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PAPER

Factors Influencing the Quality of Online Teaching: Application of DEMATEL and Cluster Technology

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ABSTRACT

With the informationization of higher education, colleges and universities can fully apply online teaching mode to education and teaching. Therefore, analysis of factors affecting teaching quality of college teachers in online teaching can effectively make evaluation object (teachers) have a sense of achievement and pride, so as to mobilize enthusiasm of evaluation object and to stimulate the consciousness of honor and shame and consciousness of competition. This study adopts application of DEMATEL and Cluster technology, conducts a questionnaire survey on 5 colleges and universities in Henan Province, analyzes and identifies the teachers' factors among factors affecting teaching quality of E-commerce courses, and analyzes comprehensive influence index of teachers' factors, namely impact degree, affected degree, cause degree and centrality degree. A cluster flight is carried out on evaluation results of students. Results show that X2-2, X2-4, X2-5, and X4-3 represent high degree of centrality and high degree of cause, that is high importance of factor and the cause factor. The results of teacher evaluation can be divided into three groups by the K-means clustering method, and the clustering group shows significant significance for all research items ($p < 0.05$). The weights of X2-2, X2-4, X2-5, and X4-3 in cluster analysis also rank the top four, which is highly consistent with the results of DEMATEL's research, demonstrating that application of DEMATEL and Cluster technology proposed is very maneuverable and scientific. Research results have important reference value for improving online teaching strategy, improving the quality of online teaching, and regulating teaching activities as a whole through the use of online teaching quality evaluation.

KEYWORDS

online teaching, college teachers, teaching quality, influencing factors, DEMATEL and Cluster technology

1 INTRODUCTION

In the era of mobile Internet, there is a high rate of mobile terminal equipment for teachers and students in colleges and universities. In the 21st century, China's higher

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education has entered the stage of mass education, and quality problems come one after another. Improving the quality of higher education is an eternal theme in our educational development. Due to the universality of evaluation system of "teacher is the core", principal position of students is not directly faced, and teaching activities cannot evaluate teaching quality of teachers from perspective of students, which is not objective. At the same time, many domestic colleges and universities still have not established a scientific and reasonable teacher teaching quality evaluation system, and some colleges and universities have problems in implementation of evaluation system. Implementation of evaluation instruction is not in place, evaluation process is merely formal, and evaluation results are far from the facts. In many cases, evaluation of teachers' teaching quality is merely formal. It has not played an effective role in improving teachers' teaching quality. Establishing and perfecting evaluation system of teaching quality in colleges and universities is an important measure to improve quality of teaching in colleges and universities. Research on evaluation system of teachers' teaching quality in colleges and universities can help colleges and universities to keep up with development trend of the Times, improve teaching methods and teachers' teaching quality, and fulfill important task of training talents in colleges and universities.

Quality of online teaching is directly related to teaching level of the school and affects success or failure of talent training. Teachers' teaching level is one of the most important indicators of teaching quality. Currently, teachers' teaching quality evaluation is an important means to measure teaching ability of schools, and also an important method to improve quality of teachers. Analysis of influence factors of online teaching on teaching quality of college teachers is of great significance in teaching quality monitoring system of higher vocational colleges. Under the background of increasingly optimized teaching management system of higher education, an objective, fair and reasonable teaching quality evaluation system can encourage teachers to take students as the center, constantly update teaching concepts, improve teaching methods and improve teaching level. It scientifically analyses of influence of online teaching on teaching quality of college teachers, and plays an important role in improving teaching quality. Then, it can guide teachers to establish correct education concept, quality concept and talent concept, promote transformation of teachers' education and teaching ideas, so as to give full play to their initiative and creativity, to promote teaching reform and development, to enhance communication between teachers and students, and to promote improvement of teaching ability. Through analysis of factors affecting teaching quality of college teachers in online teaching, administrative departments of colleges and universities can grasp teaching situation of teachers at any time, test teaching effect and check completion of teaching tasks. It may make use of evaluation data, analyze and summarize in time, adjust teaching plan and teaching task according to demand. Teachers themselves can also find out problems in teaching through evaluation and analysis, and then problems are solved. Teaching evaluation and teaching process should be built into a system of cyclic, constant monitoring and adjustment.

