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Research on the Teaching Effect of College Network Teaching Platform Based on Entropy Weight TOPSIS Model

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Abstract

In order to expand teaching space, optimize teaching activities and improve teaching mode, colleges and universities all over the country have organized and promoted the use of network platforms to assist teaching. Especially affected by the recent new crown pneumonia epidemic, network teaching has become a rigid need. In this paper, the index system is established in the two aspects of students and teachers, which can be used to reflect the teaching effect of college network platform from different angles. We sampled students from grades 19 to 21 in many colleges and universities in Hebei province, collected data, used the model, and analyzed that the use of the network platform of students in the School of Information and the School of psychology was better than that of students in other schools.

Keywords

Teaching effect evaluation; TOPSIS model; Index system construction.

1. Research Background

The emergence of the online teaching platform has broken the conflict between traditional education and quality education based on "collective education" and "indoctrination education", strengthened the interaction and cooperation between schools, teachers and students, and realized the sharing of educational resources. Regarding the quality evaluation and influencing factors of online teaching platforms, scholars have done relevant research. In the survey and research on the satisfaction of online teaching platforms, it is concluded that the main criteria for students to consider when judging the use of teaching platforms include platform reliability, System navigation, content richness, interface friendliness, page friendliness, and overall teaching level, teaching effect, teaching quality, etc. In the analysis of the factors affecting the online teaching platform, indicators and models are considered from the two dimensions of teachers and students. In addition to the basic situation and resource construction of the platform, the factors considered from the perspective of teaching students also involve the platform's content design, learning whether support services, platform technology operations, etc. meet the needs of students. In the research and analysis of the use effect of the MOOC platform, the influencing factors are mainly considered from the learning section and the interactive section, and 7 indicators related to homework, video viewing, students' absorption and understanding, and participation in interactive discussions are established.

In recent years, most domestic colleges and universities have begun to use online teaching platforms to assist teaching. Among them, the Tsinghua education online teaching platform independently developed by the institute of educational technology of Tsinghua university is the most widely used. During this epidemic, some newly emerging online course platforms such as Dingtalk and Tencent conference have also been widely used. The main structures and functions of these online teaching platforms are slightly different. Some of them are

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comprehensive teaching platforms, mainly focusing on teaching management and providing auxiliary teaching resources. The flow rate that can be carried and the flexibility of use are high.

According to the main functions of the online teaching platform and the relevant research results on the use of the platform in the existing literature, this paper determines the main content structure, use function, teaching effect, operation technology and other evaluation directions of the teaching platform, and aims at these major directions. 6 first-level indicators and 19 second-level indicators are respectively set, and corresponding reference standards are set for each indicator. The data results of the questionnaire survey were collected, and the entropy weight method was used to determine the weight of each index for the data obtained from the questionnaire survey results, and the TOPSIS evaluation method was used to establish an evaluation system and determine the final evaluation results.

2. Establishment of the Indicator System

2.1. Establishing Evaluation Indicators from the Perspective of Teachers

The indicators from the teacher's perspective use the teacher-dimension evaluation indicators in the E-learning course. There are 3 first-level indicators and 10 second-level indicators [1], including teachers' use of the platform for teaching, the efficiency of teachers' use of the platform, and the overall design of the entire platform interface.

The indicators from the student's perspective are also borrowed from the student-dimension evaluation indicators in the E-learning course. There are 3 first-level indicators and 9 second-level indicators [1], including the basic use of the platform by students, the basic characteristics of the platform's resources, and the degree of difficulty for students to use the platform [2].

Under the above two dimensions, this paper establishes relevant questionnaires and collects the data required for the subsequent evaluation model, as shown in table 1.

2.2. Establishment of Evaluation Model

Supposing n indicators $X_1, X_2, \dots, X_n$ are given, where $X_i = \{x_1, x_2, \dots, x_m\}$, and $Y_1, Y_2, \dots, Y_n$ are the standardized values of each indicator data. Taking the income data standardization formula:

$$Y_{ij} = \frac{X_{ij} - min(X_i)}{max(X_i) - min(X_i)} \tag{1}$$

According to the definition of information entropy in information theory [3], the information entropy is calculated with the corresponding data of each group of indicators:

$$E_j = -\ln(n)^{-1} \sum_{i=1}^{n} p_{ij} \ln p_{ij} \tag{2}$$

where $p_{ij} = Y_{ij} / \sum_{i=1}^{n} Y_{ij}$, if $p_{ij} = 0$, we have $\lim_{p_{ij} \to 0} p_{ij} \ln p_{ij} = 0$.

