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Research Article

Evaluation of Blended Learning Effect of Engineering Geology Based on Online Surveys

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Engineering geology applies geological theories and methods to the practice of engineering activities, evaluates the engineering geological conditions of the engineering site through engineering geological investigation and comprehensive research of theories, solves the engineering geological problems related to engineering activities, predicts and demonstrates the occurrence and development laws of engineering geological problems in the engineering activity area, and puts forward technical measures for prevention and control, so as to contribute to the planning, design, and construction and provide necessary geological and technical data for use and maintenance. Based on the theory of multiattribute decision-making, this paper puts forward the evaluation index system of engineering geology teaching quality in applied universities. A curriculum teaching quality evaluation index system is constructed, which is composed of four main indexes: online resources and teaching, offline teaching process, classroom teaching quality evaluation, and classroom teaching quality evaluation. Furthermore, 11 second-class indices and 28 third-class indices are considered. The judgment matrices and membership degree of each attribute are obtained through use of a questionnaire, and the total weight of each subitem is calculated using the analytic hierarchy process. The calculation results show that the classroom instructional quality of the engineering geology course can be considered excellent; furthermore, other courses could also be evaluated using the same method, where those with low evaluation results can be further improved. Using the fuzzy comprehensive evaluation method based on the analytic hierarchy process, we evaluate the instructional quality, comprehensively consider the nonlinear and fuzzy characteristics of evaluation factors, can scientifically calculate the weight value of each evaluation index, and combine qualitative and quantitative aspects, in order to objectively provide an evaluation of the classroom instructional quality of teachers, which is conducive to the high-quality construction of university courses.

1. Introduction

Engineering geology is an interdisciplinary subject of geology and engineering, which mainly studies the interaction between engineering activities and geological environment [1]. Evaluation of the instructional quality of university teachers involves objectively and effectively measuring and evaluating their instructional situation in all aspects. Comprehensive evaluation of a teacher's instructional quality, on one hand, helps them to effectively change their instructional ideas, increase instructional investment, and improve instructional methods [2]. On the other hand, it is helpful for education managers to understand the associated instructional dynamics and to implement effective instructional management [3]. Instructional quality has many fuzzy attributes, and there are few quantifiable attributes [4]. Therefore, fuzzy mathematics can be used to effectively make decisions on such fuzzy attributes. As early as 1957, Churchman and Ackoff began to use simple weighting methods to deal with multiattribute decision-making problems [3]. At present, the use of multiattribute decision analysis has been widely successful, and its role in different application fields has been significantly enhanced. In particular, due to the development of new methods and the improvement of old methods, multiattribute decision-making has been widely used as a model and tool to deal with complex engineering problems [5–7]. Many problems faced by decision-makers involve incomplete fuzzy multiobjective decision-making problems, as the characteristics of these problems often require such information [8].

There are many decision-making problems in engineering, especially in the process of dealing with engineering geological problems, it is necessary to consider the optimal scheme in order to ensure the optimal benefit on the premise of ensuring safety. It is necessary for decision-makers to provide specific preference information in the treatment of engineering geological problems. [9]. In recent years, multiattribute decision-making has become a very active research field, both at home and abroad [10]. Although many meaningful research achievements have been made on the ranking theory of multiattribute decision-making, and many decision-making methods have been proposed, such as the simple weighting method, linear distribution method, and TOPSIS method, they are still far from perfect. These methods require the weights of attributes to be determined in advance [11]. The object of decision-making is often complex and changeable, which is fuzzy and cannot be quantified. It is difficult to distinguish the quantitative difference of these information, only their change range can be determined, and even the influence degree of each factor is uncertain. Therefore, there is little research on factor weight in decision-making [12, 13].

