Research in the Development Trend of Chinese Higher Education Informatization

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Abstract: - Information Technology (IT) now plays a very important role in sustainable development of Chinese society and economy at all levels. Especially for Chinese higher education (CHE), it is a bridgehead to lead the society, culture, and economy. Therefore, the progress of higher education informatization has received much attention in China. In this paper, we firstly choose the development of CHE informatization to study and summarize its current development status, and then point out that CHE informatization work is seriously lagging behind the development of information technology, which thereby restricts the development of CHE; finally we discuss the fusion 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.

Key-Words: - Information Technology; Chinese Higher Education; Informatization; Development; Fusion

1 Introduction
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 of national education. It can be seen that the education informatization in China will become a powerful lever to support the education reform and development. By using education informatization we can improve education modernization, and then promote the continued change and innovation of Chinese education system [1]. As a bridgehead to lead the society, culture, and economy in China, the higher education plays a very important role in expanding the knowledge level, cultivating the high quality person, and applying the innovative knowledge to improve the work productivity. Therefore, the progress of higher education informatization has received much attention.

However, the 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" [2]. 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 equipments, 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 Higher Education Institutions (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 [3].
On the basis of the current situation of CHE informatization, this paper will analyze the opportunities and challenges for the development of CHE informatization; and then describe its next development phase when the information technology is deeply integrated with CHE; finally help people understand the future trend of CHE informatization through this study.

2 Current status of CHE Informatization

Some information industries, such as information transmission, computer services and software, are the basic and pilot industries in national economic development. In recent years, these industries which are affected by technology-driven and demand-pull have very strong development latent capacity in China. From the point of view of social form, China now has actually entered into the information age [4]. It should be noted that the traditional Chinese industries have growing needs for transformation and upgrading in information age. Additionally, these needs make communication, social service and education service become three important forces to promote the development of service industry. Among them, education service has also been the focus of service industry [5].

The above needs also force the Chinese 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 related little to the teaching informatization [6].

In the 21st century, Chinese HEIs had begun to step into the "fully integrated" stage during which the construction work included the hardware and software. 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.

3 The new problems 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 approach when the technology continues to change and innovate in 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 the development of IT [7]. Therefore, how to keep up with the development of IT has a powerful influence on the CHE informatization.

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

Problem 1. There is an uneven development rate between the development of CHE informatization and the reform of IT.

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; with the participations of experts, they try to identify and describe emerging technologies 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 in higher education in Table 1.
Table 1. The Summary of important technology developments in Higher Education

