Comparative Study on the Development of International Smart Education and Its Enlightenment to China

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Abstract—**Smart education is the product following the trend of education development under the condition of economic globalization. It is the direction of education informatization and modernization in the future. It is an inevitable choice to realize the education dream of China by guiding education innovation development with smart education. By analyzing the development status of smart education in the United States, Singapore, South Korea and China, we conduct comparative research from the national policy level, the theory level and the practice level, analyze the problems and deficiencies in the promotion of smart education in China, and then discusses the beneficial enlightenment to the education development of China and put forward some countermeasures so as to better guide and promote the all-round innovation and structural upgrading of education in China, form an education development path with Chinese characteristics, and cultivate more modern intelligent talents.**

Keywords—smart education; education informatization; development strategy

I. INTRODUCTION

Social governance requires wisdom. Since the 21st century, social wisdom governance has developed rapidly. Like smart transportation, smart medical care, and smart business, smart education is an important part of a smart city. The development of a smart city requires that smart education provides technology and talent guarantee. Therefore, in-depth study of smart education and constructive suggestions are of great significance to the construction of smart cities in China. Comparing and analyzing the development strategies, theories and practices of smart education in the first countries to implement it such as the United States, Singapore, South Korea can provide reference suggestions for the development of China's smart education.

II. THE CONNOTATION AND CHARACTERISTICS OF SMART EDUCATION

A. The Connotation of Smart Education

Regarding "smart education", "Smart Education" is popular in the world. The word Smart is interpreted as "intelligent, technical equipment that can work independently". The word Smart is used instead of Wise/Wisdom, mainly referring to developing students' intelligence ability and cultivating intelligent talents on the basis of information technology.

In China, a unified and clear definition of education is lacked. On the basis of in-depth study of educational theories, Chinese scholar Jing Guoping broke the traditional sense of smart education bondage and proposed a broader concept of smart education. The broad form of smart education is comprehensive, rich and pluralistic. It mainly contains three distinct and interrelated aspects: smart education of reason, smart education of practice and smart education of value [1]. Professor Zhu Zhiting defines smart education: smart education is a new realm of informatization in contemporary education. Through the effective use of intelligent learning environment, intelligent resources and intelligent teaching methods, it promotes learners to carry out intelligent learning and cultivate high intelligent talents to meet the needs of social development. Intelligent talents are defined from the perspective of educational informatization and personnel training. Yang Xianmin believes that smart education is supported by a new generation of information technology, realizes the deep integration of information technology and education, enhances the intelligence level of the existing education system, and creates an intelligent, materialized and perceptual education ecosystem [2].

It can be seen from this that Chinese scholars have defined and described smart education from different perspectives and different levels. The understanding of smart education has gone from one-sided to comprehensive and from narrow to deep. The analysis shows that smart

education needs to support education reform, transform educational concepts, and reform teaching and learning methods with the support of emerging information technology. It aims to optimize the education system and enhance the level of intelligence and smartness of education, and cultivate intelligent talents in the new era.

B. Characteristics of Smart Education

With the support of information technology, smart education promotes education reform and development, changes traditional teaching models, and promotes education modernization with educational informatization. It has the basic characteristics of openness, sharing, interaction and collaboration.

1) Educational characteristics of smart education: Smart education is a new type of education model formed by continuous reform and development of traditional education. It represents the development trend of future education, and requires changing educational concepts, reforming teaching and learning methods, deepening the education application, and realizing sustainable and intelligent development of education and teaching, education and research as well as education and management. From the perspective of ecology, Professor Yang Xianmin summarized the core educational characteristics of smart education as: deep integration and open learning of information technology and education and teaching, seamless integration as well as exchange and share of educational resources around the world, and efficient education management and scientific analysis based on big data.

2) Technical characteristics of smart education: Based on education informatization, smart education relies on a new generation information technologies such as Internet of Things, cloud computing and mobile networks to promote the in-depth integration and development of technology and teaching, management and scientific research, improve the construction of educational information infrastructure, and promote the construction of smart and digital campus. Promoting development with technology is a new form of education supported by information technology, which is the core feature of smart education.

3) Resource characteristics of smart education: The introduction of smart education resource cloud has promoted the profound transformation of the development, storage, composition and application of educational resources. The construction concept, technology, mechanism, system and mode of the smart education resource platform have undergone a series of changes, have changed the status of traditional digital resources and realized the wisdom of educational resources. Smart education adheres to the principle of "open and sharing", deeply integrates global excellent education resources through various channels, realizes all-round open sharing of educational resources, and breaks through the geographical restrictions of educational resources. It is convenient for people around the world to obtain and use high-quality education resources and promote the sustainable development of resources.

