

Original Paper

The Construction Practice of Informatization Ecosystem in Chinese Universities Based on Big Data of Education

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Abstract

The wave of digital reform boosts the layout and construction of university informatization. However, in view of the current problems of university informatization construction, such as inadequate overall planning of system construction, ineffective interoperability of some business system data, high construction cost, and unclear division of responsibilities of system management, the article explores a general idea of digital reform based on the reality of “information islands” and “data chimney” in school education big data. In combination with the actual situation of the school, it has planned and put into practice the idea of the school’s digital reform, built the school’s “digital intelligent medical university” information ecosystem, designed and formed the “1614” digital reform work theoretical system from the top planning, consolidated the construction of the school’s education big data warehouse, committed to data collection, governance and sharing, gathered data resources, and formed a brain-like system to help teaching decision-making, Build a “cloud” supported teaching resource supply system to help borderless teaching, and finally build a personalized teaching ecological model based on education big data.

Keywords

education informatization, Digital reform, Education big data, Data governance

1. Introduction

In the field of education, it is necessary to accelerate the systematic integration of business, data and technology, build the overall intellectual governance system of education, and improve the overall level of digital education governance. Colleges and universities are the first place in the field of education reform, and should bear the brunt. Driven by the wave of digital reform in the whole province, as well as the fragmented business systems and numerous data barriers among colleges and universities, the work of data-supported business data integration, institutional mechanism reform and business process

remodeling is urgent. This article, based on the idea of digital reform in Zhejiang Province, from the perspective of top-level design, combs the ideas and methods of digital reform in colleges and universities, with a view to providing reference for the development of information technology in colleges and universities, It also gives the idea of the construction of the university information big ecosystem, and makes its due contribution to accelerating the modernization of education, building a strong education country, and running a satisfactory education for the people.

2. Digital Reform Provides Guidance and Support for the Construction of University Information Ecosystem

The 2035 Action Plan for China's Education Modernization (Zhang &Liu, 2020), the Fourteenth Five-Year Plan for Education Informatization (2022), the Education Informatization 2.0 Action Plan (2018) and other documents, as well as the Digital Reform Conference of Zhejiang Province and *the Overall Plan for Digital Reform of Zhejiang Province*, pointed out that we should build a global digital transformation highland, break the digital barrier, eliminate the digital divide, and form a good atmosphere for the whole society to share the “digital dividend”, through digital empowerment, We can accurately grasp every task and every field from macro to micro, from qualitative to quantitative, and improve the overall synergy. On February 21, 2021, at the Digital Reform Conference of Zhejiang Province, the Secretary of the Provincial Party Committee Yuan Jiajun pointed out that we should comprehensively use digital technology, digital thinking, and digital cognition (Hu, Bao, & Pan, 2022) to comprehensively and systematically reshape the institutional mechanism, organizational structure, methods and processes, means and tools of education governance, effectively build a new platform, mechanism, and model of education governance, and promote the modernization of education governance in Zhejiang Province at a high level, In order to create a leading province and demonstration area for socialist education modernization. In March of the same year, the Ministry of Education issued *the Code for the Construction of Digital Campus in Colleges and Universities (2021)*, which pointed out that it should promote the deep integration and innovative application of information technology and talent training, scientific research, cultural heritage and innovation, social services, international exchanges and other aspects of higher education, improve the quality of education and teaching and scientific research services, improve scientific decision-making and educational governance capabilities, and cultivate high-quality talents with innovative spirit and practical ability. Therefore, the deep integration of information technology and education is particularly important. Colleges and universities urgently need to actively promote digital reform and build an education information ecosystem based on big data.

