Regional Practice of Educational Reform Based on School-to-the-Future Project in Chengdu City

Zhang Yan[1], Jingping Chen[1], Hui Dai[2]

[1] Chengdu University, Chengdu, China

[2] Education Bureau of Chengdu City, Chengdu, China

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Abstract: In the age of rapid technology development and social revolution, it has become a consensus that education needs systematic reform instead of simple tinkering. The challenges and the promises that brought by artificial intelligence made systematic reform inevitable, and it needs the collaboration among the educational administrative departments, research institutions, enterprises, school administrators, teachers, students and employees, parents and even the entire society to make it happen. The question is how to effectively coordinate the effort of all the stakeholders, and promote the reform with clear goals, plans, strategies and steps. Since 2013 the Education Bureau of Chengdu initiated the school-to-the-future project, which aiming on exploring regional systematic education reform through integrating multiple administrative and research resources within the region and building regional advancing mechanism. This project encourages and supports the schools to make innovations on various education factors, including the education philosophy, teaching and learning resources, curriculum design and implementation, instructional methods, assessments, construction and utilization of intelligent campus, school management and technology use. This paper introduces the theoretical framework, implementation strategies and working experiences of this project, which might be helpful reference for the regional systematic education reform.

1. Introduction

Our society has entered into an age of rapid technology development. The upgraded technologies, including the new generation of information technology, biotechnology, new energy technology, new material technology and intelligent manufacturing technology, are bringing the next big revolution to the human history. Among all these technologies, Artificial Intelligence is becoming the driving force that reshaping the industrial and economic ecology. It is reconstructing the relationship between human and technology as well as human and the tools. This brings out both promises and challenges to the current world. On the one hand, repetitive, predictable, routine physical and cognitive work were replaced, the efficiency and productivity is promoted, and innovated products and services are rewarded. Artificial intelligence thus became a strategic focus of the nations around the world, and international organizations also highlights the opportunities that it brought out to the human society. On the other hand, bigger divide among distinct social, geographical or geopolitical groups appears because of the uneven distribution in the access to, use of, or impact of the artificial intelligence technology. The other severe challenge is the value of human kind. Along with the transformation of many industries, many jobs are disappearing, and the professional knowledge and skills that people once made for living are becoming obsolete. Some radical thinkers even claim that the development of AI might “render most human beings superfluous” (Harari, 2018) . Are we becoming useless? What makes the human being unique in the future world? What are the qualities that makes the human still being valuable in the AI-based society? The answers to these questions lead to not only the philosophical inquiries, but also deep thinking about the education: what is the value of the education? Are we investing enormous time

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and money in the current educational establishment on producing “useless class” for the future society?

The challenge that brought by AI to education is unprecedented. The value of the education needs to be reconstructed to bring educatee intellectual, social and economic increment in an AI-based society; the purpose of the education needs to be redefined to give the young the things they need to develop into members of the society (Dewey, 1938) , and the methods of the education need to be redesigned in an AI-supported learning environment. In other words, a systematic change in the current education system is inevitable, and almost every country is standing on the same starting line.

However, change is not easy to made in education system. Paradigm shift has been a popular issue in education since the information technology era begins, but unlike the other industries which are revolutionized by the technologies, the change in education is very limited. The major reason might be as Collins and Halverson (2018) stated, education is a complex, sophisticated and closely coordinated system, and the educational reform cannot only work on one element, but ignore the relationship and connection between this element and other. Therefore, to make significant change in education, the work must be a systematic, and educational administrative, research institutions, enterprises, school administrators, teachers, students, employees, parents and even the whole society need to work together.

For instance, the educational administrative should focus on the reform of the macro system, including setting the reform goals, strategies, redesigning the value system and making developing plans with the support of research institutions. In the meantime, they should promote the reform on education governance system, management system, school evaluation system and funding system with specific policies. For the school, they should work on the change of the micro level, including education philosophies, school management, organization structure, the mechanic of information flow, HR system, teaching management system and academic innovation. Reform in school could also happen on the curriculum, pedagogies and assessments for every subject, the organization of every learning community, the design and implement of each lesson in each classroom, as well as the learning methods and process of each student. The macro and micro level change needs to influence and promote each other as a cycle to realize the systematic change.