III. COMPARATIVE STUDY ON THE DEVELOPMENT OF INTERNATIONAL SMART EDUCATION

At present, education informatization reform is being carried out worldwide. For various countries of the world, opportunities and challenges: how to promote the transformation of traditional education into smart education and improve the modernization and intelligence of education coexist. By comparing and studying the development status and characteristics of smart education at home and abroad, countries can learn from each other, which is of great significance for promoting the development of international smart education.

A. Research on the Level of National Planning Policy

The National Information and Communication Development Authority of Singapore introduced the iN2015 Plan (Intelligent Nation 2015) in June 2006. By developing information and communication technology in Singapore from 2006 to 2015, it built an information and communication system that is adaptable to the development of the Times and enhanced the country's information technology capabilities and innovation ability [3]. Smart education is an important part of the program. Its strategic focus includes: improving the educational infrastructure; building a personalized learning space centered on learners; and building an information technology innovation center in the field of global education.

The Ministry of Education, Science and Technology (MEST) in South Korea released the "Promoting Smart education Strategy" in June 2011. The strategy points out that education reform should be carried out, class reform and education method reform should be carried out, and innovative and intelligent talents should be cultivated to adapt to the information society. Its strategic initiatives include: reforming the education system; improving teacher capacity; and improving infrastructure [4].

The development of American smart education has benefited by the joint efforts of enterprises and the government. At the enterprise level, it is mainly the five major countermeasures proposed by IBM (International Business Machines Corporation) for the innovation of smart education: building a learning community; effectively using all equipment for learning; transforming into learner-centered; professionalizing learning services; forming an systematic perspective of education. At the government level, the US Department of Education issued the "Change of American Education: Technology-Enhanced Learning-- The U.S. National Education Program 2010" (NETP2010) in October 2010, setting the direction for the development of education in the United States in the next five years [5]. The strategic plan mainly includes:

- Learning: Establishing a learner-centered personalized learning model.

- Evaluation: Designing standards and evaluation systems that can measure the capabilities of the new century.

- Teaching: Joint teaching and teaching becomes the behavior of teamwork.

- Facilities: Seamless infrastructure configuration.

- Performance: Focusing on evaluation and learning efficiency.

In July 2010, the Ministry of Education of the People's Republic of China promulgated the "The outline of the national medium - and long-term education reform and development plan (2010-2020)". The strategic goal is to achieve education modernization basically by 2020 [6]. The development of education depends on reform. The plan pointed out that "Accelerating the construction of smart education in China, improving the contribution of informatization and intelligence to education development, promoting education modernization development, and building a smart education environment." The "10-year Development Plan of Education Informatization (2011-2020)" requires that "education informatization drives the modernization of education and promotes the innovation and reform of education". In addition, some areas of China have also introduced local policies for the development of smart education, such as the construction of "one center and three platforms" in Foshan.

B. Research at the Theoretical Level

The research on the theoretical level of smart education mainly studies the conceptual definition, theoretical basis, mechanism system and architecture system of smart education. The core of the IBM Smart Education Framework is to enable learners to learn individually. Among them, an important part of IBM's smart education framework is the processing of educational big data. The collection, storage, filtering and analysis of the data generated in the education and teaching process and a series of such data processing can help learners to reflect, teachers to evaluate students and administrators to evaluate courses and institutions [7]. Optimizing and upgrading teaching management is another important component of the framework. The use of new generation information technology such as cloud computing and Internet of Things and intelligent management methods and ways in education management can improve the quality of teaching and efficiency of education management to achieve economies of scale. South Korea proposes SMART Education, which represents the concept and framework of Korean smart education: Self-directed, Motivated, Adaptive, Rich Resources and Technology Embedded [8]. Professor Zhu Zhiting in China put forward the Wise education diagram of smart education--wisdom learning environment--wisdom teaching method- wisdom talents, and described the relationship between them.

C. Research at the Practical Level

The research at the practical level mainly refers to how the national planning policy of smart education operates and implements in reality, and how to construct a smart education architecture system and teaching mode through its theory to guide practical application. Singapore advocates the PPP cooperation model (People, Private, Public), and promotes the formation and development of the smart education industry chain by closely integrating individuals, enterprises, and government public departments. This is a highlight of Singapore's smart education [9]. Samsung Company in South Korea (SAMSUNG) founded the Samsung Smart School, which uses the Samsung Smart Education Cloud Platform in the teaching process of Korean primary and secondary schools, which greatly enhances the level of intelligence education in Korean primary and secondary schools. Five solutions for smart education designed by IBM have been implemented in North Carolina State University. In recent years, some counties (cities) in China have carried out smart education pilots, strengthened the construction of "three links and two platforms", and built smart campuses, educational resource clouds, intelligent classrooms (e-books), and elite schools MOOC to accelerate the intelligence and modernization process of education in China.

