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Digital Design Strategy and Communication Effect of Non-Heritage Ceramic Brands from the Perspective of Cultural Identity

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SUMMARY: *Non-heritage ceramics is a cultural treasure of the Chinese nation, and its brand digital design is conducive to enhancing the influence of non-heritage ceramics brand and improving people's sense of identity with the excellent national culture. This paper starts from the four cultural identity dimensions of sensation, emotion, cognition and association to carry out the digital design of non-heritage ceramic brand. Subsequently, it establishes the evaluation index system of digital communication effect of non-heritage ceramic brand, combines and assigns weights to the indexes based on AHP and entropy weight method, combines with the cloud model to carry out the comprehensive evaluation of communication effect, and also introduces the fsQCA method to explore the enhancement path of digital communication effect of non-heritage ceramic brand. Among the weights of the comprehensive evaluation indicators of the digital design strategy of the non-heritage ceramic brand, the weight of the brand information dimension in the first-level indicator is the highest at 0.3562, which means that the mining of the non-heritage ceramic information has an important impact on the digital design strategy and communication of the brand. The evaluation result of the brand communication effect of non-heritage ceramics based on the combined empowerment-cloud model is "medium". Through the study of brand communication effect grouping paths of 50 companies, four driving paths of high brand communication effect are formed, which are digitally empowered and digitally non-dominated. Among them, the digital empowerment group accounts for 53.75% of the total number of explained cases. For this reason the company can strengthen the integration of digitalization with technology and brand dimensions to realize the upgrading and good communication of the brand of non-heritage ceramics.*

KEYWORDS: *ahp; entropy weight method; cloud model; indicator system; fsQCA method; non-heritage ceramic brand*

1 Introduction

"Ceramic" is a general term. There are great differences between "pottery" and "porcelain" in texture and physical properties. China is one of the first countries to manufacture pottery and the first country to invent porcelain [1, 2]. And China's non-heritage ceramics refers to the ceramic production techniques with important historical, cultural and artistic values in traditional Chinese handicrafts [3, 4]. In today's increasing customer demand for ceramic product variety, performance and other diversified and individualized needs, the traditional methods of ceramic product design, manufacturing and dissemination, has not been able to match with the new development of the ceramic market in the new period, and it is also an important factor restricting the development of China's ceramic industry [5-8]. Therefore,

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China, as a large ceramic country, especially under the perspective of cultural identity, must firmly grasp the development opportunities brought by digital technology and fully apply digital design to promote the development of Chinese non-heritage ceramic brands and ceramic culture [9-11].

Digital technology is a kind of information technology based on digital code, which is expressed, transmitted and processed through software and hardware devices such as computers and communication satellites [12, 13]. It is also known as computer digital technology because it requires the use of computers to complete the important aspects such as arithmetic and storage. In particular, various design-assisted design software, three-dimensional imaging and molding equipment, digital manufacturing management line and other technologies based on computer digital technology have been widely used in the design, manufacture and dissemination of non-heritage ceramic products, which greatly improved the efficiency and quality of the development of China's non-heritage ceramic brand [14-17]. For example, 3D design software based on computer graphics technology, such as Maya and 3dMax, are used for modeling and designing ceramic products, which can greatly improve the design efficiency of ceramic products [18-20]. Three-dimensional printing technology improves the modeling flexibility of ceramic products, greatly increases the variety of products, improves the production efficiency of products, and promotes the personalization and customization of products [21-23].

The digital of communication methods is centered on the sales of non-heritage ceramic brands and the dissemination of ceramic culture, providing digital solutions for the dissemination of non-heritage ceramics [24, 25]. For example, the development of online small programs and apps related to ceramics, and the introduction of 5G interactive live broadcasting and VR/AR technology into them, to build an immersive ceramic display system, and the use of the Internet and other digital technologies to expand the dissemination channels of ceramic products, so as to enhance the efficiency of the dissemination of ceramic culture and enhance cultural identity [26-29].

