Practice of Construction of China National Public Service System for Digital Educational Resources

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***Abstract*—Construction of China National Public Service System for Digital Educational Resources is not only a practical demand for reform of public service mode for educational resources, but also a pressing need of educational development in information society. In this paper, the construction and development history of China National Public Service Platform for Educational Resources (National Platform) and China National Public Service System for Digital Educational Resources (National System) is introduced. Then this paper mainly elaborates on the construction background, architecture, and basic features of National Platform and National System, and expounds the relation between them. This paper also discusses how the mode of public service for digital educational resources has transformed from National Platform phase to National System phase nationwide, and presents their construction achievements and influences with data. The construction of National System breaks the state of Information Island which results from redundant construction of Public Service Platforms for Digital Educational Resources in many different areas nationwide without overall planning. It establishes an innovative mechanism of cross-regional sharing of digital educational resources on the national level, which is of great and far-reaching importance in promoting education modernization.**

***Index Terms*—Cyber learning space, digital educational resources, public service platform, public service system.**

I. Introduction

During the period of China's 12th Five-Year Plan (2011-2015), China has made great achievements in construction of Public Service Platforms for Digital Educational Resources. Governments at different levels have constructed many Public Service Platforms for Digital Educational Resources of different sizes one after another. Public Service Platforms for Digital Educational Resources refer to online platforms providing public service of digital educational resources through cyber learning space and constructed by the central government or local governments at different levels. Their user groups are elementary and middle schools-related education departments, schools, teachers, students, and parents. Cyber learning space refers to a basic teaching and learning environment providing public service for users on an online platform. It's a destination where a platform recommends and presents digital educational resources, and also an infrastructure where users store their digital learning assets and data produced during their use of digital educational resources on the platform. Through cyber learning space on a platform, teachers and students have quick and convenient access to all kinds of high-quality and user-oriented digital educational resources. On a cyber learning space, users can exchange their methods and points of view about education, explore educational reform, present characteristic outcomes from their use and innovation of digital educational resources, and form new learning modes such as self-directed learning, cooperative learning and personalized learning.

With the vigorous development and construction of Public Service Platforms for Digital Educational Resources at different levels in different regions, a historic change has taken place in public service mode of digital educational resources in China. Digital resources have become an important part of educational resources, and transformed from the single mode of mainly depending on uploading and downloading, to the multi-mode of integrating, exchanging and sharing which uses cyber learning space as a main carrier.

But before the construction of China National Public Service System for Digital Educational Resources, Public Service Platforms for Digital Educational Resources at nation-level, province-level, prefecture-level, and county-level are independent of each other. It's obvious that governments at different levels constructed their platforms without overall planning, which results in redundancy and isolation of many platforms. A user may register many accounts on many platforms, and digital educational resources on different platforms can't be shared across platforms. This situation brings about much waste of storage resources of cyber learning space, and causes inconvenience for users. Digital educational resources can't be shared effectively and efficiently because of these obstacles. In order to solve these problems and break the state of Information Island, China National Public Service System for Digital Educational Resources came into being under such circumstances.

China National Public Service System for Digital Educational Resources is an organic combination of Public Service Platforms for Digital Educational Resources at different levels and various kinds of digital educational resources on the basis of uniform standard specifications. There are mainly four levels for the platforms constructed by governments conforming to administrative division in China: nation-level, province-level, prefecture-level, and county-level. China National Public Service System for Digital Educational Resources has constructed a hub environment nationwide for online educational public service with uniform standard specifications and scientific open architecture. Through the hub environment, the architecture of National System takes shape, that's, one fundamental

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environment supporting Public Service Platforms for Digital Educational Resources and digital educational applications at all levels, Public Service Platforms for Digital Educational Resources at different levels distributing various kinds of digital educational applications on cyber learning space through the environment, various kinds of digital educational applications encapsulating and sharing various kinds of digital educational source materials, digital educational resources and users' data exchanging and sharing smoothly on different platforms in National System. After the construction of National System, the state of Public Service Platforms for Digital Educational Resources at different levels has gradually transformed from mutual independence to collaboration service. Fig. 1 shows the transformation from platforms in mutual independence to platforms in collaboration service in National System.

