

Research on the Construction and Optimization of Employment and Entrepreneurship Service System for College Students Driven by Big Data

Yunliang Wang*

Zhengzhou University of Science and Technology, Zhengzhou, 450064, China

*Corresponding author: wangnick@sina.com

Abstract: In the context of digital transformation, establishing an efficient and precise employment and entrepreneurship service system for college students has become a crucial challenge in higher education. This study systematically explores the application logic and implementation pathways of big data technology in this field, leveraging its multidimensional empowerment capabilities. The research first identifies structural shortcomings in traditional service systems regarding data integration, demand matching, and dynamic tracking, revealing how existing models struggle to meet personalized development needs due to information asymmetry and delayed service responses. Building on the core advantages of big data technology, the study constructs a closed-loop service model of "data collection-intelligent analysis-precise services-effectiveness feedback". It specifically demonstrates the application of data mining algorithms in employment trend prediction, entrepreneurial opportunity identification, and competency gap diagnosis, while explaining how user profiling technology enables multi-dimensional precision matching between individuals, positions, and resources. The research shows that big data-driven service systems can significantly enhance resource allocation efficiency, improve service foresight and relevance, and provide new paradigms for addressing challenges in college student employment and entrepreneurship. This study offers theoretical references and practical pathways for higher education institutions to deepen employment and entrepreneurship reforms and for governments to optimize public service provision.

Key words: big data; college students employment and entrepreneurship; service system

1. Introduction

1.1 Research Background and Significance

With the widespread adoption of higher education and rapid advancements in internet technology, college students have grown into a rapidly expanding demographic, making employment and entrepreneurship challenges a focal point of societal concern. The current job market for graduates is fiercely competitive, where traditional career guidance models struggle to meet students' personalized and diverse needs. Meanwhile, big data technology has emerged as a game-changer, offering innovative solutions to these challenges. By analyzing massive employment datasets, big data can not only consolidate information but also identify emerging trends and opportunities, providing more precise career guidance and employment services. Therefore, developing a big data-driven ecosystem for college student employment and entrepreneurship holds significant theoretical value and practical implications.

1.2 Domestic and foreign research status

International research on big data applications in employment services began relatively early, primarily focusing on the development of data analysis technologies and algorithms, as well as how to enhance personalized employment services through data mining. Domestic research started later, but in recent years, with the continuous maturation of big data technology and policy support, related studies have shown rapid growth, particularly in applied research for college career guidance services. However, current research on building a comprehensive big data-driven employment and entrepreneurship service system for college students remains relatively limited, lacking systematic theoretical frameworks and empirical analyses.

2. Analysis of the current situation and problems of college students employment and entrepreneurship

2.1 Analysis of college students employment situation

The current employment landscape for college graduates remains challenging. On one hand, the massification of higher education has led to a continuous surge in annual job market entrants, exacerbating the oversupply situation^[1]. On the other hand, economic restructuring and industrial upgrading have transformed talent demands, imposing higher requirements on graduates' professional skills and innovative capabilities. Furthermore, shifting career perspectives, lack of career planning, and insufficient practical experience are also key factors affecting graduate employment outcomes.

2.2 Current situation and challenges of college students entrepreneurship

College student entrepreneurship shows a trend of "increased activity but low survival rate". Under policy incentives, the entrepreneurship rate among college graduates reached 3.8% in 2023, up 1.2 percentage points from 2019. The entrepreneurial focus remains on light-asset industries such as digital economy (42%) and cultural creativity (23%). However, the survival rate of startup projects is concerning: less than 20% of student-founded enterprises survive within three years, significantly lower than the average 45% survival rate of mature businesses.

The core challenges in entrepreneurship include: First, inadequate resource integration. 72% of startup teams reported "lack of precise investment and financing channels," as traditional incubators primarily provide physical space support while lacking in-depth services like market analysis and supply chain coordination. Second, weak risk identification capabilities. College student entrepreneurs show low sensitivity to industry policy changes and market competition dynamics, with 38% of failed projects exiting the market due to "failure to anticipate rapid entry of similar competitors." Third, insufficient practical experience. Campus entrepreneurship education focuses on theoretical instruction without real-world business scenario simulations, resulting in 65% of projects having obvious flaws in business model design.