2 LITERATURE REVIEW

At present, most universities in China have developed relatively perfect teaching evaluation standards. Classroom teaching quality assessment is mainly composed of student assessment, peer assessment as a supplement, departmental

(secondary college) supervision evaluation and school-level supervision evaluation. Although this teaching quality evaluation system can improve efficiency of teaching management, there are also some problems in practice. Affected by the epidemic, more universities have adopted online teaching. Therefore, simply applying original traditional classroom teaching evaluation index system to online teaching mode has certain disadvantages. More universities simply inform teachers of the scores, which makes it difficult for teachers to understand shortcomings and advantages of their teaching, to effectively improve their teaching quality and to make reasonable and effective changes. As for the analysis of factors affecting teaching quality of college teachers in online teaching, Tehseen [1] believed that enjoyment of teaching, career development, challenging and competitive teaching had a certain incentive effect on teachers' teaching. Dash et al. [2] introduced results of a study on effects of teaching content knowledge, teaching practice and students' math achievement on 79 fifth-grade teachers. Results showed that teachers randomly assigned to experimental group scored significantly higher on content knowledge and teaching practice than teachers in control group. Lowenthal [3] believed that enabling teachers to achieve sound self-development could significantly improve ability of teachers' quality, and proposed feasible strategies on how to improve development of teaching team and teaching quality. Archambault et al. [4] believed that teacher quality was a key issue affecting K-12 students' participation in various forms of online learning, studied state-level policies across the United States, aimed at establishing mechanisms to ensure quality of online teachers, and put forward policy suggestions conducive to development of high-quality online teacher teams.

Bolliger et al. [5] conducted a study on all teachers who taught online courses in a small research university in the United States, and results confirmed that factors affecting teachers' improvement of teaching quality in an online environment were related to factors related to students, teachers and institutions. Truzoli et al. [6] believed that teachers' self-efficacy was a predictive factor affecting classroom teaching, and there was a significant relationship between teachers' high level of self-efficacy and students' academic performance. Badia et al. [7] investigated 965 online teachers in the Open University of Catalonia, and results showed that age, academic background, dedication to online teaching, especially role of teachers in online teaching, were important factors affecting quality of online teaching. Vander et al. [8] studied expectations of 200 Dutch teachers on online teaching, and results showed that teachers' views on determination to implement technology in the classroom in post-coronavirus era had changed significantly, as well as characteristics of teachers' and intention to implement technology in teaching. And positive experience of online teaching had important value to improve quality of online teaching. Uzunboylu [9] determined attitude of English teachers employed by public middle schools in Northern Cyprus towards online education after distance education in-service project. Online learning attitude scale of 74 teachers showed that improvement of teachers' attitude might be improved if teachers' familiarity with network technology increased, which would be more conducive to improvement of online teaching quality. King [10] believed that call of integrating Internet technology into higher education was dominant, and dynamics and experience of professors and learners participating in mixed-mode classroom in teacher education were key factors affecting quality and success of school courses. Smith et al. [11] described quality of online teaching in university education, and results showed

that administrators of all universities adhered to higher academic standards of professional knowledge of full-time teachers, which was conducive to improving quality of online teaching. Puzziferro et al. [12] argued that with increasing demand for online education, institutions were faced with problem of developing efficient and high-quality online course development process models. Results showed that teachers' proficiency in using various teaching resources in online campuses could improve students' learning performance.

Shea et al. [13] explained differences between students' learning level and online course satisfaction in the context of higher education, and results showed that technology-mediated learning environment could improve students' satisfaction in online environment. Young et al. [14] surveyed students' opinions and preferences on online course delivery, and results showed that interaction among students, quality and timely interaction between students and professors, consistency of course design availability of technical support and flexibility of online courses had a relatively obvious impact on quality of teachers' online courses. Young [15] surveyed 199 online students who used online tools, and results showed that schools providing valuable courses, teachers communicating effectively and caring about students' learning could significantly promote learners' participation in online learning. Wu et al. [16] designed an English teaching quality evaluation index system consisting of 19 indicators and calculated main factors affecting quality of English teaching by using factor analysis method. Wang et al. [17] proposed a multi-attribute fuzzy evaluation model for physical education teaching quality in colleges and universities, and established an evaluation model for physical education teaching quality in colleges and universities based on Grey Correlation Analysis (GRA). This model and strategy provided a good reference for solving similar complex system problems. From the above research literature, it can be found that factors affecting teaching quality of college teachers are relatively complex. Moreover, it is very important when determining factors affecting teaching quality of college teachers in online teaching, and educators can effectively diagnose and measure their teaching activities and give feedback. It is expected that educators can find and solve various problems in teaching in time, to guide and standardize teaching process, improve effectiveness of teaching activities, and ensure that teaching objectives can be finally achieved. Especially in aspect of mobile information construction, a relatively complete information technology infrastructure has been initially formed, and a lot of materials about teaching quality have been accumulated. How to use a more scientific identification method to discover factors affecting teaching quality of college teachers in online teaching is of more practical significance.

