A Development Study for Higher Education Informatization in China

Yu Sun, Liang Zhou, Siwen Zhang

***Abstract*—** The information age focuses on enhancing information productivity and improving Information Technologies (ITs), which play a very important role in sustainable development of Chinese society and economy at all levels and will also directly affect the Chinese Higher Education (CHE). This paper firstly summarize current development status CHE, and then points out that CHE informatization is seriously lagging behind the development of information technology, which thereby restricts the development of CHE; finally this paper discusses the future trend of modern higher education and information technology based on the current context of the information age. We also hope to provide a clear development direction for CHE informatization through this study.

***Keywords*—**Information Technology; Chinese Higher Education; Informatization; Development; Fusion

I. Introduction

THE 21st century had provided a timely opportunity for the government to highlight the information technology revolution and educational reform as important national policies. Chinese "National Program for Medium and Long-term Education Reform and Development (2010-2020)" has pointed out that speeding up the process of education informatization would be part of the overall development strategy for national education. By using education informatization we can improve education modernization, and then promote the continued change and innovation of Chinese education system [1]. In addition, "Decade Plan on Development of Education Informatization (2010-2020)" further proposes that a new education informatization system which is adapted to the goals of national education modernization will be completed until 2020; and the overall Chinese education informatization should be close to the international advanced level and can support and lead the reform and development of the education. Here for the foreseeable future, we can expect that the education informatization will be a powerful lever to promote the reform and development of Chinese education, and drive the education modernization; it also can promote the change and innovation of whole Chinese education system [1].

As a new development stage for higher education, Chinese higher education Informatization is related to many fields, such as the teaching, research, university administration and social services; therefore, it is a complicated systematic project [2]. From a macro point of view, it is about the full utilization of information technology and tools, the efficient integration of various information resources and the teaching process relying on these resources. From microscopic point of view, it is based on information infrastructure as the basis for a variety of teaching resources, universities, and the depth of integration of digital technology on the management aspects to support an efficient digital platform.

Based on the current status of CHE informatization, firstly this paper summarizes the related research on higher education informatization; and then it systematically analyzes the whole process of higher education informatization; after that, it analyzes the opportunities and challenges for the development of CHE informatization and describes the next development phase when the information technology is deeply integrated with CHE; finally it points out the future trend of CHE informatization.

II. Current Status of CHE Informatization

The Chinese Higher Education has made great progress in recent years, and the following Table 1 is a basic development statistical data for Chinese Higher Education from 2010 to 2014.

It can be seen from Table 1 that the whole scale of CHE has been expanded in the last five years. The corresponding number of colleges and adult colleges is growing from 2723 in 2010 to 2824 in 2014; the total number of enrolled students is 35 million and 590 thousand in 2014 from 31 million and 50 thousand in 2010. Meanwhile, the Gross Enrollment Rate for CHE has increased from 26.5% in 2010 to 37.5% in 2014, which shows that the popularization pace of CHE continues to accelerate in the last five years. Additionally, the china government is also constantly stepping up efforts to cultivate high-level students, and these students are entering a master's degree or Ph. D programs and they will focus on the professional scientific research in their fields. From the point of view of total number and size, China now is a great education nation. However, there

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are also some problems existed along with the rapid development of CHE. Member of The National Committee of the Chinese People's Political Consultative Conference (CPPCC) and the vice chairman of TianJin municipal CPPCC Zihe Rao proposed in 2014 that "too big to strong" was one of the main features for CHE in this period, and it was not optimistic for CHE quality [3], and Shen and Zhang further indicated that nowadays the CHE could not satisfy the social need, which had been a bottleneck for the development of CHE and was also the key issue to affect CHE quality [4].

