Research on Practical Pathways of Data Governance and Application in Higher Vocational Colleges under the Context of Informatization Model Schools

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Abstract: *With the in-depth advancement of the digital transformation in education, the development of model informatization schools has become a significant direction for the high-quality development of higher vocational colleges. Within this context, data governance and application have emerged as the core drivers supporting the transition of these institutions from system construction to data-enabled empowerment. This paper analyzes the intrinsic logical coupling between the vision of model informatization schools and data governance, systematically elucidating the cognitive framework of data as a strategic asset and its supporting mechanism for the optimization of the educational ecosystem. The study further examines the challenges faced by higher vocational colleges in data governance —namely, heterogeneity dilemmas, agility limitations, and institutional gaps —from the three dimensions of data quality, technical architecture, and organizational synergy. It proposes a systematic pathway based on top-level design, supported by a technical platform, and aimed at scenario-based application. This research provides a theoretical foundation and practical reference for higher vocational colleges to establish a data-driven governance model in the development of model informatization schools.*

Keywords: *Informatization Model Schools; Data Governance; Higher Vocational Colleges; Data Empowerment; Practical Pathways*

Introduction

Amid the advancement of the educational digitalization strategy, the informatization development of higher vocational colleges is undergoing a paradigm shift from the construction of decentralized business systems to a data-driven governance model. The construction goal of Informatization Model Schools requires institutions not only to possess advanced technological infrastructure but also to achieve optimized allocation of educational resources, precise management of teaching processes, and innovative upgrades in service models through data governance. However, higher vocational colleges currently face structural challenges in the process of data governance, such as lack of unified data standards, rigid technical architectures, and insufficient organizational synergy, which restrict the full release of the value of data elements. Therefore, systematically exploring practical pathways for data governance and application under the context of Informatization Model Schools holds significant theoretical importance and practical necessity for promoting the digital transformation of higher vocational colleges and enhancing educational quality and governance efficiency.

1. The Intrinsic Logical Coupling between the Vision of Informatization Model Schools and Data Governance

1.1 The Paradigm Shift of Model School Informatization from System Construction to Data Empowerment

Traditional informatization construction in higher vocational colleges follows a business-driven model, characterized by various departments independently building information systems based on their own business needs, with the primary goal of digitizing specific management processes. Although this decentralized construction model has achieved certain results in improving departmental-level business processing efficiency, it has simultaneously led to the fragmented distribution and systemic

fragmentation of data.

Due to the lack of a unified data standard system and standardized interaction interfaces, the various business systems have gradually formed solid data silos, creating structural obstacles to institution-level data integration and comprehensive analysis, thereby preventing the effective release of the value of data resources. This phenomenon is particularly prominent in vocational colleges, where the isolated state of data severely restricts the overall benefits of informatization, especially in characteristic business areas such as practical training management and industry-academia collaboration[1].

The construction of Informatization Model Schools signifies a fundamental paradigm shift, with its core characteristic being the transition from discrete system functionalities to continuous data value creation. This transformation reflects a strategic repositioning of the value of data elements—data is no longer merely a passive record of operational processes but has become a core production factor driving educational innovation and systemic optimization.

Within the macro-context of educational digital transformation, the specific pathway to achieve data empowerment entails constructing a unified data platform that enables the systematic collection, deep integration, and intelligent analysis of multi-source heterogeneous data from teaching processes, learning behaviors, management activities, and other areas.

The establishment of such data capabilities enables institutions to grasp the patterns of education and teaching at the macro level, optimize the efficiency of resource allocation at the meso level, and support personalized learning development at the micro level, ultimately forming a new educational governance model based on data intelligence and achieving a fundamental shift from experience-driven to data-driven approaches. This shift requires not only upgrades in the technical architecture but also synergistic innovation in organizational structures and management models.

1.2 The Cognitive Framework of Data as a Strategic Asset in Higher Vocational Colleges

Establishing the cognitive positioning of data as a strategic asset is a necessary prerequisite for higher vocational colleges to achieve the paradigm shift from system construction to data empowerment. The inclusion of data in the category of strategic asset management implies the need to establish a comprehensive management system that coordinates with human capital and physical assets.

