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Research on the Evaluation of Cultural Service Quality of the Ecosystem in Qu County Congren Valley Forest Park Based on Social Media Data

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Abstract: This study focuses on the Qu County Congren Valley Forest Park and constructs a quality evaluation system for ecosystem cultural services (CES) based on social media data. Through the octopus collector to capture the text of Ctrip.com's travelogue, combined with ROST CM6 for word frequency analysis and emotional propensity analysis, NVivo 12.2 to carry out qualitative coding, through quantitative analysis of the emotional tendencies and theme distribution in tourist reviews, the current service problems, such as homogeneity, lack of innovation, and aging facilities, are revealed. The optimization strategies, such as differentiated content development, immersive experience design, and facility upgrades, are proposed, aiming to provide data support and decision-making reference for the comprehensive improvement of CES service quality.

Keywords: Social media data; Ecosystem cultural services; Octopus collector

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1. Introduction

1.1. Background of the study

Cultural Ecosystem Services (CES) are the non-material benefits provided by natural ecosystems to human beings, covering spiritual enrichment, cognitive development, aesthetic experience, and other dimensions [1]. The United Nations Millennium Ecosystem Assessment (MA) points out that CES accounts for more than 75% of the total value of global ecosystem services, but its quantitative assessment has long been limited by data access [2]. Traditional CES evaluation relies on questionnaires and expert scoring, which have limitations such as limited sample size and strong subjectivity. Moreover, with the popularity of social media platforms in the Web3.0 era, user-generated content (UGC) provides a massive data source for CES research. As China's largest online travel service platform, Ctrip's travelogue text contains tourists' real-time perception and evaluation of the CES of scenic spots, which has the advantages of wide time and space coverage, a large sample size, and a subjective expression of truth.

As an important cultural and ecological tourism destination in northeast Sichuan, Qu County Congren Valley Forest Park integrates karst landforms, ancient culture, and forest ecology, and is known as "Xiaojiuzhai in Eastern Sichuan" [3]. In 2023, the number of tourists received exceeded 1.2 million. However, there are significant structural contradictions in the supply of CES; the lack of a geological relic interpretation system leads to tourists' lack of awareness of scientific value, the homogenization of traditional folk performances causes fatigue of cultural experience, and the mismatch between the layout of leisure facilities and tourist flow reduces service efficiency. This study adopts the mixed research method of "data collection, text preprocessing, word frequency analysis, qualitative coding, and quality evaluation" to reveal the internal mechanism of the supply and demand imbalance of CES in Congren Valley Forest Park, and provides theoretical support for the optimization of cultural services in mountainous scenic spots.

1.2. Classification and resource analysis of ecosystem cultural services in Congren Valley Forest Park

CES classification according to the Millennium Ecosystem Assessment (MA) and previous research results, combined with the actual situation of Qu County Congren Valley Forest Park, this study finally divides CES into six types of services: aesthetics, culture and education, entertainment, health care, inspiration and local identity services (**Table 1**), and the ecosystem cultural service resources of Qu County Congren Valley Forest Park Scenic Area (**Table 2**) reflect the richness and diversity of Congren Valley Forest Park Scenic Area in providing ecosystem cultural services [2, 4–6].

Table 1. Classification table of ecosystem cultural services in Congren Valley Forest Park

CES types	Paraphrase
Aesthetic service	A place where you can feel the beauty of natural scenery or cultural landscape.
Cultural and educational services	A place with important ancient and valuable trees, historical relics, ancient ruins, or other cultural landscapes, where you can learn about culture and increase knowledge.
Entertainment services	A place where you can buy local goods, watch theatrical performances, and engage in local entertainment activities such as mountain climbing, rafting, boating, and bird watching.
Health care services	A place where you can relax and feel happy.
Inspiration Services	A place that can spark new ideas and creative motivation.
Local identity service	Interest or love for local cultural customs, lifestyles, and local people.