3. Practice of the Construction of Educational Information Ecosystem in W University

3.1 Top-level Design and Overall Planning of Information Ecosystem

In order to efficiently complete the construction of the “Digital Intelligence and Medical University”

information ecosystem and ensure the orderly progress of the work, the school digital reform leading group with the school leadership as the core has been set up to realize the overall guidance of the project construction process. Through parliamentary discussion, resolution, evaluation and argumentation of the information project construction content, project construction funds allocation and other matters, Always take “whether the service is optimized, whether the data is shared and connected, whether the work is integrated and integrated, and whether the system is easy to use, effective and practical” as the core issues to ensure that the reform is not biased (Lan, 2021). The “1614” digital reform work theory system has been formed (see Figure 1). “1” refers to the integrated public data platform, which collects and manages various teaching related data; “6” refers to the six runways involved in application construction, which are divided according to different fields of teaching management business; The second “1” refers to the school-level central system, which integrates the registration center, message center, task center and other centers to facilitate education management and improve efficiency; “4” refers to four security systems, including policies and regulations, standards and specifications, organizational security and safety protection.

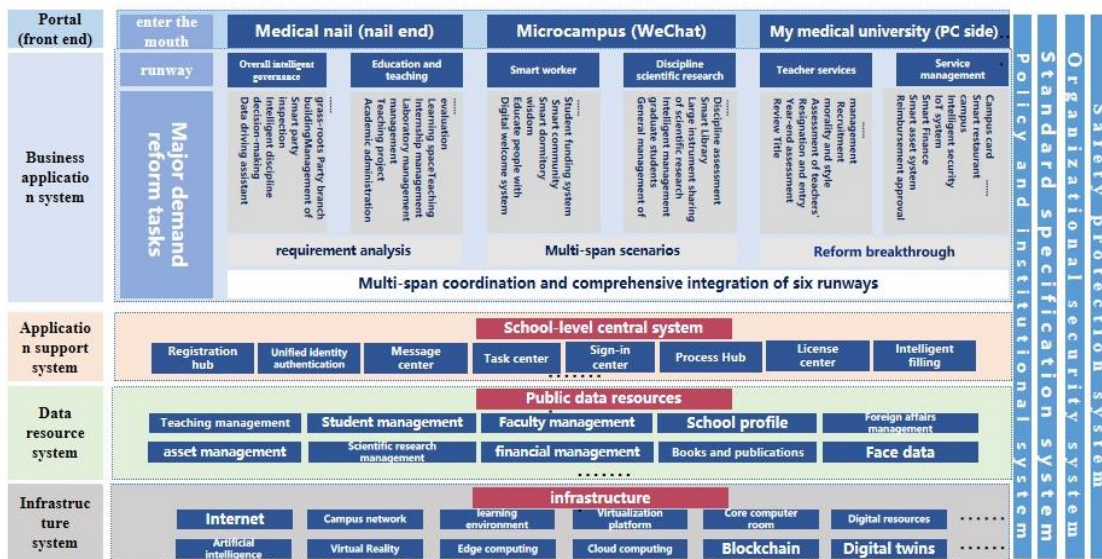


Figure 1. Architecture of School Digital Reform System

The “Digital Intelligence Medical University” project is subdivided into six runways, each of which is under the responsibility of a specially-assigned person. The runways include “overall intelligent governance, education and teaching, intelligent learning and engineering, subject scientific research, teacher service and service management”. Each runway integrates various digital applications to achieve the overall intelligent governance of teachers and students in the school.

3.2 Sedimentation, Governance and Application of Education Big Data

The application of education big data has entered a new historical period. Based on education data mining and learning analysis technology, we have developed special education data analysis and

decision-making models, tools and algorithms to achieve the efficiency of education data processing and the maximization of data application value. The outline of the education industry data analysis and application system is gradually clear (Yang, Wang, & Downs, 2015), but the premise is to urgently build the school data governance system, Let data enable education and teaching with high efficiency.