In many real decision-making problems, the decision-makers often have uncertainty in their understanding, and often encounter things that are difficult to describe accurately, such that it is difficult to determine their characteristics. This uncertainty is manifested as fuzziness [14, 15]. Such fuzzy phenomena have inherent uncertainty, and cannot be explained by the original set theory. When the fuzziness caused by objective information or human factors plays an important role in decision-making, it constitutes a fuzzy decision-making problem [16, 17]. Due to time pressure and the lack of understanding of decision-making problems, it is difficult for decision-makers to accurately express judgment information. Their judgment information is more suitable to be expressed through the use of intuitionistic fuzzy sets, rather than deterministic numbers or linguistic variables. The most important step in a multiattribute decision-making model is to obtain decision information. Decision information generally includes attribute weights and attribute values [18]. In fuzzy multiattribute decision-making, attribute weights and index values can be expressed as fuzzy sets or fuzzy numbers, either in whole or in part [19]. The actual decision-making often needs to be carried out in a fuzzy environment. At this time, those things upon decisions are made are often expressed as a series of fuzzy quantities. Therefore, the final selection generally comes down to the comparison and discrimination of fuzzy quantities [20]. Amiri and Golozari have proposed a method to determine the critical path in a fuzzy environment, considering time factors, cost, risk, and quality standards, and used fuzzy language variables to describe the attributes in decision-making [21].

There are many methods to determine attribute weights, such as the Delphi method, analytic hierarchy process (AHP), and entropy method [22, 23]. Fuzzy environment brings great uncertainty to multiattribute decision-making. For a long time, the determination of decision attribute weight has been an important problem that decision-makers need to solve. Due to the differences of decision-makers, they will have preferences for different attributes. For example, for the same attribute, multiple decision-makers often have different opinions. Therefore, the weight of attributes is difficult to be determined [24].

Saaty put forward the analytical hierarchy process in the mid-1970s [25]. The analytic hierarchy process is a qualitative, quantitative, systematic, and hierarchical analysis method. Due to its practicability and effectiveness in dealing with complex decision-making problems, it has garnered attention all over the world. The main characteristic of this method is to use less quantitative information to mathematically formalize the thinking process of decision-making, in order to provide a simple decision-making method for complex decision-making problems with multiple objectives, multiple criteria, or no structural characteristics. It comprises a model and method for making decisions on complex systems that are difficult to fully quantify [26, 27]. Darko et al. have reviewed papers based on the analytic hierarchy process in engineering management journals [28]. Their results showed that analytic hierarchy process has been widely used in the field of engineering management and sustainable construction [29].

At present, the evaluation standard of classroom instructional quality in applied universities is usually formulated in combination with the actual situation of the university. In this case, some problems may arise, such as imperfect evaluation indices and/or an unreasonable weight distribution of the evaluation indices. According to the applied characteristics of the course, this study constructs a three-level index system for the teaching quality evaluation of engineering geology course. Based on fuzzy multiattribute decision-making theory, the judgment matrix and membership degree of each attribute are obtained through questionnaire survey. Then through fuzzy calculation, the teaching quality of engineering geology is evaluated. This paper puts forward the evaluation index system of classroom teaching quality in line with the talent training mode of application-oriented universities.

2. Methodology

2.1. Fuzzy Set Theory. In a decision-making process, the nature and activities of many influencing factors cannot be described quantitatively by use of numbers, and their results are also vague and uncertain, making them unsuitable to be judged by a single criterion. In order to solve this problem, the American scholar L. A. Zadeh first proposed the concept of a fuzzy set in 1965 and established a model for fuzzy behavior and activities [30]. The fuzzy comprehensive evaluation method is a very effective multifactor evaluation method to comprehensively evaluate certain things affected by many factors. Its characteristic is that the evaluation results are not absolutely positive or negative but, instead, are expressed by a fuzzy set [31, 32]. In instructional quality evaluation and decision-making, words such as "excellent" or "good" are often used to describe the level of instructional quality. Although this description does not give the specific level of instructional quality, through this description, teachers can also obtain a basic understanding of instructional quality and consider appropriate instructional quality control measures. Using "excellent," "good," and "medium" to measure the level of instructional quality only provides a qualitative analysis. In order to quantitatively describe this fuzzy concept, the concept of membership can be introduced [33, 34].

2.2. Steps of Fuzzy Comprehensive Evaluation Method. Firstly, an evaluation index system is determined. In a multi-attribute comprehensive decision-making evaluation system, the establishment of an attribute index system is the prerequisite and the core of the whole instructional quality evaluation problem.

