



# Reliability Evaluation Model of Online Teaching Quality Based on Big Data Technology

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**Abstract.** In order to ensure the education ability of online teaching course and solve the disadvantages of traditional teaching methods in location, a reliability evaluation model of online teaching quality based on big data technology is designed. By classifying the online teaching quality assessment method, comparing the practical application ability of each evaluation method, we determine a most reliable evaluation method, and complete the construction of online teaching quality evaluation index system. On this basis, a perfect online teaching system is built. According to the application requirements of evaluation framework and evaluation strategy, the necessary reliability evaluation objectives are defined, and the online teaching quality reliability evaluation model based on big data technology can be successfully applied. Comparing the model with the traditional structural equation model, it can be seen that big data technology can strengthen the reliability evaluation of online teaching quality by network hosts, thus breaking the inhibition effect of location restrictions on online curriculum teaching ability.

**Keywords:** Big data technology · Online teaching · Reliability assessment

## 1 Introduction

Big data, as an IT industry term, refers to the data set that cannot be captured, managed and processed by conventional software tools within a certain period of time. It is a massive, high growth rate and diversified information asset that requires new processing mode to have stronger decision-making power, insight and process optimization ability. The strategic significance of big data technology is not to master huge data information, but to professionally process these meaningful data. In other words, if big data is compared to an industry, the key to making profits in this industry lies in improving the “processing ability” of data and realizing the “value-added” of data through “processing” [1–3]. Big data needs special technologies to effectively handle a large amount of data over time. Technologies suitable for big data include massive parallel processing (MPP) database, data mining, distributed file system, distributed database, cloud computing platform, Internet and scalable storage system. Big data includes structured, semi-structured and unstructured data, and unstructured data is increasingly becoming the main part of data.

Compared with the traditional offline teaching, the online teaching mode can meet more students' classroom learning at one time. The teachers' original need for on-site teaching has also become on-site teaching. The same number of students, who may need to teach in batches for various reasons, has also become one-time teaching, which greatly improves the time efficiency. But at the same time, under the bright appearance, it also has its own shortcomings. In the common practical application, because students and teachers are separated from each other, it is difficult to communicate directly across the screen, resulting in no targeted guidance, or in the face of rich resources do not know how to screen and use, a separate learning environment leads to the neglect of others, at the same time, they can not integrate into the learning society, and then reduce the learning efficiency. To sum up, online education has its own problems. How to evaluate the performance of online teaching is a problem worthy of study.

In this paper, a higher vocational college as an example, the university will set up a number of courses as its own online education pilot courses, organize students to study at fixed time, although the convenience of MOOCS is not enough, but this is a good solution to the problem of low efficiency of individual learning. But at the same time, whether online education can change the dilemma of our traditional education, whether it is the future development and reform of education, how many advantages this new online education mode has, and whether this mode can be accepted by teachers and students, this paper will use the analytic hierarchy process to establish a judgment matrix, set index weight and various scores, and draw a conclusion. Therefore, it can be used as a reference for the reform and innovation of teaching mode in Colleges and universities.

## 2 The Construction of Online Teaching Quality Evaluation Index System

### 2.1 Various Methods to Evaluate the Quality of Online Teaching

Effective evaluation of teachers' teaching quality can enable teachers to give full play to their awareness of educational innovation in the classroom and achieve the effect of different educational concepts. Evaluation of teaching quality can identify efficient teaching methods. Education reform is to bring education to a higher and better platform. Education reform has  $B$  clear direction through the invisible "eyes" of teaching quality evaluation. Let  $a$  represent the AHP evaluation coefficient of online teaching, and  $X$  represent the fuzzy evaluation coefficient of online teaching:

$$C = \left( \frac{1}{B\sqrt{y} \cdot X\sqrt{p}} \right)^{\frac{3}{n}} \quad (1)$$