3 RESEARCH METHODS

3.1 Model introduction

Seyed-Hosseini et al. [18] believed that the DEMATEL method could systematically analyze target objects, obtain relationship among indicators by using graph theory and matrix tools, and then calculate impact degree, affected degree, cause degree and centrality degree of each index, to determine causal relationship among indexes

and importance degree in the system. Direct influence matrix M is constructed. The strength of influence relationship between indexes is obtained by expert scoring, and four influence levels are defined, namely, 0, 1, 2 and 3. They are set to represent "no influence", "weak influence", "average influence" and "great influence" respectively. Direct influence matrix M was obtained through comparison, as shown in Formula (1).

$$M = \begin{bmatrix} a_{11} & \cdots & a_{1n} \\ \vdots & \ddots & \vdots \\ a_{n1} & \cdots & a_{nn} \end{bmatrix} \tag{1}$$

In formula (1), a_{ij} represents the influence degree of index i on index j. n is the number of indexes, and a_{nn} is influence degree of index itself, which is set to 0. Direct influence matrix M is normalized to obtain normal direct influence matrix X, as shown in formula (2).

$$X = \frac{M}{\max\limits_{1<i<nj} \sum\limits_{j=1}^{n} a_{ij}} \tag{2}$$

Based on direct influence matrix X, comprehensive influence matrix T is constructed again, as shown in formula (3).

$$T = (t_{ij})_{n\times n} = X(I - X) \tag{3}$$

In formula (3), I is the identity matrix. According to comprehensive influence matrix T, it calculates impact degree f_i and affected degree e_j of each index. f_i represents influence value of index a_{ij} on other indexes, and e_j represents influence value of index a_{ij} by other indexes. The calculation is shown in formula (4).

$$\begin{aligned} f_i &= \sum_{j=1}^{n} t_{ij} (i = 1,2,\cdots,n) \\ e_j &= \sum_{i=1}^{n} t_{ij} (j = 1,2,\cdots,n) \end{aligned} \tag{4}$$

According to the meaning of centrality degree, centrality degree m_i and cause degree r_i are calculated. Calculation formula is shown in (5).

$$\begin{aligned} m_i &= f_i + e_j \\ r_i &= f_i - e_j \end{aligned} \tag{5}$$

Cluster analysis (Cluster) is a method to classify things according to certain requirements and rules. Main process is to initialize, take N samples, classify the N samples into a class, and calculate distance between samples. Two samples that are grouped into a class should be those that are closest to each other. Then it set N samples to be classified, as shown in formula (6).

$$x_i = (x_1, x_2, \ldots, x_n) \tag{6}$$

Each sample has m characteristics, which are quantified, that is, to describe their characteristics numerically. Each sample x_i corresponds to a set of describing its characteristics $x_{i1}, x_{i2}, \ldots, x_{im}$. Distance between $x_i = (x_{i1}, x_{i2}, \ldots, x_{im})$ and $x_j = (x_{j1}, x_{j2}, \ldots, x_{jm})$ is shown in formula (7).

$$\left\| x_i - x_j \right\| = \sqrt{(x_{i1} - x_{j1})^2 + (x_{i2} - x_{j2})^2 + \cdots + (x_{im} - x_{jm})^2} = \sqrt{\sum_{i=1}^{m} (x_{ik} - x_{jk})^2} \tag{7}$$

The difference between two samples can be comprehensively reflected by Euclidean distance. Based on characteristic of Euclidean distance, samples with proximity and small distance are divided into a class. This operation is effective when classifying a single index, and helps to consider global characteristics of data distribution.

3.2 Index system construction

Different types of colleges and universities have different emphasis on teachers' teaching quality evaluation, so evaluation indexes will be different. Usually, index variables are mainly selected from teaching methods, teaching content, teaching means and teaching effects, etc. Selecting indexes from several evaluation perspectives is easy to lead to repeated selection and use of some indexes, which often results in different evaluation results due to different evaluation perspectives. In index system of factors affecting teaching quality of college teachers in online teaching, this study focuses on considering not only students' feelings on classroom atmosphere of teachers' classroom teaching, but also basic requirements of teachers' experts in teaching process to take classroom teaching as the center. Index system established in this way has both focus and coverage, which makes evaluation results more credible. Based on the current evaluation system of Chinese colleges and universities, this study uses the comprehensive evaluation method combining qualitative and quantitative analysis. On the basis of extensive literature review, it tries to make evaluation results reflect current education level in a detailed and sufficient way, and constructs index system of influencing factors of teaching quality, as shown in Table 1.

Table 1. Influencing factors of college teachers' teaching quality in online teaching

First-Level Index	Secondary Index	Variable Number
Teaching attitude	Full preparation before class, clear teaching tasks, writing teaching plans, ready courseware, etc	X1-1
	Teaching attitude correct, positive teaching, rigorous teaching style	X1-2
	Understanding the latest research status and teaching content of the subject	X1-3

(Continued)

Table 1. Influencing factors of college teachers' teaching quality in online teaching *(Continued)*