We establish an instructional quality evaluation attribute set $U = \{U_1, U_2, \cdots, U_n\}$. According to the results of attribute identification of instructional quality evaluation for the engineering geology course, its attribute set is $U_A = \{$online resources and instructions, offline instructional process, instructional method, instructional effect$\}$.

We establish an evaluation set $V = \{V_1, V_2, \cdots, V_n\}$. The evaluation set mainly reflects the grade of instructional quality evaluation. The evaluation set, established according to the instructional quality evaluation of engineering geology course, is {very excellent, excellent, general, poor, very poor}.

The questionnaire method was used to determine the influence degree of each attribute in the attribute set with respect to the overall goal of instructional quality, to determine the weight of each attribute, and, consequently, to determine the weight matrix R. Similarly, the questionnaire method was used to determine the level of each attribute. Finally, the membership degree of each attribute was obtained, and the fuzzy membership degree matrix was determined. Fuzzy comprehensive evaluation was carried out to comprehensively evaluate each attribute, which is generally described by $S = W \cdot R$, where S and W denote the evaluation results and the membership, respectively. The criteria based on the multicriteria decision-making approach with AHP and Fuzzy Set for the Evaluation of Instructional Quality to classify learning process into categories were as follows: very good, good, medium, poor, and very poor.

2.3. Analytic Hierarchy Process. The theoretical core of the analytic hierarchy process is to decompose the evaluation objective of a project into several levels and several factors. These factors are divided into several groups, according to different attributes. Each factor is affected by a series of subfactors, and a hierarchical structure is formed, according to the dominant relationships among objectives, factors, and subfactors. This hierarchical structure can clearly reveal the nature of various factors and the relationships between them. If these factors or subfactors are risks and risk factors, this hierarchical structure chart becomes a risk hierarchical structure chart. In the hierarchical model, the top-down usually includes target layer, criterion layer, and scheme layer. The target layer reflects the highest level in the hierarchy chart and is the final target to be evaluated. The criterion layer is the standard used to judge the target results, which is also known as element layer or constraint layer. The scheme layer, also known as the countermeasure layer, refers to the feasible scheme. In addition, the criterion layer can be subdivided into subcriterion layers, and so on. According to the correlation between the scheme and criterion layers, the hierarchical model can be divided into three hierarchical models: fully related structure diagram, partially related structure diagram, and fully independent structure diagram. The main steps of overall risk assessment using the analytic hierarchy process, in the context of this paper, are as follows:

(1) Construct the instructional quality evaluation model, determine the objectives and attributes of the object to be evaluated, and then construct the multiattribute framework diagram affecting the instructional quality evaluation objectives, that is, the multiattribute hierarchical structure

(2) Compare the decision-making attributes in pairs and construct the judgment matrix for each attribute and subattribute. As factors at the same level have different influences on the objectives at the upper level, they need to be reflected by weighted values. The questionnaire survey method compares the attributes at each level in pairs. The evaluation criteria for the relative importance between the two factors and their assignments are shown in Table 1. The matrix formed by the comparison is the judgment matrix. The assignments for the judgment matrix A are shown in Table 2

The calculation steps for the maximum eigenvalue of the matrix are as follows:

Calculate the product M_i of each row element of the judgment matrix as:

$$M_{\mathrm{i}} = \prod_{j=1}^{n} a_{ij} (i = 1, 2, \cdots, n). \tag{1}$$

Calculate the n^{th} root of M_i:

$$\varpi_i = \sqrt[n]{M_i}. \tag{2}$$

Normalize the vector $\varpi = [\varpi_1, \varpi_2, \cdots, \varpi_{\mathrm{n}}]^T$:

$$\omega_{\mathrm{i}} = \frac{\varpi_i}{\sum_{\mathrm{i}=1}^{\mathrm{n}} \varpi_i}. \tag{3}$$

Then, $\varpi = [\varpi_1, \varpi_2, \varpi_3, \cdots, \varpi_{\mathrm{n}}]^T$ is the eigenvector.

