Effectiveness Evaluation of Online Teaching Based on CRITIC-VIKOR Technology

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Abstract—A system including 18 second-level indexes was constructed first from three aspects to further scientifically evaluate the effectiveness of online teaching. These aspects are the effectiveness of technical support, students' online learning, and teachers' online teaching. Moreover, the weights of indexes affecting the effectiveness of online teaching were calculated using the improved CRITIC (Criteria Importance Though Intercrieria Correlation) method, followed by the VIKOR (VIseKriterijumska Optimizacija I Kompromisno Resenje)-based effectiveness evaluation for the online teaching of five majors, including microbiology in Henan Agricultural University. Results show that three indexes—repeated playback promotes knowledge review and consolidation (X2-2), breaking through time-space restriction facilitates learning whenever and wherever possible (X2-1), and good teacher–student and student–student interaction (X3-2)—rank top three in weight. The Q value measured using the VIKOR method reflects the best effectiveness of online microbiology teaching. The CRITIC-weighted VIKOR online teaching effectiveness evaluation model is proved to be flexible and feasible in evaluating the online teaching effectiveness of different subjects, such as schools, majors, and students. The research findings are of specific guiding significance for scientifically adjusting online teaching behaviors and carrying out online teaching activities. Moreover, this research can promote the application of big data analysis in online teaching effectiveness analysis and be of reference value for the process data evaluation of students' online learning.

Keywords—online teaching, effectiveness evaluation, CRITIC, VIKOR

1 Introduction

Education informatization is striding toward the era of comprehensive interconnection. All kinds of colleges and universities in China use digital educational resources and educational service platforms to gradually explore a new network education model. Online education uses new information technology. This technolog breaks through the limitation between schools and classes and ensures normal teaching progress and quality in the process of coronavirus disease 2019 (COVID-19) prevention and control.

Online education in colleges and universities, which differs from the teacher–student–parent cooperation in basic education, tests the ability of college teachers to guide online teaching behaviors. With the emergence of online education, research on the effectiveness of online teaching has gradually been recognized by an increasing number of scholars. The online teaching mode promotes the supply-side reform of education and teaching, innovates the teaching mode, and creates a new educational form in the era of intelligent interconnection. Under the epidemic situation, online education and teaching have not only forced educational technology to be more widely used in more colleges and universities but also exposed some problems in college teaching. Online teaching is not simply the improvement of technical means, which not only changes the traditional teaching methods and means but also leads to the continuous updating of educational and teaching concepts. In the face of the pandemic situation, all schools have fully promoted online teaching. This event has undoubtedly promoted the development of disciplines effectively, such as online teaching and distance teaching. This event has also proposed increasing demands for online education institutions or platforms. The rapid rise of online education has led to the vigorous development of online education quality evaluation. The effectiveness evaluation of online teaching is of great significance for promoting online education in colleges and universities.

Today, with the rapid development of online education, effective teaching has been discussed theoretically in the traditional classroom and also gradually applied to online teaching, with a new extension. The effectiveness of online teaching means that teachers can fully realize students' personal values, strive to achieve established teaching goals, and strengthen teaching effects in online teaching. In educational practice, teaching effectiveness has long been the goal and pursuit of teachers. Since the emergence of teaching theory, educational practitioners and researchers have been more devoted to exploration and research. Facing the new wave of network in the information age, the innovation of education and teaching paradigm has come into being. For MOOC (Massive Open Online Courses)and SPOC (Small Private Online Course)in online teaching, the evaluation of teaching effectiveness plays an important role in improving the quality of online teaching and realizing the sustainable development of colleges and universities. Moreover, it has become an important direction for academic circles to exploit the theory of effective teaching.

2 Literature review

Chinese and foreign scholars hold different opinions on the understanding of teaching effectiveness. To sum up, teaching effectiveness is concluded as teachers' teaching behaviors and the development and progress achieved by students according to the basic principles of classroom teaching and following the laws of students' physical and mental development. In addition, teaching effectiveness is an organic combination of the teaching process, teaching state, and teaching results. For the research on teaching effectiveness, Hsiao, H. C [1] discussed the relationship between professional development evaluation and the teaching effectiveness of teachers in vocational high schools. The results show that a big performance gap exists in teaching effectiveness among respondents in different types (public and private) of vocational high schools.