The question is, how to make the paradigm shift happen? What is the mechanism that can coordinate the strength and effort of all the stakeholders toward the goal of systematic change on education?

2. Literature Review

Many efforts have been made to on the systematic change of education. Some focus on the change of the education purposes. New literacy systems as the framework of the educational purposes have been proposed by UNESCO, the European Union, the Partnership for 21st Century Skills, and many countries. For instance, UNESCO presented three main competencies for future society: the professional competence (hard power), social skills (soft power), information technology competence (hard-soft power) (UNESCO, 2020). European Commission recommended eight key competences needed for personal fulfillment, a healthy and sustainable lifestyle, employability, active citizenship and social inclusion, which include: core literacy includes literacy, multilingualism, numerical, scientific and engineering skills , Digital and technology-based competences, interpersonal skills and the ability to adopt new competences, active citizenship, entrepreneurship, and cultural awareness and expression(European Commission, 2020). In September, 2016, China officially released the “Core Qualities of Chinese students' Development”, which identified six major qualities including humanistic attainment, scientific spirit, learning skills, healthy life-styles, responsibility, and innovation in practice. The well-known 21st century skills include life and career skills, learning and innovation skills, information, media and technology skills (Partnership for 21st Century Learning, 2020). The United States also released Common Core State Standards which focuses on developing the critical-thinking, problem-solving, and analytical skills students will need to be successful after high school (Common Core State

Standards Initiative, 2020). Obviously, it has become a consensus that instead of being limited on disciplinary knowledge and skills, the purpose of the education should be a comprehensive set that could respond to the need of cognitive, cultural, technical, interpersonal and intrapersonal development in the knowledge and technology-based society. However, what competencies are necessary for the AI-based society is still under discussion, and there is no widely recognized competence framework for AI-based education.

There are also national or regional programs focused on systemic change. For instance, in 2016 Finland released their new national curriculum framework, in which the contents that encompass many disciplines are advocated. The curriculum also adopts a new pedagogy known as “phenomenon-based', which encourage the students to learn from complex topics such as “climate change”, and various knowledge, skills and expertise across different disciplines are emergent along the way of students’ inquiry. Besides the curriculum and pedagogy change, the reform in Finland also include the change on educational spaces, assessments, and technology use (The Finnish National Board of Education, 2010). Japan initiated future school promotion project as a pioneering educational ICT project in 2011, and 20 schools (including primary, secondary and special schools) were selected as the experimental bases for practical research about the effects of using ICT, the development of effective ICT supported instructional methods as well as standardized electronic textbooks. This project emphasized the measures of enhancing the students’ ability to solve problems through collective learning as well as realizing subjective learning of children by using ICT effectively (Mitomo, 2020). From 2007 to 2011, Singapore selected 8 schools to participate in a school-to-the-future program, aiming on building three-dimensional (3D) virtual learning environments to overcome the limitation of certain region, optimizing the application of the ICT tools in teaching, and innovating the curriculum and assessments. In US, besides the national wide reform that brought by the common core standards, there are also schools such as Alt-School, High Tech High committed to systematic innovation on school education. In 2016, the Chinese academy of education sciences initiated the plan for China's future school, which is committed to comprehensive and structural changes in school education. This plan proposed that the main development direction of schools in the future is to promote innovation of learning space, learning style, school curriculum, educational technology and school organization. At present, this plan includes 15 experimental regions, 11 model schools and more than 200 member schools in China(Future School Lab of the Chinese Academy of Education Sciences, 2020). The current outcomes of this future school lab focused on the space and environment building for future learning(the building of the pioneering labs). These practices provided significant experiences and inspirations of how the systematic reform could be carried out in a nation, a region, or a school of . However, these practices are still not sufficient: the experiences on facing the challenges of information technologies might not work on the challenges that brought by AI.