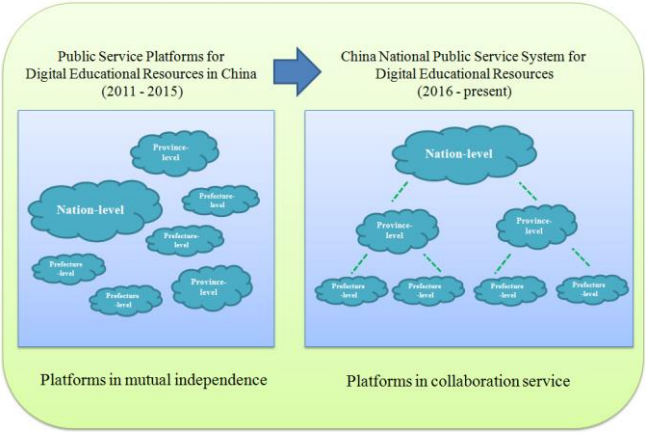

Fig. 1. Transformation from platforms in mutual independence to platforms in collaboration service in National System.

China National Public Service Platform for Educational Resources (it's conventionally named without the word 'digital' before 'educational resources') is the top and nation-level platform among all Public Service Platforms for Digital Educational Resources at different levels in National System. In the following section, we will take China National Public Service Platform for Educational Resources as an example, and elaborate on its architecture and basic features.

II. Construction of National Platform

A. Construction Background

China National Public Service Platform for Educational Resources is a platform providing public service of digital educational resources nationwide through cyber learning space. National Center for Educational Technology is in charge of this National Platform in the guidance of Ministry of Education of the People's Republic of China. National Platform with its official website at http://www.eduyun.cn/ is available for registration and use nationwide.

The reason to construct China National Public Service Platform for Educational Resources comes from suggestions and planning mentioned in The National Teleconference on Education Informatization by State Councilor Yandong Liu on September 5, 2012. She proposed that during the period of China's 12th Five-Year Plan, education departments should focus on construction of "Three Connections and Two Platforms", that is, broadband network full connection in every school, high-quality digital educational resources full connection in every class, cyber learning space full connection for every teacher and student, and construction of Public Service Platform for Educational Resources and Public Service Platform for Educational Management [1]. "Three Connections and Two Platforms" is a core goal and landmark project during the period of Education Informatization construction in 2011-2015.

During the period of China's 12th Five-Year Plan, under the unified deployment of Ministry of Education of China, National Center for Educational Technology focused on the core goal set by *Ten-Year Development Planning of Education Informatization (2011-2020)* [2], worked in coordination with administrative departments of education, audio-visual education institutions at different levels, and some educational companies, successfully completed the construction of China National Public Service Platform for Educational Resources with funds appropriated by central finance of 210 million yuan (CNY). China National Public Service Platform for Educational Resources has made great achievements in providing public service of digital educational resources for teachers and students nationwide, and it also plays an important part in supporting and leading the successful implementation of the "Three Connections and Two Platforms" landmark project of National Education Informatization during the period of China's 12th Five-Year Plan.

B. Architecture and Basic Features

1) Fundamental components of national platform

China National Public Service Platform for Educational Resources is composed of four fundamental components: spaces, resources, communities, and activities. The core concept of construction of Public Service Platform for Digital Educational Resources is to move offline daily teaching content, educational resources, educational communication, teaching and learning activities as well as relations in the activities into cyber learning space, and to take advantages of the Internet to really bring benefits to professional development of all the teachers and growth and success of every student. The following paragraphs expound definitions and functions of the four fundamental components.

a) Spaces

Spaces, or cyber learning spaces, are the core of Public Service Platform for Digital Educational Resources. Cyber learning spaces are real-name registration online learning locations integrating digital educational resources, services, and data and supporting sharing, interaction, and innovation [3]. Cyber learning spaces must be recognized by education authorities or schools. Cyber learning space on National Platform is an individualized integration of platform functions, which enables users to publish articles, communicate and interact with each other, store electronic documents, use digital educational applications, and record data. Cyber learning space is the main location and carrier of educational activities for education authorities, teachers, students and parents.