(1) Build school-level big data warehouse and realize data collection in one warehouse

Build a high capacity, high computing power, safe and green school-level big data warehouse that integrates data collection, governance, application, sharing and analysis. Carry out data standardization management according to *the W University Data Standard*, and collect the big data of school education through the data reporting system. Comprehensively collect, gather, manage and share the business data resources of each department, compile the data resource directory by classification, determine the scope and content of directory compilation, carry out business and resource survey, master the current situation of information resources of each department, sort out, analyze and merge the survey contents, and generate the department resource directory and shared directory. Ensure various basic data services such as teaching, scientific research, personnel and assets (Yang, Downs, & Li, 2016), and improve the input and output capabilities of the school-level education big data warehouse. Improve the data governance mechanism, promote the normalization of data governance, regularly feed back the data quality report based on the department data responsibility list, and establish the data quality assessment mechanism to ensure the accuracy, integrity and effectiveness of data. For the data that can be intelligently obtained from the application system or education and teaching operation process, never use the “manual filling” method, and strive to achieve “one source of data, one source for multiple purposes”.

(2) Revise and improve data standards, and serve data exchange and sharing

Data standards are normative constraints to ensure the consistency, accuracy and integrity of the unified understanding, use and exchange of data by all business systems. Today, the speed of data accumulation far exceeds the speed at which data can be processed and utilized, mainly due to the lack of unified data standards. The school will sort out the core business of each business department by referring to the national standard documents such as *JY/T 1001-2012 Education Industry Standard of the People's Republic of China* and *the industry specification of Basic Data Elements and Codes for Education Management*, transform the business information items into data fields containing objects, features and descriptions, form data elements, sort out, explain, abstract, merge and number the data elements, Form a unified data standard for the school (Wang, Y. G., Wang, Y., Wang, H. J., Hu, Li, & Lou, 2022).

(3) Governance of education big data and revitalization of data quality

Information analysis and processing based on big data operation method is the core of data application and the theoretical basis for guiding teaching practice. Therefore, special attention should be paid to data cleaning in the screening process before information processing. All systems in the school must use standardized data that has been uniformly cleaned and managed to solve the problems of data islands and data chimneys, so as to achieve data unification among heterogeneous application systems,

and can conduct in-depth data mining and analysis without generating new data islands (Yu & Li, 2018). We will investigate and understand the business data of each business system, use database docking, interface docking and other methods to collect business data into the school-level big data warehouse, develop quality rules to audit outliers, data missing, duplicate records, duplicate primary keys, and use standardized cleaning methods to clean data formats, data dictionaries, and other standardized illegal values, spaces, null values, and types, and form a resource library, According to the subject database model, the resource database data entity splitting, data integration, job scheduling and other operations can be formed into a subject database. The data model can also be created according to the requirements of the subject database construction, and the subject data can be integrated according to the model to serve the development, so as to realize the multi-span collaboration and information exchange between systems.

(4) Apply data resources to help teaching decision-making

Build a brain-like system, integrate various education laws and regulations, research reports, online course resources and other knowledge to form a data knowledge base. Integrate educational policies, curriculum standards, educational evaluation and other rules and cases to form a data rule base. Integrate general algorithms such as natural language processing, image analysis, logical regression and other characteristic algorithms to form a data algorithm library. Based on the business scenario, integrate ecological monitoring, teacher portraits, student portraits and other educational feature model libraries to promote the deep integration of information technology and higher education. Effectively support the basic functions of talent training, academic research, social services, cultural heritage, as well as the innovative development of school governance, internal security, and external relations.