(3) The consistency of the matrix is tested, through an expert evaluation

If the inspection fails, experts are invited to reevaluate and adjust the evaluation values, until the consistency inspection index CR<0.1, defined as follows:

$$\begin{cases} CR = CI/RI \\ CI = \dfrac{\lambda_{\max} - n}{n - 1}, \end{cases} \tag{4}$$

Table 1: Evaluation criteria of relative importance between pairs of factors (p, q) and their assignments [35].

Scale (b_{ij}) assignment	Implication
1	Factors p and q are equally important.
3	Factor p is slightly more important than factor q.
5	Factor p is obviously more important than factor q.
7	Factor p is strongly more important than factor q.
9	Factor p is extremely more important than factor q.
1/3	Factor p is slightly less important than factor q.
1/5	Factor p is obviously less important than factor q.
1/7	Factor p is strongly less important than factor q.
1/9	Factor p is extremely unimportant, compared to factor q.
2, 4, 6, 8, 1/2, 1/4, 1/6, 1/8	The intermediate value of the above two adjacent judgments; for example, "2" indicates being between equally important and slightly important.

Table 2: Assignment of judgment matrix A.

a_{ij}	A_1	A_2	A_3	…	A_n
A_1	a_{11}	a_{12}	a_{13}	…	…
A_2	a_{21}	a_{22}	a_{23}	…	…
…	…	…	…	…	…
A_n	a_{n1}	a_{n2}	a_{n3}	…	a_{nn}

Table 3: Randomness index values [35].

n	1	2	3	4	5	6	7	8	9	10	11
RI	0	0	0.58	0.9	1.12	1.24	1.32	1.41	1.45	1.49	1.51

where n is the order of the judgment matrix and $\lambda_{\max}$ is the maximum eigenvalue of the judgment matrix.

The empirical values of the randomness index, RI, are listed in Table 3.

Similarly, when CR<0.1, it can be considered that the overall decision result of the hierarchy has satisfactory consistency; otherwise, it is necessary to readjust the element values of the judgment matrix.

3. Case Study

The purpose of curriculum instructional quality evaluation is to determine the deficiencies in instructional quality and further improve it, in order to better complete the task of student training. According to the customer-perceived quality model, in order to comply with the customer-centric concept, manufacturers should evaluate the quality of goods from the perspective of customers. The first mock exam was also applicable to the evaluation of instructional quality. The starting point of instruction is to serve students. Therefore, when evaluating instructional quality, students should be evaluated [36–39].

3.1. Build a Decision Attribute Set. The considered decision-making goal was curriculum instructional quality evaluation. First, we established a level 1 attribute layer: $U_A = \{$online resources and instruction, offline instructional process, offline instructional methods, and instructional effects$\}$. As in previous studies, we establish a three-level instructional quality evaluation index system, as shown in Table 4. We established the decision set $V = \{$very good, good, medium, poor, very poor$\}$. We used the questionnaire method to determine the membership of decision-making attributes at all levels.

3.2. Determining Attribute Weight Vector by Analytic Hierarchy Process. The influence degree of each attribute on instructional quality evaluation was determined through the questionnaire, the importance of each index was compared, and the weight of each index attribute in the evaluation index system was determined through the analytic hierarchy process. We constructed the judgment matrix of the third level subattributes as listed in Table 5 and 6:

The eigenvectors and eigenvalues of the judgment matrix were calculated as follows:

$$\begin{cases} \omega_{C1-C5} = [0.4148, 0.2343, 0.0747, 0.2517, 0.0245]^{T}; \lambda_{\max} = 5.26 \\ \omega_{C6-C7} = [0.1667, 0.8333]^{T}; \lambda_{\max} = 1.20 \\ \omega_{C8-C9} = [0.2308, 0.7692]^{T}; \lambda_{\max} = 1.30 \\ \omega_{C10-C14} = [0.4805, 0.2218, 0.1357, 0.1386, 0.0275]^{T}; \lambda_{\max} = 5.44 \\ \omega_{C15-C16} = [0.0.3333, 0.6667]^{T}; \lambda_{\max} = 1.50 \\ \omega_{C17-C18} = [0.4118, 0.5882]^{T}; \lambda_{\max} = 1.70 \\ \omega_{C19-C20} = [0.2593, 0.7407]^{T}; \lambda_{\max} = 1.35 \\ \omega_{C21-C22} = [0.3103, 0.6897]^{T}; \lambda_{\max} = 1.45 \\ \omega_{C23-C24} = [0.1071, 0.8929]^{T}; \lambda_{\max} = 1.12 \\ \omega_{C25-C26} = [0.3548, 0.6452]^{T}; \lambda_{\max} = 1.55 \\ \omega_{C27-C28} = [0.3007, 0.6993]^{T}; \lambda_{\max} = 1.43 \end{cases} . \quad (5)$$

The results of checking the consistency of the judgment matrix were $CR_{C1-C5} = 0.058 < 0.1$ and $CR_{C10-C14} = 0.079 < 0.1$, such that the consistency test passed, indicating that the consistency of the judgment matrix was acceptable. We constructed the attribute judgment matrices for the second and first layers as listed in Table 7 and 8:

Table 4: Instructional quality evaluation index system.

First-level indicators		Secondary indicators		Tertiary indicators	
A1	Online resources and instructions	B1	Online resources	C1	Full course content.
				C2	Reasonable curriculum design for students to study on their own.
				C3	Provide domestic and foreign resources to match the instructional content.
				C4	Provide online communication, exercises, and tests.
				C5	The course website is suitable for self-directed study
		B2	Online instructional process	C6	Students learn independently and gain more.
				C7	Improve student interest in autonomous learning.
A2	Offline instructional process	B3	The classroom environment	C8	High degree of interaction between teachers and students.
				C9	Instructional aids and tools are complete.
		B4	Instructional content	C10	There is no obvious fault in instructional content.
				C11	The lectures are easy for students to grasp.
				C12	The content structure is systematic.
				C13	Discussion of the latest research achievements and research trends.
				C14	The case shows.
		B5	Class guidance	C15	Students train after class.
				C16	Practical engineering guidance and feedback to students.
A3	Offline instructional methods	B6	Diversity	C17	A combination of instructional methods.
				C18	The pertinence of instructional methods.
		B7	Leading	C19	Improve student creativity.
				C20	Improve student ability for independent thinking.
		B8	Practical	C21	Example instruction.
				C22	Practice instruction.
A4	The instructional effect	B9	Knowledge of harvest	C23	Master the instructional content of this course.
				C24	Theoretical knowledge is applied to practice.
		B10	Ability to ascend	C25	Complete scientific research tasks independently.
				C26	Can form a scientific thinking system.
		B11	Quality promotion	C27	Have good scientific and cultural literacy.
				C28	Have engineering thinking and craftsman spirit.

Table 5: C1–C5 and C10–C14 attribute judgment matrices.

C1–C5	C1	C2	C3	C4	C5	C10–C14	C10	C11	C12	C13	C14
C1	1.00	1.80	5.00	1.80	9.00	C10	1.00	2.80	5.00	1.90	8.00
C2	0.56	1.00	2.70	1.10	9.00	C11	0.36	1.00	2.60	1.30	7.00
C3	0.20	0.37	1.00	0.23	7.00	C12	0.20	0.38	1.00	2.20	7.00
C4	0.56	0.91	4.35	1.00	9.00	C13	0.53	0.77	0.45	1.00	9.00
C5	0.11	0.11	0.14	0.11	1.00	C14	0.13	0.14	0.14	0.11	1.00

The eigenvectors and eigenvalues of the judgment matrix were calculated as follows:

$$\begin{cases} \omega_{B1-B2} = [0.4867, 0.5133]^{\mathrm{T}}; \lambda_{\max} = 5.26 \\ \omega_{B3-B5} = [0.1219, 0.6477, 0.2294]^{\mathrm{T}}; \lambda_{\max} = 1.20 \\ \omega_{B6-B8} = [0.2124, 0.5732, 0.2018]^{\mathrm{T}}; \lambda_{\max} = 1.30 \\ \omega_{B9-B11} = [0.6024, 0.2461, 0.1276]^{\mathrm{T}}; \lambda_{\max} = 5.44 \\ \omega_{A1-A4} = [0.433, 0.231, 0.237, 0.1]^{\mathrm{T}}; \lambda_{\max} = 1.50 \end{cases} \quad (6)$$