Non-heritage is an important link of national cultural heritage, but also an important symbol of the national spirit, the traditional design and dissemination of non-heritage intended to be unable to adapt to the needs of the development of the times, digital design and dissemination has become an inevitable choice for the protection and inheritance of non-heritage, for the non-heritage ceramics is true, and the other non-heritage products, brands are also the same. Literature [30] examines the application of digital media technology in ceramic product design and discusses the billet and glaze technology of Chinese ceramic products as well as their origins by applying isotope technology to several case studies. Literature [31] analyzed the digital display design strategy of Jingdezhen ceramic cultural and creative products, and explored the design strategy from multiple aspects of storytelling packaging, process visualization and personalized design, which not only helped to shape the unique city IP, but also enhanced the competitiveness of Jingdezhen cultural tourism. Literature [32] describes the application of digital media in the communication of non-heritage, which helps people to understand heritage and its value in a more comprehensive and in-depth way, while non-heritage can also be utilized with other applications such as multimedia technology, mixed reality, and artificial intelligence to show its different dimensions. Literature [33] highlights the importance of Miao embroidery in Miao culture to, and the need to incorporate modern technologies in order to innovate and preserve Miao embroidery in the context of globalization and the digital age, emphasizing that the application of digital means enhances the vitality and influence of Miao embroidery. Literature [34] explores the protection and dissemination of digital information based on non-heritage, points out that there are certain drawbacks in the development of the current martial arts heritage, such as ecological marginalization and imperfect development, and identifies the benefits of combining martial arts technology with digital technology. Literature [35] examines the use of digital production techniques in the preservation and innovation of non-heritage products, arguing that the rise of modern technologies, such as 3D modeling, CAD, and artificial intelligence, and other digital tools provide new ways to document, replicate, and enhance traditional crafts. Literature [36] suggests that the traditional skills of NRM are an important expression of cultural diversity and identity, and therefore an important topic in digital preservation and dissemination research, and that indicators of the effectiveness of digital dissemination of traditional skills are shifting from a primary focus on technology to a focus on the authenticity of cultural connotations, as well as the transmission of skills. Literature [37] emphasized that the development and application of information and digital technologies have provided rich means and diversified ways for the preservation and restoration of NRH, and also become one of the main ways of NRH dissemination. Literature [38] describes the creative industries and analyzes the related issues in terms of cultural and artistic products, focusing on industries such as pottery, ceramics and and also analyzes the digital technologies and social media used to promote these products. Literature [39] investigates ways of transferring cultural elements to the digital age by analyzing sample products that contain cultural symbols and are produced or designed by post-industrial technologies and influenced by trends in the digital age. Literature [40] emphasizes the importance of Jingdezhen's ceramic cultural heritage and analyzes the process of its “digitization”, aiming to maintain and enhance the value of Jingdezhen's ceramic cultural heritage and to promote the high-quality development of ceramic culture. Literature [41] discusses how young Chinese celadon artisans use digital platforms to address the issues of authenticity and visibility in the transmission of NRH, revealing that digital storytelling and visual aesthetics enable artisans to reinterpret traditional crafts.

The article first constructs a design strategy for non-heritage ceramic brands from four experiential dimensions: sensory, emotional, cognitive and associative. On this basis, the user-centered interactive emotional factors are introduced to comprehensively consider the information, brand emotion and user willingness of the non-heritage ceramic brand, and then to establish a non-heritage ceramic brand communication effect evaluation index system. Subsequently, a non-heritage ceramic brand was selected as the research object, and the index weights were determined by using subjective and objective AHP and entropy weight method, and the measurement of its communication effect was carried out through the cloud model. Finally, fsQCA method was applied to analyze and study the group path of communication effect improvement of digitized non-heritage ceramic brands of 50 companies.

2 Method

2.1 Digital design for non-heritage ceramic brands

This section, based on the problems and audience demands in the development of digital design for intangible cultural heritage ceramic brands in terms of connotation, elements, carriers and communication channels, constructs corresponding design principles, and based on the classification method of experience dimensions in brand experience design theory, builds design strategies for the digital design of intangible cultural heritage ceramic brands in four dimensions: "sensory", "emotional", "cognitive" and "association". The design strategy is shown in Figure 1.

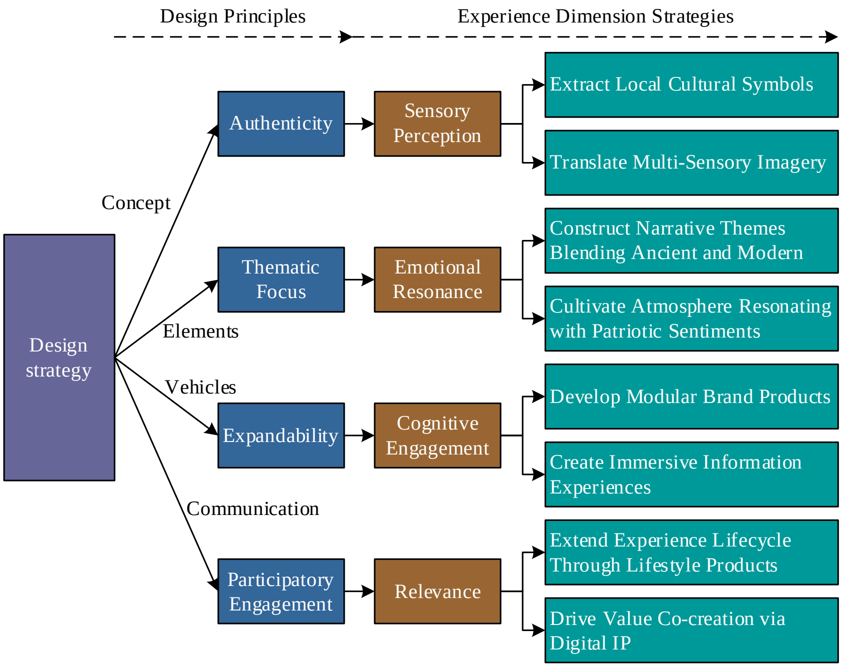

Figure 1: Design strategy

2.1.1 Sensory Experience Dimension Strategy

The core objective of the strategy of constructing sensory dimension is to deeply excavate the non-heritage ceramic culture, create attractive design symbols, and through the visual, auditory, olfactory, tactile and gustatory multi-sensory pathways of artistic translation, to provide key support for the construction of brand imagery, in the whole brand experience process, the sensory experience dimension plays a fundamental role in meeting the needs of the experiencer's experience of the senses, so that we can further After meeting the needs of the sensory experience, we can further guide the experience to form the emotional resonance and cultural identity of the non-heritage ceramic brand digital design.

