based models to prepare students for the evolving digital economy. We discusses key strategies for aligning academic programs with regional needs, including adjusting courses to industry requirements, strengthening Industry-Academia-Government collaboration, and leveraging national policies to mobilize resources. Building on existing research, the paper explores how these strategies can foster regional economic growth and digital transformation. A case study using max-min composition of fuzzy matrices was conducted to evaluate the effectiveness of these strategies. The results reveal that all proposed strategies contribute significantly to the development of the major, with aligning courses with regional industry needs identified as the most effective strategy. The findings underscore the importance of local institutions aligning their curricula with industry demands to cultivate relevant skills and enhance student employability. The study highlights the role of big data programs in supporting local innovation, talent retention, and sustainable economic growth. This research offers valuable insights for other institutions looking to optimize their data science education models in response to regional and national development goals.

1. Introduction

In recent years, the rapid development of big data technologies and their widespread application across industries have significantly reshaped the demands placed on higher education, particularly in data-related fields. The major of Data Science and Big Data Technology has emerged as a critical response to the evolving needs of the digital economy, requiring curriculum innovation and competency-based education models. To address these challenges, scholars and educators have increasingly focused on curriculum optimization, interdisciplinary integration, and outcome-based

education (OBE) to better prepare students for complex, data-intensive careers.

Wang et al. [1] emphasize the importance of curriculum reform in strengthening students' professional competencies. Their research proposes enhancing the Mathematical Modeling course as a core component of the big data curriculum, suggesting that this subject not only develops analytical and problem-solving skills but also encourages real-world application and teamwork. By refining course design and implementation strategies, such efforts can cultivate essential abilities among students, bridging the gap between theoretical knowledge and practical demands.

Similarly, Fu et al. [2] examine the construction of big data majors within the context of "New Engineering", a concept promoted in China to integrate traditional engineering education with emerging disciplines. Their study underscores the significance of aligning educational goals with industry needs, especially in local colleges and universities. The authors argue that to nurture applied talents in the big data field, institutions must adopt a strategic approach to curriculum development that supports interdisciplinary learning and application-oriented teaching.

The concept of OBE is further explored by Chen [3], who discusses how the OBE framework can guide the construction of a curriculum system for the major of Data Science and Big Data Technology. Under this model, educational objectives are defined in terms of student outcomes, focusing on what learners are expected to know and be able to do upon graduation. The author advocates for a dynamic, feedback-driven curriculum that adapts to technological trends while fostering critical thinking, data literacy, and innovation.

Zhang et al. [4] contribute to the discourse by investigating how foundational courses such as Data Analysis Technology can serve as entry points for interdisciplinary training. Their research highlights how data-related skills can be integrated with other fields to encourage a more holistic learning experience. This approach aligns with the broader goals of New Engineering, which seeks to dismantle rigid disciplinary boundaries in favor of flexible, innovation-oriented education.

Furthermore, Wang et al. [5] expand on the theme of innovation competence, illustrating how curriculum optimization can enhance students' creativity and adaptability. Although their study focuses on mathematics education, the principles are equally applicable to big data programs. By restructuring courses to prioritize student engagement and experiential learning, educators can foster the kind of agile, forward-thinking approach required in data-driven industries.

Building upon these insights, based on our teaching experience, we explore the development of the Big Data major in local colleges and universities with a focus on enhancing regional service capability. As local colleges and universities play a crucial role in supporting regional economies and digital transformation efforts, it becomes increasingly vital to align big data education with local industry demands, societal challenges, and workforce development. By advancing the development of big data programs that emphasize both technical proficiency and regional engagement, local colleges and universities can not only improve student outcomes but also contribute meaningfully to the socio-economic development of their communities.

The rest of the paper is organized as follows. In Section 2, we explain in detail the contribution of big data majors to regional development in China. In Section 3, we propose several strategies for developing the Data Science and Big Data Technology major in local colleges and universities in China. In Section 4, we perform an empirical study based on our teaching team's experience. In Section 5, we present several concluding remarks.

2. The contribution of big data majors to regional development in China

In this section, our main aim is to explore the big data majors' pivotal role in regional development in China. Local colleges and universities that offer majors in big data are playing an increasingly important role in advancing regional development. Their contributions go beyond

traditional education by directly aligning academic offerings with the evolving needs of local industries and government initiatives. Through talent cultivation, research collaboration, and knowledge transfer, these institutions act as key drivers of innovation and transformation across various sectors. This section explores three major areas where local colleges and universities with big data majors make significant impacts: talent supply for local industries, driving regional digital transformation, and strengthening Industry-Academia-Government (IAG) ecosystems for sustained regional growth and competitiveness.