When we checked the consistency of the judgment matrix, $\mathrm{CR}_{B3-B5} = 0.003 < 0.1$, $\mathrm{CR}_{B6-B8} = 0.038 < 0.1$, $\mathrm{CR}_{B9-B11} = 0.077 < 0.1$, and $\mathrm{CR}_{A1-A4} = 0.078 < 0.1$, such that the consistency test was passed, indicating that the consistency of the judgment matrix was acceptable.

3.3. Fuzzy Evaluation of Subattribute Layer. According to the establishment of the decision set $V = \{\text{very good, good, medium, poor, very poor}\}$, the third level attributes were fuzzy evaluated. We used the questionnaire method to

Table 6: C6–C9 and C15–C28 attribute judgment matrices.

C6–C7	C6	C7	C8–C9	C8	C9	C15–C16	C15	C16
C6	1	0.2	C8	1	0.3	C15	1	0.5
C7	5	1	C9	3.33	1	C16	2	1
C17–C18	C17	C18	C19–C20	C19	C20	C21–C22	C21	C22
C17	1	0.7	C19	1	0.35	C21	1	0.45
C18	1.43	1	C20	2.86	1	C22	2.22	1
C23–C24	C23	C24	C25–C26	C25	C26	C27–C28	C27	C28
C23	1	0.12	C25	1	0.55	C27	1	0.43
C24	8.33	1	C26	1.82	1	C28	2.33	1

Table 7: Second layer attribute judgment matrices.

(a)

B1–B2	B1	B2
B1	1.00	0.66
B2	1.52	1.00

(b)

B3–B5	B3	B4	B5
B3	1.00	0.20	0.50
B4	5.00	1.00	3.00
B5	2.00	0.33	1.00

(c)

B6–B8	B6	B7	B8
B6	1.00	0.30	1.30
B7	3.33	1.00	2.30
B8	0.77	0.43	1.00

(d)

B9–B11	B9	B10	B11
B9	1.00	3.30	3.50
B10	0.30	1.00	2.60
B11	0.29	0.38	1.00

Table 8: First layer attribute judgment matrix.

A1–A4	A1	A2	A3	A4
A1	1.00	3.00	1.30	3.80
A2	0.33	1.00	1.80	2.00
A3	0.77	0.56	1.00	3.10
A4	0.26	0.50	0.32	1.00

Table 9: Survey results for third-layer attribute membership.

Attribute	Very good	Good	Medium	Poor	Very poor
C1	0.851	0.122	0.018	0.000	0.009
C2	0.860	0.116	0.021	0.003	0.000
C3	0.815	0.146	0.027	0.012	0.000
C4	0.845	0.116	0.033	0.006	0.000
C5	0.845	0.128	0.024	0.003	0.000
C6	0.781	0.164	0.043	0.012	0.000
C7	0.793	0.149	0.049	0.009	0.000
C8	0.824	0.134	0.040	0.003	0.000
C9	0.821	0.128	0.030	0.018	0.003
C10	0.830	0.131	0.033	0.006	0.000
C11	0.836	0.122	0.036	0.003	0.003
C12	0.848	0.119	0.024	0.003	0.006
C13	0.821	0.131	0.040	0.006	0.003
C14	0.824	0.137	0.030	0.006	0.003
C15	0.821	0.131	0.036	0.000	0.012
C16	0.793	0.158	0.040	0.003	0.006
C17	0.824	0.128	0.036	0.006	0.006
C18	0.799	0.146	0.052	0.000	0.003
C19	0.818	0.143	0.030	0.006	0.003
C20	0.842	0.128	0.024	0.006	0.000
C21	0.851	0.103	0.033	0.009	0.003
C22	0.812	0.128	0.052	0.009	0.000
C23	0.793	0.149	0.043	0.012	0.003
C24	0.796	0.155	0.040	0.003	0.006
C25	0.790	0.164	0.030	0.009	0.006
C26	0.839	0.128	0.027	0.006	0.000
C27	0.851	0.116	0.027	0.006	0.000
C28	0.810	0.123	0.048	0.019	0.000

determine the membership of decision attributes at all levels. This questionnaire was distributed online, with a total of 500 copies. The membership degrees obtained, according to the survey results, are shown in Table 9.

