Research on Quality Evaluation of MOOCs Production Based on Analytic Hierarchy Process

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Abstract. In order to solve the problems of uneven production level and homogenization of courses, the analytic hierarchy process is adopted to evaluate and analyze the quality of MOOCs production. Combined with expert opinions and literature research, the evaluation model of MOOCs making quality is established, and the judgment matrix is constructed. The sum method is used to complete the calculation of each weight index and the consistency test of the model. The test shows that the hierarchical model is relatively reasonable and each weight index is correct and effective. According to the evaluation needs, the calculation method of relevant index scores is provided, which has certain guiding significance and application value for the quality evaluation of MOOCs.

Keywords: MOOCs production, quality evaluation, analytic hierarchy process

1 Introduction

In the past, the traditional teaching mode was mainly based on offline teaching, but the appearance of MOOCs broke the traditional teaching mode. Online teaching advocates students' inquiry learning, independent learning and research learning, and learners' learning needs and requirements for courses have changed greatly. Moocs pay more attention to students' learning experience and consider students' learning needs more from the aspects of teaching resources, learning activities, teaching environment and personalized services. The quality of MOOCs is directly related to students' learning effect. In recent years, a large number of MOOCs have emerged, but the level of MOOCs production is uneven, and the problem of curriculum homogenization is serious, so improving the quality of MOOCs production has become an issue that needs to be paid attention to [1]. Therefore, teachers must conduct comprehensive combing and in-depth thinking, and actively conduct countermeasure research and practice, so as to grasp the process of education and teaching, guide and promote the effective development of teaching, ensure the teaching quality of MOOCs, and further promote the process of education informatization.

Many experts and scholars have conducted in-depth research on the quality evaluation of MOOCs and achieved certain results. Zhao et al. [2] proposed a quality evaluation model of MOOCs based on fuzzy comprehensive evaluation method. The model conducted a questionnaire survey on the indicators of MOOCs, such as teaching objectives, course overview, teaching content and teaching evaluation, and evaluated the survey data by fuzzy comprehensive evaluation method, achieving certain results. Wu et al. [3] proposed a learner-based MOOCs quality evaluation method, which evaluated the quality of MOOCs

ICMEIM 2023, September 08-10, Wuhan, People's Republic of China

DOI 10.4108/eai.8-9-2023.2340032

from the aspects of learning behavior, student satisfaction and course selection motivation, and proposed improvement strategies. However, the index system of this method was not scientific enough, and no investigation was conducted. Huang et al. [4] built a quality evaluation system for MOOCs based on three first-level indicators (normality, scarcity and professionalism) and 18 second-level indicators (applicability and consistency). However, this method did not take factors such as MOOCs shooting and post-production into account, and the index system was not perfect enough. Yao et al. [5] proposed a quality evaluation model of MOOC based on similarity measurement, which established 5 first-level indicator systems such as course content and course management and 25 second-level evaluation indicator systems, and made assessment by Vague set's similarity measurement method. Based on the above problems and the basic characteristics of MOOCs in the information age, this paper invites 12 experts with associate senior titles or above to determine the evaluation indicators of MOOCs production quality, and uses analytic hierarchy process to build a MOOCS production quality evaluation model, in order to improve the quality of MOOCs production.

2 Hierarchical model construction

Moocs are characterized by being online, large-scale and open [6]. Therefore, this paper refers to the relevant provisions of the Online Course Evaluation Standard (CELTS-22), and invites 12 experts from the Police Academy of the Armed Police Force to evaluate and score the quality evaluation indicators of MOOCs. The authority degree of invited experts was investigated and counted by means of expert self-evaluation, and the statistical results showed that the average authority coefficient of all experts was 0.735. Literature points out that when the expert authority coefficient is greater than 0.7, it means that the invited experts have certain authority and their opinions can be accepted. The Delphi method [7] was adopted to solicit the opinions of experts for several rounds, and finally the evaluation indicators of the production quality of MOOCs were divided into four first-level indicators: "course content", "course design", "production technology" and "management and maintenance", including 24 second-level indicators such as content arrangement and learning interest. This is shown in Figure 1.

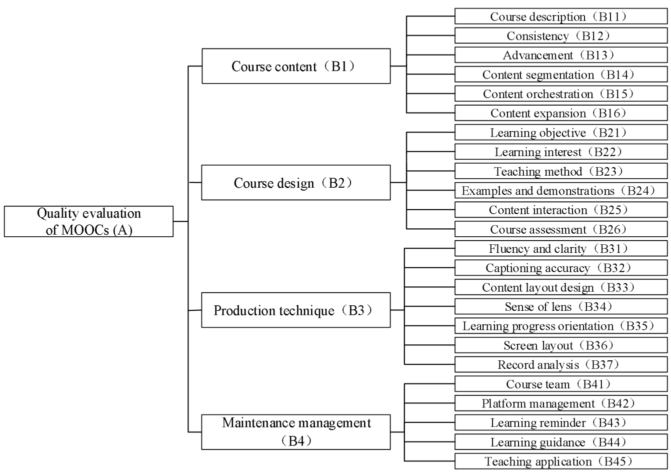

Figure 1. Hierarchical structure model of quality evaluation of MOOCs

3 Index system calculation

Analytic hierarchy Process (AHP) is a systematic method that takes a complex multi-objective decision-making problem as a system, decomposes the objective into multiple objectives or criteria, and then decomposes several levels of multi-indicators (or criteria or constraints), and computs the hierarchical single ranking (weight) and total ranking through the qualitative index fuzzy quantization method, so as to optimize the decision of objectives (multi-indicators) and multi-schemes. In this method, the decision problem is decomposed into different hierarchical structures according to the order of the overall goal, sub-goals of each level, evaluation criteria and specific backup plan. Then, the method of solving the eigenvector of the judgment matrix is used to obtain the priority weight of each element at each level to an element at the upper level. Finally, the final weight of each alternative plan to the overall goal is recurred by the method of weighting sum. By sending questionnaires to 12 experts and comparing the index elements of the same level in pairwise according to the AHP scale [8], five judgment matrices were constructed.

