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Research on the Evaluation of Ecosystem Cultural Service Quality in Qu County Congren Valley Forest Park from the Perspective of Tourist Perception

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Abstract: This study focuses on the ecosystem cultural service quality of Qu County Congren Valley Forest Park from the perspective of tourist perception. Using the Importance-Performance Analysis (IPA) questionnaire survey method and SPSS data analysis techniques, we systematically evaluate tourists' cognitive differences and improvement paths regarding the cultural service value of the scenic area. Based on the nonmaterial characteristics of ecosystem cultural services, combined with the unique Congren culture and natural landscape resources of Congren Valley, we designed a five-dimensional scale including natural landscape and ecological protection, cultural display and interpretation services, cultural activity participation and experience, infrastructure and supporting services, and safety management. This covers tourists' evaluations of the importance of elements such as cultural displays, interpretation systems, interactive activities, and facility support, as well as their actual satisfaction feedback. Through descriptive statistical analysis, reliability and validity testing, factor analysis, and IPA matrix analysis, we reveal the core contradictions and improvement directions perceived by tourists. The study found that the convenience of facilities such as signage, rest areas, toilets, roads, and the cleanliness of the scenic area are key areas for improvement. Additionally, different age groups perceive differences in the cultural service quality of the Congren Valley Forest Park ecosystem. The study concludes that tourists have a high level of concern for the convenience of scenic infrastructure and sanitary environment. Improving these facilities can help increase tourist satisfaction and the overall service quality of the scenic area. Simultaneously, meeting the needs of segmented markets and constructing a three-in-one service system of "deep excavation of cultural symbols–digital storytelling–immersive scenes" is recommended.

Keywords: Tourist perception; Ecosystem cultural services; Congren Valley Forest Park

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1. Introduction

With the rise of eco-tourism, tourists' demands for travel destinations have gradually shifted from mere appreciation of natural landscapes to the ecosystem and its cultural connotations. Ecosystem services refer to

all environmental conditions and utilities formed, maintained, and realized by ecosystems and their constituent species for human survival [1]. The Millennium Ecosystem Assessment (MA), a global assessment project led by the United Nations Environment Programme (UNEP) in 2005, defines ecosystem cultural services as "the nonmaterial benefits people obtain from ecosystems through spiritual enrichment, cognitive development, reflection, entertainment, and aesthetic experiences." These are further divided into six categories: cultural diversity and identity, cultural landscapes and heritage values, spiritual services, inspiration, recreation and entertainment, and aesthetics [2]. In short, these refer to the nonmaterial benefits provided by ecosystems, which are often related to human spirituality, culture, and social well-being. As an essential component of eco-tourism, ecosystem cultural services not only carry the protection and inheritance of natural ecology but also integrate the display and dissemination of regional culture.

Forest ecosystems, as the dominant terrestrial ecosystems, boast rich biodiversity. They serve as a crucial medium for the public to access ecosystem cultural services and enrich their spiritual lives. The function of forest ecosystems in improving people's quality of life has been widely recognized by various sectors of society. The State Forestry Administration categorizes ecosystem cultural services into aesthetic value, spiritual value, social interaction, cultural heritage, experience and education, leisure and tourism [3]. As the largest terrestrial ecosystem [4], forest ecosystems not only carry the important task of protecting natural resources and biodiversity but also shoulder the significant mission of inheriting and promoting local culture. By analyzing the relationship between resource use and ecosystem services, scientific evidence is provided for the sustainable management of forest parks, furthering the understanding of the interaction between human activities and the natural environment [5]. With the deepening of ecological civilization construction, people's demand for ecological culture is rapidly increasing, including learning about forest culture, engaging in forest recreation, and conducting nature education.

From the perspective of tourist perception, evaluating the quality of ecosystem cultural services in Congren Valley Forest Park using the Importance-Performance Analysis (IPA) method not only helps to reveal the core contradictions of tourist perception but also provides empirical evidence for optimizing the cultural services of the scenic area. This promotes the transformation of ecotourism from a resource-dependent to a culturally empowered model. This study aims to obtain data on tourists' perceptions of the cultural service quality of the ecosystem in Congren Valley Forest Park through a questionnaire survey. The IPA method is employed to analyze tourists' evaluations of the importance of and satisfaction with natural landscapes and ecological protection, cultural display and interpretation services, participation in cultural activities, infrastructure and supporting services, and safety management. This reveals the core contradictions and directions for improvement in tourist perception.

