The Study on Monitoring and Evaluation System of Teaching Quality of China Higher Education Institutions in the Era of Big Data

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Abstract
In the era of big data, the way of monitoring and evaluation of Higher Education Institutions (HEIs) in China has been undertaking drastic changing. “Letting data talk” is becoming the trend of new monitoring and evaluation system. In 2014, the Basic Teaching Status Database System designed by China Ministry of Education was officially started to collect the data from HEIs in the nationwide. This national movement of data collection urges the HEIs in China to construct their own system to monitor and evaluate teaching quality. The This article analyzes the national evaluation indexes and monitoring system, studies big data technology and concept, and comes up with an efficient system for HEIs to monitor and evaluate the teaching quality comprehensively in a normalized way.

Key words: Big data; Teaching quality; Monitor and evaluation

INTRODUCTION
Since the big data technology was invented, data has been growing rapidly. Intelligent information processing with big data has exerted the profound influences on the way of studying, working, living and thinking. Traditional method of Data mining can no longer satisfy the need of drastic changing society at the aspects of data acquisition, data storage, data analysis, and visualization. At the same time, all industries depend on data more than ever before, and the quantitative analysis which is based on the basis of data is gradually replacing the qualitative analysis which is conducted by the experts, consuming much time and intensive labor. Under these circumstances, traditional monitoring and evaluation system of teaching quality face great challenges. Former method, tool and technology of data mining are unable to deal with such massive data, let alone processing and analyzing it constantly. Thus the traditional system is incapable of producing sufficient analysis scheme to support the decision-making. Therefore, a new system that is able to handle the massive data in an efficient and user-friendly way must be introduced to the field of higher education.

1. BIG DATA AND BASIC TEACHING STATUS DATABASE SYSTEM
A shift is taking place from collecting some data to gather as much as possible, if feasible, getting everything (Mayer-Schönberger & Cukier, 2013, p.15). Before the era of big data, because of the limitation of data processing, random sampling is the only way to acquire data for scientific research, to get maximum information from minimum data. However, the side effect of limited data is so significant that it cannot guarantee the quality of processed information, sometimes lead to the incorrect result. In the era of big data, acquiring massive data is no longer troublesome. As a result, random sampling of “small data” becomes meaningless. Big data refers to the data collection which is perceived, acquired, managed, processed, and served by the traditional IT and hardware...
tool within unendurable time. Volume, variety, velocity and value are the four characteristics of big data (Li & Cheng, 2012). In a simple way, big data refers to the capability of acquiring the valuable information from various data at a high speed which has become a new mode of thinking and a new problem solving method.

Up to November, 2014, the number of Higher Education Institutions (HEIs) is up to 2491. With such a huge scale, it is almost impossible for China Ministry of Education to conduct comprehensive and constant monitoring and evaluation to higher education. Fortunately information technology and big data offer a new method to solve this problem. Under these circumstances, China Ministry of Education started a project named Basic Teaching Status Database System (BTSDS) to collect data from HEIs in 2007, in order to monitor and evaluate the teaching quality. In 2009, BTSDS began to collect data on trial. In 2012, China Ministry of Education required the newly-built HEIs to submit data annually. In 2014, BTSDS were officially initiated in the nationwide, requiring all the HEIs in China to submit data annually. After dozens of modifications, the database has been vastly improved and tends to be perfection. So far, BTSDS is comprised of seven categories of data in total, including college basic information, basic teaching conditions, faculty and staff, disciplines and specialties, talent cultivation, student information, and teaching management & monitoring. In detail, it includes 69 spreadsheets and 560 criteria, which cover all the aspects of teaching operation in HEIs. BTSDS is the largest database of higher education with a big volume of comprehensive and various teaching data in China. BTSDS aims to serve government, universities, public and HEIs evaluation. It is the basis of national report institutional eligibility evaluation and annual report on teaching quality. It is the main measure to promote information transparency and public supervision. It is the important part of the “Five-in-One” evaluation system. In the institutional eligibility evaluation and quality audit, the evaluators will examine and cite the information of BTSDS to produce evaluation and audit report.