Moreover, the evaluation variables of teachers' professional development are positively correlated with the variables of teaching effectiveness. Berry, B [2] thought that teachers showing stronger abilities in educational projects are more capable of improving learning effectiveness. Then, Casteel, C. P et al. [3] deemed that teaching effectiveness can be improved through a good medical teaching plan and multi-stage self-assessment. O 'Neill, G.P [4] analyzed considerable documents about teaching effectiveness and identified 20 teaching research factors, 17 of which have been fully recorded. Ding, C et al. [5] discussed the relationship between teachers' efficacy and students' performance. The results show that teaching effectiveness is directly influenced by the educational model of schools and teachers. Shao, L. P et al. [6] provided the survey results on 1300 administrators and teachers from international institutions certified by AACSB. This study also evaluated the differences in teaching effectiveness among respondents differing in position and work experience from different schools. Seidel, T et al. [7] summarized the research on teaching effectiveness in the past 10 years through meta-analysis. The author found that the field-specific components of teaching have the greatest influence. That is, teaching is the closest to the learning implementation process, and such field-specific teaching components are investigated mainly through quasi-experiments or experimental design. Jackson, D. L et al. [8] thought that students' evaluation of teaching quality is strengthened by understanding the nature of basic dimensions. The study examined the constituent dimensions of teaching effectiveness and discussed the significance of perceptual teaching effectiveness evaluation. Bangert, A.W [9] developed and validated an online teaching effectiveness evaluation tool for students based on the seven principles of effective teaching. A total of 87 students from a medium-sized university in the western United States participated in the WebCT course to evaluate the effectiveness of online teaching. The results show that teacher–student interaction, active learning, task time, and cooperation among students are the four explanatory factors that affect the effectiveness of online teaching. Arthur Jr, W et al. [10] used pre/post design to evaluate students' learning, aiming to check the relationship among student performance, student learning, and students' teaching evaluation. The results show that student evaluation and learning measures evaluate different aspects of the teaching effect and should not be used interchangeably. The most suitable criterion for evaluating the teaching effect is the function of the evaluation objective. Muijs, D [11] outlined some key issues in the research on the effectiveness of teachers' teaching from the process–product perspective. The author also introduced the main analysis methods applicable to the research on teacher effectiveness. Stronge, J. H et al. [12] investigated the classroom practice of efficient and inefficient teachers. In addition, the study evaluated the teacher effectiveness of 307 fifth-grade teachers in terms of students' learning benefits by using a hierarchical linear model. The study found the influencing factors of teachers' overall teaching effectiveness. Chen, Y et al. [13] thought that student evaluation is the most influential measurement criterion for the teaching effect and that their active participation and meaningful input are crucial to the success of this teaching evaluation system. The results show that high-quality student input is an important prerequisite for students to evaluate the teaching effect meaningfully. Podolsky, A et al. [14] reviewed 30 papers published since 2003. This literature found that during the most period of the teachers' career, teaching experience is positively correlated with the growth of student performance. With the accumulation of

