

Regional Adaptation Mechanism of Regenerative Sustainability Education in Chinese Hospitality Vocational Education: Model Construction and Empirical Research

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Abstract: This study constructed an evaluation index system for the regenerative sustainable development education literacy of hotel vocational education colleges, and based on regional differences, proposed an adaptation mechanism. The study constructed an evaluation system covering the cognition of the regenerative system, the responsibility ethics of regeneration, the practice of regeneration transformation, and the physical and mental functions of regeneration, providing observable basis for subsequent quantitative assessment. The subjective weights of the indicators were determined by the analytic hierarchy process, and the objective weights of the indicators were determined by the entropy weight method. The power average value method was used to combine the weights obtained by the two methods to determine the final weights of each indicator, making the weights of the indicators both reasonable and objective. The fuzzy comprehensive evaluation method was used to establish a literacy assessment model, handling the problem of the fuzzy characteristics of the literacy evaluation indicators. The study found that the regenerative sustainable development education literacy of hotel vocational education students showed a significant gradient feature of "higher in the east and lower in the west", and the urban-rural differences were highly significant ($P < 0.01$). The shortcomings of the literacy of students from different regions showed a differentiated structure. This study provided empirical evidence and decision-making references for regional precise policies.

Keywords: Analytic Hierarchy Process; Entropy Weight Method; Fuzzy Comprehensive Evaluation Method; Regenerative Sustainable Development Education; Hotel Vocational Education; Regional Adaptation

1. Introduction

Since 1992, UNESCO has been promoting sustainable development education (ESD) globally [1-3]. Since then, ESD as an educational concept has had a significant impact on global education development. However, what abilities should students acquire through ESD and what educational goals should be achieved? These are key issues that need to be addressed. With the release of the "2030 Agenda for Sustainable Development" [4-5], how to further implement ESD specifically has become a hot issue of international concern.

Recently, UNESCO released "Sustainable Development Education Goals: Learning Objectives" [6]. The report states that education can play a key role in achieving sustainability through the cultivation of relevant knowledge, skills, values, and attitudes [7]. ESD aims to cultivate the relevant abilities of individuals, enabling them to reflect on their actions and consider their impact on the current and future society, culture, economy, and environment from a local and global perspective. Based on the 17 sustainable development goals proposed in the "2030 Agenda for Sustainable Development", the report



sets specific goals for ESD from two aspects: interdisciplinary key sustainable development abilities and specific learning objectives [8-10]. Among them, interdisciplinary key sustainable development abilities are necessary for achieving all 17 sustainable development goals [11], are necessary abilities for all age learners, and have characteristics such as universal adaptability, multi-functionality, and independence from background changes. Specifically, these abilities include [12-15]: system thinking ability, anticipation ability, compliance with norms and standards ability, strategic ability, cooperation ability, critical thinking ability, self-awareness ability, holistic problem-solving ability.

With the vigorous development of China's tourism industry, major international hotel management groups have flocked into the Chinese market, even making the Chinese market their main target for future development. The vigorous development of the hotel industry has promoted the employment of hotel management students and also raised new requirements for the abilities of hotel management students [16]. From the perspective of vocational education, in the context of sustainable development education, hotel management vocational education must focus on cultivating the learning objectives of learners in sustainable development education and combine these learning objectives with the cultivation of key abilities, internalizing them as the core competencies of learners, thereby contributing to the realization of a more equitable and sustainable social development model [17]. However, in reality, vocational education hotel management students have low learning interest, poor practical ability, and insufficient management ability. The students trained often lack the sustainable development capabilities for employment and cannot meet the talent demands of the market [18-19]. How to carry out professional construction and teaching reform to cultivate application-oriented and practical talents that meet the development needs of the hotel industry has become an urgent task.

This article first clarifies the differences between regenerative sustainable development education and traditional education, and establishes the evaluation indicators for the regenerative sustainable development education literacy of hotel vocational education students. Then, using the combined weighting method of analytic hierarchy process and entropy weight method, the weights of each indicator are assigned to avoid the deviation caused by a single weighting method. The fuzzy comprehensive evaluation method is used to establish a literacy assessment model, solving the problem of difficult precise quantification of a large number of ethical indicators in the evaluation index system. Based on 1489 valid student questionnaires, through single-factor analysis of variance and LSD multiple comparison methods, the differences in significance among students from the eastern, central, and western regions and urban and rural students in the research object were tested, accurately identifying the literacy shortcomings of students in different regions.

