Chapter 2
Data Empowerment and System Remodeling Application

Lin Zhou, Lei Li, Shumin Zhang, and Yushun Li

2.1 Background

Dongcheng District of Beijing is the functional core area of the capital, which pays special attention to promoting the high-quality development of education. In 2019, Dongcheng District was awarded the first batch of the "Smart Education Demonstration Zone" by the Ministry of Education. In the same year, the overall framework of "1 + 7 + N" smart education construction was put forward. In 2021, Dongcheng District was awarded the educational characteristic base of the "National Intelligent Social Governance Experimental Base" jointly selected by the Office of the Central Cyberspace Affairs Commission, the Ministry of Education, and other eight ministries. It soon proposed to build the "1314" intelligent governance system of Dongcheng Education, which further promotes the advanced exploration and practice of artificial intelligence technology in the field of education.

L. Zhou · L. Li (✉) · S. Zhang
Beijing Dongcheng District Education Commission, Beijing, China
e-mail: lilei0901@163.com

Y. Li
Beijing Normal University, Beijing, China

2.2 Measures and Results

2.2.1 Regional Systematic Digital Transformation Empowered by "Data Brain"

Formulating data standards and specifications. According to the educational data standards of the country, the Ministry of Education and Beijing, a series of measures for the management of educational data in Dongcheng District have been formulated, which unify the data collection standards, usage specifications and return requirements. Dongcheng District Smart Education Research Center takes the responsibility to co-ordinate, set up the governance work group, and establish the "internet+" data aggregation mechanism. It has also built a smart education cloud service platform in the district (hereinafter referred to as "cloud platform"), which can be used to vertically connect the national and Beijing's platforms, and to horizontally integrate regional applications, by realizing a unified login process. Until now, the database of Dongcheng District has been formed, covering 73 types of data materials, 11 business and application systems, 12 primary data subjects, 42 secondary data subjects, and 1517 data reports.

Optimizing service-oriented products by using data. Using the multidimensional data system, a holographic portrait combined with "one school with one file" for school, "one teacher with one file" for teachers, and "one file for students' life" for students is established. Dongcheng District has established a comprehensive data management platform to realize the unified "directory tree" management of educational data resources. Up to now, the cleaning, sharing, and quality inspection of 324 duty directories, 95 data tables, and 71.51 million data records in 46 departments have been completed. Moreover, it has built a smart screen for dynamic monitoring and analysis of functions such as data convergence, smart classroom, and smart office, and explored the use of data to support educational science decision-making. After opening the data interface, the Municipal Education Commission and subordinate educational units received the modular data in the "data brain" from Dongcheng District. Thus, Dongcheng has greatly promoted the ordered and well-organized sharing of regional data resources.

2.2.2 Artificial Intelligence Boosts the Remodeling of the Education System

2.2.2.1 Double-Teacher Class Breaks the Time and Space Boundary of Education

In 2021, Dongcheng promoted the online teaching platform in the whole district, and planned to carry out the transformation and exploration of double-teacher classrooms

in the schools. Shijia Primary School and Gexinli Primary School are one of the first pilot twinning schools in double-teacher classes. The faculty forces in Gexinli Primary School are relatively weak. What's more, there is a big gap between teachers' different understandings of the textbook and those of famous teachers. Through preparing a class with famous teachers in Shijia Primary School, and conducting immersion observation and lectures, the professional ability of young teachers in the Gexinli Primary School has been rapidly cultivated and improved. Up to June 2022, 184 smart classrooms for double teachers have been put into use in Dongcheng District.

2.2.2.2 Integrating Classrooms to Improve the Quality of Education

The intelligent assistants and virtual experiment resources embedded in the cloud platform optimize the design of teaching content, which makes classroom teaching more vivid and scientific. The modern art classroom based on VR technology allows students to be immersive in the virtual art museum, in that way, students are able to be more focused on studying paintings. Smart PE classroom equipped with smart bands makes it possible to formulate exercise plans for students by using real-time monitoring data. Meanwhile, the accompanying data acquisition system and interactive feedback system supported by big data can solve students' problems in class to avoid leaving any loopholes. Some statistical tools, which can be used in the individual learning process, monitor students' independent practice in time, and accomplish accurate analysis and personalized evaluation.

After being affected by the epidemic, the whole district has entered an arena of online teaching, in which teachers need to fully tap the advantages of online teaching tools. For example, the teachers of No. 2 Middle School can guide their students and achieve the exercise effect through live interaction, roll call, online PK, etc., and the atmosphere of online PE class is very lively and relaxing. During the online teaching period, teachers have also made full use of the function of "family" and carried out work in other education fields except for academics. For example, the online Young Pioneers activity class of Jingshan School Primary School not only achieved 100% coverage and completion rate, but also completed one district-level open class, 12 school-level exhibition classes, and 31 grade observation classes.