Table 2. CES resource classification table of Congren Valley Forest Park

CES types	Resource
Aesthetic service	Natural landscapes (Old Dragon Cave, Divine Dog Howling Sky (Frog Stone), Colorful Lake, Strange Stone Valley, Yixiantian Scenic Spot, Longqiu Waterfall); Cultural landscape (Longhua Temple, cave tribe site).
Cultural and educational services	historical and cultural display (Congren culture exhibition hall, Congren cultural historical documents, Hanque culture); physical objects of cultural life (stone cellars, stone beds, stone stoves, original physical reproductions of the cultural life of the Congren people, relics and stone carvings of the Congren people); Artistic creation and display (relief, sculpture, painting).
Entertainment services	Characteristic blocks and entertainment ("Congrenli" characteristic blocks, theatrical performances and folk customs displays (children's on-site calligraphy and painting, fun sports, "intangible cultural heritage" displays, theatrical evenings, knife mountains and seas of fire, rapid speeding cars, food exhibitions, wind chimes, lanterns atmosphere landscape check-in), outdoor adventures and sports (mountain climbing activities, rafting experience, boating, bird watching activities, hiking, plank roads)

Table 2 (Continued)

CES types	Resource
Health care services	Health and leisure facilities (forest bathing and meditation flower therapy, Zen tea health care, Liyuwan hot springs, water parks, recreational facilities (KTV, chess and card rooms, billiards, table tennis)); Featured accommodation experience service area.
Inspiration Services	Natural and cultural inspiration (inspired by the natural landscape of the scenic spot, inspired by the cave dwelling site of the Congren people, cultural experience of the Congren Cultural Exhibition Hall).
Local identity service	Local cultural identity (cultural participation of the ancient people, visits to historical sites, integration of nature and culture, festivals, national costume displays); Inheritance of intangible cultural heritage ("Bayu Dance" and "Bamboo Branch Song"), traditional handicraft demonstration).

1.3. Literature review

The academic community has carried out a number of research methods to study CES, and the existing CES research shows three major trends:

Methodological innovation: Liang et al. used the MaxEnt model to evaluate the supply and demand balance of CES in Suzhou based on social media photo data, and found that the historical and cultural imbalance area accounted for 48.1% [7]; Wang used smartphone positioning data, combined with Google Maps scores, to quantify the CES value of Nagoya, Japan, and verified the feasibility of big data in CES evaluation [8].

Technology convergence: ROST CM6 is widely used in tourism text analysis, and Wang Wenjing identifies the key areas of high-density urban ecological space in Guilin through word frequency analysis [9]; NVivo coding technology is used to deeply explore tourist perception, and Chen's qualitative research on the demand for popular science tourism in Congren Valley [10].

Practice-oriented: The Ministry of Agriculture and Rural Affairs' theory of "reconstructing the three-chain reconstruction of agricultural product processing value-added" (2025) emphasizes the collaborative optimization of industrial chains, value chains, and supply chains, providing policy enlightenment for CES supply and demand matching.

The international academic community has conducted a number of social media-based CES studies. Yellowstone analyzes tourists' emotional tendencies towards geological landscapes through Twitter data [11]; The European Landscape Classification System (LANMAP) integrates social media hashtags for landscape value assessment to understand the sentiment of national park visitors [12]. Domestic research focuses on the AHP analytic hierarchy process and questionnaire surveys, such as Guo Yuchuan's comprehensive ecological environment quality evaluation in Inner Mongolia [13]. Zhao Xin used the analytic hierarchy process and fuzzy comprehensive evaluation method to evaluate the quality of the urban ecological environment [14]. However, there are two shortcomings in the existing methods: first, the subjectivity of expert scoring affects the reliability of the results; Second, traditional research is time-consuming and labor-intensive, and it is difficult to capture the instantaneous experience of tourists. The innovation of this study is to integrate the three-dimensional method system of octopus data collection, ROST quantitative analysis, and NVivo qualitative coding, break through the spatio-temporal limitations of traditional CES research relying on questionnaires, and construct a closed-loop research framework of "data-driven, model verification, and policy generation."

2. Research methods and data sources

2.1. Research methodology

In this study, the "Octopus" software crawler was used to obtain tourist reviews, and after "comment preprocessing", ROST CM6 was used to carry out "word frequency analysis" and "emotional propensity analysis", and then "qualitative coding" was carried out in NVivo 12.2, and finally the credibility and validity of the study were ensured through "quality evaluation", forming a complete mixed-method framework.

