WHICEB 2019 Proceedings
Wuhan International Conference on e-Business

Summer 6-26-2019

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Abstract：In the era of mobile Internet, more and more people choose tourism products through online tourism platforms At the same time, the rapid growth of negative reports in recent years is seriously affecting the reputation of the platform. Aiming at the quality of online tourism service, this paper constructs an online tourism service quality factor system based on customer perception, determines the causality and weight matrix among the influencing factors, establishes a fuzzy cognitive map model, and carries out dynamic simulation of multiple causality. The key influencing factors of online tourism service quality are obtained as follows. Service types are comprehensive, providing information consultation, upgrading and updating, payment security, data and information security, customer rights and interests protection, service friendliness and evaluation processing. In order to better understand the relationship between the various factors affecting service quality and the degree of impact, predict the focus of service quality improvement, and provide a reference for related enterprises to improve service quality.

Key word：Online travel, fuzzy cognitive map, customer perception, service quality

1. INTRODUCTION

The enormous economic and social benefits brought by tourism make many cities regard tourism as an important pillar of economic development. With the maturity of information and network technology, the operation mode of tourism industry has changed from pure offline service to online and offline synchronization [1]. Great changes have also taken place in tourism information dissemination and consumer behavior. In recent years, the establishment of large tourism data center, tourism public service platform and other infrastructures is a manifestation of the dominant position of the Internet in the development of tourism industry. Online tourism has become one of the most important platforms for traveling companies to exchange information and provide services to customers [2]. In 2017, the scale of the national online travel market reached 738.41 billion RMB, with a growth of 25.1%. However, with the hot sale of online travel products, the number of online travel complaints has also risen sharply, and the quality of travel service can't be guaranteed. How to reduce the number of complaints, improve service quality and enhance customer perceived value has become an urgent problem for tourism service providers.

2. ONLINE TRAVEL SERVICE QUALITY IMPACT FACTORS

Tourists' perceived value is the value perception of tourists' products or services for consumption, and is based on the rational evaluation of perceived gains and losses [3]. Based on previous research, this paper combines and modifies the characteristics of online travel platform to customer perception from two dimensions: online service and offline service. The framework of online travel service quality from the perspective of

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customers' perception is shown in table 1.

Table 1 The framework of online travel service quality from the perspective of customers' perception

Primary element	Secondary element	Tertiary element	Specific explanation
Online service	Content perception	Comprehensive service typeV1	All service items and supporting services in the product are comprehensive
		The information provided is comprehensive, true and accurateV2	Whether the information provided by the website and the client to the customer is true and comprehensive, does not affect the customer selection.
		The product information provided is novel and timelyV3	The product information provided by the website and the client is novel, changeable and timely, giving the customer the most choice
		Concise and applicable information contentV4	The product information and destination information provided by the website and the client to the customer are not complicated, so that the customer can use the information.
		Upgrade and update in timeV5	Update of website and client
	Interactive perception	Easy to learn to useV6	Easy to operate on the website and client, easy for customers to learn
		Service response speedV7	Quickly respond to customer service needs
		Smooth operation and easy operationV8	When the website and the client are in use, the customer can respond in time without delay, which is convenient and not cumbersome.
		System compatibilityV9	Smooth operation on different clients and different operating systems
		System fault toleranceV10	Probability of errors in product operation and probability and efficiency of resolution after errors occur
	Security perception	Service product stabilityV11	There is no conflict with other software and mobile phone systems.
		Payment securityV12	Trading environment security
		Data securityV13	Data information is safe, no leakage crisis.
		Transaction effectiveV14	Whether the order takes effect after the transaction is completed
		CredibilityV15	Tourism platform and the credibility of agents
		Customer rights protectionV16	The parties to the service guarantee the legitimate rights and interests of the customers
	Intuitive perception	Beautiful and reasonable interfaceV17	User interface design is reasonable
		brand reputation image V18	Customers' praise and praise on online travel platform brand and word of mouth evaluation of service quality
		Service priceV19	The actual selling price of the purchased service