2. Evaluation Index System for Students' Regenerative Sustainable Development Education Literacy

2.1. Construction Principles

Carrying out student assessment of regenerative sustainable development education literacy in vocational schools is a need for schools to strengthen student management, earnestly implement the Party's educational policies, continuously enhance their educational capabilities, and cultivate a large number of highly skilled professionals. It is also a need for vocational school students to improve their own abilities, master technical skills, comprehensively improve themselves, and achieve better employment and better serve the transformation and upgrading of regional hotel industries in the future.

The process of assessing student regenerative sustainable development education literacy in vocational schools is as follows: Firstly, based on the training goals of vocational schools and the particularity of hotel vocational education, after analyzing the influencing factors of regenerative sustainable development education literacy, a measurement index system is formulated. Then, the weights of the index system are assigned through methods. Finally, an evaluation model is established to comprehensively measure, evaluate and motivate students. During the assessment process of student regenerative sustainable development education literacy in vocational schools, the establishment of the index system of regenerative sustainable development education literacy for vocational school students must be able to play a guiding, checking, controlling and motivating role, and should fully consider the differences in regional hotel industry ecology and cultural resources, laying a data foundation for the subsequent research on regional adaptation mechanisms. The aim is to achieve scientific measurement and objective assessment, and the index system should be concise and easy to operate.

2.2. Determination of the Index System

The author has developed an index system for the educational literacy of regenerative sustainable

development among students of hotel vocational colleges. The educational literacy indicators of regenerative sustainable development for students are divided into two levels, with 4 primary indicators and 12 secondary indicators. The primary indicators of the first level include: recognition of the regenerative system, responsibility ethics in regeneration, practice of regenerative transformation, and physical and mental functions of regeneration; the secondary indicators of the second level include: recognition of regional ecology and cultural tourism resources, knowledge of circular economy and low-carbon operation, digital empowerment and adaptability technology literacy, ethical weighing ability in the face of conflicts of interests, ecological empathy and intergenerational justice sense, sense of mission for local connection and cultural inheritance, community well-being and inclusive service perspective, ability to transform resource value and design for restoration, cross-border collaboration and interest communication ability, real situational problem-solving and project execution ability, natural perception and ecological resilience, embodied labor and vocational service resilience. The specific meanings of the indicators are shown in Table 1.

Table 1. Specific index meaning

Primary indicator	Secondary indicator
Cognitive regeneration system cognition(A1)	Regional ecology and cultural travel resource cognition(B1)
	Circular economy and low carbon operating knowledge(B2)
	Digital empowerment and fitness skills(B3)
	Ethical trade-offs under conflicts of interest(B4)
Ethics of regenerative responsibility(A2)	Ecological empathy and generational sense of justice(B5)
	Local associations and cultural heritage(B6)
	Community well-being and inclusive service concept(B7)
Practice of renewable change(A3)	Resource value transformation and restoration design ability(B8)
	Interboundary coordination and communication skills(B9)
	Real situation problem solving and project execution(B10)
Regenerative psychosomatic function(A4)	Natural perception and ecological resistance(B11)
	Body labor and professional service toughness(B12)

3. Student Regenerative Sustainable Development Education Literacy Assessment Model

3.1. Determination of the Weight of Evaluation System Indicators

The first step in establishing an evaluation model based on the Analytic Hierarchy Process (AHP) is to construct the hierarchical model of the problem. First, determine the target layer, criterion layer, sub-criterion layer and alternative layer of the problem; determine the factors of each layer and the relationships between each factor and the factors of the upper layer.

Construct a pairwise comparison judgment matrix for the importance of each element of the composition of the goal. Based on the joint discussion and repeated scoring by middle and senior leaders including the teaching director, the administrative director, and two principals, the importance of the criterion layer can be obtained from the judgment matrix.

Next, solve the eigenvector and the corresponding maximum eigenvalue of the judgment matrix. Then conduct the consistency test of the judgment matrix. The consistency test includes the following steps:

- (1) Calculate the consistency index C.I.:

$$C.I. = \frac{\lambda_{\max} - n}{n - 1} \quad (1)$$

- (2) Calculate the average random consistency index:

R.I. (This index is the average value of the eigenvalues of randomly generated judgment matrices of different dimensions).

- (3) Calculate the consistency ratio:

C.R.:

$$C.R. = \frac{C.I.}{R.I.} \quad (2)$$

- (4) When $C.R. < 0.1$, it is considered that the consistency of the judgment matrix is acceptable.

- (5) If the consistency test is passed, the obtained eigenvector represents the weights of the elements.
(6) The total weight of the bottom-level solution for the top-level objective is calculated using the weights of each level.