b) Resources

Resources refer to digital educational resources which are assembled and collected through various channels on National Platform. These resources can be divided into five main categories: multimedia source materials matching with written materials, digital learning content, teaching tools, educational software systems, and application systems providing online services, also known as, APPs. These resources serve users through cyber learning space which provides diversified services to meet the demand for individualized digital educational resources from different regions, schools, teachers, and students.

c) Communities

Communities refer to online learning and communicating organizations which center on special topics. Communities gather users with same interests, where users exchange their methods and points of view about education, share digital educational resources, and cooperate with each other to create some educational outcomes or make achievements. To a certain extent, communities are topic-oriented cyber learning spaces which are larger and special in form. Through cyber learning spaces, users can create or apply for a certain community according to their own interests. And they can hold various kinds of educational events and interact with each other on communities.

d) Activities

Activities generally refer to projects, programs or research subjects which are organized by education authorities or institutions and aim at promoting teachers' teaching abilities, improving teaching methods, and advancing educational reform. To a certain extent, activities and communities all belong to the category of digital educational resources, which need to be carried out or organized through cyber learning space on National Platform.

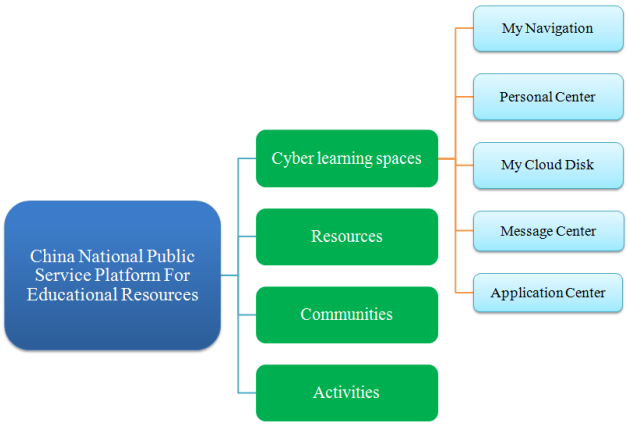

Fig. 2. Fundamental components of National Platform.

Fig. 2 shows the architecture of National Platform with four fundamental components and the structure of cyber learning spaces.

2) Layout and basic functions of cyber learning space

Cyber learning space is the main location on National Platform for users to acquire and share digital educational resources and carry out educational activities. From the perspective of its layout, cyber learning space on National Platform mainly consists of five essential components: My Navigation, Personal Center, My Cloud Disk, Message Center, and Application Center. Every component has its own special functions and complements each other, providing convenience for users when they are participating in educational activities on cyber learning space. The following paragraphs expound design ideas and basic functions of the five essential components.

a) My navigation

My Navigation locates at the top of the web page of cyber learning space. It navigates users to their own favorite applications, resources, and links in common use. In My Navigation, users can also conveniently search organizations, other people, or resources they are interested in, such as schools, classes, teachers, students, parents, communities, articles, and other digital educational resources. Users can view messages related to them, adjust the layout of web page of cyber learning space, and edit their basic personal information.

b) Personal center

Personal Center displays a broad outline of personal information, personal organizational relations, and activities information the current user creates on cyber learning space. In Personal Center, users can edit personal information, publish articles, upload electronic files, apply for certain organizations, enter web pages of schools or classes to communicate and interact with other users. Through Personal Center, users can enter their personal homepages. Personal homepages are different from cyber learning spaces. A personal homepage mainly displays published articles, photos and resources shared, and a message board where users leave messages for others to see and interact with each other. A personal homepage is a place for the purpose of external communication.

c) My cloud disk

My Cloud Disk stores users' personal electronic files and digital educational resources. Digital educational resources in common use include multimedia source materials, digital learning content, teaching tools, and educational software. In My Cloud Disk, users can upload, download, classify, and share their digital resources. It's convenient to use My Cloud Disk anytime and anywhere.