Among them,  $y$  and  $p$  represent two different online teaching quality evaluation coefficients. Teaching quality evaluation refers to taking scientific evaluation methods according to certain evaluation standards, following strict evaluation procedures, considering and evaluating the work results and behaviors of individuals or organizations, and obtaining quantitative evaluation data and results, so as to guide the work

tasks in the next period. In the specific performance evaluation, we can focus on the following issues: ① whether we understand the evaluation object; ② whether we understand the purpose of the evaluation; ③ according to what standards to carry out the evaluation; ④ whether we have sufficient relevant information consistent with the evaluation purpose; ⑤ whether the evaluation results are objective and accurate; and ⑥ whether the evaluation results can promote the evaluation object to make clear the direction of future efforts.

Big data theory holds that the management of online teaching quality evaluation is not only the summary and test of the previous management work, but also the premise of problem discovery and solution. This is to improve the management efficiency and enhance the production efficiency of the organization. It is a general evaluation of the comprehensive operation effect of the organization's management by using relevant indicators and systems. Generally speaking, the basic content of online teaching management is roughly divided into performance planning, performance communication, data analysis and performance evaluation. Teaching quality evaluation should be a comprehensive index system, a complete system and a dynamic process. At present, the construction of online teaching quality evaluation system needs to follow the basic themes of efficiency, effect, economy and fairness. For performance management, performance evaluation is not only a basic project, but also a constraint mechanism to promote management. It can not only adjust the orientation of new goals, but also highlight the value orientation of performance management.

## 2.2 Comparison of Evaluation Methods

Teaching evaluation is an effective way to understand and analyze the current situation of teacher education. Only after the evaluation of teaching quality can teachers show their advantages and disadvantages. Only by the evaluation of teaching quality can teachers have the reference objects for the development of educational and teaching, which can promote the peer to discuss, learn and promote each other. And create a kind of atmosphere between teachers to pursue each other. Through the evaluation of teaching, teachers can not only understand the advantages and disadvantages of their own education, but also enhance the motivation of internal communication between teachers to listen to and evaluate the lessons, and promote teaching research. Set  $\chi$  to represent the weighted coefficient of online teaching,  $f$  represents the characteristic value of online teaching contribution proportion, and establish a formula (1). The comparison results of teaching quality of different evaluation methods can be expressed as follows:

$$L = \frac{\sqrt{(\chi - 1)|r \cdot w|}}{C \cdot f^2} \quad (2)$$

where  $r$  is the subjective weighted value and  $w$  is the passive weighted value. Different types of colleges and universities focus on the evaluation of teachers' teaching quality, so the evaluation index will be different. Therefore, the construction of a broader teaching quality evaluation model mainly depends on the selection of index variables, which are usually scientific, comprehensive and testable. Usually, the index variables

are mostly selected from teaching methods, teaching content, teaching means and teaching effect. It is easy to repeatedly select and use some indicators from several evaluation angles, which often leads to different evaluation results because of different evaluation angles.

### 2.3 Determination of Online Teaching Reliability Evaluation Method

Big data technology model is a statistical analysis method, which uses covariance between variables to study the causal relationship of variables. The structural equation model can not only express the linear relationship of measurable variables, but also the potential variables that can not be observed; The direct and indirect relationship between variables can be expressed, so the structural equation model is more feasible than the traditional evaluation method. However, structural equation model is also mentioned as a verification factor analysis method, which usually needs the initial model with theory or experience as support [4–6]. When reading a large number of literature, it is found that the integration of the original index system by factor analysis method not only overcomes the subjectivity of the researchers in selecting the index system of the evaluation object, but also lays the theoretical foundation for the structural equation model to evaluate the teaching quality of teachers in class.