2. Literature review

2.1. Tourist perception and ecosystem cultural services

Tourist perception refers to tourists' reactions and evaluations to various stimuli in the tourist destination, which affect their satisfaction and loyalty [6]. Some scholars believe that tourist perception is a comprehensive reflection of tourists' feelings about the culture, characteristics, and style of the tourism environment, as well as their cognition of the tourist destination. It represents subjective perception and evaluation of objective things [7]. The Millennium Ecosystem Assessment (MA) defines ecosystem cultural services as "the non-material benefits that people obtain from ecosystems through spiritual enrichment, cognitive development, reflection, entertainment, and aesthetic experiences" [2].

Another scholar defines it as "the products, services, and benefits that human behavioral activities obtain from natural ecosystems, which can effectively meet spiritual and cultural needs" [8]. There is a complex coupling relationship between ecosystem service value and human well-being, especially the important role of ecosystem cultural services (such as tourism and leisure functions) in improving human well-being [9]. As an important component of ecotourism, the quality of ecosystem cultural services directly affects tourists' perception and satisfaction. Scholars at home and abroad have conducted a lot of research in the field of tourist perception and ecosystem cultural services, finding significant differences in tourists' perception and satisfaction with elements such as cultural display, interpretation systems, and interactive activities [10,11].

2.2. Application of the IPA method in the tourism field

The IPA method, also known as Importance and Satisfaction Analysis, was proposed by Martilla and James in 1977 and initially applied to analyze the attributes of automotive products [12]. Through questionnaire surveys, this method obtains tourists' evaluations of the importance and satisfaction feedback on various elements of a tourist destination, constructing a two-dimensional four-quadrant chart that visually displays the core contradictions and improvement directions perceived by tourists. Due to its intuitive and easy-to-understand characteristics, this method has been widely used in the tourism field. Utilizing data from online reviews and field surveys, Bai and Chen employed the IPA analysis method to quantitatively display public "importance-satisfaction" differences through a four-quadrant chart, thereby promoting sustainable management of city parks [13].

2.3. Current research status of the Congren Valley Forest Park

Located as a transport hub between Chongqing and Chengdu, Qu County boasts a rich Cong culture and Bashu culture. During the May Day holiday in 2025, Sichuan Dazhou Qu County welcomed approximately 168,700 tourists, with the Congren Valley Forest Park, as a significant tourist attraction in Qu County, accounting for a considerable proportion. This scenic area has a vast tourist market.

The Congren Valley Forest Park, integrating natural landscapes and Cong culture, directly impacts tourist satisfaction and loyalty through the quality of its ecosystem cultural services. This scenic spot boasts abundant tourism resources, including a wide range of natural and cultural landscapes with excellent resource combination and endowment [14], earning it the nickname "Little Jiuzhaigou" due to its rich natural and cultural landscapes. However, current research on the cultural service quality of the park's ecosystem is relatively scarce, lacking a systematic evaluation from the perspective of tourist perception. Therefore, this study employs the IPA method to evaluate the cultural service quality of the Congren Valley Forest Park's ecosystem, carrying significant theoretical and practical implications.

3. Research design and data collection

3.1. Research design

From the perspective of tourist perception, this study focuses on the cultural service quality of the Congren Valley Forest Park's ecosystem. Utilizing the IPA method combined with SPSS data analysis techniques, it systematically evaluates the cultural service quality of the ecosystem perceived by tourists. The research covers importance evaluations and satisfaction feedback on elements such as natural landscapes and ecological protection, cultural display and interpretation services, participation in cultural activities, infrastructure and supporting services, and safety management.

The questionnaire design is based on literature reviews and field visits, including two parts: basic tourist information and tourists' perceptual evaluation of the cultural service quality of the Congren Valley Forest Park's ecosystem. The perceptual evaluation section adopts a Likert 5-point scale, evaluating relevant elements from two dimensions: importance (1 indicates "extremely unimportant," and 5 indicates "very important") and satisfaction (1 represents "extremely dissatisfied," and 5 represents "very satisfied").

3.2. Data collection

In this study, a stratified sampling method was employed to distribute questionnaires at the entrance, visitor center, and major attractions of the Congren Valley Forest Park. A total of 100 questionnaires were distributed, and 63 valid questionnaires were collected. The sample covered tourists of different ages, genders, education levels, and travel frequencies, ensuring the representativeness and reliability of the data.