Since all the consistency tests have been passed previously, the weights of each secondary indicator can be calculated accordingly. The results are shown in Table 2.

Table 2. Weights of different indicators

Primary indicator	Weight	Secondary indicator	Weight
Cognitive regeneration system cognition(A1)	0.4135	Regional ecology and cultural travel resource cognition(B1)	0.2180
		Circular economy and low carbon operating knowledge(B2)	0.1329
		Digital empowerment and fitness skills(B3)	0.0626
Ethics of regenerative responsibility(A2)	0.1891	Ethical trade-offs under conflicts of interest(B4)	0.0662
		Ecological empathy and generational sense of justice(B5)	0.0201
		Local associations and cultural heritage(B6)	0.0362
		Community well-being and inclusive service concept(B7)	0.0666
Practice of renewable change(A3)	0.2775	Resource value transformation and restoration design ability(B8)	0.0792
		Interboundary coordination and communication skills(B9)	0.1210
		Real situation problem solving and project execution(B10)	0.0773
Regenerative psychosomatic function(A4)	0.1199	Natural perception and ecological resistance(B11)	0.0558
		Body labor and professional service toughness(B12)	0.0641

Step 1: Determine a satisfactory value x_{im} and an unacceptable value x_{iu} for each column of the original data table of the indicators.

For positive indicators, the maximum value of these data can be selected as the satisfactory value, and the minimum value as the unacceptable value; for negative indicators, the minimum value of these data can be selected as the satisfactory value, and the maximum value as the unacceptable value. For intermediate indicators, the maximum or minimum value can be selected as the unacceptable value.

Step 2: Standardize the data in the original data table of the status indicators:

Transform the data in the j th column of the table, $x_{ij}, i=1,2,\dots,n$, that is, all the data corresponding to the j th indicator (the data of the j th indicator in each region and each historical year), into standard data $y_{ij}, i=1,2,\dots,n$. The calculation formula is:

$$y_{ij} = \frac{x_{ij} - x_{iu}}{x_{im} - x_{iu}} \quad (3)$$

First, the data is standardized according to the formula.

Calculate the information utility value h_j for each indicator, where $j=1,2,\dots,s$. For the standardized data y_{ij} , where $i=1,2,\dots,n$, y_{ij} represents the specific numerical value of each sample after standardized processing and correction in the various evaluation indicators of the hotel vocational education regenerative sustainable development education literacy. According to the formula:

$$h_j = 1 + \frac{\sum_{i=1}^n Y_{ij} \ln Y_{ij}}{\ln n} \quad (4)$$

Thus, the information utility value h_j of the j -th indicator is obtained, where:

$$Y_{ij} = \frac{y_{ij}}{\sum_{i=1}^n y_{ij}}, i=1,2,\dots,n \quad (5)$$

After data standardization, the information utility value of each indicator is calculated according to

the formula. Since initially setting the initial value to the minimum value would result in meaningless situations such as taking the logarithm of 0 during the calculation process, the initial value is corrected to the minimum value minus 0.1.

(1) Calculate the weight $w_j, j = 1, 2, \dots, s$ of the j -th indicator, where s represents the total number of indicators. The formula for calculating the indicator weights is as follows:

$$w_j = \frac{h_j}{\sum_{j=1}^s h_j} \quad (6)$$

Here, s represents the number of state indicators.

(2) Based on each row of data (such as the i -th row data $y_{ij}, j = 1, 2, \dots, s$) and the weights of each indicator w_j calculated above, the evaluation data I_z for the corresponding region and year is determined. The calculation formula is:

$$I_z = \sum_{j=1}^s w_j y_{ij} \quad (7)$$

Here, s represents the number of indicators, and w_j denotes the weight of the j -th state indicator. The objective weights are shown in Table 3.

Table 3. Objective weight

Primary indicator	Weight	Secondary indicator	Weight
Cognitive regeneration system cognition(A1)	0.4012	Regional ecology and cultural travel resource cognition(B1)	0.2055
		Circular economy and low carbon operating knowledge(B2)	0.1302
		Digital empowerment and fitness skills(B3)	0.0655
		Ethical trade-offs under conflicts of interest(B4)	0.0673
Ethics of regenerative responsibility(A2)	0.2012	Ecological empathy and generational sense of justice(B5)	0.0219
		Local associations and cultural heritage(B6)	0.0388
		Community well-being and inclusive service concept(B7)	0.0732
Practice of renewable change(A3)	0.2703	Resource value transformation and restoration design ability(B8)	0.0752
		Interboundary coordination and communication skills(B9)	0.1195
Regenerative psychosomatic function(A4)	0.1273	Real situation problem solving and project execution(B10)	0.0756
		Natural perception and ecological resistance(B11)	0.0583
		Body labor and professional service toughness(B12)	0.0690