2.1.2 Emotional Experience Dimension Strategy

Sensory experience dimension provides rich modal sensory stimulation for the experiencer, but to truly attract tourists and produce lasting impact, it is not enough to rely on sensory stimulation alone. Emotional experience dimension strategy emotional experience dimension focuses on the inner emotional response of tourists, through in-depth excavation of cultural connotations of non-heritage ceramics, giving vitality to the sensory symbols, building narrative scenarios, stimulating the emotional resonance of the experience.

2.1.3 Cognitive experience dimension strategies

Cognitive experience dimension represents the brand to output creative way to cause the audience's attention, surprise, interest and thinking, from the cognitive experience dimension can start for the non-heritage ceramics brand audience to create new cognition and realize self-satisfaction.

2.1.4 Associative Experience Dimension Strategy

Sensory, emotional and cognitive dimensions emphasize the individual experience provided by the brand to the experiencer, while the associated experience dimension focuses on how the experiencer participates in the co-creation of the brand experience through sharing and interaction. Associative experience dimension includes behavioral experience and relational experience. Behavioral experience refers to the behavior of the brand value that influences and changes the lifestyle of the experiencer, while relational experience refers to the quality of the relationship that the experiencer establishes with the brand, which includes consumers' loyalty, trust, and the frequency of interaction with the brand.

2.2 Indicator System for Evaluating the Effectiveness of Digital Communication of Non-heritage Ceramic Brands

The digital communication assessment model of non-heritage ceramic brand based on interactive experience includes three indicators: brand information measurement, brand emotion and user willingness. The amount of information related to the non-heritage ceramic brand determines the cognitive attributes of consumers, which is summarized in this paper as brand information measurement. Consumers' emotion towards the non-heritage ceramic brand is related to the effect of product brand communication, which is summarized as brand emotion in this paper. User behavior reflects the consumer's willingness, is also one of the core measures of brand communication effect, this paper summarizes as user willingness. Based on the “stimulus a response” communication process, combined with existing research and based on the brand communication effect of the problem domain, this paper puts forward the brand information measurement, brand emotion and user willingness of the three first-level indicators, and the specific content and meaning of the three first-level indicators are described. The digital communication effect evaluation hierarchical model of non-heritage ceramic brand proposed in this paper includes 18 specific basic indicators, and the digital communication effect evaluation hierarchical model of non-heritage ceramic brand is shown in Figure 2.

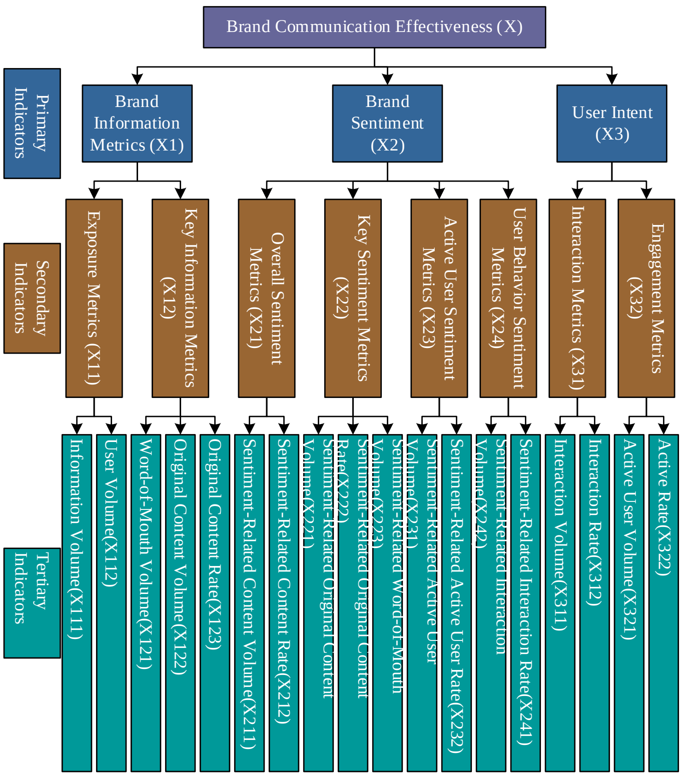

Figure 2: Hierarchical model for evaluating the digital communication effect

2.2.1 Brand Information Indicators for Non-Heritage Ceramics

The most intuitive non-heritage ceramic brand information is the amount of information. Exposure behavior involves the number of users, directly related to the exposure of brand communication. In addition to the basic brand information measurement index, but also need to consider the invisible brand information measurement index. The number of times the non-heritage ceramic brand appears in the communication process reflects the brand's reputation in the user's mind, this model introduces the amount of word of mouth to measure the key information input. Original information can reflect the originality of the brand communication process, more persuasive, this model introduces the original information volume and original information rate to measure the implicit key information measurement.