First-Level Index	Secondary Index	Variable Number
Teaching content	Clarifying training objectives specified in the course content	X2-1
	Teaching according to the syllabus	X2-2
	Teaching process having spirit, dressing neatly, having passion and vitality	X2-3
	Flexibly allocate class time according to teaching content	X2-4
	Teaching for learning, learning for use, constantly optimizing teaching content	X2-5
Teaching method	Reasonable differentiation of heavy and difficult points, content from shallow to deep, clear thinking	X3-1
	Theory comes from practice, practice by theory at the helm, edutainment in class, by analogy	X3-2
	Paying attention to special education and teach students according to their aptitude	X3-3
	Standardized terminology, clear vocabulary, vivid expression	X3-4
	Using seminar, example, problem, heuristic and topic teaching methods	X3-5
	Skilled use of PPT, computer, laser pointer and other equipment combined with the blackboard	X3-6
Teaching effect	Students' participating in the whole process of education consciously and enhancing the initiative of learning integration	X4-1
	Scientific and reasonable selection of teaching materials, combined with students' acceptability of knowledge	X4-2
	The more obvious interaction between students and teachers, the higher interaction degree	X4-3

3.3 Data sources

China's Henan Province has established a normal online teaching model, which allows teachers and students to conduct online teaching through different platforms. Due to the analysis of factors affecting teaching quality of college teachers in online teaching, this study involves factors related to teachers that may affect teaching quality. Questionnaire designed by research group is a questionnaire survey conducted by students on 17 aspects of online teaching of E-commerce course by teachers (as shown in Table 1). The questionnaire is distributed to undergraduates in Zhengzhou University, Henan University, Xinyang Normal University, Xinyang Agriculture and Forestry University and Henan University of Science and Technology. Data is collected by paper questionnaire and electronic questionnaire. In this questionnaire survey, a total of 486 questionnaires are collected to form experimental data. After eliminating invalid questionnaires, 426 valid questionnaires are obtained, with an effective rate of 87.65%. 426 valid questionnaires are processed, and 426 initial

direct influence matrices are obtained. It analyzes effect strength among factors that influence teaching quality of college teachers in online teaching and assigns values according to five levels, namely zero for no influence, 20 for small influence, 40 for general influence, 60 for large influence and 80 for serious influence. To eliminate fluctuation between fractions, 426 direct influence moments are averaged and rounded to obtain direct influence matrix. In Cluster analysis, it rates 17 aspects of online teaching by teachers and collects student evaluations by using Likert's 7-point scale.

4 RESEARCH RESULTS

4.1 DEMATEL results

DEMATEL studies logical relationship between various elements of the system to determine importance and status of each element, etc. Relationship matrix is processed to obtain normative direct influence matrix, and comprehensive influence matrix *T* is calculated. Various indicators are obtained and application display and analysis are carried out for various indicators. Relational matrix is the input data matrix, which shows logical influence relationship among elements.

Table 2. Matrix T of comprehensive influence

	X1-1	X1-2	X1-3	X2-1	X2-2	X2-3	X2-4	X2-5	X3-1	X3-2	X3-3	X3-4	X3-5	X3-6	X4-1	X4-2	X4-3
X1-1	0.032	0.179	0.059	0.023	0.051	0.021	0.011	0.026	0.131	0.015	0.014	0.016	0.022	0.012	0.072	0.011	0.026
X1-2	0.094	0.041	0.093	0.077	0.160	0.037	0.025	0.039	0.098	0.036	0.033	0.034	0.033	0.027	0.036	0.006	0.018
X1-3	0.192	0.203	0.031	0.099	0.085	0.023	0.018	0.029	0.073	0.020	0.019	0.020	0.020	0.016	0.021	0.003	0.014
X2-1	0.161	0.115	0.070	0.037	0.151	0.060	0.087	0.123	0.079	0.049	0.042	0.046	0.037	0.039	0.023	0.004	0.033
X2-2	0.040	0.036	0.024	0.035	0.020	0.194	0.124	0.162	0.266	0.212	0.193	0.192	0.167	0.158	0.050	0.008	0.039
X2-3	0.034	0.031	0.021	0.031	0.018	0.031	0.095	0.147	0.206	0.084	0.085	0.096	0.081	0.049	0.008	0.001	0.026
X2-4	0.037	0.035	0.024	0.035	0.021	0.030	0.077	0.182	0.144	0.241	0.161	0.211	0.127	0.215	0.007	0.001	0.019
X2-5	0.182	0.186	0.133	0.189	0.118	0.111	0.034	0.051	0.078	0.035	0.032	0.034	0.031	0.025	0.022	0.003	0.016
X3-1	0.072	0.051	0.031	0.049	0.024	0.100	0.020	0.145	0.071	0.019	0.019	0.039	0.118	0.015	0.027	0.004	0.131
X3-2	0.007	0.006	0.004	0.006	0.004	0.006	0.126	0.031	0.038	0.068	0.141	0.040	0.019	0.203	0.001	0.000	0.005
X3-3	0.027	0.023	0.016	0.023	0.013	0.026	0.131	0.107	0.193	0.189	0.042	0.043	0.037	0.155	0.006	0.001	0.024
X3-4	0.008	0.007	0.005	0.007	0.004	0.007	0.190	0.036	0.046	0.168	0.043	0.071	0.146	0.221	0.002	0.000	0.006
X3-5	0.011	0.008	0.005	0.008	0.004	0.015	0.033	0.026	0.154	0.029	0.009	0.173	0.039	0.037	0.004	0.001	0.019
X3-6	0.001	0.001	0.001	0.001	0.001	0.001	0.030	0.006	0.008	0.139	0.020	0.089	0.014	0.041	0.000	0.000	0.001
X4-1	0.034	0.029	0.015	0.029	0.010	0.007	0.027	0.015	0.049	0.037	0.035	0.031	0.025	0.037	0.053	0.165	0.153
X4-2	0.048	0.041	0.022	0.041	0.015	0.018	0.143	0.052	0.136	0.207	0.173	0.132	0.123	0.209	0.194	0.030	0.181
X4-3	0.228	0.195	0.100	0.195	0.062	0.037	0.043	0.061	0.235	0.041	0.066	0.091	0.047	0.039	0.190	0.030	0.058