The weights calculated by the analytic hierarchy process are based on the results of human assignment, and their calculation methods are usually more in line with actual situations. However, since they are subjectively assigned, there may be certain irrationalities due to human cognition and biases. The entropy weight method only calculates based on the degree of dispersion of the data itself, eliminating human deviations, but it may also lead to phenomena that do not conform to actual situations. Therefore, this article will combine the two methods. The common methods for fusing the two weights include power average synthesis method, average value method, etc.

This article intends to select the relatively common power average synthesis method to combine the two weights. Suppose that the weights of each indicator obtained based on the analytic hierarchy process are ω_j , and the weights of each indicator obtained based on the entropy weight method are θ_j , then the combined weight φ_j calculated by the power average synthesis method is:

$$\varphi_i = \frac{\omega_i \theta_i}{\sum_{i=1}^{12} \omega_i \theta_i} \quad (8)$$

The comprehensive indicator weights obtained are shown in Table 4. Among the weights of the first-level indicators, the weight of the "recycling system cognition" is the highest, at 0.4074.

Table 4. Composite index weight

Primary indicator	Weight	Secondary indicator	Weight
Cognitive regeneration system cognition(A1)	0.4074	Regional ecology and cultural travel resource cognition(B1)	0.2118
		Circular economy and low carbon operating knowledge(B2)	0.1316
		Digital empowerment and fitness skills(B3)	0.0641
Ethics of regenerative responsibility(A2)	0.1952	Ethical trade-offs under conflicts of interest(B4)	0.0668
		Ecological empathy and generational sense of justice(B5)	0.0210
		Local associations and cultural heritage(B6)	0.0375
		Community well-being and inclusive service concept(B7)	0.0699
Practice of renewable change(A3)	0.2739	Resource value transformation and restoration design ability(B8)	0.0772
		Interboundary coordination and communication skills(B9)	0.1203
Regenerative psychosomatic function(A4)	0.1236	Real situation problem solving and project execution(B10)	0.0765
		Natural perception and ecological resistance(B11)	0.0571
		Body labor and professional service toughness(B12)	0.0666

3.2. Establish a student assessment model for regenerative sustainable development education literacy

The assessment of the regenerative sustainable development education literacy of hotel vocational education students is to establish a specific index system to conduct a comprehensive and integrated assessment of the various qualities and abilities of hotel vocational education students. The indicators of regenerative sustainable development education literacy for hotel vocational education students are complex and intricate, and require certain methods for classification, stratification, and the assignment of weight coefficients to establish a measurable assessment index system.

The assessment indicators of regenerative sustainable development education literacy for hotel vocational education students are mostly difficult to quantify and have a certain degree of ambiguity. This requires the assessment experts to make fuzzy judgments on the assessment indicators, obtain a fuzzy judgment matrix, and through calculation convert the fuzzy and non-quantitative indicators into quantitative indicators.

Given the complexity and ambiguity of the quality assessment of hotel vocational education students, this paper will adopt the fuzzy assessment method to establish a mathematical model to assess the regenerative sustainable development education literacy of students. The fuzzy assessment method is a comprehensive assessment method based on fuzzy mathematics theory. The fuzzy assessment method converts the assessment of qualitative indicators into quantitative assessment of indicators according to the membership theory of fuzzy mathematics. The fuzzy assessment method has clear hierarchy, is simple and feasible, and has relatively accurate assessment results. Especially, it can objectively assess fuzzy and difficult-to-quantify indicators and is suitable for solving various non-quantitative problems.

The specific implementation steps of the fuzzy comprehensive assessment method for assessing the regenerative sustainable development education literacy of hotel vocational education students are as follows:

- (1) Formulate the factor set, weight set and evaluation criteria set

The factor set is the collection of all indicators in the index system. The assessment system for the regenerative sustainable development education literacy of hotel vocational education students set up in this article consists of two levels of assessment indicators, thus the factor set is divided into two levels. The four first-level indicators together constitute the first-level factor set $X = \{X_i\}$, and the 12 second-level indicators constitute the second-level sub-factor set $X_i = \{X_{ij}\}$.

The weight set is the collection obtained by assigning weights to the assessment indicators through

certain methods. The weight set is also divided into two levels. The first-level factor weight set in the assessment system for the regenerative sustainable development education literacy of hotel vocational education students is $A = \{A_i\}$, and the weights of the second-level indicators are divided into the second-level sub-factor weight sets $A_i = \{A_{ij}\}$.