teachers' experience, their students are more likely to achieve better results on other measurement criteria apart from test scores. Grissom, J. A et al. [15] found that, on average, the teacher turnover rate of more efficient principals is indeed lower. In addition, this low turnover rate is concentrated among high-performance teachers. Meanwhile, Tuytens, M et al. [16] thought that as a practice of human resource management, the evaluation of teachers' teaching effectiveness integrates the empirical research on teachers' evaluation. The results show that the definition and measurement of teacher evaluation are directly related to the results of teacher evaluation. Thus, the previous study suggested that an evaluation index system of teachers' teaching effectiveness should be scientifically established. Constantinou, C et al. [17] held that evaluating courses and teachers is very important in all higher education institutions, including medical schools. The author developed a comprehensive evaluation system by collecting and triangulating data from multiple sources, including students, peers, project managers, and self-awareness. This comprehensive evaluation system presents an effective measure of teaching effectiveness. Bi, S et al. [18] studied clustering analysis of online teaching cases and evaluation of teaching results. they gived the design flow of online teaching with case teaching as the core and proposed a text multi-view clustering algorithm based on case subject alignment, and presented a clustering model structure based on subject alignment. Bardach, L et al. [19] discussed the influences of eight identified psychological characteristics (i.e., self-efficacy, causal attribution, expectation, personality, enthusiasm, emotional quotient, emotional labor, and mindfulness) on teachers' teaching effectiveness. From the existing research literature, online teaching has changed the trend of teachers' unilateral teaching in traditional classrooms and promoted students' autonomous learning. This method emphasizes the student-oriented concept, and students take an active part in the whole learning process under teachers' guidance. However, some college students pointed out that online learning has not fully realized the effectiveness of traditional classrooms. From another aspect, the effectiveness of online teaching is constantly improving and perfecting, which can be discussed more deeply and comprehensively. Particularly, the effectiveness of online teaching is closely related to students, teachers, and parents. In this case, the administrative departments of schools are required to collaborate with relevant education departments, technical sections, and other aspects to co-build learning communities, ensuring effective online teaching. In this research, therefore, the CRITIC-VIKOR (Criteria Importance Though Intercrieria Correlation-VIseKriterijumska Optimizacija I Kompromisno Resenje) method was proposed to evaluate the effectiveness of online teaching. The objective is that teachers teaching different courses can adjust their teaching behaviors and activities specific to the speciality classification of students during online teaching, to comprehensively improve the effectiveness of online teaching.

3 Methodology

3.1 Model profile

The CRITIC weighting method is an objective weighting method proposed by Diakoulaki, D et al. [20], which is based on the correlation of indexes. In the comprehensive analysis of multi-index evaluation objects, this method considers the

conflict between evaluation indexes and the change in index weight caused by the change in the measured values of indexes. n evaluation indexes and m pieces of measured data were set. Moreover, a matrix $A = [a_{ij}]_{m\times n}$ was established, where a_{ij} represents the value of the j-th index of the i-th scheme. The benefit-type indexes were processed forwardly, whereas cost-type ones were processed reversely, to eliminate the differences among different indexes. Then, a standardized matrix $B = [b_{ij}]_{m\times n}$ was obtained through calculation. The calculated correlation coefficient matrix $R = [r_{ij}]_{m\times n}$ was solved, in which r_{ij} is the Pearson correlation coefficient between the i-th and j-th indexes, calculated in Eq. (1).

$$r_{ij} = \frac{\sum_{k=1}^{n}(b_{ik} - \bar{b}_i)(b_{jk} - \bar{b}_j)}{\sqrt{\sum_{k=1}^{n}(b_{ik} - \bar{b}_i)^2} \times \sqrt{\sum_{k=1}^{n}(b_{jk} - \bar{b}_j)^2}} \tag{1}$$

Where b_i and b_j represent the mean values of the i-th and j-th indexes in the matrix. Subsequently, the Gini coefficient was calculated in Eq. (2).

$$\gamma_j = \frac{\sum_{i=1}^{m}\sum_{k=1}^{m}\left|b_{ij} - b_{kj}\right|}{2m\sum_{i=1}^{m} b_{ij}} \tag{2}$$

Where $\gamma_j \in [0,1]$, the closer the γ_j is to 1, the more unbalanced the information distribution of index j, and the greater the amount of information. The closer the γ_j is to 0, the more balanced the information distribution of index j, and the smaller the amount of information. Then, the information coefficient g was calculated. Given the possible positive and negative correlations among indexes, the information coefficient was calculated through the absolute value of the Pearson correlation coefficient to ensure the accuracy of the final result, specifically as follows:

$$g_j = \sum_{j=1}^{n}\left(1 - \left|r_{ij}\right|\right) \tag{3}$$

The comprehensive information amount G_j of indexes was calculated, and the weight ω_j was determined. A greater G_j value indicates the greater information amount of index j and the greater corresponding weight. The calculation formula is displayed in Eq. (4):

$$G_j = \gamma_j \cdot g_j, \omega_j = \frac{G_j}{\sum_{i=1}^{n} G_j} \tag{4}$$

Opricovic, S et al. [21] thought that VIKOR is a decision-making method to sort and select multi-attribute schemes by calculating group utility value, individual regret value, and compromise evaluation value. Its basic idea is to select the optimal solution and the worst solution from all data solution sets and determine the comprehensive ranking result according to the distance between the optimal and the worst solution among different values. That is, the optimal solution is the closest, and the worst solution is the farthest. This process is often a compromise among various attributes so that the feasible solution can not only ensure the best interests of the group but also consider individual losses. The concrete steps are as follows: The matrix $A = [a_{ij}]_{m\times n}$ was weighted, the CRITIC result was adopted as the weighting result, and a weighted matrix X was obtained, as shown in Eq. (5).