Index values calculated by DEMATEL in Table 3 are obtained by Matlab2017b.

Table 3. Index values calculated by DEMATEL

	D Value of Impact Degree	C Value of Affected Degree	D + C Value of Centrality Degree	D – C Value (R) of Reason Degree
X1-1	0.720	1.210	1.930	–.489
X1-2	0.887	1.188	2.075	–0.301
X1-3	0.887	0.656	1.543	0.232
X2-1	1.154	0.887	2.041	0.267
X2-2	1.921	0.762	2.683	1.159
X2-3	1.043	0.724	1.768	0.319
X2-4	1.566	1.213	2.779	0.353
X2-5	1.279	1.237	2.517	0.042
X3-1	0.936	2.002	2.938	–1.066
X3-2	0.706	1.588	2.294	–0.882
X3-3	1.056	1.127	2.183	–0.070
X3-4	0.967	1.357	2.325	–0.390
X3-5	0.574	1.085	1.660	–0.511
X3-6	0.355	1.498	1.853	–1.143
X4-1	0.753	0.718	1.472	0.035
X4-2	1.766	0.270	2.036	1.497
X4-3	1.716	0.767	2.482	0.949

It plots Figures 1 and 2 based on the data in Table 3.

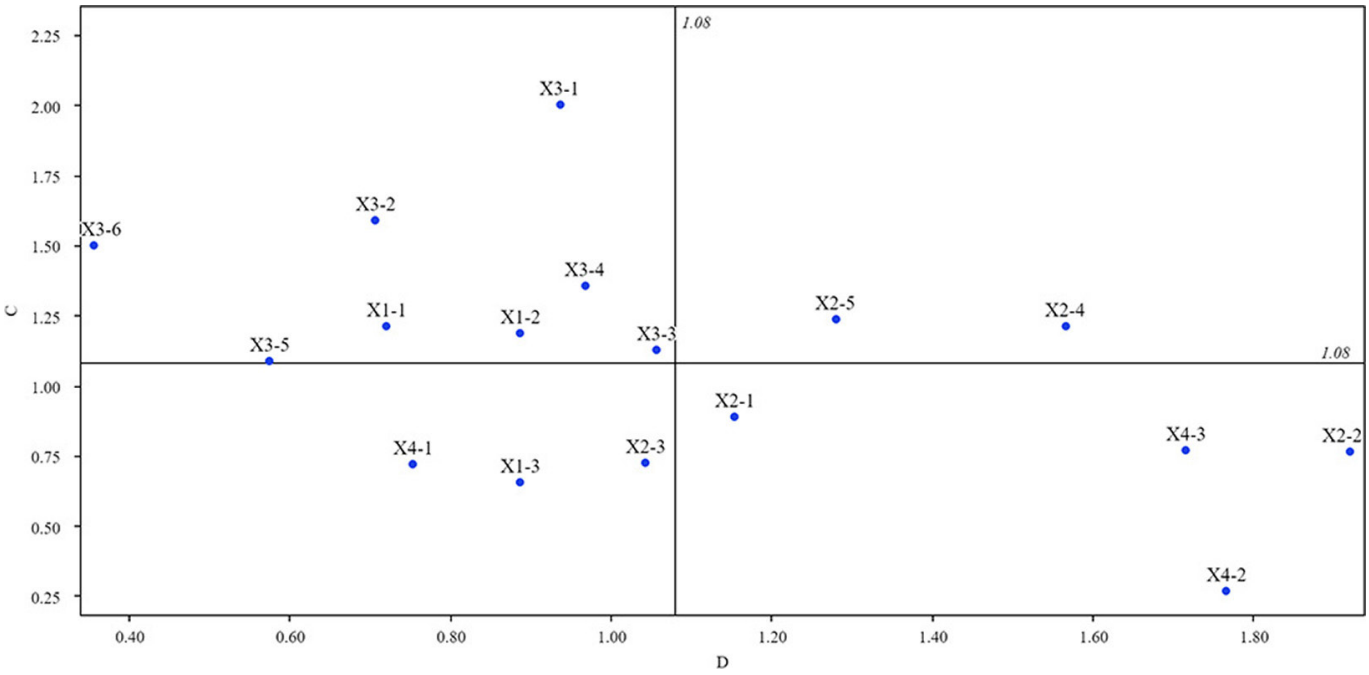

Fig. 1. Index values calculated by DEMATEL

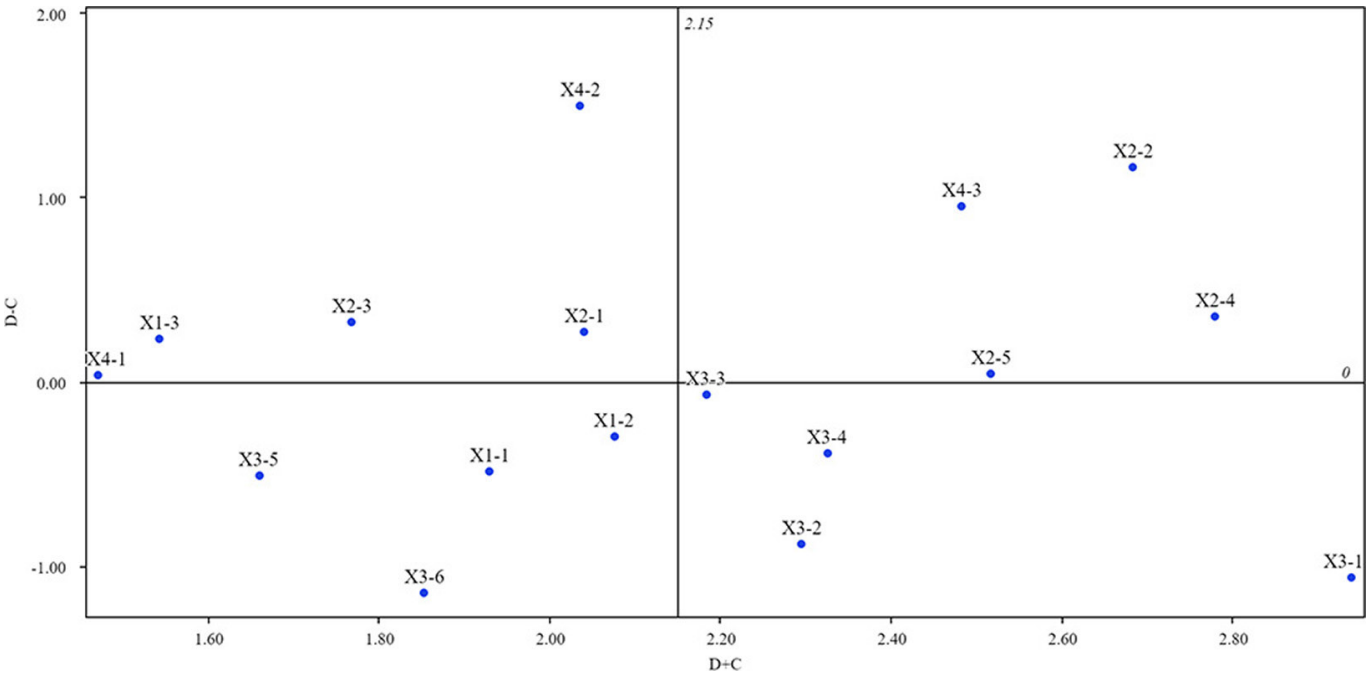

Fig. 2. Causality graph of centrality degree

As it can be seen from Figures 1 and 2, X2-2, X2-4, X2-5 and X4-3 in the first quadrant represent high centrality and high cause degree that is high importance of factors and the causal factors. Possible reason is that teaching by content of the syllabus (X2-2) has a great effect on other influencing factors. Main reason is that teaching content of online teaching must meet requirements of the syllabus, which is conducive to comprehensive and concrete realization of teaching objectives. Teaching content is more substantial and novel, and teachers can fully highlight teaching key and difficult points in online teaching, which connects theory with practice. According to teaching content, flexible allocation of classroom time (X2-4) also plays an obvious role in other factors, mainly because online teaching is not a traditional classroom teaching method, which requires teachers to design more comprehensive classroom arrangements and to make more reasonable use of time to reflect the timeliness of teaching. In online learning, some courses are boring for students. It is full of formulas and numbers, with many class hours and a long teaching week. Students are not very interested in this kind of course, so it is necessary to flexibly allocate class time comprehensively. Teaching is for learning, and learning is for application. Continuous optimization of teaching content (X2-5) has obvious effects on other factors as well. Main reason is that continuous optimization of online teaching content enables teachers to organize teaching plans more scientifically and give lectures carefully. Combination of theory and practice can better fit new concept of development of the industry, enlighten students' thinking, and stimulate their interest in learning. Students analyze and solve problems, and then students' learning ability is enhanced. Interaction between students and teachers is more obvious. High interaction degree (X4-3) is also a relatively obvious influencing factor, because after-class performance is the best platform for teacher-student interaction. Homework is assigned by teachers in class, teachers give correction after students finish their homework, and teachers' after-class question-answering guidance will have a good interaction with questions raised by teachers in class. Teachers can also stimulate students' ability to learn independently. Then students will make better evaluation of teachers in teaching evaluation.