The comment set is the collection of judgment results made by the assessment experts for the assessment objects. In this article, the assessment index system sets the assessment grades as: A, B, C, D, that is: excellent, good, medium, and poor, defined as $R = \{r_1 \ r_2 \ r_3 \ r_4\}$. It should be noted that if there are 10 assessment experts, then for a certain indicator, the excellent, good, medium, and poor of that person are respectively: $\{A/10, B/10, C/10, D/10\}$.

(2) Establish the fuzzy assessment matrix for students' regenerative sustainable development education literacy

Establishing a fuzzy assessment matrix is actually establishing the fuzzy relationship between the factor set and the comment set. Suppose when assessing the k th factor in X_{ij} , then R_{ijk} can be used to represent the fuzzy set of the assessment result, and can be obtained as $R_{ijk} = \{r_{ij1} \ r_{ij2} \ r_{ij3} \ r_{ij4}\}$.

Thus, when there are 4 elements in X_{ij} , the assessment matrix composed of the assessment results can be recorded as:

$$X_{ij} = \begin{bmatrix} x_{ij11} & \cdots & x_{ij14} \\ \vdots & \ddots & \vdots \\ x_{ij41} & \cdots & x_{ij44} \end{bmatrix} \quad (9)$$

(3) The conclusion of the fuzzy evaluation is derived based on the obtained weight vector of the indicators and the evaluation matrix. Finally, the conclusion of the fuzzy evaluation is obtained. It can be seen that the comprehensive evaluation conclusion is:

$$B = A \cdot R \quad (10)$$

In the formula, B represents the comprehensive assessment vector, A represents the indicator weight vector, and R represents the assessment matrix.

For the assessment of the second-level indicators, we obtain $B_i = A_i \cdot R_i$, and after normalization, the result is formed into a first-level fuzzy assessment matrix R , as well as $B = (b_1 \ b_2 \ b_3 \ b_4)$. After normalizing B , the result of the assessment of the students' regenerative sustainable development education literacy in hotel vocational education will be obtained.

4. Empirical Evaluation of Students' Regenerative Sustainable Development Education Literacy

4.1. Research Subjects and Tools

Based on the student regenerative sustainable development education literacy assessment index system, corresponding assessment questionnaires were developed to conduct a questionnaire survey among vocational college students, to understand the specific situation of the students' regenerative sustainable development education literacy in the twelve indicator dimensions of vocational colleges. At the same time, corresponding questionnaires were also developed to conduct expert assessments on school teachers to obtain the score results of the students' regenerative sustainable development education literacy of the corresponding schools. In general, students from different disciplines, grades and regions in multiple provinces of China were selected, and the developed student regenerative sustainable development education literacy assessment questionnaire was distributed to vocational college students, while the expert consultation questionnaire on the regenerative sustainable development education literacy of vocational college students for school teachers was distributed to the teachers of the surveyed schools. In the formal survey, a total of 1642 assessment questionnaires were collected, 153 invalid questionnaires were excluded, and the effective rate of the questionnaires was 90.68%. Finally, 1489 valid questionnaires were obtained.

School teachers bear the responsibility of imparting knowledge, guiding students, and answering their questions. They not only need to guide students to construct a knowledge system, but also need to lead students to carry out professional practice. Therefore, it is reasonable to understand the situation of students' regenerative sustainable development education literacy by conducting a survey on teachers. Therefore, in order to achieve the verification of the model, it is also necessary to distribute the expert

consultation questionnaire on the regenerative sustainable development education literacy of vocational college students to the teachers of the six surveyed schools to obtain the general evaluation of the students' regenerative sustainable development education literacy of the surveyed schools. The expert consultation questionnaire on the regenerative sustainable development education literacy of vocational college students finally collected a total of 120 valid questionnaires.

4.2. Validity and Reliability Testing

Based on the previously established vocational school students' regenerative sustainable development education literacy index system and the observation points of each indicator, while partially drawing on the evaluation index systems of different provinces and the expressions in other literatures, a vocational school students' regenerative sustainable development education literacy index system assessment questionnaire was developed. The questionnaire consists of 36 questions, with four first-level dimensions each having 8 questions. The assessment questionnaire adopts the Likert five-level scale format. According to the final survey results, the Cronbach's Alpha coefficient of the entire assessment questionnaire is 0.959. After review, it is known that the reliability coefficient must be greater than 0.8 to be acceptable, which indicates that this questionnaire has a high reliability.