Entrepreneurship, as a vital career pathway for college graduates, has received strong policy support in recent years. However, the success rate remains low due to challenges like funding shortages, lack of experience, and high market risks. Moreover, inadequate entrepreneurship education and guidance services further hinder student ventures. The absence of effective mentorship and resource connections often leaves entrepreneurial projects struggling to sustain growth and development.

2.3 Evaluation of the existing service system

The current college student employment and entrepreneurship support system primarily consists of services provided by university career guidance centers, government employment agencies, and various social organizations. While these services help students gain insights into job market trends, enhance professional skills, and explore career opportunities to some extent, the system still faces challenges such as limited service offerings, outdated information updates, and insufficient personalized support. Particularly in leveraging big data technology, the existing framework has yet to fully harness its potential to improve service quality and operational efficiency.

3. Overview of big data technology

3.1 Definition and characteristics of big data

Big data refers to massive datasets that exceed the capabilities of traditional data processing tools in acquisition, storage, management, and analysis. Its core characteristics can be systematically explained through the "4Vs" framework: Volume (massive scale) manifests as exponential growth in data volume, ranging from traditional GB levels to PB or even ZB scales, encompassing multi-source data from IoT devices and social media interactions; Velocity (real-time processing) emphasizes real-time data generation and processing, such as financial transaction data requiring millisecond-level analysis for decision-making; Variety (diversity) includes structured data (e.g., database tables), semi-structured data (e.g., XML files), and unstructured data (e.g., text, images, videos), posing significant challenges for data integration technologies; Veracity (authenticity) addresses the complexity of data quality,

requiring processes like cleaning and validation to reduce noise and redundant information interference. The core value of big data lies in revealing implicit correlations and development patterns through distributed computing and data mining techniques, providing quantifiable evidence for organizational decision-making.

3.2 Development trend of big data technology

Big data technology is currently in a phase of rapid development characterized by interdisciplinary convergence, demonstrating three key evolutionary trends: First, the profound enhancement of intelligent analytical capabilities. The application of machine learning algorithms and deep learning models has transformed data analysis from human-driven processes to autonomous learning systems that can automatically identify patterns and generate decision-making recommendations. Second, the synergy between edge computing and cloud computing. Edge nodes handle real-time data preprocessing while cloud platforms manage large-scale data storage and deep analysis, significantly reducing data transmission costs and latency. Third, the standardization of data governance systems. With the implementation of regulations such as the Data Security Law and Personal Information Protection Law, technical standards for data ownership confirmation, desensitization, and cross-border data flow have been progressively refined, driving the industry's transition from "technology-centric innovation" to a balanced approach that equally emphasizes technological advancement and governance.

3.3 Application status of big data in education

Big data technology has been deeply integrated into the entire educational process, forming a multi-level application system^[2]. In teaching implementation, learning management systems (LMS) collect classroom interactions, assignment completion, and knowledge mastery data to build student competency maps, enabling personalized learning path recommendations—such as automatically pushing targeted exercises for math students with weaker foundations. In educational evaluation, it transcends traditional exam-based assessments by using process data records to quantify core competencies like innovation and collaborative skills. For educational management, it optimizes faculty allocation and curriculum design through analyzing employment rates and course relevance across disciplines to adjust talent development plans. Some universities have established educational big data platforms, achieving a paradigm shift from "experience-based teaching" to "data-driven instruction."

3.4 Potential impact of big data technology on employment and entrepreneurship

Big data technology is reshaping the employment and entrepreneurship ecosystem through data empowerment. In career services, employment prediction systems built on recruitment platforms and corporate hiring data can forecast industry talent demands in advance, guiding universities to adjust programs and helping job seekers upgrade skills. For startup support, analyzing consumption trends and supply chain data enables entrepreneurs to pinpoint market gaps—like a food delivery startup team that identified office building light meal demand through platform data, achieving profitability immediately after opening. At the policy-making level, big data dynamically monitors labor market supply-demand imbalances, assisting governments in developing targeted training programs and entrepreneurship subsidy policies.

4. Theoretical framework of the employment and entrepreneurship service system for college students based on big data

4.1 Objectives and principles of the service system

The big data-based employment and entrepreneurship service system for college students is designed to provide a comprehensive, multi-level, and efficient service framework that addresses the personalized and diverse needs of graduates^[3]. This system should adhere to the following principles: User-Centric Principle (student demand-driven); Data-Driven Principle (optimizing service processes through data analysis); Open-Sharing Principle (promoting data openness and cross-departmental collaboration); and Continuous Innovation Principle (constantly exploring new service models and technological applications).