$$X = \begin{bmatrix} x_{11} & x_{12} & \cdots & x_{1n} \\ x_{21} & x_{22} & \cdots & x_{2n} \\ \vdots & \vdots & \ddots & \vdots \\ x_{m1} & x_{m2} & \cdots & x_{mn} \end{bmatrix} \tag{5}$$

Then, the positive x_j^+ and negative x_j^- ideal solutions of each index were determined, as shown in Eq. (6).

$$\begin{aligned} x_j^+ &= \{\max x_{1j}, \max x_{2j}, \ldots, \max x_{n_j}\}(j = 1,2,\ldots,m) \\ x_j^- &= \{\min x_{1j}, \min x_{2j}, \ldots, \min x_{nj}\}(j = 1,2,\ldots,n) \end{aligned} \tag{6}$$

With the positive ideal solution taken as a reference, the group utility value and individual regret value of each scheme are shown in Eq. (7).

$$\begin{aligned} S_j^+ &= \sum_{i=1}^{m} w_i (x_i^+ - x_{ij})/(x_i^+ - x_i^-) \\ R_i^+ &= \max[w_i (x_{ij} - x_i^-)/(x_i^+ - x_i^-)] \end{aligned} \tag{7}$$

When the negative ideal solution is taken as a reference, the group utility value and individual regret value of each scheme are shown in Eq. (8).

$$\begin{aligned} S_j^- &= \sum_{i=1}^{m} w_i (x_{ij} - x_i^-)/(x_i^+ - x_i^-) \\ R_j^+ &= \max (w_i (x_{ij} - x_i^-)/(x_i^+ - x_i^-)) \end{aligned} \tag{8}$$

Finally, the compromise evaluation value Q_i of each scheme was calculated, as shown in Eq. (9).

$$\begin{aligned} S^+ &= \min_i\{S_i\}, \quad S^- = \max_i\{S_i\} \\ R^+ &= \min_i\{R_i\}, \quad R^- = \max_i\{R_i\} \\ Q_i &= \mu\frac{S_i - S^-}{S^+ - S^-} + (1-\mu)\frac{R_i - R^-}{R^+ - R^-} \end{aligned} \tag{9}$$

In Eq. (9), Q_i stands for the compromise coefficient, also known as the coefficient of decision-making mechanism, which represents the proportion of group utility and is generally taken as $\mu = 0.5$. In this research, this value was also applied for processing.

3.2 Questionnaire design

Under the guidance of the effective teaching theory, the focus was on analyzing college students' views and attitudes on the effectiveness of online teaching and testing the differences in college students' evaluation of the effectiveness of online teaching. An evaluation scale (Table 1) for the effectiveness of online teaching among college students was proposed based on Kyrgiridis, P et al. [22], Taylor, R et al. [23], and McBean, E. A et al. [24]. The objectives were to focus the original variables of the questionnaire used in the study more on some core elements for further inductive analysis; respond to past understanding, questioning, and shortcomings of the effectiveness of online teaching; and find suitable effective evaluation indexes.