2.2.2 Non-heritage ceramics brand sentiment indicators

Non-heritage ceramic product brand and its related blog posts between the emotional situation reflects the emotional attitude of the consumer group to the product, is an important driving factor of the product value transfer, in the whole consumer behavior decision process is in the key stage of the beginning and the end. Emotional attitude also affects the consumer group's perception of brand cognition, brand association, brand positioning and other factors affecting the communication effect. Positive emotions can help increase brand reputation and promote product sales, while negative emotions will not only affect the effectiveness of product branding, but also put product brands in trouble. Real-time data collection and data analysis can enable brands to grasp the specifics of brand communication, do a good job in guiding consumers, and promote benign brand communication. At the same time, natural language processing technology is becoming more and more mature, which makes the measurement of sentiment indicators more timely.

This model divides the sentiment indicators of non-heritage ceramic brands into overall sentiment indicators, key sentiment indicators, active user sentiment indicators and user behavior sentiment indicators according to the different information attributes and user attributes, with the amount of sentiment information and the rate of sentiment information under each secondary indicator. Positive information has a positive impact on the brand communication effect, while negative information has a negative impact, the user's emotional state of the brand is affected by the combination of the two types of information, taking into account the principle of positive indicator, i.e., the influence of the indicator item on the model results is positive, so the positive minus negative method is chosen to calculate the emotional indicators.

2.2.3 Indicators of user willingness

In today's social media environment, consumer behavior has expanded and become more diverse. Users' comments, likes and retweets on brand-related content are all manifestations of users' willingness. Therefore, this paper proposes a user willingness indicator to express the influence of consumer behavior on brand communication effect. For the direct manifestation of user behavior, i.e., likes, comments and retweets, they are summarized as interaction indicators, and the three-level indicators of interaction volume and interaction rate are proposed. At the same time, this paper proposes the concept of active users, defining users who post information more than 5 times as active users, and the active users owned by the brand can to a certain extent assess the effect of brand communication, so we propose the active indicator, which consists of two tertiary indicators: the active user volume and the active rate. Regarding the evaluation model of multi-indicators, the calculation method of the weight of each indicator can be divided into subjective and objective assignment methods according to the introduction of human subjective factors, and the commonly used subjective assignment method is the hierarchical analysis method, while the commonly used objective assignment methods include entropy weight method, coefficient of variation method, etc. The paper combines the literature research and the subjective factors to assess the effectiveness of brand communication. This paper evaluates the applicability of various objective assignment methods to the sample data by combining the literature research and subjective factors, and finally chooses the coefficient of variation method to calculate the weights of the indicators in the hierarchical model for evaluating the digital communication effect of landmark product brands. The coefficient of variation method is a statistically based objective weighting method, which is calculated by measuring the variation of the indicator data, with larger weights for larger variation and smaller weights for smaller variation. In order to reduce the impact of differences in the magnitude and order of magnitude of the indicators, the method uses values normalized by the coefficient of variation as weights for the indicators.

2.3 Weight calculation based on AHP-entropy weight method

This paper combines the AHP method with the entropy weight method, which can not only integrate the professional judgment of decision makers, but also combine the objective data, so that the weights of the indicators obtained are more accurate and reliable.

2.3.1 AHP Hierarchical Analysis Fundamentals

Hierarchical analysis, or AHP for short, is a simple, flexible and practical method of subjective analysis, the core of which is the hierarchization and dataization of influencing factors, which can be applied to a variety of complex problems.The AHP method is usually used to analyze problems with multiple relationships and complex structures, and to divide them into multiple ordered levels based on the relationships between indicators. It is generally divided into three levels, including the objective level, the criterion level and the program level. According to the decision maker's experience, the weights of importance are determined by comparing two by two, and then by combining the weights of the hierarchical structure, the weights of all the indicators at the target level are derived. Using the hierarchical analysis method, the problem is first decomposed into a number of constituent factors and formed into a hierarchical structure, and the hierarchical relationship of indicators is determined by logically analyzing and researching the complex factors and the internal relationship of each influencing factor.

2.3.2 Steps for calculating initial weights

Hierarchical analysis method is mainly divided into the following four steps: the first step is to construct a hierarchical structure of evaluation index system. The second is to construct judgment matrix. The third is to calculate the weight vector, and to conduct consistency test on the judgment matrix. Fourth, the consistency test of the judgment matrix can determine the weight of the first-level indicators. The specific process is as follows:

(1) Use hierarchical analysis method to construct the structure of hierarchical analysis. First of all, using the logical idea of hierarchical analysis, on the basis of a comprehensive and profound analysis of the indicator system and the real situation, the elements in the target problem are categorized and analyzed according to their different attributes, so that the problem is hierarchical and structural, thus constructing a subjective analysis model.

(2) Utilizing the 9-level scaling method, the judgment matrix is established.