			product
		Service friendlinessV20	Whether it has a friendly user interface. A wealth of operating tips and online help information, so that users can get tips and help at any time
	Personalized perception	Satisfy customer preferencesV21	Satisfying customers' preferences for tourism products and services
		Conform to usage habitsV22	Balancing the habits of new and old users in product design and update
		Accurate push for big data formationV23	Customized recommendations based on customer preferences and historical orders when selecting projects
Offline service	Travel experience	Local real-time information reminderV24	Pushing various travel information and tips required by customers based on customer location
		Product experience is consistent with descriptionV25	The product that the customer actually experiences is consistent with the purchase.
		Service attitude and etiquetteV26	Service personnel and customer service evaluation of customer service attitude and etiquette
		Emergency capabilityV27	Emergency handling capacity in case of emergencies
	After-sales tracking	Evaluation is effective and timelyV28	Website and client provide customers with reasonable complaint and real evaluation, and deal with it in time.
		Membership rebate after order completionV29	Whether the evaluation rebate and direct rebate projects launched by the website are smooth, and whether the refund amount is in accordance with the contract
		Customer service return visitV30	Learn about travel arrangements, hotel accommodation, driver guide services, etc., and seek suggestions for improvement. Coordinate and resolve complaints.

3 FUZZY COGNITIVE MAP MODEL OF ONLINE TRAVEL SERVICE QUALITY

3.1 Self-establishment of Fuzzy Cognitive Map (FCM)

The Fuzzy Cognitive Map (FCM) was proposed by Kosko [4]. It is a combination of fuzzy logic and neural networks. The FCM consists of three parts: concept nodes (influencing factors), directed connection arcs (acting relationships among factors) and weights (relationship strength) on the arcs. With the deepening of research, the practicality of FCM has been verified and recognized [5].

Since there are many nodes in this research, the self-establishment method is used to build the FCM model for online travel service quality. The model's establishment is completely based on data [6].

3.1.1 Data collection based on the questionnaire of online tourism service quality influencing factors

Based on the online travel platform A, a questionnaire concerning the factors influencing the quality of online travel service is designed. The data were collected from 5 major scenic spots in X City, Jiangsu Province of China. The questionnaires were randomly distributed.

The 30 elements in Table 1 are used as the initial concept nodes of the FCM. The respondents' data is used as the expert data needed in the model construction to obtain the causal weight values between the conceptual nodes.

3.1.2 Data fuzzification

Each influencing factor is represented by the corresponding concept node in FCM, and the vector value V_{ij} indicates the importance of the ith respondent to the jth concept node. In order to establish a fuzzy matrix of the target, the original data needs to be converted into fuzzy data. The specific method is as follows:

（1）For any one of the numerical vectors V, find the maximum value of the vector element, set it to $MAX(\mathrm{v})$, and assign it a value of 1. that is $MAX(\mathrm{v}) \Rightarrow \chi V(\mathrm{v}) = 1$.

（2）For any one of the numerical vectors V, find the minimum value of the vector element, set it to $MIN(\mathrm{v})$, and assign it a value of 0. that is $MIN(\mathrm{v}) \Rightarrow \chi V(\mathrm{v}) = 0$.

（3）For element V_i in any of the numerical vectors V, blur it to the value on the interval [0,1], The formula for its fuzzification is:

$$\chi V(\mathrm{v}) = \frac{V_{\mathrm{i}}\text{-}MIN(\mathrm{v})}{MAX(\mathrm{v}) - MIN(\mathrm{v})} \quad (1)$$

3.1.3 Determining the correlation of concept nodes

The concept of "distance" is used to determine the positive and negative correlation, which is then used to represent the correlation between nodes. If two nodes are positively correlated, their maximum correlation is that for each element i, there is $\chi_1(V_{\mathrm{i}}) = \chi_2(V_{\mathrm{i}})$, and let T_i be the distance between the corresponding elements between nodes V1 and V2, then:

$$T_{\mathrm{i}} = \left|\chi_1(\upsilon_{\mathrm{i}})\text{-}\chi_2(\upsilon_{\mathrm{i}})\right| \quad (2)$$

Let the distance TD between the concept nodes V1 and V2 be:

$$TD = \sum \frac{|T_{\mathrm{i}}|}{\mathrm{n}} \quad (3)$$

Let the correlation between the concept nodes be S, and use the average distance TD to calculate the correlation between the nodes.: $S = 1 - TD$, If the two concept nodes are perfectly positively correlated, then each of their nodes has the same value after the fuzzification, and the distance is A. $TD = 0$, $S = 1 - TD = 1$。

The correlation calculation step in the negative correlation case is basically the same as the former. The only difference is that the distance formula between the corresponding elements of the negative correlation nodes V1 and V2 is as follows:

$$T_{\mathrm{i}} = \left|\chi_1(\upsilon_{\mathrm{i}}) - (1 - \chi_2(\upsilon_{\mathrm{i}}))\right| \quad (4)$$

Through the above calculation, the positive and negative correlations of the concept nodes of the online tourism service quality impact factors are obtained, and the positive and negative correlation tables are listed. According to experience, the general related concept node correlation is greater than 0.6. Two concept nodes with positive and negative correlations greater than 0.6 are used as related nodes, that is, one party changes, and the other party changes accordingly. However, since the correlation between conceptual nodes may not match the reality, factor analysis of the quality elements in Table 2 is required. On the one hand, nodes with low correlation can be deleted to make the FCM model more refined, and on the other hand, the correlation between nodes can be auxiliary verified.