Table 1. The Basic Statistical Data for Chinese Higher Education (Years 2010 - 2014)

Year	Total Number of enrolled students (in 10 thousand)	Gross Enrollment Rate(%)	Total Number of Colleges and Adult Colleges	Total Number of Enrolled Master Students(in 10 thousand)	Total Number of Enrolled Ph. D students(in 10 thousand)
2010	3105	26.5	2723	127.95	25.89
2011	3167	26.9	2762	137.46	27.13
2012	3325	30.0	2790	143.60	28.38
2013	3460	34.5	2788	149.57	29.83
2014	3559	37.5	2824	153.50	31.27

Source: Ministry of Education of the People's Republic of China: National Educational Development Statistical Bulletin (Years 2010 - 2014)

The problems mentioned above force the Chinese Higher Education Institutions (HEIs) to implement the corresponding reforms and step up to explore the application of IT in education. Chinese higher education informatization started in the early 1990s, and its construction was focusing on the establishment of a series of university management information systems, such as financial management system, office automation system. However, the corresponding information level was very low during this period; its construction emphasizes on hardware instead of software, and had little related to the teaching informatization [5].

As for the application of information technology in education, Richard L. Nolan developed a theoretical Stage of Growth Model (SGM) to describe the role of information technology and how it grows within an organization. This model includes Initiation, Contagion, Control, Integration, Data Administration, and Maturity [6]. The SGM shows the correlation between informational technology and development stages of an industry.

The structure of the model can be depicted in the diagram below:

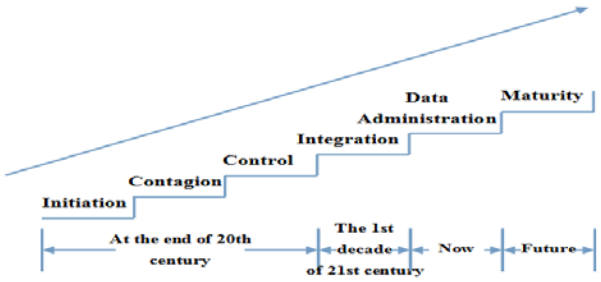

Fig 1. Diagram Showing the Six-stage Model

In China, along with the rapid development of information technology at the end of last century, the universities focused on hardware updating and automation configuration. Therefore, the computer-based automation system and management system have entered a rapid development era. The first state of educational informazation development started as “Digital Campus”. One focus of this stage is integration: integration of universities informational resource and application of information system. For example, University ERP is based on the integration of SAP products, which includes the following modules: student life-cycle management, financial management, human capital management, governance and compliance management, and so on. [7].

Another focus of stage is to construct a standard digital integration platform among all departments for information sharing and communication. This stage challenged and affected the traditional work flow and teaching mode. “Teaching” and “learning” started to integrate so that the traditional one-direction teaching and force-feeding teaching method is completely changed. Collaboration among university’s different departments is more convenience; the administration support to teaching is more efficient as well.

Related work of CHE informatization is now still in the early stages of application; the major form of CHE informatization is to use network and appropriate information technology to transfer traditional physical campus into "Digital Campus" [8]. The basic aim of digital campus is to serve teaching and education, focus on effective learning for students and the change of education teaching methods. Most of the traditional digital campuses in China are focusing on building a simple virtual interconnection campus by using the related network infrastructure equipment, constructing the digital teaching resources, and integrating all kinds of management software system to complete office automation. Nowadays, with the emerging of all kinds of transformative information technologies and tools, it is very difficult to support effectively the new education model to satisfy the social needs based on the traditional digital campus. The HEIs are now facing new challenges, not only to promote an adequate education in each field of study to the students, but, also, to develop them with skills and knowledge required to leverage information technology effectively to the workplace on firms [9].