The judgment matrix is an important basis for weight calculation, which reflects the basic information of hierarchical analysis method. Therefore, it is very important to establish a reasonable judgment matrix. The judgment matrix can be established by marking the relative importance of each indicator. The relative importance of the indicators is generally expressed using a 9-level scale, which is a psychological research method used to express the subjective judgment of human beings on the importance of two objects. Assuming that there are a total of n elements in a certain layer, respectively $C_1, C_2, C_3, \cdots, C_n$, the two indicators will be compared two by two, and the degree of importance will be labeled with C_{ij}, and with 1, 3, 5, 7, and 9, respectively, to represent the equal importance, slight importance, and extreme importance of C_i compared to C_j, obviously important, strongly important, and extremely important. On this basis, if the decision maker considers the importance of the two indicators to be between these two numbers, a score of 2, 4, 6, 8 can be given, and if C_i is less important than C_j, a score of 1/3 is given accordingly, and the rest of the assessment follows this pattern. Where i and j represent elements within the matrix, respectively.

Based on the scoring scale and matrix construction principles, a judgment matrix can be built about n elements as follows:

$$A = \begin{bmatrix} a_{11} & \cdots & a_{1n} \\ \vdots & \ddots & \vdots \\ a_{m1} & \cdots & a_{mn} \end{bmatrix} \tag{1}$$

(3) Due to the two-by-two comparison of the indicators will be due to the subjectivity of personal judgment and bias in the estimation of the degree of importance of the indicators, in order to ensure the degree of coordination of the importance of the indicators, to ensure the reliability of the results, it is necessary to pass the consistency test before determining the indicator system of the first level of the weight of the indicators.

Step 1: Normalize by column to get the judgment matrix H:

$$H_{ij} = \frac{a_{ij}}{\sum_{i=1}^{n} a_{ij}} \quad i = 1, 2, 3, \; j = 1, 2, 3 \tag{2}$$

Step 2: Calculate the weight vector:

$$W_i = \frac{\sum_{j=1}^{n} h_{ij}}{\sum_{i=1}^{n} \sum_{j=1}^{n} h_{ij}} \tag{3}$$

Get the eigenvector matrix $W = [W_1, W_2, W_3, \ldots, W_n]$

Step 3: Find the consistency test index CI, $\lambda_{\max}$ stands for the maximum eigenvalue, and n stands for the matrix order.

$$\lambda_{\max} = \sum_{i=1}^{n} \frac{(AW)_i}{nW_i} \tag{4}$$

$$CI = \frac{\lambda_{\max} - n}{n - 1} \tag{5}$$

Step 4: Query its corresponding Evaluation Randomized Consistency Indicator RI

according to n.

Step 5: Calculate the consistency ratio CR.

$$CR = \frac{CI}{RI} < 0.1 \tag{6}$$

If $CR < 0.1$, the judgment matrix conforms to consistency, the eigenvector corresponding to the largest eigenvalue $\lambda_{\max}$ is the weight scale vector, and the weight of each index is obtained after normalization. The corresponding weights are finally obtained. If $CR > 0.1$, the judgment matrix does not meet the consistency test and needs to be reconstructed.

2.3.3 Fundamentals of the Entropy Power Method

Entropy is a physical concept, the entropy value is used to measure the uncertainty of the occurrence of each possible event in the information source, the greater the uncertainty, the greater the information entropy. The greater the uncertainty, the greater the information entropy. At the same time, the greater the information entropy, the lower the probability of occurrence of the information, the less the amount of information covered. On the contrary, the smaller the information entropy is, the more information is provided. If the information entropy of the indicator is smaller, it means that the amount of information covered by the indicator in the comprehensive evaluation is more, in order to ensure the accuracy of the comprehensive evaluation score, it is necessary to give the indicator a larger proportion of weight. The entropy weight law is to use the concept of information entropy to determine the weight of each indicator. By combining the information entropy value with the relative variable degree of each indicator to be considered, the entropy weight of each indicator can be calculated. When using the entropy weight method to find the weight of indicators, it is first necessary to standardize the data using the standardized formula for positively oriented indicators and the standardized formula for negatively oriented indicators, and then calculate the entropy value according to the formula for calculating the value of information entropy, and at the same time calculate the relative degree of variability of each indicator, and finally derive the entropy weight.

2.3.4 Steps for determining portfolio weights

This paper combines the competent weight calculation of hierarchical analysis method with the objective weight calculation of entropy weight method, uses the hierarchical analysis method to calculate the initial weight of the first-level indicators, carries out a comprehensive analysis of the macro-level policy indicators of the digitalization of non-heritage ceramic brands, and then uses the advantages of the entropy method's own objectivity to cooperate to obtain the combination of weights. The specific calculation process is as follows:

(1) Data standardization

Data standardization processing transforms the indicators into relative values, which can remove the impression factor that the statistical units of the indicators are not consistent, thus solving the problem of homogeneous comparison of indicators of different nature.

Step 1: Construct the original evaluation matrix.

$$X = \begin{bmatrix} X_{11} & \cdots & X_{1n} \\ \vdots & \ddots & \vdots \\ X_{m1} & \cdots & X_{mn} \end{bmatrix} \tag{7}$$

where X is the original evaluation indicator data matrix, X_{ij} represents the evaluation indicator data of the j th indicator in the i th year, i denotes the year $(i = 1, 2, 3, \ldots, n)$, and j denotes the indicator $(j = 1, 2, 3, \ldots, m)$.