IV. THE ENLIGHTENMENT OF THE INTERNATIONAL SMART EDUCATION DEVELOPMENT TO CHINA

A. Development Status of Smart Education in China

The wave of international smart education development is an opportunity as well as a challenge for the development of China's smart education. The strong support of China's national planning policies, the continuous improvement of education informatization and the vigorous investment in education informatization have created realistic conditions for the development of smart education in China. Therefore, smart education construction in China has achieved certain achievements. But for now, compared with developed countries, smart education construction in China is still in its infancy, and there still exist some problems: First, the development between regions is uneven. The level of education informatization in the western region cannot keep pace with the development of that in the central and eastern regions. The information foundation is weak, and the development of the east and west is not balanced. Second, the problem of Information Island is increasingly apparent. The education systems and departments are not associated or connected with each other and the information sharing rate is low. Third, the study of smart education theory is relatively lagging behind. Fourth, technology is advanced, but "soft power" of talent cultivation is insufficient. Fifth, the smart education is dominated by the national government departments and the social participation is low, so the integration mechanism of production, education and research has not yet been established. Sixth, it lacks top-level design.

B. The Enlightenment of the International Smart Education Development to China

Through in-depth comparative study of the development strategies of smart education in developed countries such as the United States, Singapore, and South Korea, we can get the following enlightenment for the development of smart education in China.

1) Enhancing the "soft power" of talents and building an informatization faculty: The rapid development of new generation of information technology such as Internet of Things, big data, and cloud computing has provided important technical support for the development of smart education in China, which facilitates the acquisition and sharing of educational resources. However, smart educational equipment technology can only be a technical means. The promotion of smart education should not only pay attention to the development of modern information technology, but also pay attention to the cultivation of "soft power" talents. Compared with developed countries such as the US, Singapore, and South Korea, the informatization level of the Chinese teaching staff is generally low at the present stage, and it is impossible to skillfully use the information platform and education cloud services to carry out intelligent teaching. It requires the education authorities to actively train and guide an informatization faculty, stimulate teachers' enthusiasm for information-based teaching, promote their in-depth exploration of intelligent courses, and build an information-based teaching team.

2) Innovating the smart education theory and promoting reform with theory: The theory comes from practice, and practice requires the guidance of theory. But for now, countries around the world are immersed in the information technology development and research in the process of promoting the development of smart education and paying attention to the construction of educational informatization. More or less, there is a condition of technology going first and theory lagging behind, so to some extent, the study of intelligence education theory is neglected. The development of smart education theory and practice complement each other. It is not feasible to rely on practice alone. Technology innovation calls for theoretical innovation. This requires reforming traditional education theory, forming new theories, constantly verifying and perfecting these theories in educational practice, and using new theories to guide educational practice and promote the virtuous circle and spiral development of intelligence education.

3) Innovation and change in teaching and learning methods: In terms of education, it is very important to constantly reform education and teaching methods to adapt to the development of the times. Smart education combines new information technology with education, builds a smart education and teaching environment, shares smart resources, and creates conditions for the innovation and reform of education teaching methods. China should also conform to the trend of international smart education, build a smart

learning classroom and drive the structural transformation and upgrading of teaching and learning methods through the reform of teaching and learning methods. For example, the emergence of new teaching methods such as micro-curriculum, MOOCs, and flipping classrooms has prompted students to carry out smart learning, which has greatly improved the efficiency and quality of teaching and learning.

4) All parties working together to build an integration system of smart education: China has a vast territory and economic development varies from region to region. The construction and development of smart education not only rely on government departments to take the lead, but also the participation of the entire society. As far as China is concerned, the construction of smart education mainly depends on the government, and enterprises, universities and individuals don't make much difference.

PPP cooperation model (People, Private, Public) in Singapore ingeniously combines the individuals, enterprises, and public institutions to create synergistic effects to jointly promote the development of smart education in Singapore. China also needs to strengthen the top-level design, using the minority to bring along the majority, to integrate the forces of all parties to speed up the pace of smart education in China. It is led by the national government departments to formulate macro-policies and strategic plans for the development of smart education, carry out pilot projects, and create a good policy environment. Researchers in colleges and universities conduct theoretical demonstrations, technology research and development and information feedback. Enterprises carry out market research and design teaching products; all parties make joint efforts to promote the formation of an integrated mechanism of production, education and research.

V. CONCLUSION

The development of smart education driven by technology has been an irresistible trend and is becoming the "direction mark" for global education reform in the information age. Smart education is a grand system, including the core elements of smart environment, smart teaching, smart learning, smart management, smart research, smart evaluation, and smart service and so on. Implementing smart education is a huge test for education reform in China. It requires reforming the existing informational education methods, learning systems and evaluation systems in China, realizing the intelligent development of education and teaching, cultivating a large number of intelligent talents, and contributing to the construction of smart cities in China in order to implement smart education.

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