2.2.2.3 AI Teaching Assistants Can Improve the Quality of the Homework and Reduce the Burden of Teachers and Students

Using the units of "Accurate Management of Homework" and "English Listening and Speaking Teaching" in the cloud platform, teachers can set flexible questions and test papers. They are able to collect the learning situation of students, accurately comment and push personalized homework, etc. At the same time, the synchronous test questions of "formative exercises" compiled by a unified proposition are provided. The

local resource library in this area takes the new curriculum and new curriculum standards as the core, and marks the labels of knowledge points, subject core literacy, academic level, etc., so as to improve the quality of homework from the source.

The AI-based homework analysis system automatically generates an analysis report from students' online answers, reducing the burden of teachers' manual correction and academic situation analysis. The homework answered offline can also be integrated into the collection of academic data by means of a scanner or photo collection, etc., to meet the students' needs of individual counseling and personalized feedback. Every student's shortages of learning are recorded systematically, and teachers can put forward strategies according to the knowledge map, so that every student can get high-quality customized layered homework quickly and accurately. Through this effort, the system help students consolidate knowledge pertinently, and reduce the burden on teachers and student. Up to June 2022, Dongcheng has introduced a number of AI-based job analysis systems in its whole district, covering all the subjects of the college entrance examination, with a total of over 500,000 learners.

2.2.2.4 Regional Based "Teaching and Research" Supported by Technology

Dongcheng District has established a platform centered on teaching and research based on big data. The platform provides an online and offline integrated environment, and realizes the collection and analysis of the whole teaching process for teachers. Managers and researchers can focus on teachers' real needs through those analysis reports, and realize thorough consideration from lesson preparation, teaching, listening and evaluating to teacher training and evaluation, thus forming a relatively systematic and completely new form of teaching and research in disciplines. Accordingly, teachers can intuitively get to know their performances in teaching and research activities through reports, and benchmarks with excellent teachers to achieve accurate improvement of teaching and research quality.

It has also established an intelligent "teaching and research" system. Taking the Hepingli School District in Dongcheng as a pilot school, the district has set up the demonstration base of the Big Data Precision Teaching and Research Center of No.171 Middle School Education Group. This project has also set up the "Inter-school Collaborative Precision Teaching and Research and Resource Creation Alliance" which includes several other schools, aiming to spread high-quality teaching and research experience, models, and achievements to each other. In that case, the overall improvement of regional teaching and research ability could be improved rapidly. Relying on famous school bases and famous teaching and research staff bases in Dongcheng District, it has built to build a regional research community and an online teaching and research demonstration model school, which have promoted excellent teaching experience and methods in the form of "spreading, helping and bringing". Depending on the double-teacher classroom, a "1 + 1 + x teaching and research community" has been formed, which is led by teaching and research staff. Teachers from leading schools perform as the main lecturers, and X teachers from member

schools participate remotely, so as to realize effective interaction among teaching and research staff, experts and teachers, and teachers in the whole region and even across the country.

2.2.2.5   Integration of Teaching, Learning, and Research Under the Guidance of Scientific Research

Dongcheng undertakes the national project of "Integration of Intelligent Technology and Teaching", and continues to make efforts to carry out the integration process of teaching, learning, and research led by scientific research. Taking the English subject as a pilot, the District Education Committee has carried out various listening and speaking activities in the form of conducting a research, and has launched nearly 20 AI classes related to this form. Based on the software and hardware equipment, teachers carry out teaching on those platforms, extract all kinds of data generated in students' daily practice, and deeply mine them to form an analysis report of districts, schools, classes, and individual students. Thus, a unique "Dongcheng's mode: data empowers the quality education" has formed completely. Up to now, Dongcheng has built 75 standardized examination rooms in 44 schools, 105 listening and speaking training classrooms in 48 campuses, and 130 sets of listening and speaking resources suitable for students in different regions, with a total of over 430,000 people being served.

2.2.3   Smart Campus Innovation Based on the "Future School"

Beijing Huiwen Middle School has embraced the application of "Smart Huiwen", providing the school with better working instruments for improvement, and providing teachers with tools for daily management and micro-class. The application also provides students with personalized online learning resources and a platform for class interaction, and offers parents personalized students' learning data as well as an efficient home-school collaboration platform.

At the end of 2021, Dongcheng launched a project to popularize digital management within schools, focusing on promoting the landing of WeCom. By June 2022, the education systems of the whole district have logged in WeCom, with a 70% coverage rate of "Education and Teaching", "Home-school Communication", and "Health Report" units. There are 36 online office processes, and more than 12,000 teachers and 150,000 parents access it. There are nearly 190,000 online teachers and parents every day, and more than 1,200 active home-school communication groups, which greatly improve the efficiency of management, and ensure the security of notification and data collection.