The construction of this cognitive framework requires systematic consideration from the value, management, and operational dimensions to form a comprehensive understanding and scientific management of data assets. In the current era of the digital economy, the value of data assets has been widely recognized; however, in the field of higher vocational education, the understanding and management of this new type of asset are still in their infancy, and there is an urgent need to establish a data asset management system that aligns with the characteristics of vocational education[2].

At the value dimension level, data assets in higher vocational colleges exhibit distinctive vocational education characteristics. Process data from practical training, achievement data from skill assessments, collaborative data from industry-academy cooperation, and interaction data from industry-education integration collectively form the critical basis for evaluating talent cultivation quality, optimizing disciplinary structure planning, and improving curriculum system design.

These data not only objectively reflect the current characteristics of education and teaching but also contain deep value potential for improving the quality of vocational education. At the management dimension level, the assetization of data requires establishing a comprehensive governance mechanism covering the entire data lifecycle, including clear data ownership definition, unified quality standard formulation, strict security control measures, and standardized compliance usage frameworks. Particularly in sensitive data areas such as industry-academy collaboration data and student personal information, specific management regulations and protective measures need to be established.

At the operational dimension level, it is necessary to establish value realization and circulation mechanisms for data assets. This involves creating standardized data service catalogs, developing scientific data sharing protocols, and establishing reasonable data value assessment systems to facilitate the secure and orderly flow of data across departments and business scenarios while promoting innovative applications, ultimately maximizing the value of data assets.

1.3 The Coupling Mechanism of Data Governance Supporting Model School Construction

A deep-level structural coupling exists between the data governance system and the construction objectives of Informatization Model Schools. This coupling mechanism is reflected in how data governance, through its systematic activities, provides comprehensive support for building the core capacities of model schools, forming an organic integration of strategic goals and implementation pathways.

From the perspective of governance objectives, data governance constructs a comprehensive system of high-quality data assets through fundamental capacity building in metadata management, master data management, data quality management, and other areas.

This system provides a reliable data foundation for Informatization Model Schools to achieve precise management and scientific decision-making, enabling data-based professional evaluation, optimized resource allocation, and performance management improvements, thereby laying a solid foundation for the modernization of institutional governance. The development of such foundational capabilities must follow the principle of progressive advancement, starting from core business data and gradually expanding to all business domains.

From the perspective of technical implementation, data governance establishes a trusted data circulation environment across business domains by creating unified data integration standards, standardized security access mechanisms, and comprehensive data exchange protocols.

This technical environment enables the delivery of personalized learning services by making it feasible to integrate comprehensive data from students' learning processes, construct multi-dimensional digital profiles of learners, and implement precise teaching interventions. Particularly in vocational education contexts, specialized data processing workflows and analytical models must be designed to address specific requirements such as practical training instruction and skill certification. From the ecosystem development perspective, the data sharing rules, open interface standards, and collaborative working mechanisms established through data governance create an institutionalized foundation of trust for internal operational coordination and external ecological connectivity.

This foundational capability not only facilitates the optimization and restructuring of internal business processes, thereby enhancing operational efficiency, but also creates the necessary technical conditions and institutional guarantees for future construction of industry-education integration data spaces and expansion of vocational education's digital transformation boundaries, ultimately promoting the formation of an open, collaborative, and innovative educational data ecosystem.

2. Core Dimensions of Data Governance in Higher Vocational Colleges and Examination of Existing Challenges

2.1 The Heterogeneity Dilemma in Data Quality and Standardization

Data quality and standardization construction form the foundation for releasing data value, where higher vocational colleges face challenges of inherent heterogeneity and systematic governance. This dilemma is primarily manifested as a systematic lack of data standards and specifications.

During their initial development stages, the various business systems lacked overall planning and adopted independent data definition systems and encoding rules. This has resulted in core business entities suffering from identifier confusion, attribute structure conflicts, and inconsistent value ranges across different systems, creating deep-level semantic barriers. This structural heterogeneity in underlying data not only significantly increases the technical complexity of data cleaning, integration, and modeling but also fundamentally constrains the construction of a unified data foundation and the implementation of cross-domain analysis and intelligent decision-making[3].

On the dynamic dimension, data quality issues manifest as a lack of sustained governance mechanisms. A significant amount of business data still relies on manual entry, lacking effective real-time verification and intelligent constraint mechanisms, resulting in systematic deficiencies in data completeness, accuracy, and timeliness. Particularly in practical teaching segments such as practical training and skill assessment, the collection of process data suffers from inadequate coverage and coarse granularity, making it difficult to support refined analysis requirements.