4. Data analysis and results

4.1. Descriptive statistical analysis

Descriptive statistical analysis was conducted on the questionnaire data using SPSS 26.0. The results indicated significant differences in tourists' overall perception of the cultural service quality of the ecosystem in Congren Valley Forest Park. Specifically, 87.3% of tourists visited the park based on recommendations from friends, while 28.57% learned about the park through online searches. Additionally, 60.32% of tourists expressed a need for more diverse cultural activities (such as nighttime performances and themed festivals), and 50.79% believed that the park should improve the convenience of its infrastructure (such as adding charging stations and accessibility features) and enhance its digital development.

As shown in **Table 1**, from the overall dimension analysis, the importance score for the cultural activity participation experience element was the highest (mean of 4.38), but the satisfaction score was relatively low (mean of 4.3). The cultural display and interpretation service element also received a high importance score (mean of 4.46), but the satisfaction score was lower (mean of 4.4).

Table 1. Analysis of primary indicator dimensions

Dimension	Satisfaction (P)		Importance (I)		Gap (P-I)	*t*	*P*
	Mean	Rank	Mean	Rank			
Natural landscape & ecological conservation	4.41	1	4.52	1	-0.11	-1.507	0.137
Cultural display & interpretation services	4.40	2	4.46	3	-0.05	-0.980	0.331
Cultural activity participation experience	4.30	4	4.38	5	-0.08	-2.122	0.038
Infrastructure & supporting services	4.21	5	4.41	4	-0.21	-3.217	0.002
Safety management	4.37	3	4.48	2	-0.10	-2.140	0.036

As shown in **Table 2**, the clarity and interest of display boards and signs related to Cong people's culture, the professionalism and interactivity of tour guides/commentators on Cong people's culture, the professionalism of folklore performances (such as dance and music), the sense of participation and educational significance of handicraft experience activities (such as weaving and pottery), and the richness and attractiveness of cultural activities (such as exhibitions and performances) all rank higher in importance than satisfaction.

Table 2. Secondary index analysis

Factor	Satisfaction (P)		Importance (I)		Gap (P-I)	t	P
	Mean	Rank	Mean	Rank			
1. Natural environment quality (vegetation coverage, air quality)	4.48	1	4.52	1	-0.048	-0.652	0.517
2. Visibility of conservation measures (waste sorting, wildlife protection signage)	4.33	6	4.51	2	-0.175	-2.024	0.047
3. Clarity & engagement of Cong culture displays (information boards, signs)	4.44	2	4.48	3	-0.032	-0.629	0.531
4. Cultural heritage preservation	4.4	4	4.48	3	-0.079	-1.523	0.133
5. Expertise & interaction of guides (regarding Cong culture)	4.37	5	4.41	9	-0.048	-0.504	0.616
6. Professionalism of folk performances (dance, music)	4.3	9	4.4	11	-0.095	-2.555	0.013
7. Engagement & educational value of handicraft activities (weaving, pottery)	4.27	10	4.37	13	-0.095	-1.624	0.109
8. Diversity & appeal of cultural events (exhibitions, performances)	4.32	8	4.38	12	-0.063	-1.158	0.251
9. Convenience of facilities (signage, rest areas, restrooms, pathways)	4.27	10	4.46	7	-0.19	-2.555	0.013
10. Value & cultural features of F&B/accommodation	4.22	12	4.32	14	-0.095	-1.426	0.159
11. Sanitation conditions	4.16	14	4.46	7	-0.302	-3.609	0.001
12. Clarity of signage systems	4.17	13	4.41	9	-0.238	-2.951	0.004
13. Safety measure implementation (fire prevention, rescue systems)	4.41	3	4.48	3	-0.063	-1.07	0.289
14. Staff responsiveness to safety concerns	4.33	6	4.48	3	-0.143	-2.609	0.011

4.2. Reliability and validity testing

Cronbach's α coefficient was used to test the reliability of the questionnaire. As shown in **Tables 3** and **4**, the overall index and the α coefficients of each dimension are all greater than 0.92, indicating high internal consistency of the questionnaire. The validity of the questionnaire was tested using the KMO value and Bartlett's test of sphericity. As shown in **Table 5**, the KMO value is 0.77, and the significance level of Bartlett's test of sphericity is less than 0.001, indicating high structural validity of the questionnaire.