Step two:

Normalization of positive indicators:

$$X'_{ij} = \frac{x_{ij} - \min(x_{ij})}{\max x_{ij} - \min(x_{ij})} \tag{8}$$

Standardization of reverse indicators:

$$X'_{ij} = \frac{\max(x_{ij}) - x_{ij}}{\max x_{ij} - \min(x_{ij})} \tag{9}$$

where $\min\left(X_{ij}\right)$, $\max\left(X_{ij}\right)$ are the maximum and minimum values within the evaluation indexes, respectively.

Step 3: Obtain the normalization matrix:

$$X = \begin{bmatrix} X'_{11} & \cdots & X'_{1n} \\ \vdots & \ddots & \vdots \\ X'_{m1} & \cdots & X'_{mn} \end{bmatrix} \tag{10}$$

(2) Determination of weights by entropy weighting method

Step 1: Calculate the characteristic weight P_{ij} (representing the weight of the standardized indicator for the j th evaluation indicator in year i):

$$P_{ij} = \frac{x'_{ij}}{\sum_{i=1}^{n} x'_{ij}} \tag{11}$$

Step 2: Calculate the indicator entropy value e_j :

$$e_j = -\frac{1}{\ln m} \sum_{i=1}^{m} P_{ij} \ln P_{ij} \tag{12}$$

If $P_{ij} = 0$ then define $\lim_{P_{ij} \to 0} P_{ij} \ln P_{ij} = 0$.

Step 3: Calculate the entropy weight:

$$\mu_j = \frac{1 - e_j}{n - \sum_{i=1}^{n} e_j} \tag{13}$$

(3) Combination weight calculation

Using the correction coefficient μ_j to modify the hierarchical analysis method to find the initial weight W_j, to find the entropy weight method after the correction of the weight, using hierarchical recursion to determine the corrected weight.

$$\theta_j = \mu_j \frac{Wj}{\sum_{j=1}^{n} \mu_j Wj} \tag{14}$$

2.4 Evaluation of cloud modeling approaches

2.4.1 Overview of cloud models

(1) Concepts

Based on the intersection of the two theories of probability theory and fuzzy set theory, the cloud model uses specific algorithms to convert qualitative concepts and quantitative algorithms to each other, in order to show the intrinsic correlation between the vagueness and randomness of evaluation indexes. Due to the uncertainty and fuzzy nature of some evaluation systems, it is difficult to make effective and accurate assessment of them, so the cloud model is applied to express the directional indexes in the evaluation index system through the normal cloud, and the quantitative values of the experts' scores are converted into the qualitative evaluation grades by using the inverse cloud generator, so as to realize the interconversion of the qualitative and quantitative aspects of the sample data, and to achieve the effective and accurate assessment effect. The study of media influence on online public opinion aims at evaluating the comprehensive influence on the communication process of online public opinion due to the specificity of different media and the interaction between different media. The inverse cloud generator is shown in Figure 3.

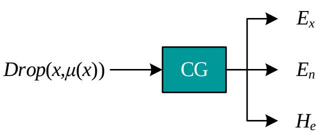

Figure 3: Reverse cloud generator

(2) Numerical Characterization

The numerical characteristics of the cloud are represented by three parameters (E_x, E_n, H_e), where E_x represents the expectation, which indicates the point of the center of gravity of the cloud droplet. E_n represents entropy, which reflects the cloud droplet position and indicates the conceptual ambiguity. H_e represents the hyperentropy, reflecting the discrete nature of the cloud droplet, which is represented as the thickness in the cloud diagram.

(3) Cloud generator

Cloud generator is divided into forward and reverse generator, which is the algorithm to generate cloud model. In this paper, we mainly generate (E_x, E_n, H_e) by expert scoring, and then convert quantitative to qualitative rating.

Therefore, the inverse cloud generator is chosen, which is to convert the data into qualitative concepts represented by (E_x, E_n, H_e), and the calculation process is as follows:

① Calculate the expectation of n samples:

$$\overline{x} = \frac{1}{n}\sum_{i=1}^{n} x_i \tag{15}$$

②Calculate the absolute center distance and variance of the sample, as in the following formula:

$$\frac{1}{n}\sum_{i=1}^{n}\left|x_i-\overline{x}\right| \tag{16}$$

$$S^2=\frac{1}{n-1}\sum_{i=1}^{n}\left(x_i-\overline{x}\right)^2 \tag{17}$$

③Calculate the entropy of the sample:

$$E_n=\sqrt{\frac{\pi}{2}}\times\frac{1}{n}\sum_{i=1}^{n}\left|x_i-E_x\right| \tag{18}$$

④Calculating superentropy:

$$H_e=\sqrt{S^2-E_n^2} \tag{19}$$

2.4.2 Cloud Model Evaluation Steps

(1) Calculate the weights

①Firstly, by referring to the relevant literature, find experts in the relevant fields to score the relative importance between two two indicators in the indicator set, and obtain the expert scoring matrix $W=\begin{bmatrix}\omega_{11} & \cdots & \omega_{1j}\\ \vdots & \ddots & \vdots\\ \omega_{i1} & \cdots & \omega_{ij}\end{bmatrix}$.

where ω_{ij} is the importance scale of the i th indicator compared to the j th indicator.