How to make systematic education reform happen in a specific region in China as the answer to the promises and challenges brought by AI? What is the mechanism that can coordinate the strength and effort of all the stakeholders toward the common goal? This paper will introduce the school-to-the future program in Chengdu as one of the regional attempts on these questions.

3. Research Design & Methods

This study utilized a case study design. The “school-to-the-future” project is the major case for this study. The participants include the Education Bureau of Chengdu City, Education Bureau of five counties in Chengdu, the researchers who work on this project, and 42 schools who are selected as the experimental basis. Data were collected through interviews and observation. The administrative authorities who are in charge of this project, the researchers, and the principals/teachers of 42 experimental schools were interviewed to describe their working mechanism, innovative attempts and experiences from the practice. The classrooms of each school were observed twice, focused on the pedagogy change and technology use. The data was analyzed through qualitative analysis procedure (Creswell, 2007) to create codes, themes and categories. Data resource triangulation and member checking (Stake, 1995) were used as validation strategies.

4. Results

4.1 Project Overview

Chengdu City is one of the biggest cities in China with the population over 16 million. It is also one of China's "national central cities" which are geographically and economically important modern metropolis with the mission of leading regional development and participating the international competition. The development of this city needs large number of high-quality human resources, and a high-quality education system is highly needed as the support. Based on its favorable geographical environment, economic status and strategic development vision, the Education Bureau of Chengdu City started the school-to-the-future project as a strategic initiative for regional systemic education reform from 2013. Thirteen top-ranking primary and secondary schools were selected as the first batch of the experimental basis at the beginning, and 29 schools and five counties were added in 2016, which makes each county of Chengdu City at least has one school as the experimental basis for future education. The original intention of gathering these schools together is to ease the difficulty of the systematic reform: each school is encouraged to find their possible breakthroughs based on its own characteristics, and hopefully through experience sharing and integration, the small breakthroughs may evolve into a big new system.

In the Chengdu City's initial plan for school-to-the-future project in 2013, the mission of the experimental schools and counties was stated as making the schools innovative educational establishment that prepare the young to participate, influence, and be responsible for a rapidly changing unknown future. The integration of the educational practices with the technology tools and resources is recognized as the leverage of the reform. The experimental schools and counties were also encouraged to conduct unprecedented experiments through trial-and-error, and keep revising and improving their measures.

The theoretical framework for the school-to-the-future project is based on the 21st century skills, constructivism (Piaget, 1980), social development theory (Vygosky, 1978), connectivism (Siemens, 2005) and knowledge building theory (Scardamalia & Bereiter, 2003). It puts the human as the center of the education: the learning paradigm, learning environment and the learning resources should work together to support the human being to realize their best potentials and be prepared for the unknown future. It emphasizes both individual property and social attribute of the learning, and advocates the cognitive agency of the students on deciding the purpose, methods, paths and resources on their individual or community inquiries. The framework also stated that all factors of the education system should open to possible disruptive innovations brought by the technologies.

4.2 Emerging Themes

4.2.1 Macro and Micro Level Change

The reform that brought by the school-to-the-future project happened in both macro and micro level. The educational administrative, including the education bureau of Chengdu and the education bureaus of five experimental counties, focused on the reform of the macro system. This includes setting the reform goals, strategies, redesigning the value system and making developing plans with the support of research institutions. In the meantime, they try to promote the reform on education governance system, management system, school evaluation system and funding system with specific policies. For instance, Wuhou county tried new administrative methods like proactive management (take measures before things happen) with the support of big-data technology. They also employ new funding policy that is in favor of the schools that have good records on planning and implementation of technology infrastructure instead of equal distribution. For the schools, they worked on the change on the micro level, including education philosophies, school management, organization structure, the mechanic of information flow, HR system, teaching management system and academic innovation. Reform in school also happened on curriculum, pedagogies and assessments for distinct subjects, the organization of distinct learning communities, the design and implement of distinct lessons, as well as the learning methods and process of different students. The macro and micro level change influence and promote each other as a cycle to realize the systematic

change.