Table 3. Overall indicators of items

Scale/dimension	Cronbach's alpha	Number of items
Overall satisfaction-importance scale	0.986	28
Satisfaction subscale	0.980	14
Importance subscale	0.973	14

Table 4. Dimension indicators

Dimension	Satisfaction		Importance	
	Cronbach's α	Items	Cronbach's α	Items
Natural landscape & ecological conservation	0.923	2	0.930	2
Cultural display & interpretation services	0.942	3	0.945	3
Cultural activity participation experience	0.960	3	0.945	3
Infrastructure & supporting services	0.961	4	0.957	4
Safety management	0.927	2	0.947	2

Table 5. Validity analysis

KMO and Bartlett's test		
Kaiser-Meyer-Olkin measure of sampling adequacy		0.77
Bartlett's test of sphericity	Approx. chi-square	3445.433
	Degrees of freedom (*df*)	378
	Significance (*P*)	< 0.001

4.3. Factor analysis

Factor analysis was used to reduce the dimensionality of the questionnaire data, extracting five common factors: natural landscape and ecological protection, cultural display and interpretation services, cultural activity participation and experience, infrastructure and supporting services, and safety management. The cumulative variance contribution rate reached 78.6%. The factor loads of the internal items of each common factor are all greater than 0.5, indicating high content validity of the questionnaire.

4.4. IPA matrix analysis

IPA matrix analysis was used to analyze tourists' importance evaluation and satisfaction feedback on various elements of the cultural service quality of the Congren Valley Forest Park ecosystem. As shown in **Figure 1**, a two-dimensional four-quadrant graph was constructed using the mean importance (4.45) and mean satisfaction (4.34) as segmentation points. The results show that natural landscape and ecological protection, cultural display and interpretation services, and safety management are located in the first quadrant (continue to maintain area). Cultural activity participation and experience, as well as infrastructure and supporting services, are located in the third quadrant (low priority area), indicating that tourists' demand for participation in cultural activities and related infrastructure and supporting services is relatively insufficient, and the priority is low, which may reflect that resource allocation and management focus are biased towards other aspects.

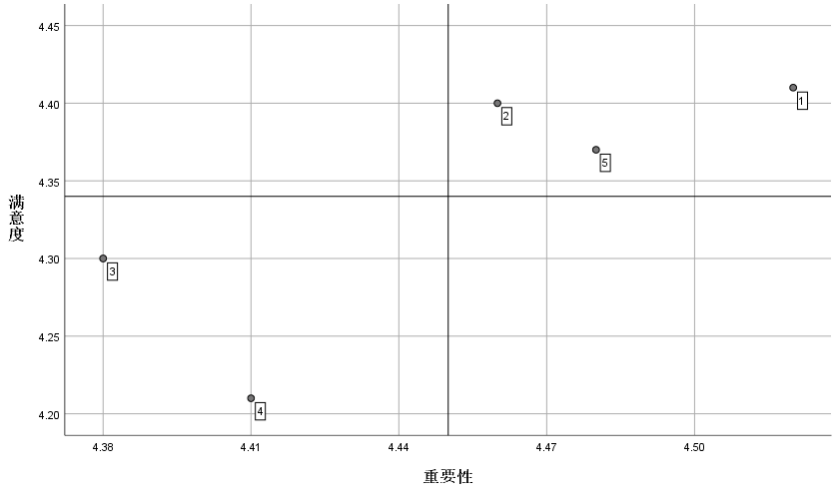

Figure 1. Scatter plot of first-level indicators

As shown in **Figure 2**, the analysis reveals that various aspects such as the quality of the natural environment (A1) including park vegetation coverage and air quality, the visibility of ecological protection measures (A2) like waste sorting and wildlife protection prompts, the clarity and interest of exhibition boards and signs related to the Cong people's culture (B1), the preservation of cultural heritage (B2), the completeness of safety measures such as fire protection and rescue (E1), and the staff's attention and response speed to tourist safety (E2) are all distributed in the "continue to maintain" zone. This suggests that the scenic area has managed these aspects well and only needs to continue its current efforts. The professionalism and interactivity of guides/interpreters regarding the Cong people's culture (B3) are in the "oversupplied" zone. Aspects like the professionalism of folk performances (such as dance and music) (C1), the sense of participation and educational value of handicraft experience activities (such as weaving and pottery) (C2), the richness and attractiveness of cultural activities (such as exhibitions and performances) (C3), the cost-effectiveness and cultural characteristics of commercial services such as dining and accommodation (D2), and the clarity of the signage system (D4) are in the "lower priority" zone. The convenience of facilities such as signboards, rest areas, toilets, and roads (D1), as well as the sanitary conditions of the scenic area (D3), are in the "key areas for improvement" zone.