d) Message center

Message Center assembles all user-related messages. Users can view and deal with them accordingly. In Message Center, users can receive many kinds of messages, such as system messages related to school or class management, notices and announcements made by schools or higher level education institutions, instant messages with friends, latest news of friends, notices and reminders from applications in Application Center. In Message Center, these messages display in different places according to their categories.

e) Application center

Application Center assembles high-quality digital educational applications from various providers. Application Center is an important place where cyber learning space on National Platform receives resources from China National Public Service System for Digital Educational Resources. In

other words, Application Center is a destination where digital educational applications arrive after the applications are distributed by National System. Digital educational applications refer to software assisting teaching procedures and aiming at achieving certain educational goals. Applications can encapsulate, use, and share various kinds of digital educational source materials. Applications in common use are teaching tools, educational software systems, and application systems providing online services, a.k.a. APPs. In Application Center, all applications must abide by the principles of "governments evaluating admittance of resources, companies competing in providing services, users independently choosing what they want to use" [4]. Applications provide great convenience and diversified choices for users when they are participating in educational activities on cyber learning space.

Fig. 3 displays a screenshot of a teacher's cyber learning space on National Platform. We can see the layout of a cyber learning space, where there are five essential components: My Navigation, Personal Center, My Cloud Disk, Message Center, and Application Center. There is also an extendible component named Today Class Schedule, which can be added or hidden like any other extendible components through Settings.

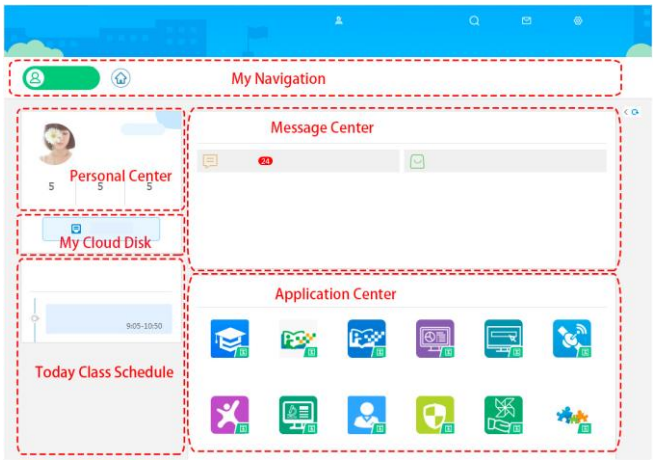

Fig. 3. Screenshot of a teacher's cyber learning space on National Platform.

According to users' roles, cyber learning spaces can be divided into two categories: personal space and organizational space. Personal spaces include teacher space, student space, and parent space. Organizational spaces include class space, school space, and administration space. In addition to basic functions of cyber learning space, organizational spaces have access to management of users' organizational relations and statistical data within organizations.

C. Achievements and Influences

By the end of June, 2019, China National Public Service Platform for Educational Resources has registrations of 13,258,923 teacher spaces, 6,165,500 student spaces, 5,701,552 parent spaces, and 402,839 school spaces. Users on National Platform have established 264 educational communities (http://sns.eduyun.cn/), where there are 235,365 participants in total. National Platform has assembled and collected over 14 million digital educational source materials or multimedia files covering every academic subject in elementary education and part of specialized subjects in vocational education.

On National Platform, the project "Gifted Teachers, Outstanding Lessons" (http://1s1k.eduyun.cn/) has been successfully carried out for several years. In the past two years, the number of teachers' participation in the project has exceeded 10 million person-times. And on National Platform, teachers have accumulatively uploaded and displayed over 7.3 million videos of lessons covering every academic subject in elementary education.

Another project "Digital Education Resources Universal Coverage Program for Rural Primary and Secondary Schools (Study Centers)" (http://jxd.eduyun.cn/) has basically accomplished the goal of helping over 60 thousand study centers in outlying districts complete national curriculum to the fullest with information technology. This project helps over 4 million students in study centers preliminarily realize the dream of "enjoying high-quality education together under the same sky" [5].