This uncertainty in data quality directly affects the credibility of analytical outcomes and the

reliability of decision-making support, thereby severely diluting the value of data assets at the source stage. The establishment of a full-lifecycle governance system encompassing data standard management, quality monitoring, and continuous improvement has become an imperative choice for breaking through the current predicament.

2.2 Agility Limitations in Technical Architecture and Platform Capabilities

The rigid characteristics of existing technical architectures constitute a key bottleneck restricting the effectiveness of data governance. Most higher vocational colleges exhibit distinctly siloed distributions in their information infrastructure, with systems connected through customized point-to-point interfaces that lack underlying data circulation design based on unified standards.

This architectural pattern results in data resources being confined within isolated business domains, making seamless cross-departmental flow and intelligent scheduling difficult to achieve, thereby severely constraining the allocation efficiency of data elements. When confronted with new data application demands such as real-time analysis and intelligent early warning, traditional technical architectures demonstrate significant maladaptation and scalability limitations.

At the platform capability level, the data processing chain exhibits significant structural disconnections. Data integration primarily relies on traditional batch processing modes, which struggle to support real-time data services and stream processing requirements; the data storage layer lacks unified logical control, while the development of modern storage components such as data lakes and data warehouses remains relatively underdeveloped, ultimately failing to meet the storage and analysis requirements of multimodal data.

At the data service level, the platform lacks end-to-end support capabilities spanning from data preprocessing and feature engineering to model construction, with an incomplete data analysis toolchain and weak visualization capabilities. This insufficient agility in the technical ecosystem makes it difficult for institutions to respond rapidly to increasingly complex data application scenarios, thereby impeding the deep advancement of data-driven innovation. Constructing a data middle platform based on cloud-native architecture and possessing microservices-based characteristics has become an important evolutionary direction for enhancing technical support capabilities.

2.3 Systematic Absence of Organizational Coordination and Authority-Definition Mechanisms

The effective implementation of data governance highly depends on sound organizational structures and coordination mechanisms, yet this dimension remains a weak link in most higher vocational colleges. The core issue is primarily reflected in the ambiguity and institutional absence of data authority and responsibility definitions. The ownership, management rights, and usage permissions of data lack clear definition and institutional guarantees, resulting in responsibility vacuums and coordination obstacles in critical areas such as data quality accountability, sharing approval processes, and security risk control. This unclear delineation of authority and responsibility directly hinders the effective advancement of data governance initiatives, leaving governance measures without clearly defined executing entities or responsibility boundaries[4].

The absence of a cross-departmental collaborative governance culture further intensifies implementation difficulties at the organizational level. Various business departments often regard data as exclusive departmental assets, lacking intrinsic motivation to promote data sharing and value co-creation from the perspective of the institution's overall development, which results in invisible barriers to data circulation at the organizational level.

Furthermore, the general absence of dedicated data governance organizational structures along with their supporting working mechanisms, performance evaluations, and communication channels makes it difficult for data governance initiatives to obtain sustained organizational drive and resource support. This systematic lack of organizational mechanisms often confines data governance measures to project-based phases, preventing them from achieving routine, institutionalized long-term operation and making it even harder to develop self-optimizing, continuously evolving organizational capabilities. Establishing a cross-level, cross-functional data governance committee with its supporting systems has become an essential path to resolve the current organizational coordination challenges.

3. Construction of a Data Governance and Application System for Model School Development

3.1 Collaborative Construction of Top-Level Design and Governance System

The effective implementation of data governance is rooted in a scientifically sound top-level design architecture, which must maintain high alignment with the institution's development strategy.

The top-level design must first define the vision, objectives, and evolutionary pathway for data governance, and establish a data governance maturity assessment model tailored to the institution's characteristics, thereby providing clear directional guidance and measurable standards for the system's development.

At the organizational architecture level, a three-tier governance structure should be established, comprising decision-making, management, and implementation layers. The decision-making level is responsible for approving data strategies and major issues; the management level oversees the formulation and implementation of governance standards; and the implementation level handles data management tasks in specific domains, forming an organizational system with clear authority and efficient operation.