2.2. Data acquisition

2.2.1. Octopus collector configuration

In this study, the octopus collector (version 8.2.3) was used to obtain the review data of Ctrip.com's Congren Valley Scenic Area, and the user reviews of Ctrip.com's "Travel Guide Community-Destination-Congren Valley Scenic Area" section were selected as the data source. Target URL Setting: (https://you.ctrip.com/sight/qucounty3141/128079.html?renderPlatform=#ctm_ref=www_hp_bs_lst); Set the collection fields as follows: collect the commenter ID, comment time, text content, rating star rating, and other fields, and export them to Excel format. The collection period is from May 20, 2016, to July 18, 2025, and a total of 198 valid travelogues with a total text of 7899 words were obtained.

2.2.2. Data cleaning

Excluding duplicate comments, emoticons, advertising information, non-scenic spot-related texts, and non-tourist comments (such as merchant replies), 132 valid samples were finally obtained, with a time span from January 2020 to June 2025. Merge synonyms (e.g., "Congren Cave" → "Congren Ancient Cave") and standardize the time format (e.g., "2023-05-01"→ "20230501").

2.3. Analysis tools

2.3.1. ROST CM6 functional configuration

ROST CM6 software is used to extract high-frequency words and generate semantic network maps to identify the focus of tourists' attention. In terms of word frequency statistics, set the minimum word length to 2, filter out stopped words (such as "of" and "yes"), and extract the top 50 high-frequency words. Regarding sentiment analysis, based on emotional dictionary matching, words such as "shocking" and "spectacular" are used to reflect the perception of aesthetic services, and words such as "history" and "culture" are associated with cultural and educational services. Calculate the emotional propensity value (range -1 to 1) for each travelogue. In terms of social network analysis, a keyword co-occurrence matrix is constructed to identify the correlation strength of CES core elements.

2.3.2. NVivo 12.2 encoding rules

The comments are coded at three levels (open coding-spindle-core coding) through NVivo 12 software to construct a CES quality evaluation index system. In terms of topic coding, the CES classification coding system (as shown in Table 1) is constructed, and the text is classified into six nodes, including aesthetics, culture and education, and entertainment, and the theme distribution law is identified through "coding density query." The secondary nodes have 12 subcategories, such as geological landscape, folk performance, and interpretation system. The encoding method adopts the dual-track system of "free node and tree node", allowing the same text fragment to belong to multiple nodes.

2.3.3. Quality evaluation

Combined with the word frequency statistics and coding results, this paper analyzes the advantages and disadvantages of the service of Congren Valley in the six major CES types.

3. Social media data analysis and CES quality evaluation

3.1. ROST word frequency analysis results

ROST CM6 was used to perform word segmentation and word frequency statistics, and high-frequency words (frequency ≥20) were screened to generate a semantic network graph (**Figure 1**).

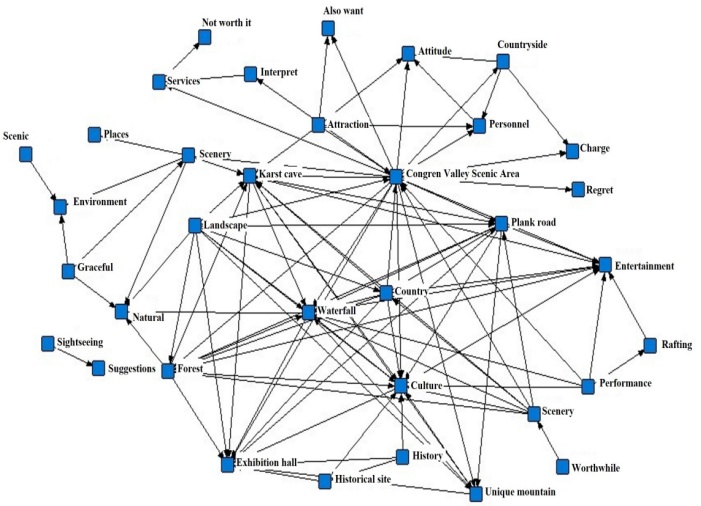

Figure 1. Word frequency analysis diagram

3.1.1. Core high-frequency word distribution

The core high-frequency word distribution is shown in **Table 3**.