<table>
<thead>
<tr>
<th>Year</th>
<th>Technologies</th>
<th>Time to Adoption</th>
<th>Relevance for Teaching, Learning, or Creative Inquiry</th>
</tr>
</thead>
<tbody>
<tr>
<td>2012</td>
<td>Mobile Apps</td>
<td>1 year or less</td>
<td>Mobile apps to educational use; Extend learning outside of the classroom.</td>
</tr>
<tr>
<td></td>
<td>Tablet Computing</td>
<td>1 year or less</td>
<td>To increased student engagement and enhance learning experiences.</td>
</tr>
<tr>
<td></td>
<td>Game-Based Learning</td>
<td>2 to 3 Years</td>
<td>For students to acquire the some important skills.</td>
</tr>
<tr>
<td></td>
<td>Learning Analytics</td>
<td>2 to 3 Years</td>
<td>To affect the learning performance; To enable faculty to more precisely understand students’ learning needs; To enable educators perceive the education processes.</td>
</tr>
<tr>
<td></td>
<td>Gesture-Based Computing</td>
<td>4 to 5 Years</td>
<td>To have profound implications for special needs and disabled individuals.</td>
</tr>
<tr>
<td></td>
<td>Internet of Things</td>
<td>4 to 5 Years</td>
<td>To promote the sharing efficiency of teaching resource.</td>
</tr>
<tr>
<td></td>
<td>Massively Open Online Courses (MOOCs)</td>
<td>1 Year or Less</td>
<td>For learners to freely experiment with a variety of subjects and acquire new skills; learners are not stuck on a single pathway; To emphasize personalized learning.</td>
</tr>
<tr>
<td></td>
<td>Tablet Computing</td>
<td>1 Year or Less</td>
<td>To build a personalized learning environment; To provide more interactive action.</td>
</tr>
<tr>
<td></td>
<td>Games and Gamification</td>
<td>2 to 3 Years</td>
<td>To increase soft skills in learners.</td>
</tr>
<tr>
<td></td>
<td>Learning Analytics</td>
<td>2 to 3 Years</td>
<td>To develop learning potential of students.</td>
</tr>
<tr>
<td></td>
<td>3D Printing</td>
<td>4 to 5 Years</td>
<td>To enable authentic exploration of objects that may not be available to universities.</td>
</tr>
<tr>
<td></td>
<td>Wearable Technology</td>
<td>4 to 5 Years</td>
<td>To improve teaching efficiency.</td>
</tr>
<tr>
<td></td>
<td>Flipped Classroom</td>
<td>1 Year or Less</td>
<td>To rearrange face-to-face instruction, create a more efficient use of class time; the learning environment transforms into a dynamic and more social space.</td>
</tr>
<tr>
<td></td>
<td>Learning Analytics</td>
<td>1 Year or Less</td>
<td>Predictive analytics and developing forecast &amp; warning system.</td>
</tr>
<tr>
<td></td>
<td>3D Printing</td>
<td>2 to 3 Years</td>
<td>To use 3D printing to invent new objects and then implement innovative research.</td>
</tr>
<tr>
<td></td>
<td>Games and Gamification</td>
<td>2 to 3 Years</td>
<td>Educational gameplay has proven to foster engagement in critical thinking, creative problem-solving, and teamwork-skills.</td>
</tr>
<tr>
<td></td>
<td>Quantified Self</td>
<td>4 to 5 Years</td>
<td>To create an exponentially increasing amount of data; to combine with learning analytics to reveal how environmental changes improve learning outcomes.</td>
</tr>
<tr>
<td></td>
<td>Virtual Assistants</td>
<td>4 to 5 Years</td>
<td>To recognize and interpret human speech and emotions; to improve the efficiency of learning and research.</td>
</tr>
<tr>
<td></td>
<td>Bring Your Own Device (BYOD)</td>
<td>1 Year or Less</td>
<td>To enable students and educators to leverage the tools that make them most efficient.</td>
</tr>
<tr>
<td></td>
<td>Flipped Classroom</td>
<td>1 Year or Less</td>
<td>To transform the learning environment into a dynamic and more social space.</td>
</tr>
<tr>
<td></td>
<td>Makerspaces</td>
<td>2 or 3 Years</td>
<td>To provide students and faculty a place that is integrated into the community to do their tinkering.</td>
</tr>
<tr>
<td></td>
<td>Wearable Technology</td>
<td>2 or 3 Years</td>
<td>To help students learn from an unprecedented first-person perspective; to improve teaching efficiency.</td>
</tr>
<tr>
<td></td>
<td>Adaptive Learning Technologies</td>
<td>4 to 5 Years</td>
<td>To foster more personalized learning while providing institutions with key insights about the effectiveness of their instruction.</td>
</tr>
<tr>
<td></td>
<td>The Internet of Things</td>
<td>4 to 5 Years</td>
<td>To come into focus as terms such as &quot;hypersituation&quot;</td>
</tr>
</tbody>
</table>

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, the integration efforts in education data by using new information technology become stronger. Take the Learning Analytics for example, the initial use of education data emphases on statistical job in order to analyze and evaluate the current teaching process in 2012; however, we can use the education data to build a mathematical model to forecast in the teaching process in 2014.

Thirdly, 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. When Professor Dr. Robert A. Reiser of Florida State University and his work team research on the 10 technology trends that will have strong influence on education in 2015, their survey data indicate that the proportion of higher education institutions which 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. It is due to this, the future development of MOOC is not clear [8].

On the whole, the emergence of new information technologies and their applications have been a growing influence on higher education. These new information technologies can effectively support students to implement individual learning, and play a positive role in promoting efficient education management; but for the whole higher education industry, the informatization practice has always run behind the theory and technology. Therefore, if the HEIs can not combine their development with the appropriate information technologies and their development of higher education informatization will be restricted to some extent.

**Problem 2.** The trend from traditional learning to "Fragmented Learning" and "Mobile Learning" has been increased clearly.

Nowadays with the support of new technology, the dissemination channels of information and knowledge are diversification; the dissemination forms become "rich media"; the dissemination contents are decentralized. Here we choose mobile internet by using mobile terminals for information carrier as an example.