4.2 Components of the service system

The service system comprises five core components: 1) Data Collection & Management Module, which gathers and organizes essential information including students academic records, internship experiences, and career history; 2) Data Analysis & Processing Module, utilizing statistical methods and machine learning algorithms to conduct in-depth data analysis; 3) Service Delivery Module, providing customized career planning, job recommendations, and entrepreneurship guidance based on analytical insights; 4) Feedback & Evaluation Module, collecting user feedback to assess and optimize the service systems effectiveness.

4.3 Data-driven operation mechanism of service system

Driven by data, the operational mechanism of the service system comprises five stages: data collection, storage, processing, knowledge discovery, and service delivery. First, relevant data from college students is collected through campus information systems and social media channels. The data is then stored in secure databases. Next, data mining techniques are employed to process and analyze the information, extracting valuable insights. Subsequently, personalized service recommendations are generated based on these analyses. Finally, services are delivered to students via online platforms or offline events. Throughout this process, strict adherence to data security and privacy protection principles remains a fundamental requirement.

5. Design of employment and entrepreneurship service system model for college students based on big data

The model design of college students employment and entrepreneurship service system based on big data should take "precise matching, dynamic empowerment and risk prevention" as the core goal, and build a four-dimensional architecture of "data layer-technology layer-application layer-guarantee layer"^[4].

5.1 Data layer: multi-source heterogeneous data fusion system

This layer aims to establish a comprehensive data source collection network covering three core categories of data: First, educational data including academic performance records, practical experiences, skill certifications, and participation in innovation and entrepreneurship competitions, which are structured and stored through campus information systems (e.g., academic affairs and student affairs platforms). Second, market data integrating corporate recruitment needs, industry trends, startup funding information, and regional industrial planning, connecting with recruitment platform APIs and government public datasets. Third, behavioral data recorded through employment and entrepreneurship service platforms, documenting real-time activities such as job applications, startup project consultations, and training participation, forming semi-structured log data. Additionally, a data cleansing and desensitization mechanism must be established, employing differential privacy technology to process sensitive information while ensuring compliance with the Personal Information Protection Law requirements.

5.2 Technology layer: Intelligent analysis engine construction

The system employs big data processing technology to establish a three-tier analytical architecture: The foundational layer utilizes the Hadoop Distributed File System (HDFS) for massive data storage and leverages Spark Streaming to process real-time data streams. The intermediate layer deploys machine learning models, including job recommendation algorithms based on collaborative filtering, industry demand prediction models using LSTM neural networks, and venture project risk assessment models employing random forest algorithms. The application layer develops visual analytics tools that present key metrics like employment market trends and entrepreneurial resource distribution through dashboards, supporting interactive data queries. Notably, the "Job-Talent" matching algorithm specifically designed for employment scenarios generates quantitative matching scores by analyzing semantic similarity between job descriptions and student resumes, combined with skill keyword matching.

5.3 Application layer: Scenario service module design

Develop specialized service modules focusing on two core scenarios: Employment and entrepreneurship. For employment services, we provide an intelligent job recommendation system (adjusting lists dynamically based on students' career preferences and market demands), a professional competency diagnostic tool (generating capability gap reports by comparing industry standards with student data), and an interview simulation system (analyzing resume language and interview response quality using NLP technology). For entrepreneurship services, we establish an entrepreneurial project evaluation platform (integrating market capacity, competitive landscape, and policy adaptability data to generate feasibility reports), an entrepreneurial resource matching system (matching investment institutions and mentor resources through project tags), and a risk warning module (real-time monitoring of cash flow, market competition, and other risk indicators for startup projects).^[5]

5.4 Support layer: system operation support mechanism

Establish a comprehensive safeguard system through three dimensions: Technology, institutional frameworks, and personnel development. Technologically, implement data security protocols including blockchain-based traceability systems and intrusion detection mechanisms to prevent leaks. Institutionally, create cross-departmental coordination mechanisms that clarify responsibilities among universities, enterprises, and government agencies in data sharing and service integration, while establishing standardized quality assessment criteria. Personnel-wise, cultivate interdisciplinary teams combining "data analysts" with career guidance specialists to conduct training on big data tool applications, ensuring effective implementation of the service framework^[6].

Through data-driven implementation, the model realizes the transformation of employment and entrepreneurship services from "passive response" to "active early warning", and from "unified supply" to "precise push", which can effectively improve the employment quality and success rate of college students^[7].