The first 10 years of 21 century, informatization of higher education in China has reached great achievement, mainly in the

following two aspects: firstly, CHE had begun to step into the "fully integrated" stage during which the construction work included the hardware and software. Chinese ministry of education started the “Digital Campus” project since 2001; by 2008, all higher education schools have finished the digital network, which was the foundation of long distance education. Secondly, the Digital resource construction has achieved initial success. One of the most significant achievements is the initiation of the fine course construction project. It utilizes the teaching resources in higher education institutions to develop fine courses and put them online for free via internet. In this way the fine teaching resources can be shared broadly. Until 2010, there are 3750 fine courses developed by national higher education institutions, among them 2525 are undergraduate level courses. In addition, most of the universities have developed a teaching resource dataset, among which 53.4% universities established university wild standard management platform of teaching resources, and the average digital teaching resource is 618GB; 83.72% universities have established digital library and has average 322,000 digital books [10]. Thirdly, higher education system has begun the integration of resources. They relied on the network platform to build digital campus, and then completed the campus all-in-one card system, education information system, office automation, and digital treatment of academic resources. From these works, Chinese HEIs combined together all kinds of resources which were dispersed into teaching and research, university management and administration office before. In this process, there was not a national unified standard for the development of CHE informatization, therefore, the related development work for CHE informatization was in a relatively closed environment between different universities. Until now the main form for the digital campus is the realization of multimedia teaching, the automation of education management and administrative office; and the main objective for it is to improve the efficiency of daily education and teaching.

However, there are still unsolved issues with the “Digital Campus”. This stage essentially is a “horizontal” extension of the previous stage of “automation control”.

First, digital campus is actually based on the university information portal platform and integrates the management system of all departments to make the work flow more convenience.

Second, in the process of developing the digital campus, it emphases the one-direction digital integration of teaching resources within the classroom but ignores the resources outside the classroom; therefore it reduces the interaction and lowers the utilization of the digital resources. The correlation analysis and how the digital resources promoting the teaching are not reflected in this stage.

Third, the digital campus is trying to provide a standard teaching service to teachers and students; however, it neglects students’ individual character and hold down students’ creativeness.

In general, CHE digital universities development has made some progresses, however, its support to CHE teaching is decreasing.

III. The Challenges Faced in the Development of CHE

Higher education informatization is a complicated system project, so it is very difficult to rely on traditional digital campus to support reform of educational when the technology continues to change in this information age. Meanwhile, it is very easy to generate phenomenon of "Information Island" because the application of IT in HEIs is always not catching up with the development of IT. [11] Therefore, how to keep up with the development of IT has a powerful influence on the CHE informatization.

In this section, from the perspective of combination of information technology and CHE, we will summarize the challenges which appear in the process of CHE informatization.

American New Media Consortium (NMC) is collaborated with the EDUCAUSE Learning Initiative (ELI) to release annually the NMC Horizon Report in order to analyze emerging technology uptake in education. They try to identify and describe emerging technologies which are likely to have an impact on higher education. This report will provide the leaders of HEIs with more in-depth insight into how the trends and challenges are accelerating and impeding the adoption of educational technology, along with their implications for policy, leadership and practice. Here we summarize the important technology developments of the last four years in higher education in Table 2.

Table 2 indicates the continuous development of the information technology supports the reformation of higher education’s informatization. Innovated application of information technology in higher education not only improves higher education efficient, but also has profound and lasting effect on the whole higher education environment.

Firstly, the higher education expands significantly in space and time. With the application of new information technologies, our education form and teaching environment have undergone a revolution. For example, the traditional teaching is to plan ahead in a fixed physical teaching space; however, now it has been transformed into individualized teaching style in an anytime, anywhere virtual space.

Secondly, with more assistant teaching technics, teaching mainly aims to make a platform of multimedia teaching system in the “Digital Campus” period. It has become a trend to create teaching actives using advanced teaching technics and to provide new teaching environment.

Third, the life cycle of applying IT in higher education is constantly changing. For example, the MOOC began to rise in 2013; however, it was no longer the focus since 2014. The survey conducted by Dr. Robert A. Reiser and his team indicates that the proportion of higher education institutions decide not to participate in the production of MOOC has risen from 30% to 45% in the last two years. That is to say, interest in MOOC is now decreasing. There are a lot of reasons for this, such as the low completion rate of MOOC, and lacking of

interactive and participatory. Because of this, the future development of MOOC is not clear [12].