![Usage situation of mobile internet by users for information](https://example.com/mobilenet_chart.png)

**Fig. 1. Usage situation of mobile internet by users for information**

*Source*: CNNIC Statistical Report Internet Development in China

It can be seen from figure 1 that the transferring trend of mobile internet by Chinese users to mobile phones 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 intelligent 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" [9].

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, flexible learning (F-Learning), and 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 [10].

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 [11]. This issue also brings the following problems for learners, such as the possibility of lowering the information quality, information simplification and redundancy.

4 The development trend for Chinese Higher Education Informatization

Based on description above, we can see a profound understanding of effective integration of modern higher education and information technologies is necessary; and a trend analysis has also positive significance for the development of CHE informatization. Here we summarize a detailed trend analysis in this section.

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 today we mentioned the internet thinking is not simply constrained within the provision and use of Internet products and services, in fact, now it is on behalf of 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; it is blended with the offline traditional industries in order to generate a new productive formation and then achieve the effect of "1 (online) +1 (offline) > 2".

"Internet +" also brings opportunities for the development of CHE Informatization [12]. Therefore, it is necessary to consider how to combine Internet + with the related management processes in CHE, and then to form "Internet + Education". On the basis of "Internet + Education", it can not only enrich the teaching forms and improve the teaching efficiency which can not be available in traditional higher education and, but also allow higher education from a relatively closed to a more open environment. It can be expected the new forms of higher education and teaching will continue to emerge by the leading of "Internet +". Here are the examples as following.

"Internet+specialty". The responsibility of traditional higher education is to cultivate talents to satisfy the society needs, and the traditional higher education also adheres to the philosophy of "student - oriented" and "specialized education ". However, nowadays the society needs more compound talents. By relying on "Internet + specialty", we can create an interdisciplinary specialty platform, which ensure students been allowed to choose their multi-disciplinary courses more convenient; and the flexible and personalized learning are easier. Furthermore, "Internet + specialty" is also striving forward multi - subjects amalgamation in the learning contents and methods, and lays a foundation for cultivation interdisciplinary talents.

"Internet+Teaching". Different from the face to face teaching and learning in classroom, "Internet + teaching" can provide comprehensive educational services. For example, the ways students acquiring knowledge will be more flexible through online virtual classroom, professional online communities, and flipped classroom; with the help of "rich media" characteristic of the network, we can constantly improve the form of relevant teaching activities, and then increase the students' enthusiasm to participate in learning; at the same time, by relying on internet, instant messaging program and mobile devices, we can design efficient interaction activities between students and teachers, such as achieving online test by teachers and providing online help for students. It should be noted that 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.

Trend 2. To integrate, process and analyze big data will be the core task for CHE Informatization

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 get rid of 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, together. Here every segment in 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 age of education big data.

On the other hand, these education big data come from different sources, they have different data types, and information density; but the inherent association begin to loom over these data. Predictably, we can collect the students' data from their school life and learning process in campus, and then measure students' qualities and preferences in order to match their personality learning. At the same time, for the teachers, we can track and analyze details related to the students' learning process, and then rely on the interactive teaching from online to offline to collect the data and then complete cluster analysis. These analysis results will help teachers adjust teaching resources in real time and provide a reference for the subsequent curriculum design and adaptation.

Besides, the 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 into what is happening to the students' social networks and learning networks. On the basis of these new discoveries, the 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 defend stability of campuses.

On the whole, under the background of "Internet +", big data and Internet of things, we need to 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 high-frequency interactive data; we can also integrate and analyze effectively the related data set, and provide more real time technical supports on teaching and learning for administrators, educators, and learners. Ultimately, all above changes will also ensure administrators, educators, and learners constantly examine their own roles in the educational process, and join them together to promote the development of CHE Informatization; and then achieve the efficient management for CHE Informatization.

5 Conclusion

In conclusion, several remarks should be made as following. Firstly, with rapid development of information technology and wide use of the Internet, it provides a broad space for the reform of CHE informatization. The second is the development of higher education informatization can promote the share of excellent higher education resources, and improve the quality of higher education; thirdly, an inevitable result can be expected that higher education informatization will also lead to higher education massification, high-quality educational resources popularization and lower-paid cost of education; then we can educate more high-quality talents to satisfy the social needs. In addition, through the accumulation of CHE informatization construction experience, it can be introduced into high schools and primary schools; and then lays solid foundations for the whole education system to implement informatization.

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