4.2 Cluster results

This study continues to use cluster analysis to explore and study group classification of teachers' teaching quality and study characteristics of each category. The k-means clustering method is used for cluster analysis, and frequency distribution of final generated categories is shown in Figure 3.

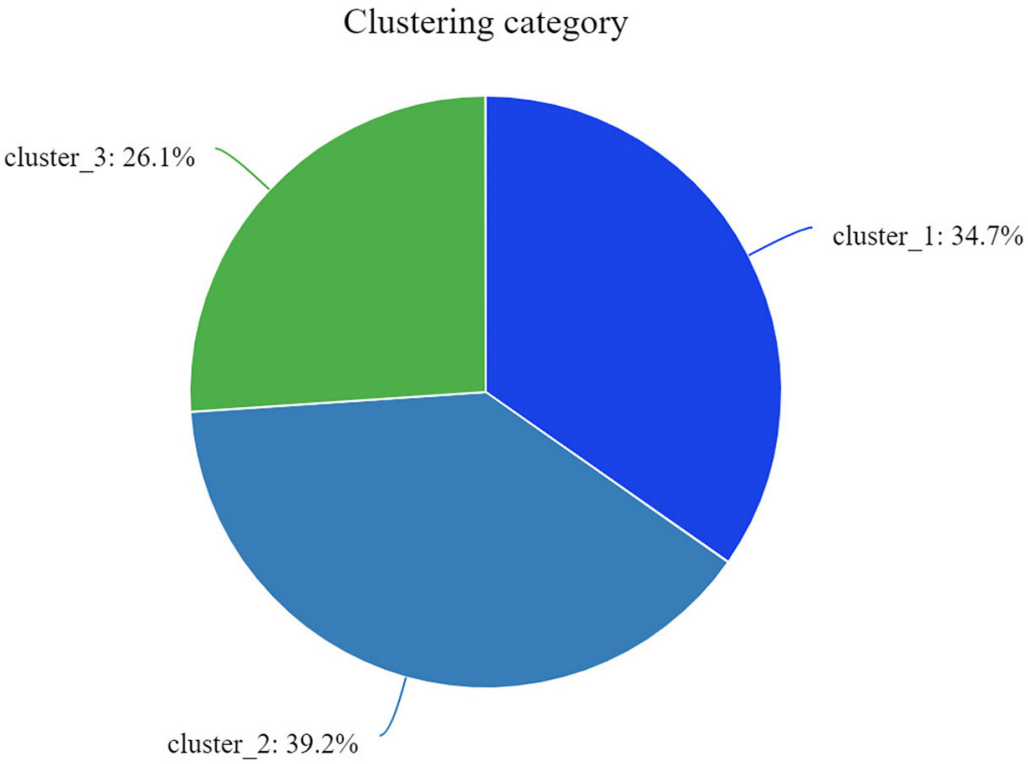

Fig. 3. Cluster analysis results

As it can be seen from the above Figure 3, final clustering can be divided into three groups, and proportion of these three groups is 34.74%, 39.20% and 26.06%. On the whole, distribution of the three groups is relatively uniform, which indicates that the clustering effect is good.

Table 4. Difference comparison results of clustering category variance analysis

Factor	Mean ± Standard Deviation			*F*	*p*
	Cluster_1 (N = 148)	Cluster_2 (N = 167)	Cluster_3 (N = 111)		
X1-1	4.71±1.04	5.25±1.18	3.49±1.00	89.007	0.000**
X1-2	4.61±1.07	5.34±1.10	3.71±1.05	75.927	0.000**
X1-3	4.67±1.00	5.40±1.06	3.51±1.13	105.727	0.000**
X2-1	4.68±1.01	5.34±1.09	3.50±1.14	97.495	0.000**
X2-2	4.74±0.89	5.50±1.01	3.01±1.02	221.742	0.000**
X2-3	4.97±0.95	5.46±1.02	3.10±1.10	188.868	0.000**
X2-4	4.76±0.96	5.54±0.97	3.14±1.10	194.778	0.000**

(Continued)

Table 4. Difference comparison results of clustering category variance analysis *(Continued)*