Table 2. The Summary of Important Technology Developments in Higher Education

Year	Technologies	Time to Adoption	Relevance for Teaching, Learning, or Creative Inquiry
2012	Mobile Apps	1 year or less	Educational use; Extend learning outside of the classroom.
	Tablet Computing	1 year or less	To increased student engagement and learning experiences.
	Game-Based Learning	2 to 3 Years	For students to acquire the some important skills.
	Learning Analytics	2 to 3 Years	To affect the learning performance; To enable faculty to more precisely understand students' learning needs; To enable educators perceive the education processes.
	Gesture-Based Computing	4 to 5 Years	To have profound implications for special needs and disabled individuals.
	Internet of Things	4 to 5 Years	To promote the sharing efficiency of teaching resource.
2013	Massively Open Online Courses (MOOCs)	1 Year or Less	For learners to freely experiment with a variety of subjects and acquire new skills; to emphasize personalized learning.
	Tablet Computing	1 Year or Less	To build a personalized learning environment.
	Games and Gamification	2 to 3 Years	To increase soft skills in learners.
	Learning Analytics	2 to 3 Years	To develop learning potential of students.
	3D Printing	4 to 5 Years	To enable authentic exploration of objects
	Wearable Technology	4 to 5 Years	To improve teaching efficiency.
2014	Flipped Classroom	1 Year or Less	The learning environment transforms into a dynamic and more social space.
	Learning Analytics	1 Year or Less	Predictive analytics and developing forecast & warning system.
	3D Printing	2 to 3 Years	To use 3D printing to invent new objects and then implement innovative research.
	Games and Gamification	2 to 3 Years	To foster engagement in critical thinking, creative problem-solving, and teamwork- skills.
	Quantified Self	4 to 5 Years	To create an exponentially increasing amount of data; to combine with learning analytics.
	Virtual Assistants	4 to 5 Years	To recognize and interpret human speech and emotions; to improve the efficiency of learning and research.
2015	Bring Your Own Device (BYOD)	1 Year or Less	To enable students and educators to leverage the tools that make them most efficient.
	Flipped Classroom	1 Year or Less	To transform the learning environment into a dynamic and more social space.
	Makerspaces	2 or 3 Years	To provide students and faculty a place that is integrated into the community to do their tinkering.
	Wearable Technology	2 or 3 Years	To help students learn from an unprecedented first-person perspective; to improve teaching efficiency.
	Adaptive Learning Technologies	4 to 5 Years	To foster more personalized learning while providing institutions with key insights about their instruction.
	The Internet of Things	4 to 5 Years	To come into focus as terms such as "hypersituation"

Source*: NMC Horizon Report (Higher Education Edition) 2012, 2013, 2014, 2015. Austin, Texas: The New Media Consortium.

Fourthly, it can be noticed from Table 2 that higher education has begun to integrate and analyse the educational data. The integration efforts in education data by using new information technology become stronger. For example, in 2012, the initial use of education data only focuses on analyzing and evaluating the current teaching process. In 2014, the Emerging technologies enable us to use the education data to build a mathematical model to forecast the teaching process. This predictable analysis aims to achieve the optimal utilization of future resources and therefore improve the teaching quality.

A worthy noticeable technical phenomenon is that the introduction and application of Internet of Things (IoT)

provides an effective support to the Ubiquitous-Learning (U-Learning). IoT uses intelligent labels to identify learning objectives and adjust learning content based on the records of students learning behaviours. This is an extension of traditional classroom and virtual experiment, which enrich students' experience through space and interaction of field investigation and practice. For example, a practical teaching class of biology requires students to identify different plants on the campus. We can put labels with scan code on the plants. When students find the labelled plants, they can learn the names of the plants, as well as obtain related knowledge about the plants through the teaching resources platform by scanning the code using their cell phones. IoT can be used in education management, such as checking on working attendance, library management, equipment management, etc. For example, the student ID cards with RFID labels enable the monitoring of students' utilization of teaching facility, as well as their action routes. The RFID can also be applied in library management. RFID makes it easier to locate a book and obtain the book information during the process of someone borrowing the book, avoid scanning the books one by one to obtain the book information. The application of IoT in experiment equipment management makes it easier to manage the equipment like tracking the equipment's location and utilization status. IoT can also be applied in campus traffic management, vehicle management, campus security, intelligent building, student life service etc. The applications of IoT help to build the "Intelligent Campus" and intelligentialized teaching environment.