III. Construction of National System

A. Construction Background

During the period of China's 12th Five-Year Plan, with the construction of Public Service Platforms for Digital Educational Resources at different levels, China's Education Informatization has embraced a rapid development, and the "Three Connections and Two Platforms" project has made dramatic breakthroughs, blazing a trail of Education Informatization with Chinese characteristics that information technology supports and leads the development of education modernization. An investigation by National Center for Educational Technology shows that, except for National Platform, all over the country there are 28 provinces having constructed province-level Public Service Platforms for Digital Educational Resources. In addition, there are 152 prefecture-level platforms and 165 county-level platforms. Some regions have more than one platform providing digital educational resources for users at the same time in the same region. There are 63 million teachers and students using cyber learning spaces nationwide to explore innovative modes of teaching, learning, and education research with the support of Education Informatization technology. The standard of services from Public Service Platforms for Digital Educational Resources at different levels is improving day by day. Education authorities have accumulated a lot of experience in providing digital educational resources by means of information technology.

But from the perspective of the whole country, public services of digital educational resources are far from being able to satisfy the needs of development of Education Informatization for the following reasons.

Firstly, Public Service Platforms for Digital Educational Resources at different levels are independent of each other. And there is a common phenomenon that governments at different levels constructed their platforms without overall planning, which results in redundancy and isolation of many platforms. A mechanism of cross-regional sharing of

high-quality digital educational resources has not formed.

Secondly, there is a shortage of a complete standard specifications system nationwide. A miscellaneous catalog of digital educational resources has increased the difficulty of sharing, exchanging, and searching of users' digital educational resources, which brings awful experience to users. For every resources provider, resources need to be uploaded, deployed or connected technically to many platforms, which increases cost of development and maintenance of resources, and lowers efficiency of services.

Thirdly, a new mechanism of digital educational resources construction and deployment with the principles of "governments evaluating admittance of resources, companies competing in providing services, users independently choosing what they want to use" has not formed. Information of government procurement of digital educational resources is not transparent. The potential of market competition in providing resources has not been completely released.

Finally, the application capability of cyber learning space still needs to be enhanced urgently. Public service mode of digital educational resources still needs further innovation.

In order to solve the above-mentioned problems, through survey and argumentation in many ways, Ministry of Education of China proposed constructing China National Public Service System for Digital Educational Resources with Chinese characteristics, which connects Public Service Platforms for Digital Educational Resources at different levels in one system with user unified identity authentication, administers the system and shares data or resources together by members who run platforms at different levels, and covers the whole country with platforms in collaboration service. China National Public Service System for Digital Educational Resources came into being under such circumstances.

B. *Architecture and Basic Features*

National Public Service System for Digital Educational Resources is the carrier of government-provided basic public service of digital educational resources, and provides resources service mainly in the form of cyber learning space and supports innovative modes of teaching and education based on information technology [6].

National Public Service System for Digital Educational Resources is an organic whole composed of Public Service Platforms for Digital Educational Resources at different levels (nation-level, province-level, prefecture-level, and county-level), cyber learning spaces, and digital educational resources, all of which are combined through a hub environment that is safe and efficient with uniform standard specifications and interface specifications. And National System in collaboration service is administered and shared together by members who run platforms at different levels. As service principal of National System, Public Service Platforms for Digital Educational Resources at different levels abide by the requirements of uniform standard specifications and user real-name unified identity authentication, which forms the new pattern of multi-level collaboration with digital educational resources and users' data exchanging and sharing smoothly on different platforms in National System.

From the perspective of the architecture of National System, National System is composed of a Space Layer, an Application Layer, and a Source Material Layer, and it's combined through a hub environment with uniform standard specifications and data interfaces. Through the hub environment, National System forms a unified mechanism of information and resources sharing, which enables exchanging and sharing of resources and users' data on different platforms in National System. Platforms at different levels with cyber learning spaces, resources in the form of multimedia source materials, and resources in the form of applications connect technically to the hub environment of National System through open service interfaces and uniform standard specifications.

Fig. 4 displays the architecture of National Public Service System for Digital Educational Resources. Some basic features of the architecture are explained in the following paragraphs.