3.2 Fuzzy Cognitive Map Correction Based on Factor Analysis

In this section, factor analysis is used to decrease the nodes of the FCM, and correct the correlation. The reliability test result is 0.963, and the Cronbach's α coefficient is greater than 0.7, indicating that the scale has high reliability. The KMO value is 0.955 > 0.7, and Bartlett's sphericity test results are significant. The principal component with eigenvalue greater than 1 is determined as a common factor. So, five common factors are selected, and the cumulative variance contribution is more than 63%. The degree of association between the common factor and the original element can be expressed by the factor load value. The higher the load value, the higher the degree of association.

The correction of the factors in the FCM self-establishment process includes two aspects: one is to filter the concept nodes, deleting the nodes that are not qualified in the factor analysis; the other is the correlation correction between nodes [7]. The load values of the concept nodes " concise and applicable information content " and "local real-time information reminder" are all less than 0.5 to the five common factors, which means that they have less correlation with other nodes, and there will be little information loss to eliminate these nodes. So, the two nodes are eliminated. Finally, the remaining 26 concept nodes are obtained, and they are rearranged by C1 to C26. However, the correlation between two nodes does not mean that they must have a causal relationship, and the final FCM model is adjusted through consulting experts.

3.3 Construction and Analysis of FCM Model

Based on the above related relationship between the online travel service quality FCM concept nodes and their weights, the final FCM structure diagram is constructed, as shown in Figure1:

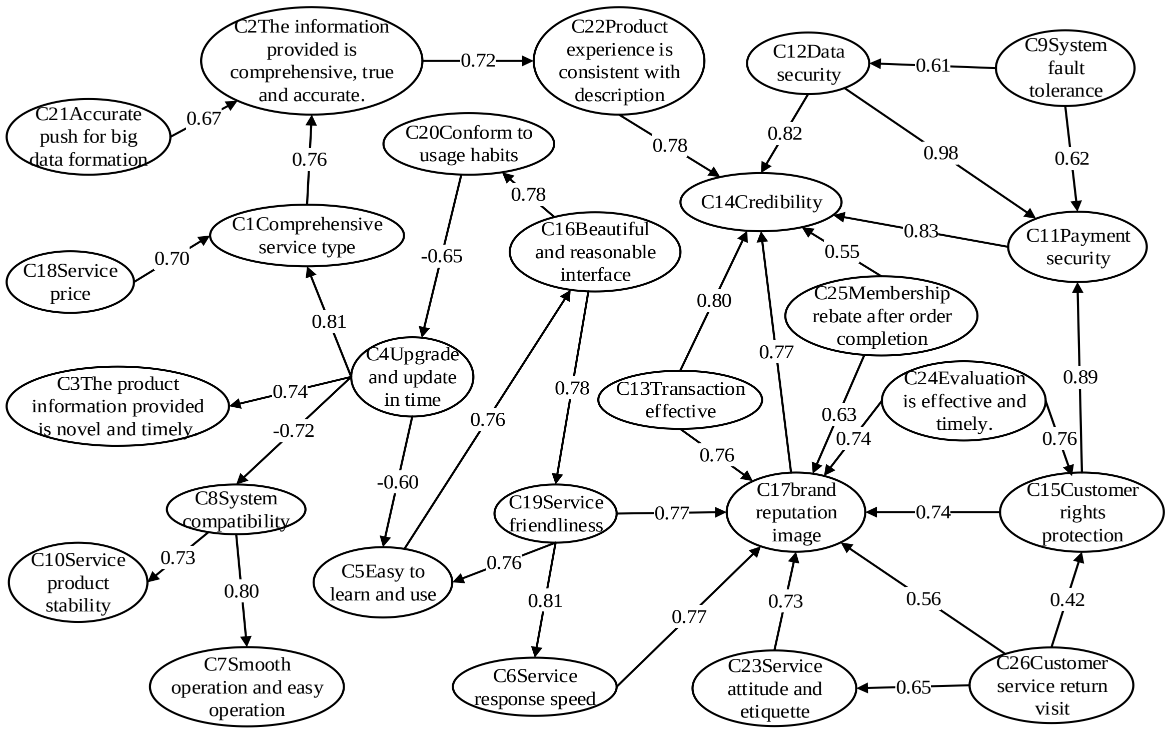

Figure 1 Online travel service quality FCM model

On basis of the FCM model shown in Figure 1, the adjacency matrix W that reflects the causal weight value between nodes can be obtained.