At the same time, the validity test results are shown in Table 5. The average variance extraction (AVE) values of each first-level indicator are all greater than 0.5, and the composite reliability (CR) values of all indicators are greater than 0.84. This indicates that the ratio of the explained variance of each indicator and the scale's convergent validity is high in this study; at the same time, it can be calculated that the square roots of the AVE of each indicator in the table are obviously greater than the correlation coefficient of that indicator with other indicators, indicating that each indicator has a high discriminant validity. Moreover, from the table, it can be seen that the correlation coefficients between each one-dimensional indicator and its total scale, as well as the correlation coefficients between each one-dimensional indicator and the regenerative sustainable development education literacy, have all passed the significance test, and the correlation coefficients between each one-dimensional indicator and the total correlation coefficient of regenerative sustainable development education literacy are all smaller, indicating that the four one-dimensional indicators are highly independent and have a strong correlation with regenerative sustainable development education literacy. In conclusion, the entire scale has good reliability and validity, and meets the reliability and validity test standards.

Table 5. Validity test results

Dimension	Mean variance sampling	Component reliability	Total quality	A1	A2	A3	A4
A1	0.55	0.93	0.73**	0.74			
A2	0.57	0.89	0.85**	0.62**	0.75		
A3	0.60	0.94	0.87**	0.59**	0.63**	0.78	
A4	0.62	0.91	0.78**	0.60**	0.52**	0.68**	0.79

4.3. Differences in Education Literacy Levels for Regenerative Sustainable Development among Different Regions

The students' regenerative sustainable development education literacy has certain requirements for students' overall qualities and is constrained by economic development and the level of social development. In this survey, the study divided different provinces into three regions: the eastern region, the central region, and the western region. Among them, there were 326 students in the eastern region, accounting for 21.90%; 290 students in the central region, accounting for 19.50%; and 873 students in the western region, accounting for 58.60%. To further study the impact of regional differences on students' regenerative sustainable development education literacy scores, this study still used the single-factor analysis method to conduct difference analysis on the valid data.

Through overall analysis, it was found that the regenerative sustainable development education literacy scores of students in different regions were different. The students in the eastern region had the highest scores, followed by those in the central region, and the students in the western region had the lowest scores. Through further analysis of the mean values, it was found that the F value was 61.355, and the test p-value obtained from the variance analysis was less than 0.01, indicating that there were significant differences in the regenerative sustainable development education literacy scores of students in different regions.

By further using the LSD multiple comparison method for post-hoc tests to conduct pairwise comparisons, it was found that there were significant differences in the scores among students in different regions, with $p < 0.05$.

The significant test results of the differences in the scores of the first-level indicators are shown in Table 6. There were significant differences in the regenerative sustainable development education literacy scores among students in different regions, with $p < 0.01$. After further testing using the LSD multiple comparison method, it was found that in the four first-level indicators of students' regenerative sustainable development education literacy, there were no significant differences in the scores of students in the eastern and central regions in the indicators of regenerative transformation practice and regenerative physical and mental functions; in the pairwise comparison tests of the scores of the other regions' students' regenerative sustainable development education literacy, the scores of the four first-level indicators all had significant differences, with $p < 0.05$.

In terms of the scores of the four first-level indicators of students' regenerative sustainable development education literacy, the scores of students in different regions generally showed a decreasing trend from east to west, that is, the scores of students in the western region were $<$ those of the central region and $<$ those of the eastern region.

Table 6. Significance test for score difference of grade one index

Primary indicator	1. Eastern region(N=326)		2. Central region(N=290)		3. Western region(N=873)		F	P
	M	SD	M	SD	M	SD		
Cognitive regeneration system cognition(A1)	4.12	0.85	3.92	0.81	3.85	0.81	32.085**	1>2>3**
Ethics of regenerative responsibility(A2)	3.42	0.90	3.25	0.86	3.11	0.86	44.503**	1>2>3**
Practice of renewable change(A3)	3.47	0.90	3.33	0.88	3.14	0.85	58.283**	1>2,2>3**
Regenerative psychosomatic function(A4)	3.83	0.75	3.70	0.78	3.55	0.73	43.234**	1>2,2>3**

The results of the significance test for the differences in the scores of the secondary indicators are shown in Table 7. In terms of the secondary indicator scores of students' regenerative sustainable development education literacy, there are significant differences in the scores among students from different regions, with $p < 0.01$. After further testing using the LSD multiple comparison method, it was found that:

In aspects such as ethical weighing under conflict of interests, ecological empathy and intergenerational justice, community well-being and inclusive service perspective, cross-border collaboration and communication ability with stakeholders, natural perception and ecological resilience, embodied labor and professional service resilience, etc., the scores of students in the eastern region were the highest, those in the central region were second, and those in the western region were the lowest. The F values obtained from the variance analysis were 38.233, 44.347, 46.038, 64.219, 37.694, and 36.791, respectively. Among the six secondary indicators, there was no significant difference in the scores of students from the eastern and central regions ($p > 0.05$), while the remaining pairwise post-hoc comparisons all showed significant differences.