2.1. Talent supply for local industries

Local colleges and universities, having big data major, are key providers of related talent for regional industries. By offering specialized programs in data science, big data technology, and analytics, these institutions equip students with essential skills in data collection, processing, analysis, and visualization. Many graduates choose to work locally, applying their expertise in sectors such as finance, healthcare, manufacturing, logistics, and public services, where big data plays a central role in optimizing operations and informing strategic decisions. Through partnerships with local businesses and internship opportunities, students gain hands-on experience with real-world data challenges. This strong connection between education and industry ensures a continuous, high-quality talent pipeline that supports regional innovation and economic growth.

2.2. Driving regional digital transformation

Local colleges and universities offering majors in big data play a vital role in driving regional digital transformation. By equipping students with cutting-edge knowledge in data analytics, machine learning, and data-driven decision-making, these institutions create a talent pool ready to meet the evolving needs of local industries. Graduates often stay in the region and contribute their expertise to sectors such as healthcare, finance, manufacturing, agriculture, and public services, helping businesses and organizations harness the power of big data for smarter operations and innovation. Moreover, colleges and universities frequently collaborate with local governments and enterprises through research projects, data labs, and technology incubators, providing customized solutions to real-world challenges. These partnerships not only enhance student learning but also accelerate the digitalization of traditional industries. By serving as hubs for knowledge exchange and technological advancement, higher education institutions with big data programs foster a data-literate workforce and support the adoption of intelligent systems. In doing so, they become essential drivers of digital transformation and sustainable economic growth in their regions.

2.3. Strengthening Industry-Academia-Government ecosystems

Local colleges and universities with big data majors play a critical role in strengthening Industry-Academia-Government (IAG) ecosystems at the regional level. These institutions serve as vital connectors, bringing together academic expertise, industry needs, and government initiatives to foster innovation, economic growth, and digital transformation. By offering specialized programs in big data, data science, and analytics, colleges equip students with the technical and analytical skills needed to tackle complex real-world problems. Graduates often join local industries or public agencies, contributing directly to data-driven decision-making and operational efficiency in diverse sectors such as healthcare, finance, agriculture, and transportation. Furthermore, colleges collaborate with regional industries and government bodies through joint research projects, technology development, workforce training, and consulting services. These partnerships encourage knowledge sharing, co-creation of solutions, and alignment between educational programs and

workforce demands. For example, local governments may work with colleges and universities to analyze public data for better urban planning, while businesses may engage in collaborative innovation through university-run data labs and incubators. Such synergies reinforce a dynamic ecosystem where education supports economic and social development, industry drives innovation, and government facilitates policy and funding. This tri-sector collaboration not only enhances the region's capacity for technological advancement but also creates sustainable pathways for continued growth and resilience in the data-driven era.

3. Strategies for developing the Data Science and Big Data Technology major in local colleges and universities in China

In this section, we discuss strategies for developing the Data Science and Big Data Technology major in local colleges and universities in China. Developing the Data Science and Big Data Technology major in local colleges and universities in China requires strategies that are closely aligned with regional needs, national priorities, and industry demands. This section explores various strategic approaches that enhance the relevance and impact of academic programs. Key strategies include aligning courses with regional industry needs, strengthening collaboration between academia, industry, and government, building regional talent retention mechanisms, enhancing applied research for local problem-solving, and leveraging national policies for resource mobilization. These strategies collectively ensure that the Data Science and Big Data Technology major not only provides graduates with industry-relevant skills but also contributes to regional innovation, workforce development, and economic growth. By integrating local challenges, national policy support, and industry expertise into academic programs, local colleges and universities can become essential drivers of digital transformation and competitiveness in the data-driven economy.

3.1. Aligning courses with regional industry needs

Aligning courses with regional industry needs is a key strategy for developing the Data Science and Big Data Technology major in local colleges and universities across China. As regional economies vary significantly in terms of industrial structure, labor demands, and technological advancement, tailoring academic programs to reflect these differences ensures that graduates possess the skills and knowledge most relevant to their local job markets. By conducting needs assessments and engaging in on-going dialogue with regional enterprises, colleges can identify the specific competencies required in fields such as smart manufacturing, financial technology, healthcare informatics, e-commerce, and urban planning. These insights inform curriculum design, enabling institutions to offer targeted coursework in data analytics, machine learning, database systems, cloud computing, and domain-specific applications. Incorporating real-world projects, internships, and case studies into the curriculum helps students build practical experience while addressing actual business challenges. Additionally, guest lectures and collaborative teaching with industry professionals keep course content current and industry-relevant. This alignment not only enhances students' employability but also supports local economic growth by ensuring a steady supply of well-prepared data professionals. It fosters a mutually beneficial relationship between academia and industry, where education directly contributes to regional innovation and competitiveness. Ultimately, such a strategy positions local colleges and universities as critical drivers of talent development in the data-driven economy.