In general, the emergence of new information technologies and their applications have been continuously influencing the higher education. These new information technologies can effectively support students to implement individual learning, and play a positive role in promoting efficient education management.

However, we should always be caution about the side effects of the application of the new technologies. For example, in 2015, the spotlight is on Bring Your Own Device (BYOD). BYOD enable students to leverage the smart digital tools (such as PCs, smart phones and tablets etc.) that make their learning and searching process more efficient. However, this also makes the informatization process of higher education becoming more complicated. Most BYOD utilize mobile terminal and connect to internet via mobile network. This would make personal devices expose to an open networks. How to assure the device's security is a prior thing we need to consider. Besides, there are so many personalized APPs in personal device. If these APPs contain malware, it would jeopardize the security of students' learning and research data. Another concern is that the personal devices are easily lost, which would bring potential security problem by abnormal use of the data.

Moreover, from Table 2, the new technologies are similar to Tablet Computing, Games and Gamification and Virtual Assistants are gradually used in the classroom. The utilization of high-tech equipment in classroom is the biggest change in education now; however, it does not necessary bring a better education quality directly. An OECD statistical research shows that when teenage students strongly reply on the computers and internet, the education quality would be greatly reduced. [13-14].

However, for the entire higher education industry, the practice of informatization always runs behind the theory and technologies. Therefore, if the higher education industry cannot adopt appropriate information technologies in its development, the development of informatization in the higher education will be restricted to some extent.

Additionally, nowadays with the support of new technology, it provides variety channels to obtain information and knowledge. Here we see an example of obtaining information via mobile terminals and desktop computers.

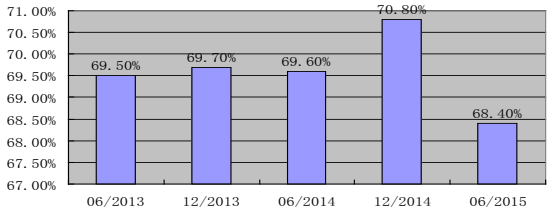

Fig 2. Obtaining information via desktop computer internet

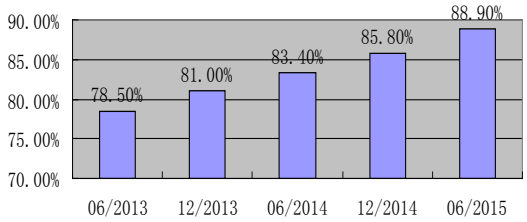

Fig 3. Obtaining information via mobile internet

Source*: CNNIC Statistical Report Internet Development in China (Year 2013, 2014, 2015)

It can be seen from figure 2 that the number of people who use desktop computers to access internet becomes saturated, and there is a clear downward trend until June, 2015. Figure 3 shows that the transferring trend of mobile internet by Chinese mobile phones users is becoming more obvious, and 88.9% of users use mobile internet for information until June, 2015. At the same time, with the application of smart mobile terminals and wearable devices, we can expect a further arisen of mobile internet in China. Here the above changes supported by these new technologies and devices have stimulated the appearance of "fragmented time, fragmented space", which also change the way people perceive the external environment and acquire information and knowledge imperceptibly, and stimulated further "fragmented information". On the basis of this appearance, people's demands for learning anytime and anywhere, lifelong learning, or mobile learning begin a substantial growth. It should be noted that the learners' learning behavior has also began to change; at this time, the traditional higher education will face the following challenges:

Firstly, the traditional higher education has the features of centralizing, ordering, system and comprehensive. However,

the learning of "fragmentation" shows the features of random, disorder, and fragmentary. Zhu Zhiting proposed in his paper that a new learning way "Fragmented learning" began to emerge and also become a new learning concept. Fragmented learning usually begins with fragmented information, and then generates fragmented knowledge, fragmented time, fragmented space, fragmented media, fragmented relationship, ..., and now we have entered into a " fragmented age" [15].