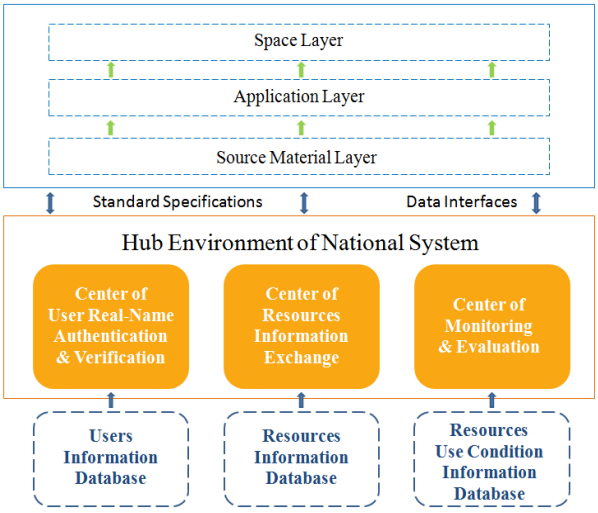

Fig. 4. Architecture of National System.

1) *Space layer*

Space Layer is mainly composed of platforms at different levels, which provide services for users through cyber learning spaces.

There are mainly four levels for the platforms constructed by governments conforming to administrative division in China: nation-level, province-level, prefecture-level, and county-level. Based on this four-level structure of platforms, platforms at different levels connect technically to the hub environment of National System through open service interfaces and uniform standard specifications, which realizes distribution of resources from top to bottom and data exchanging, sharing, and management.

Through the hub environment of National System, platforms can provide safe and stable user space unified identity authentication, receive messages and distributed resources from National System, store data of users' resources use conditions, store and protect users' data assets, and guarantee popularization of in-depth application of cyber learning spaces.

2) *Application layer*

Application Layer is mainly composed of digital

educational applications which are developed by various providers and connected technically to the hub environment of National System. Through the hub environment, applications will be distributed and pushed into cyber learning spaces on platforms at different levels, which provide diversified choices for users when they are participating in educational activities.

Digital educational applications refer to software assisting teaching procedures and aiming at achieving certain educational goals. Applications can encapsulate, make use of, and share various kinds of digital educational source materials. Applications in common use are teaching tools, educational software systems, and application systems providing online services, a.k.a. APPs. Source materials used by applications in the process of services come from Source Material Layer.

3) Source material layer

Source Material Layer is mainly composed of various kinds of resources in the form of multimedia source materials, which can effectively ensure and satisfy users' individualized needs for resources of applications. Resources in the form of multimedia source materials contain electronic documents of some commonly used formats, such as audios, videos, images, texts, or Office files. All of the source materials enrich the source materials database which applications can make use of. Source Material Layer provides strong support for educational activities based on applications.

4) Three databases and three centers

The hub environment of National System consists of three databases and three centers, which realizes unified management of basic data in National System.

a) Center of user real-name authentication and verification

Center of User Real-Name Authentication and Verification is based on real-name registration Users Information Database, which is unified nationwide and reflects relations of educational management among education authorities and schools throughout the country.

Center of User Real-Name Authentication and Verification ensures that every user can only choose and designate a unique real-name authentication cyber learning space no matter how many accounts a user has registered on platforms at different levels.

b) Center of resources information exchange

Center of Resources Information Exchange is based on Resources Information Database, which abides by metadata standard for educational resources [7].

Center of Resources Information Exchange ensures stable services of resources and realizes management of application distribution and source material authorization.

c) Center of monitoring and evaluation

Center of Monitoring and Evaluation is based on Resources Use Condition Information Database, which gathers data when users are using resources.

Center of Monitoring and Evaluation monitors and evaluates use conditions of resources, which can form reports of use conditions and trends of digital educational resources in different regions of China through data analysis and statistical inference. This Center encourages market competition in providing high-quality and diversified digital educational resources to meet the demand for individualized digital educational resources from different regions, schools, teachers, and students, which forms a new pattern of public service with characteristics of digital educational resources constructing and enjoying together.

C. Achievements and Influences

Platforms at different levels are continuously being connected to National System since its construction.