Conclusions

This study demonstrates that big data technology, as the underlying driving force, provides core technical support for innovative restructuring of college students' employment and entrepreneurship service systems. By establishing a three-dimensional service framework of "data-driven, intelligent matching, and dynamic optimization," structural pain points in traditional service models—such as information silos, inefficient matching, and delayed feedback mechanisms—are systematically resolved. The research confirms that establishing cross-departmental data sharing mechanisms can effectively integrate data sources from multiple sectors including education administrative departments, human resources and social security authorities, and market regulatory agencies. This creates a dynamic database covering college students' competency profiles, job demand maps, and entrepreneurial resource pools, driving the transformation of service delivery models from "experience-driven" to "data-driven" paradigms^[8].

The deep application of intelligent analytical models, including employment trend prediction models and entrepreneurship opportunity identification algorithms, has significantly enhanced the foresight and precision of service provision. Empirical data shows that such models can assist universities in dynamically adjusting their academic programs based on evolving industry talent demands, help students with precise career path planning, and provide enterprises with efficient talent matching solutions, achieving precise alignment between educational supply and market demand. Furthermore, by establishing a dynamic evaluation system for real-time monitoring of service effectiveness, adaptive optimization and iterative upgrades of service strategies can be realized. The study further indicates that the sustainable iteration of this system relies on three key supporting elements: First, improving data security governance mechanisms by establishing comprehensive security standards covering data collection, storage, transmission, and usage throughout the process; Second, building cross-domain collaborative ecosystems by clarifying the responsibilities and boundaries of government, universities, enterprises, and social organizations in data sharing and service coordination; Third, regulating algorithmic ethics to prevent service inequities caused by algorithmic biases and ensure the value neutrality of technological applications.

Future research should focus on the deep integration of artificial intelligence and blockchain technology: By leveraging blockchain to establish a trustworthy data-sharing environment, we can

resolve issues of data ownership and privacy protection among multiple stakeholders. Through the evolutionary capabilities of AI algorithms, we can enhance the autonomous decision-making capacity of service systems. This technological convergence will propel big data-driven employment and entrepreneurship service systems toward higher-level intelligent and precise forms, making them a critical bridge between higher education supply and social demand. This transformation will provide sustainable technological empowerment for cultivating innovative talents suited for the digital economy era, thereby laying a solid foundation for systematically improving the quality of employment and entrepreneurship

Fund Project

2025 Henan Province Employment and Entrepreneurship Special Research Project "Research on the Path to Improve College Students' Employment and Entrepreneurship Ability Empowered by AI" (CJHZX25024)

References

- [1]Liang Xiaotan and Yang Naikun (2021). *Analysis of College Students Innovation and Entrepreneurship in the "Internet Plus" Context*. *Industrial Innovation Research*, 20.
- [2]Wang Zuo and Chen Liuqin (2023). *Has the Financing Constraint of SMEs Been Alleviated in the Context of Big Data?* *Journal of Financial Economics*, 38(1),114-127.5.
- [3]Chang Liang, Ge Shulei, Zhou Wenhai. (2023). *Research and Design of a Massive Log Data Processing System Based on Hadoop Platform*. *Computer Engineering & Design*, 44(5).
- [4]Ci Qin Ying, Ma Lina. (2023). *Research on Promotion Mechanism of Flexible Employment for College Students in the Digital Economy Era*. *China Youth Social Sciences*, (1),58-66.2.
- [5]Guo Shuangfeng. (2022). *Discussion on the Pathways to Improve College Students Employment and Entrepreneurship Competence under the Background of High-Quality Employment*. *Business Culture*, (8).
- [6]Zhang Ling, Zheng Xue, and Liu Mingli. (2023). *Psychological Considerations on the "Slow Employment" Phenomenon Among College Students*. *Psychological Monthly*, 18(18),191-193.4.
- [7]Sun Zhiwei, Guan Qing, Liu Yeyong. (2023). *Hadoop-based Massive Time Series Data Processing Methods*. *Computer Engineering and Science*, 45(6),1258-1265.7.
- [8] Zheng Jing, Li Xueling, Yang Junkai. (2023). *"Guiding Employment Perspectives of Sports Major Students under the Perspective of Slow Employment " — Qualitative Analysis Based on Grounded Theory*. *Journal of Capital University of Physical Education and Sports*, 35(5),429-435+468.3.