



Construction of Online Teaching Quality Assurance Index System Based on Big Data and TQM Theory

Lei Wang^(✉)

Guangdong University of Science and Technology, Dongguan 523000, Guangdong, China
13667373@qq.com

Abstract. Through the analysis of the online teaching of teachers in universities and colleges, online teaching has key shortcomings in teaching technology concepts, teachers' role reshaping, teacher-student interaction, teaching evaluation, etc. The root cause is that the online teaching quality assurance index system in colleges and universities has not been further improved in the data age, and has not played its due role in guiding teachers and students to solve problems and promoting online teaching reform. Based on big data technology and total quality management (TQM) theory, a systematic index system of online teaching quality assurance is constructed to clarify the main factors affecting the quality of online teaching and to help the healthy development of online teaching reform in colleges and universities.

Keywords: big data technology · TQM theory · online teaching · quality assurance index

1 Introduction

As COVID-19 prevention and control becomes normal, online teaching in colleges and universities has shifted from an emergency measure to a normal mode. For most teachers, online teaching is no longer strange. In the big data era, however, there are still some shortcomings in the online teaching practice [1], and the silence of online classrooms is still an indisputable fact [2]. The introduction and implementation of the "Implementation Opinions on the Construction of First-Class Undergraduate Courses" by the Ministry of Education put forward specific requirements for the construction of online first-class courses and online-offline-blended first-class courses, and further clarified the importance of high-quality development of online teaching. Therefore, in the context of building online first-class courses, how to use big data technology to influence online teaching process management, as well as to establish an online teaching quality assurance index system, and how to guide teachers and students to solve the problems exposed in online classrooms, have become urgent topics to discuss.

Table 1. Main Problems in Online Teaching [self-drawn]

No.	Problems	Frequency	Proportion
1	Teachers' willingness to change online teaching is not strong enough	16	61.5%
2	Teachers' information literacy needs to be improved, and there are not many cases of teaching analysis and reform using big data technology	22	84.6%
3	The role of teachers in the big data era needs to be reshaped	12	46.2%
4	The software platform interaction technology needs to be further improved	23	88.5%
5	The data analysis and presentation functions of the software platform are not mature enough	20	76.9%
6	Teacher-student interaction and communication are neither frequent nor in-depth	23	88.5%
7	Most students remain silent when questions are asked in class	18	69.2%
8	Students' learning status is difficult to monitor	21	80.8%
9	Teaching evaluation methods are traditional	16	61.5%
10	Others	-	-

2 Main Problems in Online Teaching in Colleges and Universities

To have a deeper understanding of the key problems in online teaching, the research team conducted in-depth interviews with 26 backbone teachers of different majors in colleges and universities. The interview outline mainly focused on the design and discussion of the online teaching reform concept, big data technology, teaching model, teaching method, teacher-student interaction, teaching evaluation, and other aspects. After sorting and summarizing the interview materials, there are some outstanding problems in online teaching quality assurance, as shown in Table 1.

3 Application of Big Data and TQM Theory

With the gradual maturity of big data technology, the increasingly closer integration of big data and higher education provides new ideas and methods for solving the shortcomings of online teaching. Online teaching also has the advantage of naturally applying big data. By embedding big data technology into the online teaching platform, learners' data can be collected and recorded for whole samples and processes. Through processing and analyzing these data, data support can be provided to teachers and students (see Fig. 1). Through the visualization of big data technology, students can clearly see their learning trajectory, check the omissions and fill the gaps, and objectively evaluate their learning performance. Teachers can track the learning status of students through the data, predict the learning effect of students' online learning, and provide them with teaching guidance and after-school tasks accordingly [3].



Fig. 1. General Process of Education Big Data Processing [self-drawn]

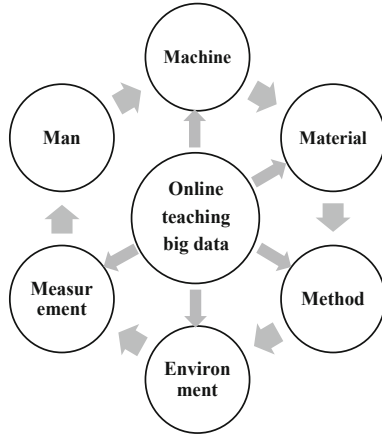


Fig. 2. Research Framework Based on Big Data and TQM Theory [self-drawn]

Total Quality Management (TQM) theory is a set of quality management systems with product (service) quality as the core and full participation as the basis. According to the theory, the factors that affect the quality of products (services) include 6 aspects, namely, man, machine, material, method, environment, and measurement, which are “5M1E” for short. TQM theory emphasizes full participation, the whole process, and all links, and has been widely applied in many fields, including higher education [4]. Researchers have further verified the applicability of TQM theory in higher education from several dimensions, including the influencing factor framework of online teaching quality [5], international talent cultivation [6], and online course quality assurance system [7].

Obviously, the application of big data and TQM theory is helpful to establish the online teaching quality assurance model (see Fig. 2), construct the online teaching quality assurance index system, and solve the shortcomings of online teaching.

