Research on Improving the Quality of Online Teaching Based on Big Data under the COVID-19 Coronavirus Epidemic

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Abstract. In 2020, the global COVID-19 outbreak came out of the blue and caught people and businesses by surprise, including the education sector. In order to ensure the "suspension of classes", schools at all levels in China implement online teaching. How to ensure the quality of online teaching is an important issue. Based on the big data of online teaching, it is of great practical significance to analyze the factors affecting the quality of online teaching, so as to improve the path of improving the quality of online teaching. With the help of big data analysis, the index system of online teaching quality improvement is constructed and applied. Through questionnaire survey and SPSS software analysis, it can be concluded that the teaching quality of online teaching can be improved from three aspects: the behavior level of school, the learning level of students and the behavior level. Therefore, the following Suggestions are put forward: improve the hardware environment, perfect the teaching organization, strengthen the teaching supervision, strengthen students' mastery of knowledge and skills, strengthen students' active inspection and team learning. It is hoped that the implementation of such recommendations will further improve the quality of online teaching in the context of COVID-19.

1. Introduction
The concept of big data was first put forward by NASA in 1997. In 2011, McKinsey & Company believed that big data could independently mine and analyze information with the help of computers and output effective information. In 2020, as the world enters the COVID-19 epidemic, all kinds of schools will use big data for online teaching. In order to improve the teaching quality of online teaching, some scholars believe that big data of online teaching quality can improve the teaching quality. In terms of school factors, the teaching quality can be improved by improving teaching resources and teaching conditions, enriching teaching organization and teaching content. In terms of student factors, students' abilities can be improved through independent learning and team learning. Finally, the online teaching database is optimized to achieve high-quality online teaching quality big data, so as to obtain better teaching quality and form a virtuous cycle, as shown in Figure 1.
2. Construct the index of online teaching quality improvement

Based on the theoretical research and literature review of big data and online teaching quality, an online teaching quality improvement system is constructed. A total of 26 indicators were set, and each of them was scored in the form of Likert scale. From "very inconsistent" to "very consistent" were scored by 1, 2, 3, 4 and 5 respectively, as shown in Table 1.

### Table 1. Indicators of online teaching quality improvement

| Ordinal | Index                     | Variable             | Ordinal | Index                     | Variable              |
|---------|---------------------------|----------------------|---------|---------------------------|-----------------------|
| 1       | Teaching organization     | X1                   | 14      | Skills acquisition        | X14                   |
| 2       | Teaching supervision      | X2                   | 15      | Autonomous learning       | X15                   |
| 3       | The teacher               | X3                   | 16      | Cooperative learning      | X16                   |
| 4       | The teaching method       | X4                   | 17      | Study planning            | X17                   |
| 5       | Teaching attitude         | X5                   | 18      | Active learning           | X18                   |
| 6       | Refinement of teaching content | X6               | 19      | Team learning             | X19                   |
| 7       | Highlight key and difficult points | X7               | 20      | Take the initiative to check | X20                  |
| 8       | Abundant teaching resources | X8               | 21      | learn                     | X21                   |
| 9       | Stable and smooth platform | X9               | 22      | To share learning         | X22                   |
| 10      | Hardware environment      | X10                  | 23      | Improvement of learning ability | X23              |
| 11      | Knowledge acquisition     | X11                  | 24      | Improvement of learning desire | X24          |
| 12      | knowledge                 | X12                  | 25      | Improvement of learning interest | X25         |
| 13      | Professional knowledge    | X13                  | 26      | Improved problem solving ability | X26       |

3. Questionnaire survey and descriptive statistics

Through big data and questionnaire survey, the survey will last for one month starting from March 1, 2020. The number of valid questionnaires was 1126, and the effective recovery rate was 93.83%.

It can be concluded from Table 2 that the majority of the survey samples in terms of educational background are those with higher vocational or junior college education, accounting for 80%. The total number of samples in undergraduate education is 215, which meets the requirements of analysis. The number of online courses is concentrated in 4 or more, accounting for 92%, among which 6 or more account for 66.8%. This shows that in the context of the COVID-19 epidemic, the number of online teaching courses is very large. In terms of professional category, management (44.85%), economics (28.33%) and literature (13.85%) take the top three positions.
4. Research on the improvement path of online teaching quality

4.1. Reliability and validity analysis

Through SPSS software, calculate the reliability, Cronbach $\alpha$ coefficients of 0.961, more than 0.6, show the questionnaire on the online evaluation of teaching effect has higher credibility. For the validity test, the overall validity of the questionnaire was 0.981, far greater than 0.7. The P values in Bartlett test were all 0.00, far less than 0.05. This indicates that the validity of factor analysis is higher, and factor analysis can be performed.

4.2. Analysis of variance for common factors of online teaching quality

As shown in table 3, through the common factor analysis of variance, the extracted values of all evaluation indicators were $>0.85$, indicating that all the observed variables had a good explanatory effect on the common factor variables. Therefore, these observed variables are retained in the COVID-19 offline teaching quality improvement indicator system.