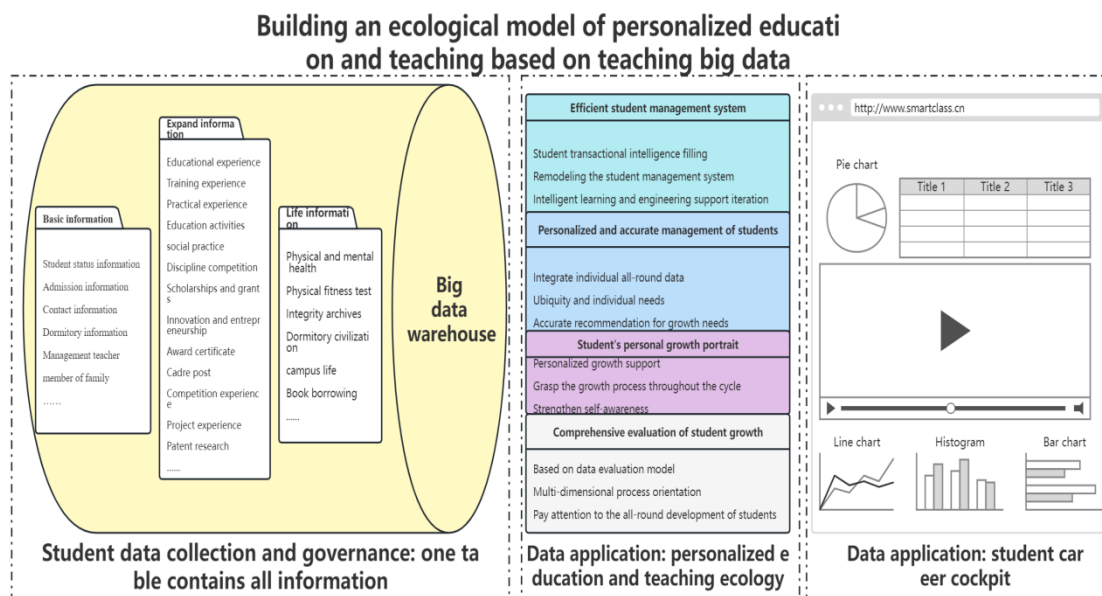
3.3 Build a “Cloud” Supported Teaching Resource Supply System

Create a “medical university education cloud” to achieve wireless wired network gigabit to the desktop, 10Gbit to the core, and sensorless authentication. Deploy 5G dual-domain private network in cooperation with China Mobile and China Telecom, and pilot 5G direct access to campus resources. Promote the scale deployment of IPV6, transform the core equipment of IPV6, and realize all and system support IPV6 access. Fully integrate offline resources, massive courses, online systems, practice platforms, mobile applications and other virtual and real intelligent education space, emphasize process evaluation and big data analysis, and focus on learning situation analysis and teaching quality analysis. Continue to promote the construction of relevant advanced and cutting-edge education and teaching resources of the same type of medical colleges and universities across the country, build a teaching ecosystem based on the school-based teaching resource pool, create a “smart education community” with cross-region, cross-school, multi-level and medical university characteristics, help teachers and students to teach and learn without boundaries, and improve the quality of medical professional training.

3.4 Build Personalized Teaching Ecology Based on Education Big Data

Based on the precipitated big data of education, an ecological model of education and teaching is

constructed from three aspects: teacher development, student growth and teaching management. The core of this process needs to be clear is that all teaching activities are student-centered, and all activities are for the better growth of students. Therefore, the focus of the whole model will be on the construction of student learning ecology, and the other two aspects will be considered as components of the extension. Personalized education services must be aimed at meeting students' personalized learning needs. Only when students can really benefit from education services, students' demand for education services will continue, and the existence and development of education services will have sustained momentum (Liu, Wang, Lei, & Zhang, 2017). It is also a false proposition to talk about individuality without generality. Therefore, this model will build a personalized education and teaching ecological model with generality and individuality complementing each other and developing in an all-round way, based on the common development of students and the promotion of individual uniqueness development, as shown in Figure 2.