Teaching level and ability are the foothold of teachers. One of the most important topics in teacher education is how to effectively improve teachers' teaching level and ability. Obviously, the good evaluation of classroom teaching quality has become a pair of eyes, which can provide scientific understanding for most teachers' teaching situation. Let teachers understand the shortcomings of teaching and the direction of future efforts, and guide the improvement of teachers' professional quality. Teaching evaluation is not only used to evaluate the work of teachers, but also to make the quality of teachers more detailed, and to distinguish the professional ability, attitude and teaching quality of a teacher through objective and fair quality assessment. Through processing a large number of raw data generated by students online evaluation, the teachers' hard work is displayed scientifically and fairly. At the same time, it also provides system guarantee for more students to meet a good teacher who is conscientiously responsible. Set  $v_1$  and  $v_2$  to represent two different original online teaching data, and establish a formula (2), which can express the reliability evaluation results of online teaching as follows:

$$T = \frac{|L|}{\sum_{i_0} g(v_1 + v_2)} \quad (3)$$

Among them,  $i_0$  represents the minimum missing value of reliability evaluation information, and  $g$  represents the contribution coefficient of reliability evaluation. With the support of big data technology, online teaching quality evaluation refers to making an objective, fair and accurate comprehensive evaluation on the operation benefit and the performance of the operators during a certain operation period of the project by using the principles of mathematical statistics, operational research and specific index system, according to the unified standards and certain procedures, through quantitative

and qualitative comparative analysis. The results of performance evaluation can directly affect the vital interests of many employees, such as salary adjustment, bonus payment and job promotion.

### **3 Reliability Evaluation Model Based on Big Data Technology**

#### **3.1 Construction of Online Teaching System**

Online teaching is not only a safe and reliable online teaching platform, but also the school system uses reasonable programming and simple technology to realize. The purpose is to create a platform for teachers and students to learn and communicate easily and happily. Teachers can quickly operate the platform, spend more time on the design of teaching content and the development of teaching activities. Students can watch the live teaching course through the student client. The teaching process is no longer just video, and the interactive communication between the live broadcast and the teaching teachers and other students is used to solve the difficult problems encountered in the learning process by online questions and answers. System management personnel can easily check the running state of the system, reduce the difficulty of management technology and management cost, improve the efficiency of management, and better promote the work of online education in schools.

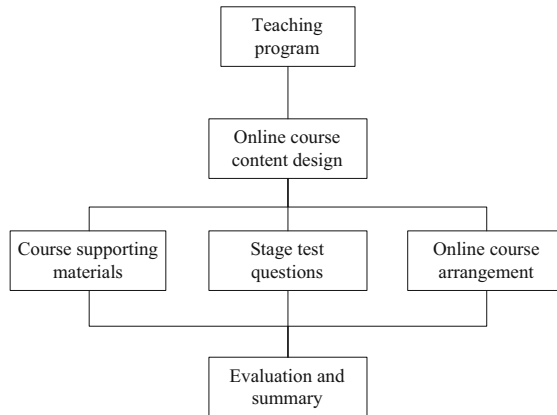
In summary, the main means of big data system establishment are mature computer system and advanced information communication technology, which can make students, teachers and managers meet the requirements of high efficiency, high quality and good operation effect interactive teaching platform. The construction characteristics of the system are safety, reliability, convenient operation, strong practicability and strong maintainability.

The following principles must be followed in the establishment of a perfect online teaching quality reliability evaluation system:

- (1) Reliability principle. In any system, the first thing to ensure is the reliability of the system. The system has a certain fault tolerance rate, and there must be a backup scheme for the key data of the system platform, so as to facilitate the fault recovery in an extraordinary period. Once there is an accident, it can ensure the data security to the maximum extent, and have the means of fast and safe recovery of data, so as to reduce or even avoid the loss caused by the loss of key data.
- (2) The principle of concurrent processing ability. When the system is running, it must have the ability to bear a large number of visits and concurrent requests. When selecting the big data server used by the system, it is necessary to pay attention to whether the performance of the selected server can meet the processing of a large number of concurrent requests and a good queuing mechanism, so as to prevent the system from no response due to excessive visits during the course.
- (3) The principle of advanced nature. The use of hardware and architecture system of the system must be in line with the advanced level of the industry, to ensure that the platform system has a long vitality, at the same time has a certain advance and development potential, and can be used for a long time, in line with the current

and future needs. The advanced nature of the system is mainly reflected in advanced concepts, advanced technology, advanced hardware and advanced software architecture.