According to the calculation formula of information entropy, the information entropy of each indicator is calculated as $E_1, E_2, \dots, E_n$. Calculating the weight of each indicator through information entropy [4]:

$$W_i = \frac{1 - E_i}{k - \sum E_i} (i = 1,2, \dots, n) \tag{3}$$

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Table 1. Establishment of evaluation index system

	First-level indicators	Second-level indicators	Evaluation criteria				
			A very agreeable	B somewhat agreeable	C agreeable	D somewhat not agreeable	E very disagreeable
			5	4	3	2	1
Evaluation index system from the perspective of teachers	Teaching operation	Knowledge point explanation	A comprehensive explanation of the corresponding knowledge points, as well as doubts, difficulties and key knowledge points				
		Content division	Reasonable division of learning units or modules according to content and knowledge points				
			The size of the learning unit or module is appropriate, in line with the characteristics of micro-learning				
		Cases and Demonstrations	There are case studies and visual demonstrations in the course, which can effectively promote learners' understanding and deepen their impression				
		Resource extension	Provides links to rich external resources and reference materials relevant to the course				
			The resources provided have a high learning value				
	Availability	Action Response	The response time is normal and within the acceptable range				
		Communication and feedback	Learners can receive online real-time communication and instruction and learner feedback through multiple channels				
		Fault tolerance	In case of failure, error or misoperation, it can quickly return to normal use				
	Overall design of the interface	Unified style	Maintain a consistent style throughout the course content and avoid distraction or cognitive load on messy style sheets				
			Unified page format, style, language style, buttons, navigation, text, pictures				
		Color design	The colors are beautiful and harmonious, the contrast is appropriate, and will not cause fatigue and discomfort to the learners				
		Interface layout	The page layout is reasonable, the visual elements such as text and graphics are well coordinated, concise and beautiful, and visually appealing				
The evaluation index system from the perspective of students	Use base case	Platform preference	Most learners are willing to accept the platform				
		Frequency of use	The frequency of learners using the platform to study, browse materials, and watch teaching replays				
		Learning result	Whether learners have improved and promoted compared with traditional teaching methods				
	Basic characteristics of platform resources	The current content quality of the platform	Whether the platform teaching resources are fully available, and whether the current content meets the needs of learners				
		The current content arrangement of the platform	The current overall resource layout is beautiful and easy to use				
		The appropriateness of resources and student learning	Whether the resources are pushed to students by majors and grades, whether they have teaching significance and representativeness				
	Platform operability	Platform running smoothness	Whether the platform runs smoothly during long-term use, and the number of freezes				
		Comprehensive management functions	Whether the development of various interactive functions of the platform is comprehensive				
		Ease of use of the platform	Whether the platform is concise and usable				

The entropy weight method is used to determine the weight of the set index, and the ideal solution method is used to establish an evaluation system [5]. The following initial evaluation index matrix V is obtained by the score values of m groups of samples under the set n indicators:

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$$V = \begin{bmatrix} v_{11} & v_{12} & \cdots & v_{1n} \\ v_{21} & v_{22} & \cdots & v_{2n} \\ \cdots & \cdots & \cdots & \cdots \\ v_{m1} & v_{m2} & \cdots & v_{mn} \end{bmatrix} \quad (4)$$

Normalizing the original data to get the standardized evaluation matrix R:

$$R = \begin{bmatrix} r_{11} & r_{12} & \cdots & r_{1n} \\ r_{21} & r_{22} & \cdots & r_{2n} \\ \cdots & \cdots & \cdots & \cdots \\ r_{m1} & r_{m2} & \cdots & r_{mn} \end{bmatrix} \quad (5)$$

With the help of the weighting idea, combined with the normalization matrix R, the weighted normalization evaluation matrix E is constructed:

$$E = \begin{bmatrix} e_{11} & e_{12} & \cdots & e_{1n} \\ e_{21} & e_{22} & \cdots & e_{2n} \\ \cdots & \cdots & \cdots & \cdots \\ e_{m1} & e_{m2} & \cdots & e_{mn} \end{bmatrix} \quad (6)$$

where $e_{ij} = r_{ij} * w_i$.

Determining the positive and negative ideal solutions of the evaluation object. The positive and negative ideal solutions of the evaluation object are determined by the weighted evaluation matrix E[6]. Let e_j^z be the maximum score of the index i in the j group of samples, that is, the most preferred scheme, called a positive ideal solution. e_j^n be the minimum score of the index i in the j group of samples, that is, the least preferred scheme, called negative ideal solution:

$$e_j^z = \begin{cases} max\{e_{ij}, i = 12 \dots m\}, & j \in J \\ min\{e_{ij}, i = 12 \dots m\}, & j \in J' \end{cases} (j = 12 \dots n) \quad (7)$$

$$e_j^n = \begin{cases} min\{e_{ij}, i = 12 \dots m\}, & j \in J \\ max\{e_{ij}, i = 12 \dots m\}, & j \in J' \end{cases} (j = 12 \dots n) \quad (8)$$

where J is the benefit index. Within a moderate range, the larger the index is, the better the effect of the platform is. J' is a cost index, within a moderate range, the smaller the index, the better the effect.