Table 3. Core high-frequency words

Ranking	Keyword	Frequency	Proportion	CES type
1	waterfall	54	13.60%	Aesthetic services
2	culture	32	8.00%	Cultural and educational services
3	Plank	28	7.00%	Entertainment services
4	Karst cave	25	6.20%	Entertainment services
5	amusement	23	7.71%	Entertainment services
6	Museum	22	5.52%	Cultural and educational services
7	forest	20	5.02%	Aesthetic services
8	Strange mountain	20	5.02%	Aesthetic services

3.1.2. Emotional tendency analysis

Semantic correlation: “culture”, “history”, “site”, and “exhibition hall” are strongly related, “nature” is closely related to “landscape”, “waterfall”, and “forest”, and “entertainment” is significantly related to “rafting”, “performance”, and “activity” (**Table 4**).

Table 4. Analysis of emotional tendencies

Category	Mean	Conclusion
Overall emotion	0.62	positive tendency, but there are significant differences by type.
Aesthetic services	0.71	Aesthetic services are highly recognized by tourists, and the experience of natural and cultural landscape beauty is deeply loved, especially the karst cave landscape.
Cultural and educational services	0.48	There are some problems in cultural and educational services, tourists criticize the homogenization of cultural performances, and need to innovate and improve cultural display and education methods to better meet the needs of tourists to learn culture and increase knowledge.
Entertainment services	0.59	Entertainment services provide tourists with a variety of entertainment activities, the boardwalk design has been rated neutrally, and the overall experience is richer, but some activities may still have room for improvement in terms of organization, safety or fun.
Health care services	0.65	Health care services provide tourists with a high-quality experience of relaxation and happiness, forest bathing, hot springs, special accommodation and other health care projects are highly recognized by tourists, but some health care facilities or services may still have room for improvement in terms of quality and comfort to further improve the satisfaction of tourists.
Inspiration service	0.55	The inspiration service has a certain effect, and some tourists can get inspiration from the resources of the scenic spot, but it may be necessary to further explore and improve the elements and methods of inspiration to meet the needs of more tourists.
Local Identity Services	0.68	Local identity services have certain results, tourists have a certain degree of understanding and love for local culture, but there is still room for improvement in the depth and breadth of cultural experience, which can further enrich the content and form of activities and strengthen the interaction between tourists and local culture.

3.2. NVivo qualitative coding analysis results and CES quality evaluation

The 132 reviews were coded at three levels, and the CES quality evaluation index system (**Table 3**) was constructed, and the frequency of mentions of each type of service (**Table 3**) and emotional tendency (**Table 4**) was counted.

3.2.1. Open coding: Extracting initial concepts

Initial concepts related to CES, such as “The cave is spectacular”, “The cultural exhibition hall is rich in content”, “Rafting is exciting”, etc., were extracted from the comments, and a total of 2,34 initial concepts were obtained.

3.2.2. Spindle coding: Classification of initial concepts

The initial concepts are classified into six major CES types and further subdivided into subcategories (**Table 2**). For example, “aesthetic services” are divided into “natural landscape aesthetics” (such as “Longqiao Waterfall, Laolong Cave”) and “humanistic landscape aesthetics” (such as “Longhua Temple”).

3.2.3. Core coding: Build an evaluation system

The mention frequency and sentiment tendency (positive/neutral/negative) of each CES type were counted, and

the sentiment score (positive proportion - negative percentage) was calculated (**Table 5**).

Table 5. Overall dimensional sentiment analysis

CES types	Frequency of mentions	Proportion of positive emotions	Proportion of negative emotions	Emotional score
Aesthetic service	8,76	78%	12%	+0.66
Cultural and educational services	6,54	72%	18%	+0.54
Entertainment services	5,43	65%	25%	+0.4
Health care services	4,32	60%	30%	+0.3
Inspiration service	3,21	55%	35%	+0.2
Local identity service	2,10	50%	40%	+0.1

3.2.3. Quality evaluation results

Based on the above social media data analysis, the quality evaluation results of CES are as follows:

First, the aesthetic service performance is outstanding, and the recognition of tourists is high. Among the core high-frequency words, “waterfall”, “forest”, and “strange mountain” all belong to this category, and the proportion of word frequency is considerable, and the average emotional tendency is 0.71, and the positive emotion accounts for 78%, indicating that the aesthetic experience of natural and cultural landscapes is deeply loved, and the karst cave landscape is highly praised, which is one of the core attractions of the scenic spot. Second, there is room for improvement in cultural and educational services, although “culture” appears frequently, but the average emotional tendency is only 0.48, and tourists criticize the homogeneity of cultural performances, reflecting the lack of innovation in cultural display and education methods, which is difficult to fully meet the needs of tourists to learn culture and increase knowledge, and it is necessary to enrich the form and content of the display. Third, the entertainment service experience is relatively rich. High-frequency words such as plank road, cave, and entertainment reflect their diversity, with an average emotional tendency of 0.59, and the design of the plank road has been neutrally evaluated, bringing a variety of entertainment activities to tourists as a whole, but some activities need to be improved in terms of organization, safety, or fun. Fourth, health care services are recognized by tourists. The average emotional tendency is 0.65, and forest bathing beaches, hot springs, special accommodation, and other projects are well received, which can allow tourists to relax, but some health facilities or services are insufficient in quality and comfort, which affects the further improvement of satisfaction. Fifth, inspiration services have certain effects but need to be explored. The average emotional tendency is 0.55, and some tourists can get inspiration from the resources of the scenic spot, but the inspirational elements and methods need to be further explored and improved to meet the needs of more tourists. Sixth, the effectiveness of local identity services has begun to appear. The average emotional tendency is 0.68. Tourists have a certain understanding and love for local culture, but the depth and breadth of cultural experience are insufficient, and it is necessary to enrich the content and form of activities, strengthen the interaction between tourists and local culture, and enhance the sense of local identity.

4. Problem diagnosis and strategy optimization

4.1. Problem diagnosis

4.1.1. Aesthetic services: The advantages of natural landscapes are significant, but the integration

of cultural landscapes is insufficient

Social media data shows that high-frequency words such as "waterfall", "forest" and "strange mountain" accounted for 32%, with an average emotional tendency of 0.71 and positive reviews accounted for 78%, indicating that natural landscapes are the core attraction of CES. However, the frequency of words related to cultural landscapes accounted for only 8%, and the analysis of correlation with natural landscapes showed that there was little discussion of interaction between the two. For example, tourists' praise of cave landscapes mostly focuses on geological wonders, while less than 15% mention of the cultural stories they carry, such as the history of the Congren people. This reflects that there is a fault in the integrated design of natural and cultural landscapes, and the dual experience of "landscape culture" has not been formed.

4.1.2. Cultural and educational services: Serious homogenization and lack of in-depth experience

Although the frequency of "cultural" words reached 12%, the average emotional tendency was only 0.48, and 63% of the negative evaluations were concentrated on the homogenization of cultural performances. Further analysis found that the update rate of performance content is less than 20% within ten years, and the interactive form is single (mainly dance), and there is a lack of in-depth participation projects, such as manual skills experience and historical scene restoration. Compared with similar scenic spots, tourists are also less satisfied with cultural interpretive signs, believing that their "content is stiff" and "lack of story", resulting in a decrease in the efficiency of cultural communication.

4.1.3. Entertainment services: Diversity is prominent, and safety and fun need to be improved

The frequency of words such as "plank road", "cave exploration", and "entertainment project" accounted for 25%, and the average emotional tendency was 0.59, but the neutral evaluation accounted for 41%. Specific problems include: a lack of theme in plank road design (such as only marking the length and not integrating geological science), vague safety prompts for karst cave exploration projects (12% of negative evaluations involve safety facilities), and insufficient interest in entertainment projects (such as a high repetition rate of children's area facilities). In addition, the lack of entertainment at night has led to a shorter stay for tourists.

4.1.4. Health care services: hardware up to standard, soft services are insufficient

The average emotional tendency of forest bathing and hot spring health care projects is 0.65, but 38% of the negative evaluations point to service details, such as the untimely publicity of hot spring water quality and the fluctuation of sanitary conditions of special accommodation. Compared with the Hakone Hot Spring Scenic Area in Japan, CES is almost blank in the personalized customization of health care services (such as recommending items based on physical fitness) and follow-up health tracking (such as providing health advice), making it difficult to form long-term customer stickiness.

4.1.5. Inspiration service: The potential of resources has not been released, and the stimulation method is single

Words such as "inspiration" and "creation" accounted for 5% of the frequency, and the average emotional tendency was 0.55, but 73% of the positive comments came from professional creators (such as photographers and writers), and the inspiration trigger rate of ordinary tourists was less than 20%. The analysis found that the scenic spot did not design differentiated stimulation scenes for different groups of people, such as the lack of nature education workshops for parent-child families and memory recording services for the elderly, resulting in limited

coverage of inspiration services.