② Second, calculate the n th root of the product of the elements of each row of the expert scoring matrix, A_i:

$$A_i=\sqrt[n]{\prod_{j=1}^{n}\omega_{ij}}, i=1,2,\cdots,m \tag{20}$$

where m is the number of indicators and n is the number of experts.

③ Finally, A_i is normalized:

$$a_i=\frac{A_i}{\sum_{i=1}^{m}A_i}, i=1,2,\cdots,m \tag{21}$$

Obtain indicator weights $\varphi=(\varphi_1,\varphi_2,\cdots\varphi_n)^T$.

(2) Generate standard cloud

The establishment of standard cloud is mainly used for grade evaluation, which divides the communication effect of non-heritage ceramic brand into five grades, and the grade theory domain $U=\left(U1,U2,U3,U4,U5\right)$ = (poor, worse, average, good, excellent). The standard cloud digital features are calculated as follows:

$$E_x = (f_{\min} + f_{\max})/2 \tag{22}$$

$$E_n = (f_{\max} - f_{\min})/6 \tag{23}$$

$$H_e = d \tag{24}$$

where E_x is the expected value, E_n is the entropy, H_e is the hyperentropy, $f_{\min}$ is the lower limit of the evaluation interval, $f_{\max}$ is the upper limit of the evaluation interval, and d is an empirical constant.

(3) Calculate digital features

The cloud model map is generated according to the inverse cloud generator calculation. The formula for calculating each digital feature is as follows:

$$E_x = \frac{\sum_{i=1}^{n} x_i}{n} \tag{25}$$

$$E_n = \sqrt{\frac{n}{2}} \times \frac{\sum_{i=1}^{n} \left| x_i - E_x \right|}{n} \tag{26}$$

$$H_e = \sqrt{\left| S^2 - E_n^2 \right|} \tag{27}$$

$$S^2 = \frac{\sum_{i=1}^{n} \left(x_i - E_x \right)^2}{n-1} \tag{28}$$

where, Eq. x_i is the indicator value, n is the number of samples, and S^2 is the sample variance.

(4) Generate comprehensive evaluation cloud

Generate a comprehensive evaluation cloud and evaluation cloud for comparison. Non-legacy ceramic brand digital design communication effect of comprehensive digital features formula is:

$$E_x = \sum_{i=1}^{n} \varphi_i E_{xi} \tag{29}$$

$$E_n = \sum_{i=1}^{n} \varphi_i E_{ni} \tag{30}$$

$$H_e = \sum_{i=1}^{n} \varphi_i E_{ei} \tag{31}$$

where E_{xi} is the expected value of each sample, E_{ni} is the entropy of each sample, and H_{ei} is the hyperentropy of each sample.

(5) MATLAB is used to program and generate the composite cloud and standard cloud for comparison and analysis respectively.

3 Results and Discussion

3.1 Determination of weights of indicators for comprehensive evaluation of strategies

3.1.1 Weights calculated by the hierarchical analysis method

When using AHP to determine the weights of indicators at all levels in the indicator system of digital design and communication of non-heritage ceramic brands, the relative importance among the indicators in the indicator system is mainly based on the experience of experts. The questionnaires were distributed to professors and associate professors engaged in the digital design of non-heritage ceramic brands, teachers of universities with relevant courses, in addition to professionals who have worked in non-heritage ceramic brand design companies for more than three years. A total of 10 electronic questionnaires were distributed and 10 valid ones were received. According to the calculation steps of the hierarchical analysis method, finally the levels need to be total sorted and the weights of the evaluation indicators relative to the highest level need to be calculated. After the calculation, we can get the weight results of all expert scoring. The summary of expert scoring weight results is shown in Table 1.