Factor	Mean ± Standard Deviation			*F*	*p*
	Cluster_1 (N = 148)	Cluster_2 (N = 167)	Cluster_3 (N = 111)		
X2-5	4.81±0.90	5.45±0.99	3.05±1.06	205.509	0.000**
X3-1	4.24±1.22	5.65±1.05	4.14±1.50	70.867	0.000**
X3-2	4.11±1.28	5.62±1.12	4.10±1.42	72.908	0.000**
X3-3	4.08±1.36	5.63±1.00	4.06±1.22	86.799	0.000**
X3-4	4.05±1.38	5.66±1.16	4.16±1.48	70.472	0.000**
X3-5	4.05±1.38	5.60±1.04	4.34±1.45	65.467	0.000**
X3-6	4.17±1.28	5.60±1.05	4.48±1.39	58.809	0.000**
X4-1	4.21±1.24	5.68±1.04	4.11±1.34	81.125	0.000**
X4-2	4.14±1.16	5.73±1.02	4.20±1.45	87.861	0.000**
X4-3	4.76±0.96	5.54±1.00	3.06±1.10	201.52	0.000**

As can be seen from Table 4, after clustering categories are obtained, to explore specific characteristics of each category, variance analysis is used to study differences of each category group, and finally category naming can be combined with characteristics of each category. Analysis of variance will be used to explore difference characteristics of each category. As can be seen from Table 4, cluster category groups are significant for all research items ($p < 0.05$), which means that there are three categories of groups obtained by cluster analysis.

Weights of four factors, including X2-2, X2-4, X2-5, and X4-3, are also ranked the top four, which is highly consistent with results, indicating that survey quality of DEMATEL and Cluster questionnaires is very good. This study demonstrates that 426 students have a high level of understanding of factors affecting teaching quality of college teachers in online teaching, and highlights that application of DEMATEL and Cluster technology proposed has very good operability and science.

5 DISCUSSIONS

Quality of education and teaching is the lifeline for survival and development of colleges and universities. At present, to meet needs of development of online teaching, China vigorously promotes connotation development level of colleges and universities, improves quality of personnel training, and strengthens monitoring and evaluation of teaching quality. To meet needs of high quality development of higher education, scientifically determining factors that affect teaching quality of college teachers and using student evaluation to classify teaching quality of teachers can help colleges and universities to formulate corresponding incentive system and constantly promote teachers to improve their online teaching ability. Based on existing research literature on online teaching quality, this study proposes specific observation indexes from aspects of teaching attitude, teaching content, teaching method and teaching effect, so that students, as an important part of the evaluation subject, can participate in evaluation of teachers' teaching quality, to better adapt to teaching methods of teachers. More consideration should be given to needs and levels of students. Students should be encouraged to actively participate in evaluation of

teaching quality of college teachers, and more emphasis should be placed on considering teachers' teaching behavior from the perspective of students in aspects of evaluation content and methods. Analysis of factors affecting teaching quality of college teachers in online teaching is a complex process, and there are many factors affecting teaching quality. This study proposes to use teaching quality evaluation system to find out these factors, and to carry out targeted adjustment and improvement, with ultimate purpose of improving teaching quality of teachers. However, traditional teaching quality evaluation attaches too much importance to data, just like students' test scores, which use fixed scores to advertise merits and disadvantages of teachers' teaching quality, completely ignoring influence of teachers' implicit characteristics in teaching, such as teachers' professional attitude, teachers' personality, teachers' emotional investment in students and so on, which cannot be measured by numbers and data. Qualitative analysis can solve this problem effectively to a certain extent. However, development of teaching quality evaluation of Chinese college teachers so far still cannot get rid of participation of administrative departments, and even need to participate in organization and management of educational administrative departments, with a strong color of administrative management. Therefore, student-centered analysis of factors affecting teaching quality of college teachers in online teaching can help to further explore and analyze causes of existing problems from different aspects, and provide basis for improvement suggestions for teaching quality evaluation system of Chinese college teachers, and promote perfection of teaching quality evaluation system of Chinese college teachers.

6 CONCLUSIONS

Because there is no unified evaluation standard required for teaching, traditional teachers' teaching activities, often present some random and blind in classroom teaching, coupled with teaching methods lag and teaching means aging, which greatly affect the quality of teacher teaching. Scientific determination of influence factors of online teaching on teaching quality of college teachers is helpful to establish teachers' teaching quality evaluation system and to implement teaching quality evaluation, which plays an important role in improving teaching quality. This study adopts application of DEMATEL and Cluster technology, conducts a questionnaire survey on 5 colleges and universities in Henan Province, analyzes and identifies teachers' factors among factors affecting the teaching quality of E-commerce course, and analyzes comprehensive influence index of teachers' factors, namely impact degree, affected degree, cause degree and centrality degree. A cluster flight is carried out on evaluation results of students. This study mainly draws following three research conclusions. (1) X2-2, X2-4, X2-5 and X4-3 are the factors of high importance and cause. (2) K-means clustering method could divide results of teacher evaluation into three groups, and clustering group shows significant significance for all research items ($p < 0.05$). (3) Results of DEMATEL's study on weight of influencing factors in cluster analysis are highly consistent, indicating that application of DEMATEL and Cluster technology is scientific. It is suggested that further research should be carried out on establishment of quality evaluation standards and quantitative indexes for different subjects such as schools, colleges, teachers and students, and realization of regular summary, regular evaluation and timely feedback mechanism of big data platform for teaching quantity.

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