2. IDENTIFYING THE KEY ELEMENTS OF MONITORING AND EVALUATION SYSTEM AND IMPROVING TEACHING QUALITY SPIRALLY

Currently scholars define the teaching quality from deferent perspectives. However, they generally admit that teaching quality is the complete structure of cultivating talents, a continuously developing system, the overall result of running school and managing teaching, a dynamic process with unceasingly development (Huang, 1996, pp.40-41). The definition emphasizes that the teaching quality is a dynamic and changing process. It produces massive data every minute. Therefore it is impossible for traditional monitoring and evaluation system to adopt random sampling method to conduct quality monitoring and evaluation. However, big data technology makes it possible that sample equals full data. It can provide us with a more efficient and more effective method to deal with the massive data. The HEIs in China needs to utilize the modern IT, construct a three dimensions feedback system of teaching quality on the basis of key aspects of talents cultivation, evaluating subject of teaching quality, and evaluators who have the authorities in higher education. They need to establish an IT forum and use its functions of acquisition, archiving and analysis to monitor and evaluate big data from different perspectives and at different stages to come into the diagnosis conclusion and improvement scheme (Liao, Li, & Ou, 2015).

Therefore colleges and universities in China need to integrate all kinds of information system into BTSDS, and establish a scientific and efficient monitoring and evaluating system. The ideal framework of the system can be illustrated in Fig.1. Obviously the monitoring and evaluation system is a complicated system which needs to coordinate all the departments related to teaching quality, including Finance Department, Personnel Department, Academic Office, Infrastructure Department. Student’s Affair Department and so on. So an independent department needs to be established to coordinate data collection, audit data quality and analyze data reports. It is normally named Teaching Quality Office, which must report to the president directly, bypassing the rest of the departments, in order to maintain its independence. In this framework, there are five key procedures, including identifying the key aspects, data acquisition, data quality audit, data analysis, and feedback, which are needed to be controlled strictly. The system is supposed to be a circle. It repeats continuously to monitor, evaluate and improve the teaching quality in a spiral way. The prerequisite of quality data analysis is the high quality of the raw data. So a data verification system is very necessary to ensure the accuracy, integrity and completeness at the phases of data inputting, data processing and data outputting. The evaluation criterion is the core element of the system. The evaluation indexes need to be quantized as much as possible. Otherwise the data analysis will be less feasible. With the scientific evaluation indexes, a variety of statistics report, variation report and even annual quality report can be produced to support decision making for top managers. Feedback and improvement scheme are what we looking for to improve teaching quality. There must be a follow-up system to ensure that all improvement schemes are conducted and achieve the expecting effect.
3. BASED ON BIG DATA, BUILDING EVALUATION INDEXES INTO MONITORING AND EVALUATION SYSTEM TO ENFORCE THE ANALYZING FUNCTION

Big data is capable of collecting all data from all the aspects of teaching and achieving full data analysis, which makes the results of monitoring and evaluation more authentic and objective. Apart from the advanced technology, the evaluation criterion is another key element. Early in 2004, China Ministry of Education issued *The Indexes of Basic Running Conditions for General HEIs* to ensure the basic teaching conditions of higher education. In 2011, China Ministry of Education issued *The Indexes of institutional eligibility evaluation for HEIs*, in order to improve the teaching quality level. Both of the indexes are crucial to HEIs in China. They are the main basic criteria of teaching quality eligibility evaluation and quality audit organized by the China Ministry of Education. Thus the HEIs in China need to integrate the two indexes into their monitoring and evaluation system, in order to comply with government regulations and improve teaching quality.