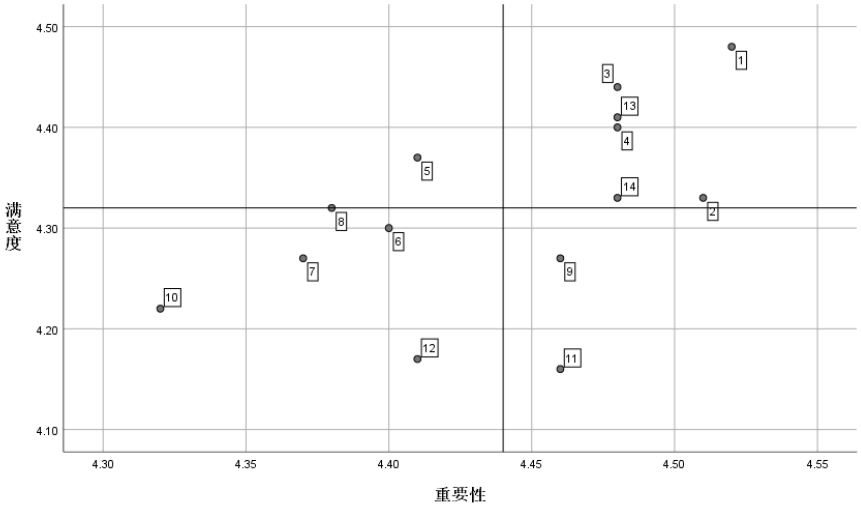

Figure 2. Scatter plot of second-level indicators

4.5. Difference analysis

Using the *t*-test to analyze the perceived differences in the cultural service quality of the Congren Valley Forest Park's ecosystem among different age groups, the results indicate that elderly tourists (>45 years old) have higher demands for the convenience of facilities such as signboards, rest areas, toilets, and roads than young and middle-aged tourists (18–44 years old). Young and middle-aged tourists have significantly higher demands for the professionalism and interactivity of guides/interpreters regarding the Cong people's culture than elderly tourists. The average willingness to use digital interactive devices reaches 4.21, while elderly tourists prefer traditional interpretation methods, with an average of only 3.78.

5. Discussion and suggestions

5.1. Discussion

This study finds significant differences in tourists' perceptions of the cultural service quality of the Congren Valley Forest Park's ecosystem. The convenience of facilities such as signboards, rest areas, toilets, roads, and the sanitary conditions of the scenic area have become key areas for improvement. This suggests that tourists desire a safe, convenient, and comfortable touring environment to enhance their overall experience and satisfaction. Aspects such as the professionalism of folk performances, the sense of participation and educational value of handicraft experience activities, the richness and attractiveness of cultural activities, the cost-effectiveness and cultural characteristics of commercial services, and the clarity of the signage system are in the lower priority zone. Together, these reflect the diverse needs of tourists for cultural experiences and service quality in the scenic area. These issues not only affect the service quality of the scenic area but also influence whether tourists are willing to visit again or recommend it to others. Furthermore, significant differences in the needs of different age groups for the convenience of infrastructure, sanitary environment, and cultural immersion experiences suggest that the scenic area should implement differentiated service strategies.

5.2. Suggestions

5.2.1. Facility convenience improvement project

(1) Smart navigation system upgrade

Plan dynamic pathways and deploy an IoT sensor network to monitor real-time crowd density in various areas. Push optimal routes through electronic signboards and mobile apps, and install interactive ground screens at intersections that trigger voice navigation when stepped on. Use 3D laser scanning technology for terrain modeling and plan barrier-free passageways across the entire area. Set up Braille guidance screens and vibration sensors in restrooms and resting areas, and develop a dedicated navigation mini-program for disabled individuals. Design AR (Augmented Reality) markers for visitors to access 3D spatial navigation by scanning with their phones. Install solar-powered illuminated signboards at key nodes that automatically switch to strobe warning mode at night.

(2) Modular service facility deployment

Build smart resting areas with movable container-style stations equipped with photovoltaic roofing, wireless charging tables, and air quality monitors. Also include smart seats that automatically adjust their tilt angle based on pressure sensors.

Promote microorganism-degrading toilets equipped with a self-processing system for waste.

Install smart induction faucets, negative pressure deodorization devices, and infrared occupancy display systems for toilet stalls.