3.2. Strengthening Industry-Academia-Government collaboration

Strengthening Industry-Academia-Government (IAG) collaboration is a vital strategy for

developing the Data Science and Big Data Technology major in local colleges and universities in China. By fostering innovation clusters and knowledge exchange, this tripartite model ensures curriculum relevance and workforce readiness. Through close partnerships with local industries and government agencies, academic institutions can better align their programs with practical needs, enhance research relevance, and expand student learning opportunities. Joint initiatives such as curriculum co-design, applied research projects, and internship programs help integrate real-world challenges into academic training, preparing students for immediate contribution to the workforce. Government support, including funding, policy guidance, and innovation platforms, further encourages collaboration and resource sharing among stakeholders. These efforts foster a dynamic ecosystem where education, industry, and public institutions work together to develop high-quality talent and technological solutions. By embedding colleges within this cooperative framework, the Data Science and Big Data Technology major becomes a key driver of regional digital transformation, workforce development, and long-term economic competitiveness, ultimately boosting local innovation capacity and industrial upgrading.

3.3. Building regional talent retention mechanisms

Building regional talent retention mechanisms is a crucial strategy for the successful development of the Data Science and Big Data Technology major in local colleges and universities in China. The growing demand for data professionals, particularly in emerging technology sectors, has led to a shortage of qualified talent. However, retaining these skilled professionals within the region after graduation is essential for sustaining long-term economic development and innovation. One key approach is to strengthen partnerships between local colleges, industries, and government bodies, creating an environment where graduates are encouraged to stay in the region. Colleges can offer career support services, such as job placement assistance, networking events, and internship opportunities with local companies, ensuring that students are connected with potential employers early on. These initiatives not only enhance employability but also foster ties between students and their future employers, making them more likely to stay within the region. In addition, local governments can implement incentives such as tax breaks, housing subsidies, and research funding for graduates who choose to work or start businesses in the region. These measures provide financial and career-oriented support that encourages talent retention. Colleges and universities can also contribute by offering continued education and professional development programs, allowing graduates to upgrade their skills and maintain long-term professional growth within their local ecosystems. Furthermore, promoting a vibrant and innovative ecosystem in the region, where big data applications contribute to solving local issues and driving economic growth, can help graduates see the value of remaining in the area. By building these retention mechanisms, China's local colleges and universities can ensure a steady supply of skilled data professionals, boosting regional competitiveness and innovation in the digital age.

3.4. Enhancing applied research for local problem-solving

Enhancing applied research for local problem-solving is a critical strategy for developing the Data Science and Big Data Technology major in local colleges and universities in China. By focusing on real-world challenges specific to the region, colleges and universities can make their research more relevant and impactful, while also providing students with practical learning experiences. Colleges can partner with local industries, government agencies, and community organizations to identify pressing regional issues, such as optimizing urban planning, improving healthcare services, or enhancing agricultural efficiency. This collaborative approach ensures that research projects are directly aligned with the needs of local stakeholders, creating solutions that

have immediate, tangible benefits. Encouraging students to participate in these applied research projects through internships, thesis work, or capstone projects further enhances their learning while contributing to solving regional problems. Moreover, faculty members can lead interdisciplinary research that combines data science techniques with local industry knowledge, addressing unique challenges with customized solutions. This strategy not only strengthens the link between academia and industry but also boosts the reputation of colleges and universities as innovation hubs. By actively contributing to the region's growth and development through applied research, local colleges and universities can position themselves as key drivers of digital transformation, fostering a culture of innovation and problem-solving within the community.

3.5. Leveraging national policies for resource mobilization

Leveraging national policies is a crucial strategy for developing the Data Science and Big Data Technology major in local colleges and universities in China. The Chinese government has implemented several national policies aimed at promoting technological innovation, education, and regional economic development. By aligning their programs with these policies, local colleges and universities can tap into government resources, funding opportunities, and initiatives that support the development of data science and big data technologies. For example, policies such as the `` Made in China 2025'' initiative, the `` New Generation Artificial Intelligence Development Plan'' and regional development strategies focus on strengthening the digital economy, which provides colleges and universities with funding, research grants, and infrastructure development opportunities. These resources can be used to build state-of-the-art facilities, update curriculums, and support faculty research in the field of data science.