Assuming that $\boldsymbol{P}$ is a judgment matrix, the graph feature vector $\boldsymbol{w} = (w_1, w_2, \cdots, w_n)^T$ of the above five judgment matrices is calculated by the sum method [9] . This is shown in formula 1.

$$\boldsymbol{w} = \mathrm{eig}(\boldsymbol{P}) \tag{1}$$

In the formula, eig [10]represents the sum operation. Then the maximum characteristic root $\lambda_{\max}$ is approximated and can be obtained. This is shown in formula 2.

$$\lambda_{\max} = \frac{1}{n}\sum_{i=1}^{n}\frac{(\boldsymbol{Pw})_i}{w_i} \tag{2}$$

Where, n is the order of the matrix, $(\boldsymbol{Pw})_i$ is the i th element in the matrix obtained by multiplying the judgment matrix $\boldsymbol{P}$ and the approximate eigenvector $\boldsymbol{w}$ .Then, the consistency test index CI is solved according to the obtained approximate maximum feature root $\lambda_{\max}$. This is shown in formula 3.

$$CI = (\lambda_{\max} - n) / (n - 1) \tag{3}$$

According to the given average random consistency index RI [11], the random consistency ratio CR is obtained[12]. This is shown in formula 4.

$$CR = CI / RI \tag{4}$$

When the consistency test ratio is less than 0.1, it can be considered that the judgment matrix satisfies the consistency test. The above methods were used to calculate and test the consistency of 5 judgment matrices, and the results were shown in Table 1.

Table 1. Consistency test results and hierarchical ordering of each judgment matrix

	$\boldsymbol{A}$	$\boldsymbol{B}_1$	$\boldsymbol{B}_2$	$\boldsymbol{B}_3$	$\boldsymbol{B}_4$
$\lambda_{\max}$	4.046	6.326	6.269	7.487	5.293

CI	0.0153	0.0508	0.0538	0.0811	0.0732
CR	0.0170	0.0409	0.0434	0.0614	0.0654

As can be seen from Table 1, the CR of all judgment matrices is less than 0.1, which meets the requirements of consistency test[13], indicating that the structure of the hierarchical model constructed in this paper is relatively reasonable, and the weight of each index obtained is effective, which can be used as an evaluation index of the quality of MOOCs. It is assumed that a percentage system is adopted to evaluate indicators. In order to effectively determine the rating levels of primary and secondary indicators, a top-down approach is adopted to calculate the scores of each indicator during evaluation. This is shown in formula 5.

$$M_{ij} = 100 * W_{Bi} * W_{Bij} \tag{5}$$

Where, M_{ij} is the score value of a single indicator, W_{Bi} is the weight of the i th indicator, and W_{Bij} is the weight of the j th secondary indicator in the i th primary indicator. According to Table 1 and Formula 9, the evaluation weight scores of each index are obtained, as shown in Table 2.

Table 2. Evaluation index scores

Index	B1	B11	B12	B13	B14	B15	B16	
Score	34.2	3.3	2.0	7.6	13.5	4.1	3.8	
Index	B2	B21	B22	B23	B24	B25	B26	
Score	36.4	1.2	11.7	9.5	6.5	3.0	4.5	
Index	B3	B31	B32	B33	B34	B35	B36	B37
Score	20.4	6.2	0.9	2.3	1.5	2.0	2.0	5.5
Index	B4	B41	B42	B43	B44	B45		
Score	9	2.5	0.9	1.3	2.1	2.1		

As can be seen from Table 2, among the first-level indicators, course content B1 and course design B2 have the greatest impact on the quality of MOOCs production, with a total score of 70.6 points, while management and maintenance B4 has little impact on the quality of MOOCS production, with a score of only 9 points. In the secondary index, course knowledge and content segmentation B14 and learning interest B22 have a large impact on the quality of MOOCs production, while subtitle accuracy B32 and platform management B42 have a small impact on the quality of MOOCS production, both scoring 0.9 points. Table 2 is used to evaluate the quality of MOOCs production. A weight ranging from 0 to 1 is assigned to each secondary index in the form of expert scoring. The final evaluation score of MOOCs production quality is obtained by multiplying the weight with the evaluation index score.

4 Conclusion

This paper adopts the methods of expert consultation and literature research to build a quality evaluation model of MOOCs, which contains 4 first-level indicators and 24 second-level indicators, and determines the weight coefficient of each indicator through the analytic hierarchy process, which provides an effective reference basis for the quality evaluation of MOOCs. The establishment of this hierarchical model is helpful to the improvement of MOOCs making technology, the design and development of MOOCs teaching for teachers, and the learning of students' course selection, and has certain guiding significance for the construction of MOOCs. However, the questionnaire in this paper was only carried out in the Police Academy of the Armed Police Force, and no investigation and research was conducted in universities. The design of the relevant indicator system is not mature enough, and the evaluation indicators need to be further refined and improved to make the evaluation results more accurate and effective.

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