Table 1. Evaluation scale of online teaching effectiveness for college students

First-Level Index	Second-Level Index	Second-Level Index No.
Effectiveness evaluation of technical support	Network fluency	X1-1
	Stability of platform operation	X1-2
	Definition of pictures and audio	X1-3
	Instantaneity of teacher–student interaction	X1-4
	Efficient online technical service support	X1-5
	Sufficient supporting electronic teaching resources for the course	X1-6
	Suitability of some teaching content for online teaching	X1-7
	Complete and stable functions of teaching platforms	X1-8
Effectiveness evaluation of students' online learning	Breaking through time-space restriction facilitates learning whenever and wherever possible	X2-1
	Repeated playback promotes knowledge review and consolidation	X2-2
	Make it possible for sufficient sharing of famous teachers and courses	X2-3
	Let students fully express the issues they concern	X2-4
	Facilitate the exchange and collaboration between students	X2-5
	Students can choose learning content as required and improve their learning efficiency	X2-6

(Continued)

Table 1. Evaluation scale of online teaching effectiveness for college students *(Continued)*

First-Level Index	Second-Level Index	Second-Level Index No.
Effectiveness evaluation of teachers' online teaching	Teachers can know about students' learning status in time	X3-1
	Good teacher–student and student–student interaction	X3-2
	Teachers feed the issues concerned by students back the first time	X3-3
	Teachers give field guidance and supervision with good classroom discipline	X3-4

3.3 Data sources

Henan Agricultural University, located in Zhengzhou City, Henan Province, China, is an undergraduate college focusing on agriculture. During the COVID-19 pandemic, the school promoted the online teaching mode in an all-round way. The school provided help at the appropriate time and held video conferences from time to time to communicate by grasping the teaching situation and students' learning situation in real time. They focused on the problems in online teaching, explored teaching methods suitable for the course, and provided feedback to teachers in time to promote the continuous improvement of online teaching. In the present study, a questionnaire survey was performed on students from five majors, including the microbiology major at Henan Agricultural University. A total of 304 questionnaires were recovered by designing a questionnaire scale and using online and paper questionnaire methods. After excluding invalid questionnaires, 262 valid questionnaires were obtained, with an effective recovery rate of 86.18%. The Likert seven-point scale was adopted for the questionnaire. Table 2 presents the specific frequency analysis results of the questionnaire survey.

Table 2. Frequency analysis results of the questionnaire survey

Name	Option	Frequency	Percentage (%)	Cumulative Percentage (%)
Gender	Female	123	46.95	46.95
	Male	139	53.05	100
Grade	Freshman	77	29.39	29.39
	Sophomore	76	29.01	58.40
	Junior	83	31.68	90.08
	Senior	26	9.92	100
Major	Microbiology	51	19.47	19.47
	Biochemistry and Molecular Biology	71	27.10	46.56
	Genetics and Cell Biology	59	22.52	69.08
	Food Science and Engineering	41	15.65	84.73
	Food Quality and Safety	40	15.27	100
Total		262	100	100

4 Results analysis

4.1 CRITIC results

The benefit-type indexes in the acquired original data were processed forwardly, the Pearson correlation coefficient was calculated, and all correlation coefficients were acquired. The CRITIC weight results were calculated as per Eqs. (2)–(5).

Table 3. CRITIC weight calculation results

Second-Level Index No.	Index Variation	Index Confliction	Information Amount	Weight
X1-1	1.531	10.978	16.811	5.38%
X1-2	1.569	11.276	17.689	5.66%
X1-3	1.444	11.413	16.48	5.27%
X1-4	1.567	11.288	17.687	5.66%
X1-5	1.533	10.99	16.844	5.39%
X1-6	1.483	10.959	16.256	5.20%
X1-7	1.492	10.534	15.717	5.03%
X1-8	1.588	10.451	16.599	5.31%
X2-1	1.588	11.941	18.962	6.07%
X2-2	1.574	12.48	19.639	6.28%
X2-3	1.497	12.484	18.687	5.98%
X2-4	1.392	12.027	16.741	5.36%
X2-5	1.424	11.588	16.499	5.28%
X2-6	1.432	11.42	16.353	5.23%
X3-1	1.504	11.972	18.003	5.76%
X3-2	1.565	11.96	18.719	5.99%
X3-3	1.615	11.337	18.313	5.86%
X3-4	1.463	11.284	16.509	5.28%

Figure 1 depicts the weights of second-level indexes.