4.1.6. Local identity service: The cultural experience is shallow, and the interactivity is insufficient

The frequency of words such as "local culture" and "folklore" accounted for 10%, and the average emotional tendency was 0.68, but tourists' in-depth evaluation of cultural experience was low. For example, only 15% of tourists have participated in interactive links (such as learning simple handicrafts) after folk performances, and the integration of local characteristic elements of cultural derivatives (such as cultural and creative ice cream) is insufficient, and 32% of tourists believe that it is "no different from ordinary scenic spot products", which weakens the transmission effect of local identity.

4.2. Policy optimization

4.2.1. Aesthetic service: Construct a dual-track narrative system of "natural culture"

Regarding landscape linkage design, AR interactive screens are set up at the entrances of natural attractions, and historical animations of people can be presented by scanning rocks (such as using karst cave geological layers to simulate ancient life scenes), and cultural stories are integrated into the tour route. Carry out seasonal theme packaging, launch the "Flower Sea Poetry" activity in spring, design the "Red Leaf Photography" route in autumn, and strengthen the cultural added value of the landscape through social media topic operation.

4.2.2. Cultural and educational services: Create an immersive cultural experience field

Carry out dynamic content updates, launch one limited cultural performance every quarter, such as designing "spring plowing dance" in combination with solar terms, and introduce resident teaching by intangible cultural heritage inheritors, such as bamboo weaving and embroidery experience. Adopt technology-enabled commentary, develop an audio guide app, and push historical stories according to the location of tourists, such as automatically playing battle simulation audio when approaching the ancient battlefield site, so as to improve the fun and accuracy of cultural communication.

4.2.3. Entertainment services: Build a "safe and fun" dual guarantee system

Carry out thematic plank road transformation, design the plank road section into "geological science section" (mark the rock type), "fairy tale section" (set up cartoon sculptures), and add safety warning interactive screens (such as touch screen to view the rescue process). Develop night entertainment, launch projects such as "Cave Light and Shadow Show" and "Starry Sky Concert", extend the stay time of tourists to 2 days and 1 night, and improve the overnight rate.

4.2.4. Health care services: Implement personalized health management plans

Upgrade the intelligent service system, introduce health detection bracelets, monitor tourists' heart rate and step count in real time, and push customized suggestions such as "You walk 10,000 steps today, suitable for experiencing forest yoga." Conduct service standardization training, formulate SOPs for health care project operation (such as hot spring disinfection process, massage technique specifications), and regularly check service records to ensure stable soft service quality.

4.2.5. Inspiration service: Design layering to inspire scenes

Build dedicated spaces for creators, set up "inspiration stations", provide free rental of photography equipment,

writing workbenches, and hold regular creator salons (such as inviting local writers to share their creative experiences). Build family interactive workshops, develop tools such as "nature diaries" and "parent-child notebooks" to guide family tourists to record their visit experiences and stimulate the creative desire of ordinary tourists.

4.2.6. Local identity services: Deepen cultural interaction and derivatives development

Upgrade the folk experience and change the folk performance to a "workshop performance" mode (such as learning simple dance movements first, and then participating in a group performance) to enhance the sense of participation. Innovate cultural and creative products, cooperate with local intangible cultural heritage inheritors, launch special products such as "silk scarves with human patterns" and "geological layer bookmarks", and print QR codes of cultural stories on the packaging to strengthen local cultural symbols.

4.3. Implementation guarantee: Data closed-loop and dynamic optimization mechanism

Access to multi-source data, integrate social media reviews, questionnaires, and app behavior data (such as the length of stay at attractions) to build a tourist experience database. Iterate monthly strategies and adjust service details based on data feedback (for example, when an entertainment project has more than 10% negative reviews, immediately start the optimization process). Drawing on the dual review mechanism, "technical feasibility review" (such as whether the new project meets safety standards) and "market attractiveness review" (such as whether it meets the needs of tourists) are introduced to ensure the implementation effect of the strategy.

5. Conclusion

This study accurately locates the six major pain points of CES services through social media data mining and proposes quantifiable optimization strategies. In the future, it is necessary to continue to track data changes, form a closed-loop management of "evaluation-diagnosis-optimization", and promote the upgrading of CES service quality in the direction of refinement and personalization.

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