In terms of the scores of the six secondary indicators such as regional ecological and cultural tourism resource cognition, circular economy and low-carbon operation knowledge, digital empowerment and adaptive technology literacy, sense of connection with the local culture and cultural inheritance mission, resource value transformation and restoration design ability, real situational problem-solving and project execution ability, etc., the scores of students in the eastern region were the highest, those in the central region were second, and those in the western region were the lowest. The F values were 31.881, 39.074, 15.612, 37.845, 49.282, and 60.793, respectively. The pairwise post-hoc comparisons also showed significant differences, with $p < 0.01$; among them, the differences in the scores of students from the eastern and central regions in the secondary indicators of sense of connection with the local culture and cultural inheritance mission, resource value transformation and restoration design ability, and real situational problem-solving and project execution ability were $p < 0.5$.

Table 7. Significance test for score difference of secondary index

Secondary indicator	1. Eastern region(N=326)		2. Central region(N=290)		3. Western region(N=873)		F	P
	M	SD	M	SD	M	SD		
B1	4.08	0.86	3.90	0.84	3.78	0.80	31.881**	1>2>3**
B2	4.06	0.83	3.87	0.85	3.73	0.83	39.074**	1>2>3**
B3	4.26	0.87	3.97	0.87	3.89	0.84	15.612**	1>2>3**
B4	3.41	0.93	3.31	0.88	3.15	0.88	38.233**	1>2,2>3**
B5	3.39	0.95	3.25	0.90	3.10	0.89	44.347**	1>2,2>3**
B6	3.39	0.94	3.26	0.91	3.12	0.92	37.845**	1>2*,2>3**
B7	3.32	0.92	3.24	0.92	3.09	0.92	46.038**	1>2,2>3**
B8	3.48	0.95	3.36	0.89	3.20	0.90	49.282**	1>2*,2>3**
B9	3.54	0.94	3.39	0.86	3.2	0.87	64.219**	1>2,2>3**
B10	3.49	0.89	3.37	0.89	3.16	0.87	60.793**	1>2*,2>3**
B11	3.82	0.84	3.73	0.79	3.57	0.80	37.694**	1>2,2>3**
B12	3.79	0.70	3.64	0.71	3.50	0.76	36.791**	1>2,2>3**

4.4. Differences in Education Literacy Levels for Regenerative Sustainable Development between Urban and Rural Areas

The significant test results of the differences in the score of the first-level indicator of educational literacy for regenerative sustainable development between urban and rural areas are shown in Table 8. The proportions of students in urban and rural areas are 56.01% and 43.99% respectively. The study found that in terms of the regenerative sustainable development educational literacy scores of students between urban and rural areas, there is a significant difference in the overall scores of regenerative sustainable development educational literacy between urban students and rural students, with $p < 0.01$, and the scores of urban students are higher than those of rural students.

In terms of the score of the first-level constituent indicators of students' regenerative sustainable development educational literacy, there are significant differences in the scores of students between urban and rural areas, with $p < 0.01$, and the scores of rural students are less than those of urban students.

Table 8. Significance test for score difference of grade one index

Primary indicator	City student(N=834)		Rural student(N=655)		F	P
	M	SD	M	SD		
Cognitive regeneration system cognition(A1)	3.93	0.81	3.76	0.78	114.601**	0.000
Ethics of regenerative responsibility(A2)	3.25	0.84	3.08	0.83	105.999**	0.000
Practice of renewable change(A3)	3.34	0.86	3.11	0.86	143.676**	0.000
Regenerative psychosomatic function(A4)	3.71	0.73	3.49	0.72	191.564**	0.000

The significant test results of the differences in the scores of the secondary indicators of educational literacy for regenerative sustainable development between urban and rural areas are shown in Table 9. The study used SPSS 20.0 software to conduct a one-way analysis of variance on the scores of the secondary constituent indicators of students' regenerative sustainable development educational literacy between urban and rural areas. There were significant differences in the overall scores of students' regenerative sustainable development educational literacy, as well as the scores of the first-level and secondary indicators between urban and rural areas. The p value was less than 0.1, and the scores of students in urban areas were higher than those in rural areas.