- (4) The principle of easy management. Generally speaking, after the successful operation of the system, the follow-up emphasis should be placed on maintenance and management. This requires that in the initial design of the big data platform, the need for future system maintenance and management should be taken into account, so as to reduce the unnecessary capital and personnel investment in the later maintenance, so as to ensure the daily operation of the system and reduce the unnecessary loss caused by system failure as far as possible (Fig. 1).

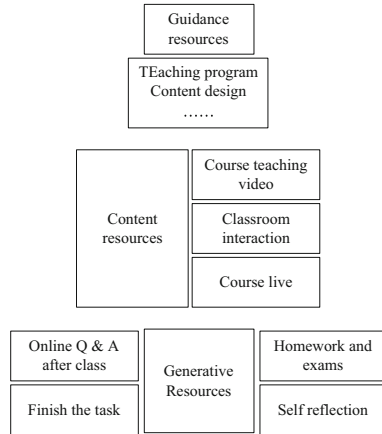


**Fig. 1.** Online teaching course route design

How to evaluate online courses has been discussed from different perspectives by many experts and scholars at home and abroad. For example, the MOOC education quality evaluation benchmark of the European Union of distance education universities is called “open education quality label”, which is mainly used to evaluate and compare the MOOC courses of schools. This set of evaluation mechanism includes two first level indicators, namely “institutional level” and “curriculum level”, which mainly correspond to 11 indicators, such as curriculum content, curriculum activities, curriculum structure, curriculum interaction and curriculum evaluation. When evaluating the quality of online teaching, there is a strong correlation between the indicators, which not only increases the workload, but also affects the effectiveness of the evaluation structure. Through the analysis and comparison of the evaluation methods of teachers’ teaching quality, we can easily think about the method of dimensionality reduction of indicators factor analysis. Dimensionality reduction reduces the original indicators to several main parts which no longer have linear relationship. The main factors obtained by factor analysis are usually difficult to have a specific meaning in real life, so we must rotate the principal components, and the rotated common factors have a clear meaning.

### 3.2 Evaluation Framework and Strategy

The design and development of online teaching quality reliability evaluation framework is an important part of the success of online teaching mode. It can also be said that the important factors of teaching success or failure are determined by curriculum resources. According to the different functions and uses of information-based teaching resources, our school classifies online course resources into three categories: guidance resources, content resources and generative resources (Fig. 2).



**Fig. 2.** Framework of online teaching course

#### Guiding Resources

It is not difficult to see from the figure above that the guiding resources are at the top of the pyramid. For the whole educational curriculum framework, they play a leading role and are programmatic resources. Combined with the characteristics of online teaching, the school puts forward the syllabus and teaching content which are different from the traditional teaching. Teachers write teaching materials according to the syllabus and content, so that students can quickly understand the objectives of online courses and get familiar with the contents of online courses. Due to the existence of big data technology, this stage is mainly teachers' teaching preparation, which includes the design of teaching scheme and the preparation of teaching resources. Before each class, teachers prepare courseware and videos suitable for online live teaching, and upload the general scope and outline materials of the class to the online education platform as pre class guidance materials. Push information from the platform to the student terminal to remind students. At this time, students can log on to the platform to watch these guiding resources, understand and be familiar with the content of the course, have a certain understanding of the knowledge about the upcoming course, and preview independently, so as to lay a certain foundation for the development of classroom teaching.