Secondly, the learners in traditional higher education is studying in a closed physical space, and they learn and receive modular new knowledge; however, the new learning ways begin to emerge in the environment of fragmented learning. For example, the flexible learning (F-Learning) and the mobile learning (M-Learning). As for M-Learning, it relies on interconnected and handheld smart terminals to implement a variety of interactive teaching. Because of this, the learners can break through the traditional higher education form and the limit in traditional classrooms to studying, which then further inspires people's needs for flexible learning, and personalized learning [16].

Thirdly, massive information which is scattered and perceptible will continue to appear in the form of rich media. On the one hand, this gives learners more chance to access huge amounts of data; on the other hand, because the learners' energy is limited, it is impossible for them to accept all the data and identify the data quality with high efficiency. As for this issue, J. M. Tien pointed out originally in 2003 that data rich, information poor (DRIP), which is an embarrassing problem in information stage [17]. This issue also brings the following problems for learners, such as the possibility of lowering the information quality, information simplification and redundancy.

As knowledge quantity increases, it is very necessary to develop a knowledge management system (KMS) in university environment， The KMS facilitates the access of the knowledge assets to the faculty, and especially, it make it is easier to fast and search, find and retrieve the information and knowledge needed [18].

IV. The development trend for Chinese Higher Education Informatization

A. Trend 1: To reinvent the CHE Informatization with "Internet Thinking"

With the wider application of information technology and internet, CHE institutions gradually improve their comprehensive education reform. During this process, "Internet Thinking" began to be emphasized in recent years. It should be noted that the internet thinking we mentioned here is not simply constrained within the provision and use of Internet products and services. In fact, it means an advanced productivity, which can promote a continuous evolution for the economy formation. In 2015, Chinese government firstly proposed the plan of "Internet +" as upgrade expression of "Internet Thinking". "Internet +" is based on traditional Internet and blended with the offline traditional industries to generate a new productive formation and to achieve the effect of "1 (online) +1 (offline) > 2".

"Internet +" also brings opportunities for the development of CHE Informatization [19]. Therefore, it is necessary to consider how to combine “Internet +” with the related management processes in CHE, and then to form "Internet + Education". "Internet + Education" can not only enrich the teaching forms and improve the teaching efficiency which is not available in traditional higher education, but also allow higher education from a relatively closed to a more open environment. We can expect more and more new forms of higher education and teaching with the idea of "Internet +". Here are some examples.

"Internet specialty"

The responsibility of traditional higher education is to cultivate educated people to meet the society needs. The traditional higher education adheres the philosophy of "student - oriented" and "specialized education ". However, nowadays the society needs more interdisciplinary people. By relying on "Internet + specialty", we can create an interdisciplinary specialty platform, which ensure students being able to choose their multi-disciplinary courses more convenient, and make the flexible and personalized learning easier. Furthermore, "Internet + specialty" also stride to combine multiple subjects in the learning contents and methods, and lay a foundation for cultivating interdisciplinary people.

"Internet+Teaching"

Different from the face to face teaching and learning in the classroom, "Internet + teaching" can provide comprehensive educational services. For example, it will be more flexible for student to acquire knowledge through online virtual classroom, professional online communities, and flipped classroom. With the help of "multimedia", we can constantly change and update the teaching activities, and then increase the students' enthusiasm to participate in learning. In addition, by using the internet, instant messaging program and mobile devices, we can design efficient interaction activities between students and teachers, such as assessing online test for teachers to provide online help for students. This kind of interaction can let teachers accumulate teaching experience, and improve their understanding on professional knowledge. On the other hand, this interaction can ensure students' learning more efficient, and help them absorb knowledge quickly.