Calculating the Euclidean distance between the value of each decision variable and the ideal value, let Q_i^Z be the distance between the ith index and e_j^z, and Q_i^n be the distance between the ith index and e_j^n:

$$Q_i^Z = \sqrt{\sum_{j=1}^{n} |e_{ij} - e_j^z|}, i = 1,2, \dots, m \quad (9)$$

$$Q_i^n = \sqrt{\sum_{j=1}^{n} |e_{ij} - e_j^z|}, i = 1,2, \dots, m \quad (10)$$

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where the smaller Q_i^Z is, and the larger Q_i^n is, the better the use effect of network teaching platform is.

The degree of closeness between the evaluation object and the ideal value is finally calculated:

$$I = \frac{Q^n}{Q^n + Q^Z} \quad i = 1,2,\ldots \tag{11}$$

The larger the obtained I, the better the effect of the group on the use of the platform, so that the level of the use effect of the network teaching platform is judged according to the closeness of each group of research objects, and the order of pros and cons is determined.

3. Application of the Model

3.1. Applications by College

After the collected data is integrated and processed, an index evaluation system of the use effect of the university network teaching platform from the perspective of students is established, and the index data collected from the perspective of students is calculated by using the constructed TOPSIS model. The results are shown in table 2.

Table 2. Final score ranking

college	closeness	ranking
information	0.8164	1
psychology	0.7898	2
manage	0.7896	3
base	0.7237	4
clinical	0.7112	5
oral cavity	0.6972	6
traditional Chinese medicine	0.6809	7
in liters	0.6456	8
mining	0.5924	9
health care	0.5860	10
electric	0.5576	11
pharmacy	0.5573	12

It can be seen from table 2 that the students of the school of information have the best use of the online teaching platform, because the students of the school of Information have more courses than other grades during the epidemic, so they are more proficient in the use of the network platform, and the effect is remarkable. The school of information also has more complete cognition and understanding of its own disciplines than students in other schools. In line with the actual situation of students in different colleges.

3.2. Application By Grade

Selecting the 16th, 17th, 18th, and 19th grade students in Hebei province as the sampling target, focusing on the Chaoxing Xuetong learning platform, to explore the effect of using the online teaching platform in different grades, 20 questionnaires were collected for each grade, and a total of 80 groups were tested. The samples are substituted into the aforementioned model, and the results are shown in Fig. 1.

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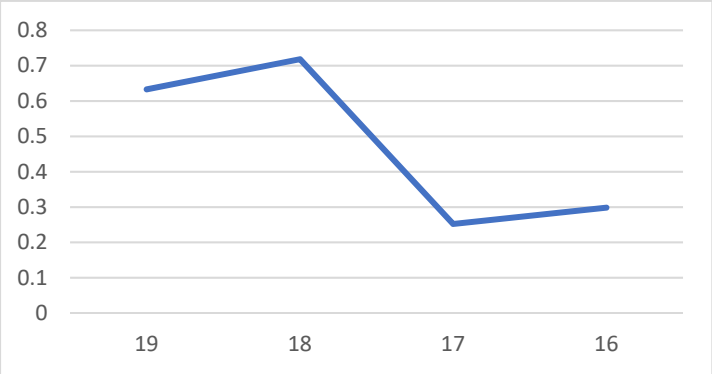

Figure 1. The final solution result of the model

From Figure 1, it can be seen that the 18th grade students have the best use of the online teaching platform. Because the 18th grade students have more courses than other grades during the epidemic, they are more proficient in the use of the network platform and have achieved remarkable results. Grade 18 also has a better understanding and understanding of their own subjects than grade 19, while students in grades 16 and 17 are less affected by the epidemic during their studies, so the basic time is offline teaching, and the understanding and use of online classrooms is relatively, the 18th and 19th grades performed relatively well. In line with the real situation of different grades in practice.

4. Conclusion and Outlook

The network teaching platform is the implementation environment of the new teaching method under the network environment. With the help of the entropy weight TOPSIS method, this paper establishes a complete set of comprehensive evaluation system of the use effect of the network teaching platform in colleges and universities. Studying the use effect of the network teaching platform is helpful to improve the guiding ideology of the design and development of the network teaching platform, and can also provide a reference for the formation of new concepts of teaching and learning in the network environment.

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Through the research of this paper, we try to put forward strategies or suggestions to promote the optimization of teaching activities based on the network teaching platform, which will help to enrich the theory of teaching design. Providing reference opinions for network teaching platform developers to improve the structure and functions of network teaching platforms, and provide some reference materials for the construction, use and evaluation of network teaching platforms in colleges and universities.

In this paper, we want to establish a suitable evaluation model among the many teaching platforms, and make a reasonable evaluation of the network teaching platform. Different evaluation models are applicable to different scenarios and reflect different problems. The TOPSIS model established in this paper performs matrix operations completely according to the collected data, and there is a certain lack of subjectivity. However, it fully utilizes and responds to the objectively collected data. The indicators established in this paper can quantitatively evaluate the use effect of the same platform and different groups of people. At

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the same time, it can also quantitatively evaluate the use effect of the same group of people on different platforms. It is also possible to collect data on various groups of different platforms from different platforms, and comprehensively obtain a quantitative evaluation of the online teaching effect of each platform.

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