4.2.2 Multi-Layer Administrative Measure as Driving Force

One trait that makes this project unique is that it is driven by the administrative measures. In the implementation plan, three layers of administrative subjects are identified: the education bureau of Chengdu City, the education bureau of the counties, and the experimental schools. The education bureau of Chengdu City is responsible for the overall project planning, top-level measure designing and policy-making. The administrative authorities of each county are responsible for coordinating regional resources, providing funding support as well as providing technical and human resource support. The experimental schools are responsible for integrating resources, conducting the reform, reflecting and summarizing the working measures and experiences. The administrative authorities use their administrative measures to advance the project. For instance, the education bureau of Chengdu city made the performance of each county on the project part of the annul administrative evaluation system. The education bureau of the counties also put scores on experimental schools in their annual evaluation if these school made significant progress on this project. These measures make sure that the counties bureaus and the experimental schools see the importance of the project and put enough resources and efforts on it.

4.2.3 Cooperation Mechanism among Government, Enterprises, Research Institutes and Schools

Collins and Halverson (2018) stated that education is a complex, sophisticated and closely coordinated system, and the educational reform cannot only work on one element, but ignore the relationship and connection between this element and other. Therefore, to make significant change in education, the work must be systematic, and all the parties needs to work together toward the same goal. Based on this argument, the school-to-the-future project built a four-way cooperation mechanism among the administrative authorities, technology enterprises, research institutes and experimental schools. The administrative authorities take the lead of coordinating the resources from all parties through making corresponding policies, dedicating special funds, calling for special meetings, and organizing theme training programs. Technology enterprises provide project consultation service, technical service and technical products based on the requirements from the administrative authorities and the schools. For instance, before the project plan was released, technology enterprises including Apple and Cisco were invited to provide suggestions and feedback on the plan design. Some technology companies deeply involved in the integration of the technology and educational practice, and provide on-campus technical services and customized teacher training. The research institutions (including University of Electronic Science, Sichuan Normal University and Chengdu Institute of Educational Sciences) provide theoretical guidance and intellectual support to the administrations and the experimental schools. They also conducted annual inspection and evaluation to the experimental counties and schools. The results of the evaluation were provided to administrative authorities to see the progress and challenges. Specific status report and suggestions based on the evaluation result were provided to each school to direct possible next move. The school plays the role of putting all the resources into practices, and working as a community to look for breakthroughs in classroom teaching, curriculum development, assessment, teacher professional development and other factors.

4.2.4 Paradigm Shift of Learning as the Core of Changing

The core element for the education reform is the paradigm shift about learning. The learning is conceptualized as a social, cultural, distributed, and collaborative process rather than merely an individual act (Bereiter, 2002; Kafai, 2006; Lave & Wenger, 1991). The inquiry is considered as sustainable emerging process aiming on deep understanding and systematic idea construction instead of completing pre-determined tasks (Zhang et.al, 2011). The learners should take epistemic agency on making learning decisions and creating knowledge instead of receive knowledge as passive consumers. The changes that are made in the “school-to-the-future” are designed to support this paradigm shift on learning and make it go deeper. For instance, the key principle for the

technology infrastructure construction in schools is to make internet connection readily available around the campus, so that the learning can happen anywhere and anytime with the support of the internet resources and online learning community. The learning spaces should also make ubiquitous, fluid, customized, and social learning happen naturally. Based on that consideration, some schools like Zongbei Elementary school tried to expand the concept of the space from traditional physical space to an integration of physical space, network space that supported by information technology, and virtual space supported by AR and VR technology. They also tried to change the original single-function space to gray space with variable and flexible functions. The technology tools such as power interface, projectors and network terminal as well as human-computer interfaces in each learning space are also readily available, so that the information, resources and tools can be used to resond to the emerging learning needs whenever necessary.