3.1 Based on the Principle of Data Connection, Monitoring the Basic Teaching Conditions

The concept of big data technology searching for connection is in accordance with the true need of the sufficient and valid evidence in the situation of teaching evaluation (Zheng & Liu, 2015). Searching for data connection is the basic principle of big data technology, by which data comparison, analysis, and prediction can be achieved. The data of students and teachers has the most complicated connections in the BTSDS. The data of students is connected to the teaching conditions. Most of the criteria of teaching conditions are averaged by the number of students. The data of the teachers is connected to specialty, course, scientific research and teacher rewarding. All these interconnected data has plenty verification relations to ensure the accuracy and completeness of the data.

As the foundation and prerequisite of education, campus, teaching building, faculty and staff are the basic teaching conditions to organize teaching and cultivate talents. Without these conditions, the teaching quality is impossible to achieve. In China, the index of basic teaching conditions has detailed and compulsory requirements on the basic teaching conditions. Of them all, the ratio of students and teachers, rate of teacher with master’s or doctoral degree, the area of teaching building per student, the value of teaching and scientific research facilities/student and the averaged books are the five basic teaching conditions. Any of the five conditions is unqualified, the recruitment of new students will be restricted; two or above of the five conditions are unqualified, the recruitment of new students will be cancelled. The quantized index of basic running conditions for general HEIs is shown in Table 1.
The index of institutional eligibility evaluation for HEIs is the basic criterion of eligibility evaluation organized by China Ministry of Education. It is the most important evaluation to all the colleges and universities in China. There are specific requirements on the land area, floor area, books, faculty and staff, capital assets and current expenses of teaching and so on. The quantized index of institutional eligibility evaluation for HEIs is shown in Table 2.

### Table 2
The Quantized Index of Institutional Eligibility Evaluation for HEIs

<table>
<thead>
<tr>
<th>No</th>
<th>Criterion</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Ratio of associate professors and professors</td>
<td>30%</td>
</tr>
<tr>
<td>2</td>
<td>Land area (square meter /student)</td>
<td>54</td>
</tr>
<tr>
<td>3</td>
<td>Dormitory (square meter /student)</td>
<td>6.5</td>
</tr>
<tr>
<td>4</td>
<td>Numbers of computers for every 100 students</td>
<td>10</td>
</tr>
<tr>
<td>5</td>
<td>Seats of multi-media classroom and language lab for every 100 students</td>
<td>7</td>
</tr>
<tr>
<td>6</td>
<td>Rate of annual increase of value of teaching and scientific research facilities (yuan/student)</td>
<td>10%</td>
</tr>
<tr>
<td>7</td>
<td>Annual increase of books per student</td>
<td>4</td>
</tr>
<tr>
<td>8</td>
<td>Gymnasium and playground (square meter /student)</td>
<td>3</td>
</tr>
<tr>
<td>9</td>
<td>Annual current expenses of teaching (yuan/student)</td>
<td>1200</td>
</tr>
<tr>
<td>10</td>
<td>Rate of qualified lecturer</td>
<td>90%</td>
</tr>
<tr>
<td>11</td>
<td>Ratio of students and counselors</td>
<td>200</td>
</tr>
<tr>
<td>12</td>
<td>Ratio of graduates and employment instructors</td>
<td>500</td>
</tr>
</tbody>
</table>

The entire criteria in Table 1 and Table 2 are interconnected. The principle of connection enables the big data to deal with the correlation between the data. And the connection and verification ensure that the data is free from manipulation of data, because once the some data is changed, the rest of data need to be modified until all the data is matched. If any of the criteria is failed, the early warning and quick respond system will be activated.