B. Trend 2. To integrate, process and analyze big data which is the core task for CHE Informatization

It emphasizes more on management but pay less attention on using data for the applications of information technologies and information systems in higher education institutions. Actually, how to integrate the data with information technologies and information systems is very important and necessary for the “Digital Campus”.

Nowadays, with the combination of higher education and the related internet service, we can construct a new network platform. This platform allows teachers, students and the corresponding administrators to not restricted by the limit of time and space; and improve the efficiency of teaching and educational management.

However, it should be noted that the internet services can not only improve the process of CHE informatization, but also link a lot of segments, such as teaching activities, academic research and school management. Here every segment in the implementation process will produce and stimulate huge amounts of data which are related to education and administration. In the age of "Digital Campus", these segments are relatively independent, and people pay less attention on these data resource. Now we have entered a new era of big data along with more education forms, therefore, more data resource are constantly inspired on the campus. These data resource include not only basic education and teaching data, but also many non-traditional data, such as the education and teaching data associated with administrative management details, and school consumption data. From the quantitative point of view, our higher education is in the era of big data.

On the other hand, these education big data come from variety sources which contain different data types and information terminal. Predictably, we can collect the students' data of learning process on campus, qualities and preferences in order to match their personality learning. For teachers, we can track and analyze records related to the students' learning process, and then use interactive online and offline teaching to collect the data to complete cluster analysis. These analysis results will help teachers pull together the teaching resources and provide a reference for the subsequent curriculum design and modification.

Moreover, different universities can share their non-private data, and then implement visualization analysis on students' learning and non-learning environment, which can give us new insights of what is happening to the students' social and learning networks. Based on these new discoveries, teachers and higher education institutions can provide more suitable learning opportunities for students who have different needs and different levels of ability. Meanwhile, we can also excavate the association rules and capture abnormal data from the education big data, which can play a positive role in monitoring public opinion in cyberspace, maintaining students' emotion, and finally defending stability of campuses.

In general, with the background of "Internet +", big data and Internet of things (IoT), we can see the network mode of higher education with "Internet Thinking" will change a lot. The traditional "Digital Campus" will transform into "Intelligent Campus". This new "Intelligent Campus" will include more high-frequently interactive data. We can also effectively integrate and analyze related data set, and provide more real time technical supports on teaching and learning for administrators, educators, and learners. Ultimately, all above changes ensure administrators, educators, and learners constantly examine their roles in the educational process, and en to promote the development of CHE Informatization; and then achieve the efficient management for CHE Informatization.

The flattening, networking, dispersing and collaborating characteristics of new learning process modify the traditional definition of learning. The new learning focus more on the knowledge, information, technology and experience shared between teachers and students, students and students, and teachers and teachers. The flattening education will make the passive student more active. This new education and learning style fits the organization of production of the third industrial evaluation, and meets the needs of the re-industry. This is also an important direction for CHE to reform and develop in the future.

The increased students' dropout rate in higher education is one of the important problems in most institutions. We can use data mining technology to analysis the educational data system and find factors that affect student dropout rate, and therefore lead to a better academic planning and management to reduce the dropout rate, as well as provide valuable information for stakeholder in decision making to improve the quality of higher educational system [20].

V. Conclusions

In conclusion, several remarks will be made as following. Firstly, with rapid development of information technology and wide use of the Internet, it provides broad opportunities for the reformatoin of CHE informatization. Secondly, the development of higher education informatization promotes sharing of excellent higher education resources, and improves the quality of higher education. Thirdly, higher education informatization will eventually lead to massification of higher education, popularization of high-quality educational resources and low cost of education. In addition, the development of CHE informatization is a good experience to guide and implement informatization to high schools, elementary schools, and eventually for the whole education system in China.

References

[1] LIANG Lin-mei, LIU Yong-gui, SANG Xin-min, A Development and Research Outline of IT in Higher Education, *Modern Educational Technology*, Vol.22, No.1, 2012, pp. 5-9.