4.2.5 Data as the Center of the Technology Infrastructure Construction and Implementation

At present, the experimental schools realized that the data is the core element of the technology infrastructure. These schools' major direction of the technology infrastructure construction is moving from "digitization" to "datalization", and then "intelligent". In the era of "digitization", many schools build various of isolated applications and thus "data islands" become the common problems. The experimental schools started to build unified database and tried to connect the data from the existing applications and build standard entries for new applications. The data from multiple resource was then put together and analyzed, and students' data panorama, teachers' data panorama, schools' data panorama and data dashboard for distinct users are created. These data presentations are then interpreted by the users to improve the school management, classroom teaching, curriculum development and teachers' professional development. The data is also used on supporting proactive management, individualized learning and career planning. Some counties like Wuhou County and Chenghua County is building county-level data center to collect, analyze and present the education data for each school, and tried to improve their administrative level though data-alerted proactive-management and data-supported decision making.

5. Discussion

As an administrative measure driven project, the school-to-the-future project in Chengdu has its advantages and disadvantages. The advantages include the incomparable power of administrative authorities on gathering resources. The administrations can also use the administrative measures such as changing funding policies, giving incentives based on evaluations, issuing administrative orders to compel the participants keep making breakthroughs. However, administrative power also has its disadvantages. The major motivation of conducting the education reform come from the pressure from the upper-level administrations instead of the internal needs of the schools and counties. This is the major reason that the school-to-the-future program are advancing slower than expected. Some schools even use the title of "experimental school" as the leverage for asking more funding from the government instead of seeing this project as a mission of the school. How to raise the intrinsic motivation of the schools for the education reform and better utilize the administrative power on project management and development are the important challenges that needs to be addressed in the future.

The breakthroughs that made by the project are significant, but most of them are at the micro level. The change on the macro-level is very limited. The county-level management system is a very complex system of labor division and power distribution, which makes thorough change very hard to make. Moreover, to most of the counties the "school-to-the-future" project is only one of the many projects that assigned by the higher-level administrations, not a decisive work that influence the future of the county. The ones who are in charge of the project belongs to one department of the county bureau, and generally they do not have the strength and resource to take actions on county-level reform. In this case how to make significant macro-level education reform remains an open question.

The school-to-the-future project is an attempt of current education system to meet the challenge

of the information technology. The current methods and experiences from this project are still not sufficient to answer the challenges that brought by AI. What competencies are necessary for the AI-based society is still under discussion. Although some actions have been taken, including incorporating AI-related knowledge and skills into curriculum (such as brief introduction to AI, the methods and ethics about living and working with AI, AI-related coding, AI-related STEAM inquires), compiling textbooks for AI, and hosting AI-related innovation project competitions. However, the knowledge about how to really relate AI knowledge and skills with students' development remains unclear. The AI tools for teaching are also utilized at a preliminary stage due to the lack of the data of students' learning and on-campus living. Even with sufficient data, how to leverage the power of AI to advance the learning is still a challenge. In the future, there might be more technologies that brings unpredictable opportunities and challenges, and the educational reform projects like school-to-the-future needs to be open and dynamic enough to embrace the change.

In conclusion this case study about the "school-to-the-future" project reveals the mechanism and driving forces of a regional systematic education reform case to meet the challenge of the technology development and social evolution. The administrative measures as the driving forces of the regional education reform have their advantages, but the shortcomings are also obvious due to the lack of motivations from the school side. The regional level (macro level) reform are harder to made compare with school level (micro level) reform due to the complex power distribution system. The practices and measure for the AI challenges are still at the preliminary due to the limited knowledge to AI technologies and its mechanisms. Nonetheless the measures and experiences from this project still can be useful to the policy makers and researchers who are interested with the regional systematic education reform, and the challenges may also help them to go deeper in the relevant research and practice.

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