### **Content Resources**

It is located in the middle of the pyramid and plays a pivotal role as a link between the preceding and the following. At the same time, it is also the most important part of the whole teaching framework and the highlight of the teaching content. Curriculum resources are transferred from it to students. Once the design of content resources is defective, it will directly have a negative impact on the whole teaching framework. In the design of content-based resources, teachers generally use the idea of modularization to develop, summarize and divide the course content according to certain standards and connections, and modularize the teaching content, so that students can better understand and distinguish the learning content and learning objectives of each module [7–10]. This stage is the central link of the whole online teaching stage, the quality of classroom teaching directly affects the implementation of the whole teaching mode, and the content resources are the key to determine the success or failure of the classroom teaching stage. Unlike ordinary online teaching, which uses recorded video courses as course resources, the teaching in our school adopts the way of live video. The so-called teaching behavior should be a real-time process completed by teachers and students. There is a time gap between ordinary video teachers' recording and students' watching, which will cause further estrangement between teachers and students, It is not conducive to the development of teaching. At this stage, teachers' direct teaching is still the most efficient and direct teaching method. In the process of activities, people prefer to face a living person rather than a cold machine [1, 11, 12].

One of the advantages of online teaching is that it can carry out more communication between teachers and students. In order to ensure the quality of classroom teaching, students can be arranged to speak on behalf of each other after group discussion for many times in a semester. The students who speak can be scored [13–15]. When the final settlement of classroom performance, the system calculates the students who have not spoken or who have not spoken enough, the score of the project was discounted or even failed. At the same time, the students' attendance rate can be recorded through the student camera system. After the students log in to the system through the account, the system can monitor the students' performance in class. If there is no reason to leave, those who leave more times can be judged as late, leave early or even absent from class, which is more effective and accurate than taking time to call the roll. Du Juedai's attendance also saves time.

After the class assignment is finished, the teacher summarizes the class content and the students' speech, which is the end of the class teaching stage.

### **Generative Resources**

At the bottom of the pyramid, it is generated naturally from the use of the first two kinds of resources. In ordinary online courses, this part was once regarded as the closest and richest content in teaching practice, because there is no online live broadcast in ordinary online courses, and only when it comes to generative resources can there be interaction between teachers and students. But our school has expanded the content resources and advanced the interactive behavior of classroom teaching activities.

As the name suggests, this stage is the supplementary review after the completion of classroom teaching. Generally speaking, the teachers use the live broadcast software to set up the after-school question answering class at a fixed time. Although the online live broadcast class can let the students have no scruples about asking questions and discussing, after all, the classroom time is limited, so it is impossible to do everything. Therefore, increasing the communication time between teachers and students can help students better understand the course content, and review the subject content at the same time. Students can also log in to the system at any time during non question answering time to watch the video of online teaching course to consolidate their knowledge. The video content is temporarily reserved for one academic year. If they are rated as excellent demonstration course, the video content of the course will be further edited and launched as an online excellent course. If teachers have no special requirements, they usually submit the electronic version of homework through the system or email. After correcting, the teacher logs the scores into the system. The quality and quantity of students' homework in a semester can be clearly recorded, which is convenient for the final score scoring. In the final examination, our school combines 70% of the usual scores with 30% of the test paper scores. The usual scores can be obtained by referring to the class attendance rate, the number of classroom speeches and the scores of homework submission in the platform system, which is convenient for teachers to query and for the school to keep the bottom data.

### 3.3 Objective of Reliability Assessment

In practice, with the support of big data technology, although the online education teaching performance evaluation method in China has begun to pay attention to speaking with data, it still relies on expert judgment and human input as a whole. For example, the general process of evaluating the teaching course of online education learning center by educational management institutions is to check teaching materials on site first, and then sample and interview teachers and students. For example, as a large-scale network higher education institution in China, the state Open University, namely, the state Open University, should conduct online teaching inspection on the nationwide school running institutions every year. Generally, it is to conduct spot check on the curriculum platform in various regions, organize dozens of experts to study the implementation of the sampled courses, and finally evaluate and score according to the indicators. The detection process is usually up to 4–5 months. At the same time, it consumes a large amount of human and material resources, so it can only be carried out once a year, and the sustainability and effectiveness of monitoring cannot be guaranteed. Moreover, the number of experts in the organization is limited, and the proportion of sampling courses is only a small part, and the comprehensive evaluation is also not guaranteed. As mentioned above, the data retrieval and analysis of online education platform teaching behavior, based on the data, establish an index system, and evaluate the results, which can be obtained with certain objectivity (Table 1).