4 ANALYSIS ON THE IMPROVEMENT OF ONLINE TRAVEL SERVICE QUALITY FROM THE PERSPECTIVE OF FCM REASONING

Taking online travel platform, A, as a case to conduct simulation analysis, Firstly, the initial state value of the concept node is input [8]. Based on the expert investigation, the linguistic variables are quantified by using the fuzzy theory and normalized to [0,1]. The quantization rule used in this paper is: { very low, low, average, high, very high }→{0,0.25,0.5,0.75,1}. Therefore, the initial values of the 26 concept nodes that make up the quality control system are shown in Table 2.

Nodes in the online travel service quality FCM model interacts with each node, and the value of each variable remains at a stable value when it reaches the final state. Table 3 shows the steady-state values of the nodes in the system after 37 iterations.

Table 2 Initial value of concept node

	Concept node												
	C1	C2	C3	C4	C5	C6	C7	C8	C9	C10	C11	C12	C13
Status value	0.57	0.70	0.65	0.56	0.59	0.64	0.67	0.57	0.56	0.70	0.97	0.94	0.79
	C14	C15	C16	C17	C18	C19	C20	C21	C22	C23	C24	C25	C26
Status value	0	0.89	0.57	0	0.57	0.74	0.60	0.53	0.76	0.64	0.68	0.38	0.31

Table 3 Steady state of concept node

	Concept node												
	C1	C2	C3	C4	C5	C6	C7	C8	C9	C10	C11	C12	C13
Steady state value	0.87	0.88	0.66	0.89	0.74	0.78	0.75	0.76	0.66	0.84	0.98	0.95	0.84
	C14	C15	C16	C17	C18	C19	C20	C21	C22	C23	C24	C25	C26
Steady state value	0.99	0.94	0.76	0.99	0.76	0.89	0.80	0.68	0.79	0.81	0.86	0.58	0.70

As can be seen from the inferred state values of concept nodes in Table 3, the final state values of all concept nodes in FCM model are changed compared with the state values that did not consider the interaction feedback relations between concept nodes at the beginning. The final concept node state values are sorted in order, and the concept nodes with larger state values are: C1 (Comprehensive service type), C2 (The information provided is comprehensive, true and accurate), C4 (Upgrade and update in time), C11 (Payment security), C12 (Data security), C15 (Customer rights protection), C19 (Service friendliness) and C24 (Evaluation is effective and timely). As the key factor of service quality, the final state values of the eight concept nodes are all greater than 0.85, and the investment degree under the quality improvement scheme is higher. At the same time, the state values of C6 (Service response speed), C8 (System compatibility), C16 (Beautiful and reasonable interface) C25 (Membership rebate after order completion), and C26 (Customer service return visit) also changed greatly.

5 CONCLUSIONS

This paper divides the dimensions from the perspective of customer perception, obtains the original data through questionnaires, establishes an evaluation framework of factors affecting the quality of online tourism services, identifies the causality of 26 selected indicators, and establishes a FCM structure chart model, which visually reflects the complex relationship among the factors. Using iterative analysis, the comprehensive service type, The information provided is comprehensive, true and accurate, Upgrade and update in time, Payment security, Data security, Customer rights protection, Service friendliness and Evaluation is effective and timely. These 8 nodes have a huge impact on the overall system of tourism service quality. The two concept nodes "Credibility" and "brand reputation image" as controlled variables receive direct or indirect effects from other concept nodes. The iterative process can foresee the changing trend of various factors in the future, and improve the factors in the actual product design to improve the competitiveness of online travel enterprises and customer perceived value to improve customer loyalty. In the modeling process, the limitation of sample collection is the defect of constructing fuzzy cognitive map. At the same time, in the future research, we can consider strengthening the learning of FCM and improve the algorithm to improve the adaptability of FCM model, In order to provide reference for online tourism service developers and operators, as well as other user-centered service departments.

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