Fig. 5 shows the cloud chart of platforms connected to National System. By the end of June, 2019, there are 96 platforms at different levels in total connected successfully to National System, including the unique National Platform, 21 province-level platforms, 37 prefecture-level platforms, and 37 county-level platforms (source: http://system.eduyun.cn/).

Fig. 5. Cloud chart of platforms connected to National System.

One person has only one cyber learning space in National System with the support of real-name registration. With platforms at different levels connected to National System, users on their local platforms can use applications which are also connected to National System no matter which platforms they log onto. By the end of June, 2019, there are 11.31 million cyber learning spaces having gone through real-name authentication on different platforms in National System, including 5.31 million teacher spaces, 5.63 million student spaces, and 337 thousand parent spaces. Daily page views of National System are about 2.92 million times.

Through the hub environment of National System, nation-level, province-level, prefecture-level, and county-level resources can be smoothly and conveniently distributed and pushed into users' cyber learning spaces on platforms at different levels in National System, which enables applications to be connected at one level and shared cross-platform.

China National Public Service System for Digital Educational Resources has aggregated 38,000,000 items of digital educational resources from professional organizations, more than 300 companies and tens of millions teachers, covering application scenarios like management, teaching, training etc., hence teachers and students have access to diversified options, promoting the innovative development of

Education Informatization integrating application.

IV. Conclusion

China National Public Service System for Digital Educational Resources is playing a more and more important part in reform of public service mode of digital educational resources. It gives full play to solid support of basic public services of digital educational resources and continuously improves the standard of equalization, popularization, and convenience in basic educational public services.

The construction of National System forms an information service system integrating big data of application and service of resources, which promotes cross-regional sharing of information and enables education authorities to know use condition of resources conveniently. According to results of data analysis and statistical inference, education authorities can make more scientific and accurate decisions on construction and service-purchasing of digital educational resources, thereby providing better services to satisfy teachers' and students' needs of teaching and learning with the support of information technology.

The construction of National System is an inevitable choice of development of Internet plus Education, expansion of coverage of high-quality educational resources with information technology, and narrowing the gaps of education between different regions, schools, and urban and rural areas. National System lays the foundation of development of Education Informatization 2.0 [8], and is of great significance in deepening education reform, accelerating education modernization, working hard to run education to the satisfaction of the people, and constructing a powerful country in education.

Conflict of Interest

The author declares no conflict of interest.

Author Contributions

Yijun Lin conducted the research, analyzed the data, and wrote the paper. The author had approved the final version.

References

[1] Official website of Ministry of Education of the People's Republic of China. *Speech in the National Teleconference on Education Informatization by State Councilor Yandong Liu on September 5, 2012*. [Online]. Available: http://old.moe.gov.cn//publicfiles/business/htmlfiles/moe/s3342/201211/xxgk_144240.html

[2] Ministry of Education of the People's Republic of China, *Ten-Year Development Planning of Education Informatization (2011-2020)*, March 2012, pp. 3-7.

[3] Ministry of Education of the People's Republic of China, *Guideline for Construction and Application of Cyber Learning Space*, April 2018, pp. 2-3.

[4] L. Fei, *Informationized Education with the Support of Cyber Learning Space*, 1st ed. Beijing, China: Educational Science Publishing House, 2019, ch. 2, pp. 53-56.

[5] China Education News. *A Letter of Congratulations by President of the People's Republic of China, Jinping Xi to Opening Ceremony of International Conference on Education Informatization*. [Online]. Available: http://www.jyb.cn/china/gnxw/201505/t20150523_623267.html

[6] Official website of Ministry of Education of the People's Republic of China. *Guidance on Construction and Application of China National Public Service System for Digital Educational Resources from Ministry of Education*. [Online]. Available: http://www.moe.gov.cn/srcsite/A16/s3342/201802/t20180209_327174.html

[7] *Basic Education Teaching and Learning Resource Metadata Information Model*, Education Standard of the People's Republic of China JY/T 0607-2017.

[8] Official website of Ministry of Education of the People's Republic of China. Notice *on Issue of Education Informatization 2.0 Action Plan from Ministry of Education*. [Online]. Available: http://www.moe.gov.cn/srcsite/A16/s3342/201804/t20180425_334188.html

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