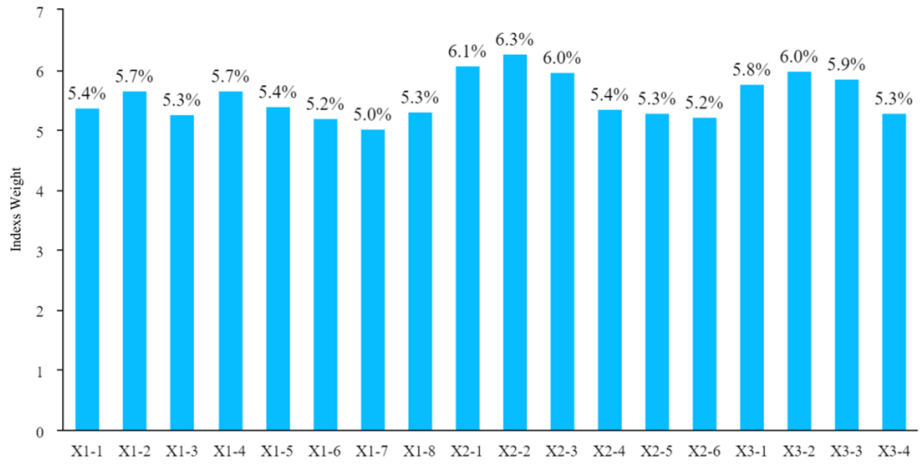

Fig. 1. Weights of second-level indexes

Figure 1 shows that X2-2, X2-1, X3-2, X2-3, and X3-3 reached the largest weights and ranked top five. Therein, the index X2-2 in the effectiveness evaluation of online learning had the largest weight, which was also very consistent with the characteristics of online learning. The reason is that students interact with the teacher in the whole process of a live broadcast course, with input and output. Teachers can sometimes correct students' learning behaviors in time. Learning is not only a simple transfer of knowledge between teachers and students but also a deep spiritual exchange and interaction between them. Its essence is emotional labor. Owing to the existence of live broadcasts, teachers and students can communicate with each other in reality and face to face. Moreover, students can consult teachers at any time and get a correct answer. However, the live broadcast time is relatively short. As soon as the live broadcast course ended, some students did their assignments after class and found some knowledge points they had not understood well. They can go back to the doubtful knowledge points and carry out re-learning and re-practice by watching the playback. When encountering some forgotten knowledge points in their notes, some students in the exam preparation stage can turn them out and play them back for memorization. All this is enough to show the great role played by the unlimited course playback function. X2-1 ranks second in weight mainly because online learning itself is sometimes free to learners whenever and wherever possible, which is closely related to evaluation information and teaching content. Moreover, the environment is still the most important component affecting the effectiveness of online teaching. It is also related to the indispensable technical factor of online teaching under the specific teaching situation, namely, online teaching whenever and wherever possible. College students pay more attention to the guarantee and promote free learning time and rhythm with the support of online platforms and technologies. Then, X3-2 ranked third mainly because college students pay the most attention to the effective interaction between teachers and students in their evaluation of the effectiveness of online teaching. That is, teachers should fully consider students' process experience in the teaching process and particularly guide and design the interaction between teachers and students. Faced with spatial heterogeneity,

the online teaching process poses a great challenge to the interaction between teachers and students. From the students' perspective, the key to ensuring effective online teaching is how teachers create a good environment for interaction between teachers and students with the help of an online teaching environment and pay enough attention to students' learning status.

4.2 VIKOR results

On the premise of calculating the weight of each index, the improved VIKOR method was used to evaluate the effectiveness of online teaching in five majors. The final group utility value was obtained and ranked in ascending order of the Q value. Table 4 shows the ranking results. A smaller Q value reflects a better result.

Table 4. Summary of VIKOR analysis results

Major Name	Sum S of the Distance Ratio of the Optimal Scheme	Maximum Value R of the Distance Ratio of the Optimal Scheme	Q Value of Benefit Ratio	Scheme Ranking (Q Value)
Microbiology	0.1767	0.0345	0.0000	1
Biochemistry and Molecular Biology	0.1932	0.0375	0.0828	2
Genetics and Cell Biology	0.9911	0.0556	1.0000	5
Food Science and Engineering	0.2331	0.0441	0.2625	3
Food Quality and Safety	0.5245	0.0556	0.7135	4