[2] Song Chao, Li Gen, System Engineering Construction of Higher Education Informatization: a Literature Review, *Review of Economic Research*, No. 36, 2011, pp 40-45

[3] Zihe Rao, http://cppcc.china.com.cn/2014-03/08/content_31716687.htm, 2014.

[4] SHEN Guo-chang，ZHANG Wan-hong, New Reform of Higher Education and the Third Industrial Revolution, *Jianghan Academic*, Vol. 34, No. 2, 2015, pp. 90-95.

[5] Xu Mian, Wang Jingguang, Current Situation, Problems and Solutions in Higher Education, *The Chinese Journal of ICT in Education*, 2003, No. 10, pp. 10-11.

[6] John Leslie King, Kenneth L. Kraemer, Evolution and organizational information systems: an assessment of Nolan's stage model, *Communications of the ACM*, Volume 27 Issue 5, May 1984 Pages 466-475.

[7] Ana Ramona Lupu, Razvan Bologa, Gheorghe Sabau, Mihaela Muntean, The Romanian Universities in the Process of Data and Information System Integration, *7th*

WSEAS Int. Conf. on ARTIFICIAL INTELLIGENCE, KNOWLEDGE ENGINEERING and DATA BASES (AIKED'08), 2008, pp. 527-531.

[8] Wang Yunwu, Research Summary of Digital Campus in China, *Modern Distance Education Research*, No. 4, 2011, pp. 39-50.

[9] Fátima David, Rute Abreu, Information Technology in Education: Recent Developments in Higher Education, *2014 9th Iberian Conference on Information Systems and Technologies (CISTI)*, 2014, pp 1-6.

[10] Zhu Zhangting, China Education Informztization in Past Decade, *China Educational Technology*, Vol 22, No. 1, 2011, pp. 20-25.

[11] Luo Yongping, Ding Weize, To Promote the development of Higher Education Informatization by Integrating the Information Island, *Education and Vocation*, 2009, 8, No. 23, pp. 168-170.

[12] Yu Wenhao, Liu Di, What is the Value of Technology in the Marriage Between Learning and Technology – An Interview with Dr. Robert A. Reiser of Florida State University, *Modem Distance Education Research*, 2015, No. 4, pp. 3-9.

[13] The Organisation for Economic Co-operation and Development (OECD) [http://www.thepaper.cn/newsDetail_forward_1375608.

[14] The Organisation for Economic Co-operation and Development, http://www.oecd.org/education/new-approach-needed-to-deliver-on-technologys-potential-in-schools.htm, 2015.

[15] Zhu Zhiting, The Latest Developments of Education Informatization: International Observations and Domestic Trends, *Modern Distance Education Research*, No. 3, 2012, pp. 3-13.

[16] Charalampos Giousmpasoglou, Evangelia Marinakou, The future is here: m-learning in higher education, *2013 Fourth International Conference on e-Learning "Best Practices in Management, Design and Development of e-Courses: Standards of Excellence and Creativity*, 2013, pp 417-420.

[17] James M. Tien, Toward a Decision Informatics Paradigm: A Real-Time, Information-Based Approach to Decision Making, *IEEE TRANSACTIONS ON SYSTEMS, MAN, AND CYBERNETICS-PART C: APPLICATIONS AND REVIEWS*, VOL 33, NO 1, 2003, pp 102-113.

[18] ELISSAVETA GOUROVA, LILIA ZOGRAFOVA, Knowledge Management in Higher Education, *Recent Advances In Telecommunications, Informatics And Educational Technologies*, WSEAS Press, 2014, pp. 154-159.

[19] Guangming Online, http://news.gmw.cn/2015/06/09/content_15916656.htm, 2015.

[20] WILAIRAT YATHONGCHAI, CHUSAK YATHONGCHAI, KITTISAK KERDPRASOP, Factor Analysis with Data Mining Technique in Higher Educational Student Drop Out, *Latest Advances in Educational Technologies*, WSEAS Press, 2012, pp. 111-116.