4 Online Teaching Quality Assurance Index System Construction

With big data and the 5M1E factor analysis method, this paper analyzes the factors of “man, machine, material, method, environment, measurement” for online teaching in colleges and universities, and constructs an online teaching quality assurance index system, as shown in Table 2.

Table 2. Online teaching quality assurance index system based on big data and 5M1E [self-drawn]

First-grade index	Second-grade index	Third-grade index	Main measuring points
Man	1. Teachers	(1) Willingness to reform	Strong motivation to reform online teaching, willing to learn and apply big data technology
		(2) Information technology ability	Ability to use online teaching platform tools and analyze data
		(3) Teaching design ability	Ability to design online teaching objectives, teaching schedules, teaching strategies, and teaching evaluations based on big data
		(4) Teaching presentation ability	Ability to integrate teaching contents and guide students' discussion
	2. Students	(5) Learning motivation	Strong inner motivation and willingness to learn online
		(6) Learning strategies	Ability to optimize learning methods and carry out deep learning with the results of visual analysis of big data
		(7) Self-efficacy	Confidence in completing online learning tasks; using the platform's big data technology for self-assessment of learning effects
	3. Service providers	(8) Technical support ability	The extent to which information technology problems are handled in online teaching
		(9) Management service ability	Timeliness and accuracy of big data release for teaching management
	Machine	4. Teaching hardware	(10) Reliability
5. Teaching software		(11) Strength	All functions are available, including big data mining, analysis, and visualization
		(12) Usability	Users can get familiar with the main functions of the platform in a short time
		(13) Interactivity	Support various forms of interaction

(continued)

Table 2. (continued)

First-grade index	Second-grade index	Third-grade index	Main measuring points
Material	6. Teaching material	(14) Integrity	The integrity of online teaching resources
		(15) accessibility	Online teaching resources can be accessed at any time
	7. Teaching content	(16) accuracy	The accuracy of online teaching resources
		(17) timeliness	Online teaching resources are updated with the time
		(18) variety	The variety of online teaching resources
	method	8. Teaching design	(19) teaching objectives
(20) teaching process			The big data is reflected in the integrated arrangement of pre-class, in-class, and post-class sessions.
(21) teaching tasks			The tasks are based on the students' ability
9. Teaching methods		(22) Diversity	Flexible teaching methods
		(23) Personalization	Big data is used to diagnose the learning situation; teaching is based on students' abilities and reflecting differences
10. Teaching interactions		(24) Quality of interaction	Various forms of interaction Good feedback on interactive data
Environment	11. Network environment	(25) Smoothness	No lag and delay during peak network periods
	12. Physical environment	(26) Comfortability	Independent and quiet physical space
	13. Policy environment	(27) Sustainability	A department dedicated to online teaching and data management Rules and incentive policies
Measurement	14. Measurement standards	(28) Systematic	Standards for evaluation of teaching and learning
	15. Measurement methods	(29) Differentiation	Outcome evaluation based on big data
			Process evaluation based on big data Developmental evaluation based on big data

5 Conclusion

From the perspective of big data and TQM theory, this paper combines the existing theoretical findings to establish a more refined online teaching quality assurance index system, which clarifies the key factors of online teaching quality, solves the practical problems of online teaching quality evaluation, and provides some suggestions for online teaching reform. However, this study fails to assign the weights of each index, which will be further improved in the future study in light of the application effect.

References

1. Gong Huaping, You Jianxin. (2021) Quality Factors and Short Boards Improvement of Online Teaching in Colleges and Universities Based on TQM Theory. *China Educational Technology*, 417:79-85.
2. Cui Sijia, Zhu Hong. (2022) College students' Silence in Online Classroom: Questioning and Rethinking. *Heilongjiang Researches on Higher Education*. 337:10-15.
3. Zhang Han-ping. (2021) Strategies and Implementation Paths for Improving the Effectiveness of Online Teaching based on Big Data Analysis. *Journal of Wuhan Polytechnic*, 20:55-59.
4. Liu Ping. (2009) Total quality management theory of quality management in higher education applied research. *Science -Technology and Management*, 11:143-145.
5. Han Feifei. (2021) Construction of influencing factors model of online teaching quality based on grounded theory. *Journal of Chengdu Normal University*, 37:27-33.
6. Zhang Meng et al. (2019) Research on the Strategy of Global Talents Cultivation for Undergraduate Students of Tokyo University: Based on Total Quality Management Tool-PDCA Cycle. *Research in Educational Development*, 39:78-84.
7. Chen Ran. (2021) Research on the Construction of Quality Assurance System of Online Courses in Open University-Based on TQM Theoretical Perspective. *Lifelong Education Research*, 32:66-72.

Open Access This chapter is licensed under the terms of the Creative Commons Attribution-NonCommercial 4.0 International License (<http://creativecommons.org/licenses/by-nc/4.0/>), which permits any noncommercial use, sharing, adaptation, distribution and reproduction in any medium or format, as long as you give appropriate credit to the original author(s) and the source, provide a link to the Creative Commons license and indicate if changes were made.

The images or other third party material in this chapter are included in the chapter's Creative Commons license, unless indicated otherwise in a credit line to the material. If material is not included in the chapter's Creative Commons license and your intended use is not permitted by statutory regulation or exceeds the permitted use, you will need to obtain permission directly from the copyright holder.