Model segmentation includes efficient student management system, student personal growth portrait, personalized and accurate management of students and comprehensive evaluation of student growth. The “efficient student management system” module mainly includes student registration information, enrollment information, contact information, dormitory information, management teachers, family members and other data related to student management. Functions include student’s transactional intelligent filling, student management system remodeling, intelligent learning and work support iteration, etc. The “Student Personal Growth Portrait” module contains the personal information of students in all aspects. Students can always know all the data of their study, life, entertainment, sports and so on. Its functions mainly include personalized growth support, whole-cycle grasp of the growth

process, and strengthening self-cognition. The “personalized and accurate management of students” module mainly refers to the system will analyze all the data of students and further realize the refinement of information push. Students’ learning, safety, whereabouts, physical status, consumption and other conditions can be understood without perception. The “comprehensive evaluation of student growth” module mainly focuses on the growth of students from the perspective of managers, and then forms a complete ecosystem of training objective system, curriculum teaching system, management system and other systems conducive to the personalized development of students. Provide students with appropriate education models, including functions based on data evaluation model, multi-dimensional process orientation, and focus on students’ comprehensive development.

A pile of cold data is useless. Only by “being active” and building a visual cockpit according to the key indicators to evaluate the development of students, can managers easily grasp the real development status of students and make better decisions. The contents of the cockpit are retrieved and integrated according to the reasonable requirements of the Academic Affairs Office, the Department of Education and Engineering, and the Security Office. It includes basic information such as student status information, enrollment information and contact information, expanded information such as education experience, training experience and practical experience, and life information such as physical and mental health, physical fitness test, and integrity archives. The integrated functions include course selection suggestions, employment guidance suggestions, learning progress promotion suggestions, score distribution curve, radar chart, etc. Let students fully understand their specialty, learning ability and living conditions. In addition, on the basis of big data analysis, carry out online teaching effect evaluation and teaching progress prediction, integrate information technology with the current curriculum and teaching system evaluation, improve the evaluation scheme formulation, teaching implementation, result analysis, etc. in the process of building university teaching model, make the process more accurate and efficient, and then realize the effective evaluation of university teaching.

4. Summary

The outbreak of the epidemic has made people more aware that data is an important strategic asset in the 21st century. If properly used, it will accelerate the improvement of national governance capacity and the modernization of governance system. During this period, a large-scale and lasting wave of digital reform was set off around the world, and reached the height of national strategy in China. As a sharp tool to narrow the gap between the rich and poor in education and maintain education equity, the digital reform of education is also the only way to improve the quality education of the whole people. It plays a vital role in moving towards “digital civilization” and embracing common prosperity. As the cradle of talent training, colleges and universities need to make good plans to improve the efficiency of reform in the face of the wave of digital reform. First, establish a special working group (personnel guarantee): select information technicians from all departments as members. The special group has the guiding responsibility for the school’s digital reform project, and can ask relevant departments to

cooperate in completing the relevant reform work. The special group members regularly organize the school-wide digital reform training, and teach the digital reform experience. The special group for digital reform needs to report the school's digital reform situation and progress to the school leaders regularly. Second, plan the top-level design: design the digital reform framework from the overall perspective, clarify the reform track, and clarify the reform objectives; Third, strictly implement the "three lists" of demand list, reform list and scenario list: consider the application construction based on the national requirements, industry norms, and the most urgent needs of teachers and students, and use the three lists as constraints to build the application and improve the construction efficiency; Fourth, make good use of "V model" and other tools: break down the traditional business into the smallest granularity, use digital thinking, digital cognition and digital tools to reconstruct the business, and improve the efficiency of transaction operation; Fifth, improve the four major systems, strengthen policies and regulations, standards and specifications, organizational security and security protection, and escort the digital reform of colleges and universities and the construction of the information ecosystem.

Fund Project

1. Higher education teaching reform project (school level) in 2021 (in Chinese) (project number: JG2021106)
2. Wenzhou Basic Public Welfare Research Project (in Chinese) (project number: 2022R0192)
3. The collaborative education project of the Ministry of Education (in Chinese) (project number: 220601282130318)
4. The "Fourteenth Five-Year Plan" teaching reform project of ordinary undergraduate universities in Zhejiang Province (in Chinese) (project number: jg20220373)

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