### 3.2 Based on Powerful Analysis, Producing a Variety of Specialized Evaluation Reports and Even Annual Quality Report

In the era of big data, the sum of all data together is worth more than the data individually. Data can produce new value and achieve data innovation by continuous analysis and mining. Based on the enormous data, the system of monitoring and evaluation has powerful analysis ability, which can meet diversified need of the users. The system can produce a variety of reports mainly on four aspects of teaching, including the overall profile, teaching units, specialties and teaching quality report. The reports on overall profile cover the structures of faculty and staff, courses statistics, the utilization of all teaching resources, employment of graduates and so on. The reports on teaching units cover teachers of undergraduates, academic pacesetters, laboratory assistant and so on. The reports on the specialties cover students recruitment, rate of employment, credits system, comparison of specialties and so on. Based on these diversified reports, the top managers can work out the special improvement scheme such as quantity and quality of the teacher recruitment, the training need of the teachers and motivation plan. Moreover, in order to increase the transparency of higher education, China Ministry of Education requires all the HEIs to publish their annual quality report on the websites of China Ministry of Education and provincial education department for public supervision. Since BTSDS covers all the aspects of the teaching, most contents of the annual report can be produced automatically, which guarantees the authenticity of the report.

### 3.3 Based on Accumulation and External Links, Achieving Horizontal Comparisons and Vertical Comparisons

With the accumulation and external link to the national database, BTSDS can make the horizontal and vertical comparisons. The president needs to know the current position with comparison of the key criteria such as scale, scientific and research level, the rank of discipline and specialty in nationwide or across the province. For example, the construction of disciplines and specialties is the core competitive force for the development of the colleges and universities. With the access to national database system, BTSDS can compare disciplines and specialties nationally and provincially, such as the number of HEIs who open the same majors, the number of the students, employment rate of graduates and so on. As usual, every province will organize the supplementary data collection after the BTSDS data collection is finished. The supplementary data collection is much more detailed. It covers the aspects of conditions of individual specialty, disciplines and professional titles, courses, employment rate, the academic achievements of teachers, and the academic achievements of students. Based on the BTSDS data and supplementary data collection, the provincial education department publishes the rank of all specialties once a year, which exerts a crucial impact on the development of every college and universities. The president of HEIs can compare the specialties horizontally, and find out the rank of every
specialty in the province. In addition, after years of data accumulation, BTSDS can help to predict the trend of development of discipline and specialties by comparing the former and current discipline system vertically. The horizontal comparison and vertical comparison can clearly locate the position of the HEIs in the nationwide and in the course of the development, contributing to identifying the objective and mission.

3.4 Based on Full Data Acquisition From All the Aspects of the Teaching, Monitoring and Evaluating Teaching Quality in a Normalized Way

Because of the limitation of Traditional evaluation, the evaluation can only rely on partial contents and evidences, which constantly lead to subjective judgments. In the era of the big data, instead of depending on the sampling, monitoring and evaluation system covers all the aspects of teaching procedure. It is able to collect the full data related to teaching quality, and focusses on the data deep mining and analysis, which ensure the system to conduct an all-round monitoring to teach quality. Furthermore, every detail in the teaching procedure can be monitored by quantized criteria. For example, the spreadsheet of courses and professional courses in BTSDS reflects the number of courses, credits of practice and experiments, information of textbooks, credits of optional courses. China Ministry of Education encourages HEIs to increase the credits of practice, experiment and optional course. According to the Institutional Eligibility evaluation index, for the specialties in the categories of humanity and social science, the credits of practice are required to be above 20%; for the specialties in the categories of science, engineering, agriculture, and medicine, the credits of practice are required to be above 25%; rate of the experiments which are implemented is not less than 90%; 50% of the dissertations or graduation projects are completed in the context of experiment, practice and social investigation; The employment rate of graduates is not less than the average level in local area. Based on the full data acquisition, all the above criteria can be monitored and evaluated in a normalized way.

CONCLUSION

Big data has brought benefits to economy and society and transformed the way of living, working and thinking of human. The application of big data in the field of education has achieved the initial success. Unlike traditional monitoring and evaluation system is based on random sampling big data technology is able to achieve full-data analysis. It can collect all data from all the aspects of teaching, which makes the results of monitoring and evaluation more authentic and objective. All in all, The HEIs in China have to seize the opportunity of big data technology, pay more attention to the data collection, data mining and data analysis. They need to embed evaluation indexes into the monitoring and evaluation system, and establish early warning and quick response system, to provide timely, accurate and readable support to decision-making, in order to improve the teaching quality.

REFERENCES