The construction of the governance system requires the establishment of management specifications covering the entire data lifecycle. At the data standards level, it is necessary to develop a comprehensive standards system including metadata standards, master data standards, data quality standards, and data security standards, thereby laying the foundation for data interoperability and sharing.

At the management mechanism level, institutions should establish a data classification and grading management system, implementing differentiated management strategies based on data sensitivity and value density. Meanwhile, it is necessary to construct a regular data quality monitoring mechanism that enables continuous improvement of data quality by defining core data quality dimensions, establishing quality inspection rules, and creating a quality evaluation system[5].

In the field of data security, it is necessary to establish a comprehensive security control system covering the entire process of data collection, transmission, storage, use, and destruction, ensuring compliant data usage and controllable risks.

3.2 Systematic Integration of Technical Platforms and Data Assets

As the physical carrier of the data governance system, the technical platform needs to construct a technical capability system that supports full data lifecycle management.

A modern data platform should employ a cloud-native architecture to build a complete technology stack encompassing data collection, storage and computing, data development, data services, and data operations. The data collection layer must support unified ingestion of structured, semi-structured, and unstructured data; it should possess capabilities for both batch and real-time data synchronization, while additionally providing data lineage tracking functionality to ensure data sources are traceable and destinations are accountable.

At the data storage and computing layer, a dual-mode architecture coexisting with both data lakes and data warehouses should be adopted. The data lake layer is responsible for storing raw data and enabling exploratory analysis, preserving the maximum value density of data; the data warehouse layer, based on subject-area models, provides standardized data that has been cleansed and integrated, supporting stable analytical applications.

The data development platform should provide visual tools for data integration, data processing, and data modeling, supporting agile development and intelligent maintenance of data pipelines. At the data service layer, standardized and reliable data services should be delivered to business applications through various forms such as API services, data products, and self-service analysis tools. The entire technical platform must possess characteristics of elastic scalability, intelligent operations, and security controllability, thereby providing a solid technical foundation for the continuous accumulation and value realization of data assets.

3.3 Scenario-Based Realization of Value Closed-Loop and Innovative Applications

The ultimate realization of data value relies on deep integration with business scenarios, requiring

the establishment of a complete value closed-loop where "data drives decision-making, decisions optimize operations, and operations generate data."

In the field of talent cultivation, by integrating multidimensional data such as classroom teaching, practical training operations, and online learning, institutions can construct digital profiles of learners to achieve personalized learning path recommendations and targeted teaching interventions based on competency maps[6].

In the area of program development, institutions should establish dynamic program adjustment mechanisms and continuous curriculum optimization mechanisms through correlation analysis of multi-source data, including course evaluations, skill certifications, employment tracking, and industry demands, thereby enhancing the alignment between talent cultivation and market needs.

In the domain of administrative services, data applications also demonstrate significant value. By analyzing operational data such as equipment usage, energy consumption monitoring, and space utilization, institutions can construct intelligent campus resource allocation models to enhance the efficiency of resource deployment and utilization. Based on multidimensional characteristics including student behavior data, consumption records, and social networks, they can establish precise service and care mechanisms to improve the personalization level of campus services.

In the realm of quality assurance, the establishment of a quality monitoring indicator system covering the entire teaching process enables real-time monitoring and early warning of educational quality, thereby supporting the development of a continuous improvement-oriented quality culture. These scenario-based applications share the common characteristic of forming a complete closed-loop for data value realization, where the feedback data generated by each application scenario further enriches data assets, continuously optimizes analytical models and application outcomes, and ultimately promotes the formation and refinement of a data-driven governance model.

Conclusion

This study establishes a theoretical framework for data governance and application within the context of Informatization Model Schools, clarifying the profound coupling relationship between data governance and institutional development strategy. It systematically analyzes core issues across the three dimensions of data, technology, and organization, and proposes a systematic pathway encompassing top-level design, platform integration, and scenario implementation. The effective implementation of data governance requires not only the establishment of standardized institutional systems and agile technical architectures but also relies on the cultivation of cross-departmental collaboration mechanisms and a data culture.

In the future, higher vocational colleges need to further explore the deep integration of data middle platforms and intelligent analysis technologies, construct an open and shared data ecosystem, and continuously optimize data application models in typical scenarios such as industry-education integration and personalized learning, thereby truly achieving a comprehensive leap from data resourceization to business value realization.

Fund Projects

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