**Table 1.** Configuration of online teaching evaluation platform

Processor	Intel Xeon processor e5-2660 V2
Operating system	Microsoft Windows Server 2012 R2 x64
Remote management	iDRAC8 Express
Power Options	Up to two 350 W hot swap redundant power supplies
Network adapter	Four port 1 GB Base-T adapter
Memory	32GB DDR3 DIMM
Storage	“3.5” enterprise sata7.2k hard disk x 4 (RAID10)
Computer room server group	CAT-6 cabling Gigabit Network
Customer terminal	Cat-5e wiring 100 m to desktop

#### 4 Analysis of System Practicability

To verify the design and application value of online teaching quality reliability evaluation model based on big data technology, the following comparative experiments are designed. 200 students in a university were selected as the experimental objects, of which 100 students were participants in the experimental group and 100 other students as the control group participants. For the former, online teaching quality reliability assessment model based on big data technology was adopted for the former curriculum quality assessment, and the traditional structural equation model was adopted for the latter (Fig. 3).

**Fig. 3.** Online teaching scene

The DSR (data set ready) data readiness index and the DUR (Data utilization durability) data utilization durability index can both reflect the reliability of the network host's evaluation of the quality of online teaching courses. In general, the physical values of the DSR index and the DUR index are more reliable. Larger, the higher the reliability of the web host's evaluation of the quality of online teaching courses, and vice versa, the lower. The following table records the specific numerical changes of the DSR index and DUR index of the experimental group and the control group.

**Table 2.** DSR index values

Experimental time/(min)	DSR index value/(%)	
	Experience group	Control group
5	67.3	40.5
10	68.1	40.5
15	69.6	40.4
20	70.2	40.3
25	70.5	40.2
30	70.7	40.1
35	71.0	40.0
40	71.4	39.9
45	71.8	39.8
50	72.2	39.8

Analyzing Table 2 shows that with the extension of the experiment time, the DSR index of the experimental group always maintained a rising value trend; while the DSR index of the control group maintained a first stable, then decreased, and finally stable value trend. From the perspective of the limit value, the maximum value of 72.2% in the experimental group is an increase of 31.7% compared with the maximum value of 40.5% in the control group.

**Table 3.** DUR index values

Experimental time/(min)	DUR index value/(%)	
	Experience group	Control group
5	63.6	32.1
10	63.6	32.3
15	63.8	32.5
20	63.8	32.7
25	64.1	32.9
30	64.1	33.2
35	64.3	33.4
40	64.3	33.6
45	64.7	33.6
50	64.7	33.6

Analysis of Table 3 shows that with the extension of the experiment time, the DUR indicator of the experimental group has always maintained a numerical trend of rising in a stepped manner; the DUR indicator of the control group has gradually tended to a relatively stable numerical performance after a period of numerical upward trend. From the perspective of the limit value, the maximum value of 64.7% in the experimental group is 31.1% higher than the maximum value of 33.6% in the control group.

In summary, with the application of the online teaching quality reliability evaluation model based on big data technology, the value of DSR index and DUR index have shown a significant upward trend, which can fundamentally realize the effect of the network host on the quality of online teaching courses. Reliability assessment.

## 5 Concluding Remarks

With the support of big data technology, online teaching quality evaluation involves different disciplines, majors, and teachers. The sample selected in this empirical study is the index data of a university, which requires higher reliability and effectiveness. For the verification analysis, it may be necessary to find more suitable samples and interviewees. In addition, this article only uses the measured samples to train the model, and obtains a model structure with reliability analysis. If you want to prove the wide applicability of the model, you can rely on the structure relationship to calculate the weight and use the regression method to solve the final results of each discipline. The ranking order is compared with the school evaluation results. In the future, the model can be checked and accepted with the data of other majors in other colleges and universities.

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