In addition to financial support, national policies can also provide a framework for fostering collaboration between academia, industry, and government. By aligning their curriculum with national priorities, local colleges can ensure that their graduates are equipped with the skills and knowledge needed to meet the demands of the country's rapidly evolving digital economy. National policies also create incentives for partnerships between colleges as well as universities and local industries, facilitating joint research, internships, and talent development programs. This strategic alignment helps colleges and universities to not only secure necessary resources but also contribute to national goals such as technological advancement, economic transformation, and the development of a highly skilled workforce in data science and big data technologies.

4. An empirical study based on the max-min composition fuzzy matrices

Building on the collective experience of our teaching team, we aimed to identify effective methods for enhancing the services provided by the Science and Big Data Technology major at our affiliated university. To achieve this, we developed a max-min composition of fuzzy matrices to explore how the five strategies proposed in Section 3 influence the effectiveness of the Science and Big Data Technology major in serving the region in China.

Max-min composition of fuzzy matrices is a fundamental operation in fuzzy logic and fuzzy set theory, commonly used to model and analyze relationships in systems characterized by uncertainty, imprecision, or vagueness. It extends traditional matrix operations into the domain of fuzzy logic, where the elements of matrices are fuzzy values instead of crisp ones. In the context of fuzzy matrices, each element represents a degree of membership, typically ranging from 0 to 1, indicating the strength or degree to which an element belongs to a fuzzy set. The max-min composition is a method for combining two fuzzy matrices to capture the interaction between their elements.

Given two fuzzy matrices, $A=(a_{ik})$ and $B=(b_{kj})$, the max-min composition of A and B,

denoted as , results in a new matrix $A \circ B$, where each element c_{ij} is calculated as

$$c_{ij} = \max_k(\min(a_{ik}, b_{kj})).$$

Here, the operation involves taking the minimum of each pair of corresponding elements from the row of matrix A and the column of matrix B, and then finding the maximum of these minimum values. This captures the strongest relationship between the fuzzy sets represented by the two matrices. Max-min composition is widely used in various applications, such as in fuzzy relation analysis, decision-making, and control systems, where it is crucial to consider the interactions between uncertain or imprecise data.

Table 1: Judgement and evaluation of the influence of curriculum on professional competencies.

	Judge 1	Judge 2	Judge 3	Judge 4	Judge 5	Judge 6	Judge 7	Judge 8	Judge 9
Initial judgement	0.95	0.96	0.91	0.86	0.88	0.98	0.87	0.97	0.93
Aligning courses with regional industry needs	0.86	0.89	0.90	0.88	0.89	0.99	0.98	0.88	0.86
Strengthening Industry-Academia-Government collaboration	0.89	0.91	0.91	0.99	0.84	0.92	0.87	0.92	0.88
Building regional talent retention mechanisms	0.80	0.86	0.86	0.96	0.96	0.90	0.91	0.85	0.97
Enhancing applied research for local problem-solving	0.81	0.81	0.84	0.91	0.99	0.92	0.84	0.90	0.90
Leveraging national policies for resource mobilization	0.91	0.81	0.98	0.84	0.82	0.89	0.88	0.87	0.81

Table 2: Judgement and evaluation of the influence of curriculum on professional competencies.

Strategies	Final judgement
Aligning courses with regional industry needs	0.98
Strengthening Industry-Academia-Government collaboration	0.92
Building regional talent retention mechanisms	0.93
Enhancing applied research for local problem-solving	0.92
Leveraging national policies for resource mobilization	0.91

Based on visits to several experts and our teaching experience, we gathered initial judgments on the following strategies: aligning courses with regional industry needs, strengthening IAG collaboration, building regional talent retention mechanisms, enhancing applied research for local problem-solving, and leveraging national policies for resource mobilization (see Table 1). By applying the max-min composition of fuzzy matrices, we obtained the final judgment (see Table 2). The results show that all five strategies proposed in Section 3 are effective methods for developing the Data Science and Big Data Technology major in local colleges and universities in China, with the final judgment greater than 0.9. Furthermore, aligning courses with regional industry needs is considered the most effective strategy, with a final judgment of 0.98. Leveraging national policies for resource mobilization is seen as the least efficient strategy, with a final judgment of 0.91.

5. Conclusions

In conclusion, the development of the Big Data major in local colleges and universities, exemplified by the practice at Suqian University, plays a crucial role in enhancing regional service capabilities. By using several strategies such as aligning curriculum with local industry needs, fostering strong IAG collaboration, and leveraging national policies, local colleges and universities have effectively contributed to regional economic growth and innovation. The strategies outlined in this study offer valuable insights for other institutions aiming to strengthen their role in regional development. Continued focus on applied research and talent retention will further support the success of big data majors in addressing local challenges and driving sustainable growth.

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