Table 5. Lambda value and the Q value of the benefit ratio

Major Name	Lambda Value										
	0.0	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9	1.0
Microbiology	0	0	0	0	0	0	0	0	0	0	0
Biochemistry and Molecular Biology	0.1453	0.1328	0.1203	0.1078	0.0953	0.0828	0.0703	0.0578	0.0453	0.0328	0.0203
Genetics and Cell Biology	1	1	1	1	1	1	1	1	1	1	1
Food Science and Engineering	0.4557	0.4171	0.3784	0.3398	0.3011	0.2625	0.2238	0.1852	0.1466	0.1079	0.0693
Food Quality and Safety	1	0.9427	0.8854	0.8281	0.7708	0.7135	0.6562	0.5989	0.5416	0.4843	0.427

Tables 4 and 5 show that the effectiveness of online teaching of microbiology ranks first. Combined with the original data, the possible reason is that teachers in the teaching and research section of microbiology promote students' autonomy and enthusiasm for learning by improving the supervision mechanism of students' online learning.

When lacking timely tracking and supervision of students' learning behaviors, online teaching cannot achieve the goal of teachers and students or face-to-face communication between students. Microbiology teachers set up online discussion sessions to urge students to maximize the use of online teaching platforms and resources to promote their learning effects. Meanwhile, the overall level of teachers' information literacy is higher, which enhances the effect of online teaching. The effect of teacher–student interaction in microbiology has a significant impact on the effect of online teaching. Teachers should change their teaching ideas and methods in a timely manner; innovate platforms, technical processes, and teacher–student interaction to adapt to online teaching' and be better qualified for online teaching. This discovery also reveals that China's university management departments should strengthen the effectiveness evaluation of online teaching. In addition, technical support will become indispensable, even exceeding the important analysis elements of students and teachers. How to adapt to the development of the teaching mode in the new technological changes should be considered to ensure its inherent advantage in teaching quality.

5 Discussions

Online teaching has broken through the time–space restriction between teachers and students. However, the way of teaching and learning and the relationship between teachers and students have not substantially changed. In terms of teaching principles, the influencing relationship between effective online teaching and effective face-to-face classroom teaching was investigated using large sample data. Moreover, the differences between different majors were analyzed, aiming to encourage teachers to adjust and optimize their teaching behaviors and practically improve the effect and quality of online teaching. In this research, an evaluation scale for the online class teaching effect of colleges and universities suitable for the epidemic situation was established. The standard factors for effective online teaching were designed by combining the interview results with teachers involved in online teaching. The research results show that colleges and universities must strengthen the curriculum design according to the characteristics of online teaching methods. In online teaching, the teaching content still plays a core role in the classroom. Emphasizing the breadth and depth of teaching content, designing the course according to the effective online teaching behavioral characteristics of university courses, and optimizing the teaching content with moderate difficulty and step by step are the key factors that bring charm to online teaching and promote teaching effectiveness and results. According to the characteristics of autonomous learning in online teaching, pre-class preparation should be strengthened, and learning resources should be established. Learning resources have a great influence on students' satisfaction, reflecting the need for online teaching to shift toward autonomous learning characteristics. Online teaching changes the trend of teachers' unilateral teaching in a traditional classroom and promotes students' autonomous learning. This method emphasizes the student-oriented concept, and students proactively devote themselves to the whole learning process under the guidance of teachers.

6 Conclusions

Online teaching effectively improves teaching effectiveness with the help of Internet technology. Compared with traditional classroom teaching, online teaching has revolutionized the way of knowledge acquisition and teaching and also changed the way of students' learning experience. The more effective and scientific evaluation of the effectiveness of online teaching has become a subject that university administrators have to face. In this research, the effectiveness of online teaching of five majors at Henan Agricultural University, Henan, China, was comprehensively evaluated through the CRITIC-VIKOR dynamic evaluation model. The following three research conclusions were drawn: (1) X2-2, X2-1, and X3-2 rank top three in the weight; (2) The Q value measured by the VIKOR method shows that the online teaching of microbiology is the most effective; (3) The CRITIC-weighted VIKOR online teaching effectiveness evaluation model is proved to be flexible and feasible. In the future, the correlations between the effectiveness of online teaching and learning motivation, student communication, technical support conditions, and online learning experience should be deeply explored.

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