2.3   Promotion Mechanism

Actively carry out the construction of various universal communities. Relying on the Modern Educational Technology Department of the Chinese Institute of Electronics (CIE), Dongcheng has set up an excellent community of "data-driven precision teaching", and trained a group of superior discipline teams and teachers with outstanding teaching performance and strong data application ability. It cooperates with Beijing Normal University, Capital Normal University, Beijing Institute of Technology, Peking University, and other scientific research institutions and professional colleges to carry out research projects. They have formed an action research community, and try to promote theoretical innovation with the guidance of experts. Dongcheng unites the teacher training system of the Academy of Education and the "Information Leadership Improvement Project of Principal" of the Education Central Party School to build a community for improving teachers' information literacy. Relying on the Dongcheng District Youth College and School Innovation Association, they cultivate a regional talents training community and cultivate students' innovative consciousness and ability.

Pilot goes first, then multi-type pilot follows. Taking the Lama Temple Primary School as a pilot, Dongcheng has built a dedicated online teaching system for mathematics, and explored the transformation path with discipline characteristics. Moreover, being led by Beijing No.5 Middle School, six primary and secondary schools have carried out the "double classroom" research together, discussing the mechanism and method of cultivating reading and writing ability across long chains of Chinese disciplines, and improving the quality of regional education through training. Gexinli Primary School-Shijia Education Group and Qianmen Foreign Languages School-Jingshan School took the lead in the demonstration. Both of them have comprehensively pushed forward the double-teacher class of teacher rotation and twinning schools in the school district. Cooperated with Peking University in the "Winter Training Camp for Innovative Music Lessons", Dongcheng District not only speeds up the construction of innovative classroom forms, but also achieves its goal to assist teachers in the whole region with the mobile application.

Build a platform to optimize the supply service of educational resources. By building an intelligent self-learning platform, Dongcheng has set up a distance learning model of "self-access + guided tour + interactive Q&A". Dongcheng also explores self-learning scenarios based on learning resource supply, intelligent resource recommendation, and teacher-student Q&A interaction. It has promoted quality courses in the "college system", and carried out the training of artificial intelligence courses in primary and secondary schools. It tries to develop literacy-oriented subject courses and interdisciplinary courses. Therefore, it makes efforts to support interactive class in different schools, districts, and cities. Based on the cloud service platform of smart education in Dongcheng District, Dongcheng has also fully popularized the "one person and one space" model for online teaching and learning between teachers and students in the whole district, realizing that

teaching applications cover all teachers and learning applications cover all school-age students, and striving to form a new normal of talent cultivation and resource supply in the "internet+" circumstance. Until now, 106,247 students' spaces, 21,576 teachers' spaces and 193 schools' spaces have been set up, integrating 41 national educational resources public service platforms, national primary and secondary school network cloud platforms, Beijing education public resources platforms, and third-party education and teaching applications.

2.4　Experiences and Expectations

Sustainable development. Dongcheng has broken through the traditional mode of educational informatization construction, embraced the Internet application positively, and absorbed the superior business services of various Internet companies actively. Combining with the "data brain" in Dongcheng, the District Education Commission has also actively created an integrated ecology of Internet applications and regional smart education applications, "leaving" the educational data generated by Internet applications in Dongcheng. During the process, Dongcheng has helped the sustainable development of regional smart education with the accumulated educational big data.

　　Application. In the process of digital transformation in Dongcheng District, the faculties resolutely implement the two-way promotion of technological innovation and business promotion. They have adhered to improve educational informatization from a scientific perspective, and insisted on giving priority to business applications. After fully implementing the three links of pilot exploration, highlighting demonstration and experiencing promotion in all work, Dongcheng has promoted the branding of smart education achievements.

　　Data brain. Dongcheng District's "data brain" grasps the development trend of regions, schools, teachers, and students in real time. It contributes to exploring the full application of educational data in monitoring, campus security warning, management, information control, inter-school collaboration, smart teaching comprehensive literacy evaluation, etc. To form a new mechanism of "using data to assist decision-making", it has constructed a new model of "one picture" education governance based on data visualization.

　　In the future, Dongcheng will continue to promote the systematic construction of "data brain", cooperate with technology companies to optimize algorithms and develop technologies, and cooperate with university think tanks to construct educational data models. Ad hoc, it will provide support for accurately evaluating the present situation of education and teaching, accurately predicting the development of education as well as refining education decisions. Dongcheng will explore the establishment of a smart decision-making system based on the comprehensive level of students' ability, knowledge, psychology, etc. and rules suitable for educational applications. It will be dedicated to exploring education equity under technological empowerment, and studying the smart educational application and service system,

providing support and basic guidance for the access and evaluation of smart education and artificial intelligence products, so as to effectively enhance educational quality and promote education equality.