Set up AED emergency stations and smart first aid kits every 500 meters, allowing visitors to scan and access medical supplies.

5.2.2. Sanitation management system

(1) Smart sanitation management system

Deploy smart trash cans that can automatically classify waste through AI image recognition and send cleaning instructions when they are full. Develop a garbage classification integral game, where tourists can redeem scenic area services by correctly disposing of waste. Establish a monitoring network for PM2.5, temperature and humidity, and odor, with data projected onto an electronic screen in real time. When the air quality exceeds the standard, the fresh air system and the atomization deodorization device will automatically start. Additionally, a micro-sewage treatment station can be built, adopting membrane bioreactor technology to achieve water reuse. Set up ecological floating islands in the landscape water bodies to purify water quality through plants.

(2) Dynamic cleaning mechanism

Implement grid-based cleaning management by dividing the scenic area into 200 m^2/unit cleaning grids. Cleaners equipped with positioning bracelets can upload their work trajectories in real time.

Establish a cleaning quality scoring system that allows visitors to rate the area's hygiene by scanning a code.

Deploy automatic patrolling robots that operate at night using a laser radar obstacle avoidance system, and utilize drones for high-altitude cleaning in open areas such as squares.

Develop a pollution source tracking system that uses odor sensors and cameras to locate behaviors like spitting and littering, and automatically generates warning messages pushed to visitors' phones.

5.2.3. Constructing a trinity service system of "deep exploration of cultural symbols–digital storytelling–immersive scenes"

(1) Digital translation of cultural symbols

Establish a cultural gene bank of the Cong people, use 3D modeling technology to conduct high-precision digital collection of cultural relics such as petroglyphs and bronze ware, and develop an AR real-scene navigation system that allows visitors to trigger historical scene reproduction by scanning with their mobile phones. Set up VR immersion pods at key nodes to restore scenes such as Cong people's sacrifices and wars, and achieve multi-sensory interaction with haptic devices. Create a thematic route called the "Time and Space Corridor," set up interactive light and shadow installations along the way, and project the mythology of the Cong people onto natural landscapes through projection technology. Develop a story-based puzzle-solving game where visitors need to unlock hidden attractions by cracking cultural symbol codes, creating an exploratory touring experience. Deploy AI cultural assistants to answer visitor questions through voice interaction. Set up interactive digital screens in resting areas so that visitors can choose their own cultural storylines for deep learning. Establish a visitor experience database to analyze behavioral data in real time and optimize service routes.

(2) Implementing layered design for all-age services

Empower young visitor groups with technology, develop MR mixed reality script games that integrate Cong people's history into the reasoning plot. Set up a haptic competition area to restore ancient ceremonies such as archery rites through motion capture technology. Launch a digital collection check-in system where visitors can collect virtual cultural fragments to redeem unique cultural creations.

Provide warm services for silver-haired visitor groups and form a team of elderly cultural mentors to provide

dialect interpretation services. Offer aging-friendly experience courses such as morning Tai Chi and traditional tea ceremonies. Design a barrier-free digital navigation system that allows access to information through voice commands. Establish a cultural salon for the elderly, and regularly hold intangible cultural heritage handicraft workshops.

Promote interactive integration for family visitor groups, create a parent-child cultural laboratory with projects such as building ancient architecture with blocks and oracle bone script graffiti. Develop AR parent-child treasure hunt games where parents and children collaborate to complete cultural tasks. Set up a family shared creation area to provide a digital shadow puppetry creation platform.

6. Conclusion and outlook

From the perspective of tourist perception, this study systematically evaluated the cultural service quality of the ecosystem in Qu County's Congren Valley Forest Park using the IPA method and SPSS data analysis techniques. The study found that the display depth of Cong people's cultural symbols and the participation in natural education activities have become the focus of improvement, and there are significant differences in the demand for cultural immersion experiences among different educational groups. The research conclusions provide empirical evidence for optimizing the cultural services of Congren Valley Forest Park and have practical guiding significance for promoting the transformation of eco-tourism from resource-dependent to culturally empowered.

Future research can further expand the perspective of tourist perception, combining multi-source data (such as social media data, tourist comment data) to dynamically monitor and evaluate the cultural service quality of the ecosystem in Congren Valley Forest Park. At the same time, the relationship between cultural service elements, tourist loyalty, and word-of-mouth communication can be explored to provide more comprehensive theoretical support and practical guidance for the continuous optimization of cultural services in scenic areas.

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