According to the weight vector and membership degree of the third layer of subattributes, the fuzzy comprehensive evaluation of the third layer of attributes was carried out by calculating:

$$S = \omega_n^T \bullet R_{nm}. \quad (7)$$

The membership matrices of the second and first layers were then obtained, as as listed in Table 10:

Finally, the decision-making results for the instructional quality evaluation were obtained as (0.8169, 0.1347, 0.0351, 0.0060, and 0.0023). According to the principle of maximum membership, within the five evaluation levels (very good, good, medium, poor, and very poor), the decision-making results from the conducted instructional quality survey belonged to the "very good" level.

Table 10: Attribute membership for second and first layers.

Attribute	Very good	Good	Medium	Poor	Very poor
A1	0.819113	0.136667	0.035977	0.006426	0.001817
A2	0.825544	0.132909	0.034485	0.005438	0.003398
A3	0.817265	0.1293	0.033598	0.00578	0.001533
A4	0.786445	0.143055	0.036515	0.006052	0.003945
B1	0.848762	0.121024	0.023298	0.003183	0.003733
B2	0.791	0.151501	0.048	0.0095	0
B3	0.821692	0.129385	0.032308	0.014538	0.002308
B4	0.835764	0.128078	0.033467	0.004952	0.001978
B5	0.802332	0.149001	0.038667	0.002	0.008
B6	0.809295	0.138588	0.045411	0.002471	0.004235
B7	0.835777	0.13189	0.025556	0.006	0.000778
B8	0.824102	0.120243	0.046104	0.009	0.000931
B9	0.795679	0.154357	0.040321	0.003964	0.005679
B10	0.821615	0.140773	0.028064	0.007064	0.002129
B11	0.822329	0.120895	0.041685	0.015091	0

4. Conclusion

In this paper, we studied the advantages and disadvantages of using the multiattribute fuzzy comprehensive evaluation method and determined a more effective instructional quality evaluation method based on the analytic hierarchy process. A perfect questionnaire about the course quality of applied universities is made, and the characteristics of engineering geology course are studied. A multilevel fuzzy comprehensive evaluation model is constructed to evaluate the quality of online and offline hybrid engineering geology courses. It not only adopts Internet technology, but also establishes a quantitative mathematical model of curriculum evaluation. Combining qualitative and quantitative methods, the weight of each evaluation factor is calculated to obtain a more objective evaluation of classroom teaching quality. The following conclusions are obtained.

(1) In the actual instructional quality evaluation process, 11 secondary attributes and 28 tertiary subattributes were selected to make decisions on the instructional quality of an engineering geology course from four aspects: online resources and instructions, offline instructional process, offline instructional methods, and instructional effect. Based on information technology, the judgment matrix and membership degree of each attribute were obtained by use of a questionnaire

(2) The calculation showed that the classroom instructional quality evaluation of the engineering geology course is excellent, and other courses can also be evaluated using the same method. Those with low evaluation results can be further improved, which is conducive to the high-quality construction of university courses

(3) It should be noted that the fuzzy comprehensive evaluation method used in this study only evaluated instructional quality from the perspective of a student evaluation. In the actual instructional evaluation process, expert supervision and peer evaluation also play very important roles. In future practical evaluation work, it will be necessary to add expert and peer evaluation to the fuzzy comprehensive evaluation model, in order to evaluate the classroom instructional quality more comprehensively

Data Availability

The datasets generated during the current study are available from the corresponding author on reasonable request.

Conflicts of Interest

No conflict of interest exits in the submission of this manuscript, and manuscript is approved by all authors for publication.

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