4.3. Total variance analysis of online teaching quality

The 26 variables of online teaching quality improvement index were processed through SPSS software to extract 3 components with characteristic values greater than 1, and then the cumulative contribution rate was obtained. The cumulative contribution rate reaches 88.828% and the contribution rate is greater than 80%, showing a high reliability, indicating that these three components can reflect the data information, as shown in Table 4.
Table 4. Total variance interpretation

| Component | Initial Eigenvalues | Extract the sums of squared loadings |
|-----------|---------------------|--------------------------------------|
|           | Total Variance %    | Cumulative %                          | Total Variance %    | Cumulative %                          |
| 1         | 20.714              | 76.727                                | 20.714              | 76.727                                |
| 2         | 2.261               | 85.102                                | 2.261               | 85.102                                |
| 3         | 1.006               | 88.828                                | 1.006               | 88.828                                |
| 4         | 0.356               | 90.147                                |                      |                                      |
| 5         | 0.276               | 91.169                                |                      |                                      |
| 6         | 0.242               | 91.169                                |                      |                                      |
|          | ...                 | ...                                   |                      |                                      |
| 24        | 0.052               | 99.678                                |                      |                                      |
| 25        | 0.044               | 99.843                                |                      |                                      |
| 26        | 0.042               | 100                                   |                      |                                      |

4.4. Principal component analysis of online teaching quality
As shown in Table 5, the rotated component matrix of online teaching quality can be divided into three categories, namely, the three major principal components. For the sake of data simplicity, the value below the absolute value of 0.5 is eliminated. The first type can be classified as the learning layer, and the variables are X25, X24, X23, X26, X17, X15, X14, X12, X13, X11, and X16. The second type is divided into the reaction layer. The variables are X4, X6, X5, X7, X3, X8, X2, X1, X10 and X9. The third category is divided into the behavior layer. Variables are X20, X21, X18, X19, and X22.

Table 5. Composition matrix of online teaching quality after rotation

| Variable | Component | Variable | Component |
|----------|-----------|----------|-----------|
| X25      | 0.884     | X5       | 0.852     |
| X24      | 0.878     | X7       | 0.849     |
| X23      | 0.861     | X3       | 0.821     |
| X26      | 0.857     | X8       | 0.819     |
| X17      | 0.726     | X2       | 0.785     |
| X15      | 0.717     | X1       | 0.764     |
| X14      | 0.699     | X10      | 0.761     |
| X12      | 0.697     | X9       | 0.755     |
| X13      | 0.682     | X20      | 0.608     |
| X11      | 0.671     | X21      | 0.587     |
| X16      | 0.671     | X18      | 0.579     |
| X4       | 0.864     | X19      | 0.574     |
| X6       | 0.855     | X22      | 0.500     |

4.5. Determine the weight of online teaching quality improvement index
Through SPSS software, principal component analysis was used to determine the weight of each variable. Combined with the online teaching quality improvement system, the weight of quality improvement index is obtained, as shown in Table 6.

Table 6. Online teaching effect evaluation index System Table

| Category       | Index               | Variable | Weights |
|----------------|--------------------|----------|---------|
| Reaction layer | Teaching organization| X1       | 4.20%   |
|                | Hardware environment| X10      | 4.15%   |
|                | Teaching supervision| X2       | 4.14%   |
|                | Highlight key and difficult points | X7   | 4.10%   |
|                | Abundant teaching resources | X8 | 4.07%   |
|                | Stable and smooth platform | X9 | 4.06%   |
|                | Refinement of teaching content | X6 | 4.00%   |
|                | The teaching method | X4 | 3.99%   |
5. Conclusion

Under the COVID-19 epidemic, a teaching quality improvement system based on big data was built for online teaching. According to principal component analysis, the index system is divided into three categories, which are as follows.

(1) The first principal component is the reaction layer, namely the relevant factors of school. The reaction layer includes teaching organization, hardware environment, teaching supervision, outstanding key and difficult points, rich teaching resources, stable and smooth platform, detailed teaching content, teaching methods, teaching attitude, teachers, etc. The weight of teaching organization (4.20%), hardware environment (4.15%) and teaching supervision (4.14%) ranked top three, indicating that the improvement of teaching quality requires more efforts to improve the hardware environment, perfect teaching organization and strengthen teaching supervision.

(2) The second principal component is the learning layer, namely the relevant factors of students. The learning layer includes skills acquisition, professional understanding, knowledge acquisition, cooperative learning, knowledge mastery, learning ability improvement, learning interest improvement, learning desire improvement, problem-solving ability improvement, autonomous learning, learning planning, etc. Among them, skill acquisition (3.88%), professional understanding (3.88%) and knowledge acquisition (3.87%) are among the top three, indicating that the improvement of teaching quality requires the enhancement of students' mastery of knowledge and skills as well as their own understanding of the major.

(3) The third principal component is the behavioral layer, namely the behavioral change of students. Students' behavior changes include active inspection, team learning, sharing learning, communication learning, active learning, etc. Among them, the weight of active inspection (3.69%) and team learning (3.68%) is in the top two, indicating that students get new behaviors of active inspection and team learning through online learning, which further improves the teaching quality.

Acknowledgments

This work was supported by the Key Project of Quality Engineering Teaching research of Anhui Provincial Department of Education (Grant No.2019JYxm0747). This work was funded by the Quality Engineering High Level Vocational Major Construction Project of Anhui Education Department (Grant No.2018ylzy136).

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