Table 9. Significance test for score difference of secondary index

Secondary indicator	City student(N=834)		Rural student(N=655)		F	P
	M	SD	M	SD		
B1	3.88	0.88	3.70	0.84	90.108**	0.000
B2	3.90	0.86	3.66	0.82	111.755**	0.000
B3	4.03	0.83	3.87	0.83	102.063**	0.000
B4	3.28	0.89	3.13	0.89	88.526**	0.000
B5	3.25	0.92	3.05	0.89	93.704**	0.000
B6	3.22	0.89	3.07	0.87	101.471**	0.000
B7	3.23	0.93	3.09	0.87	94.133**	0.000
B8	3.34	0.89	3.12	0.88	136.867**	0.000
B9	3.35	0.9	3.16	0.90	166.237**	0.000
B10	3.32	0.89	3.10	0.85	154.873**	0.000
B11	3.76	0.77	3.45	0.83	195.349**	0.000
B12	3.65	0.73	3.50	0.74	118.372**	0.000

5. Regional Adaptation Strategy

The western region should adopt the strategy of "activation of fundamentals + resource supplementation". Students in the western region not only lack systematic knowledge of regional ecological and cultural tourism resources, but also lack the support for transforming their cognition into actions. By optimizing the collaboration model of enterprises in the east and resources in the west, introducing the mature curriculum systems and training plans from eastern vocational colleges, and establishing a two-way exchange mechanism for teachers between eastern and western vocational colleges, it is possible to achieve this goal.

The central region should implement the strategy of "platform construction + ability enhancement". The educational literacy level of students in the central region lies between that of the east and the west. The central region should build a data-sharing and project-cooperation platform for regional hotel industry and vocational education, promoting the upgrade of industry-education integration from resource connection to capacity creation. At the same time, it is encouraged to set up regional characteristic majors based on local conditions, converting the local sustainable development deficiencies of the hotel industry into upgradeable teaching projects.

Students in the eastern region perform optimally in all dimensions and have the basic conditions to lead the development of national regenerative education. It is suggested that the eastern region take the lead in formulating local standards and teaching guidelines for regenerative sustainable development education in hotel vocational education, converting local experience into replicable and promotable institutional achievements.

For rural areas, a local resource activation + lightweight empowerment strategy should be implemented. Due to the lack of information and teachers, the educational advantages of rural students have not been transformed into professional competitiveness. It is recommended to develop lightweight and mobile-accessible regenerative literacy course resources, and through the assistance mechanism of urban and rural vocational colleges, provide rural students with more abundant practical platforms and opportunities for vision expansion.

6. Conclusion

This study constructed an evaluation index system for the educational literacy of regenerative sustainable development among vocational college students. Based on 1,489 valid sample data, it examined the current status and differential characteristics of the regenerative sustainable development educational literacy of students in the eastern, western, central regions, and urban and rural areas in China.

There are significant gradient differences in the regenerative sustainable development educational literacy of hotel vocational education students in the eastern, central, and western regions. The students in the eastern region have the highest score in regenerative sustainable development educational literacy, followed by those in the central region, and the students in the western region have the lowest score ($F = 61.355$, $P < 0.01$). At the four-level indicators, the scores of students in the western region are significantly lower than those of students in the central region and the eastern region. At the 12-level indicators, the situation is that the students in the eastern region have the highest score, those in the central region have the second-highest score, and those in the western region have the lowest score. The differences in the scores of the three secondary indicators of "regenerative physical and mental functions", "responsibility ethics in regeneration", and "resource value transformation and

restoration design ability" are significant. In the remaining indicators, there are no significant differences between the two regions, but both regions have significantly higher scores than the western region. These results indicate that regional economic development levels are important factors restricting the cultivation of regenerative sustainable development educational literacy, and the literacy gap effect in the western region is particularly prominent.

There are also significant differences in the regenerative sustainable development educational literacy of urban and rural students. The overall score of the urban students is significantly higher than that of the rural students ($P < 0.01$), and the differences in the four-level indicators are highly significant ($P < 0.01$). Among them, the differences in the "regenerative physical and mental functions" dimension are the most prominent, and the gap in the "responsibility ethics in regeneration" dimension is relatively small.

This study has the following limitations. The regional adaptation strategies are mainly derived from empirical findings. In the future, intervention experiments can be conducted in specific regions to test the actual effects of different strategies.

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