Table 1: Summary of expert scoring weight results

Indicator	Expert Number									
	1	2	3	4	5	6	7	8	9	10
X1	0.3823	0.172	0.2071	0.1362	0.2653	0.1794	0.1909	0.3401	0.4757	0.509
X2	0.2184	0.3383	0.254	0.1465	0.4159	0.4433	0.2704	0.2919	0.2501	0.3107
X3	0.3993	0.4897	0.5389	0.7173	0.3188	0.3773	0.5387	0.368	0.2742	0.1803
X11	0.0938	0.0827	0.1446	0.0962	0.0967	0.0935	0.0874	0.0948	0.0912	0.0936
X12	0.0296	0.0293	0.0516	0.0321	0.0593	0.0342	0.0322	0.028	0.031	0.0303
X21	0.0288	0.0238	0.0242	0.0376	0.0187	0.0222	0.0331	0.0312	0.0349	0.0303
X22	0.0548	0.0578	0.0484	0.0713	0.0591	0.0649	0.0678	0.0644	0.0722	0.072
X23	0.1806	0.1777	0.1646	0.2102	0.1623	0.193	0.2112	0.1945	0.216	0.2172
X24	0.2781	0.2937	0.1652	0.1496	0.2454	0.2269	0.1489	0.1548	0.1872	0.1199
X31	0.0744	0.071	0.0385	0.0386	0.0621	0.0586	0.0367	0.0363	0.0455	0.151
X32	0.2599	0.264	0.3629	0.3644	0.2964	0.3067	0.3827	0.396	0.322	0.2857
X111	0.0182	0.0243	0.0415	0.1288	0.0248	0.0171	0.025	0.0164	0.024	0.0298
X112	0.0646	0.0698	0.1071	0.0694	0.0776	0.0679	0.0691	0.0719	0.0716	0.0733
X121	0.0285	0.127	0.0377	0.0238	0.0293	0.0264	0.1222	0.0205	0.0254	0.0239
X122	0.0105	0.0064	0.1077	0.1027	0.0087	0.0051	0.1049	0.0094	0.0087	0.0075
X123	0.1193	0.0169	0.0092	0.02	0.0116	0.0038	0.0153	0.0137	0.0208	0.0118
X211	0.0086	0.0115	0.0075	0.0112	0.1096	0.1082	0.0032	0.1023	0.0071	5.00E-04
X212	0.0014	0.0038	0.1073	0.0014	0.0085	0.0155	0.0142	0.0067	0.0117	0.0134
X221	0.1044	0.1058	0.0048	0.009	0.0126	0.0057	0.0086	0.1099	0.006	0.1043
X222	0.0242	0.0133	0.0132	0.0188	0.0198	0.023	0.0265	0.0206	0.0198	0.0177
X223	0.0343	0.0372	0.0269	0.0371	0.1306	0.0394	0.0427	0.0364	0.145	0.0438
X231	0.0961	0.0896	0.0846	0.0961	0.0829	0.0974	0.1085	0.0924	0.1087	0.1051
X232	0.1364	0.0419	0.0347	0.1397	0.0321	0.0392	0.0501	0.0413	0.0351	0.0394
X241	0.0211	0.0191	0.0178	0.0223	0.0248	0.0245	0.0236	0.0262	0.0237	0.1223
X242	0.0338	0.0323	0.0311	0.0365	0.1293	0.0384	0.0353	0.0385	0.0417	0.0364
X311	0.0532	0.0593	0.1294	0.1363	0.0493	0.0392	0.0323	0.1358	0.0323	0.0471
X312	0.1744	0.1892	0.1001	0.0953	0.1519	0.1455	0.0993	0.0894	0.1135	0.1258
X321	0.0517	0.0497	0.0257	0.0295	0.0409	0.0343	0.0184	0.0189	0.1349	0.0298
X322	0.0193	0.1029	0.1137	0.0221	0.0557	0.2694	0.2008	0.1497	0.17	0.1681

The weights of the indicators derived by applying AHP were solved according to the formula and the weights calculated by AHP are shown in Table 2.

Table 2: The weights calculated by AHP

<table>
<tr><th>First-level indicator</th><th>Weight</th><th>Secondary indicators</th><th>Weight</th><th>Tertiary index</th><th>Weight</th></tr>
<tr><td rowspan="5">X1</td><td rowspan="5">0.2261</td><td rowspan="2">X11</td><td rowspan="2">0.1343</td><td>X111</td><td>0.0604</td></tr>
<tr><td>X112</td><td>0.0739</td></tr>
<tr><td rowspan="3">X12</td><td rowspan="3">0.0918</td><td>X121</td><td>0.0236</td></tr>
<tr><td>X122</td><td>0.0304</td></tr>
<tr><td>X123</td><td>0.0378</td></tr>
<tr><td rowspan="9">X2</td><td rowspan="9">0.3235</td><td rowspan="2">X21</td><td rowspan="2">0.0615</td><td>X211</td><td>0.0351</td></tr>
<tr><td>X212</td><td>0.0264</td></tr>
<tr><td rowspan="3">X22</td><td rowspan="3">0.0926</td><td>X221</td><td>0.0162</td></tr>
<tr><td>X222</td><td>0.0405</td></tr>
<tr><td>X223</td><td>0.0359</td></tr>
<tr><td rowspan="2">X23</td><td rowspan="2">0.1023</td><td>X231</td><td>0.0874</td></tr>
<tr><td>X232</td><td>0.0149</td></tr>
<tr><td rowspan="2">X24</td><td rowspan="2">0.0671</td><td>X241</td><td>0.0223</td></tr>
<tr><td>X242</td><td>0.0448</td></tr>
<tr><td rowspan="4">X3</td><td rowspan="4">0.4504</td><td rowspan="2">X31</td><td rowspan="2">0.2178</td><td>X311</td><td>0.0888</td></tr>
<tr><td>X312</td><td>0.129</td></tr>
<tr><td rowspan="2">X32</td><td rowspan="2">0.2326</td><td>X321</td><td>0.1326</td></tr>
<tr><td>X322</td><td>0.1</td></tr>
</table>

3.1.2 Weights calculated by the entropy weight method

(1) This paper adopts the 5-scale method to measure the importance of indicators. Questionnaires were distributed to personnel from industries related to the digital design of intangible cultural heritage ceramic brands. They rated all the indicators within the index system based on the actual situations of the projects they had experienced. "1" represents very unimportant, "2" represents unimportant, "3" represents generally important, "4" represents important, and "5" represents extremely important. A total of 100 electronic questionnaires were distributed this time, and all 100 were valid. By organizing the collected questionnaires, the entropy values, difference coefficients and entropy weights of each indicator can be calculated according to the formula. The entropy values, difference coefficients and entropy weights of each level of indicators are respectively shown in Tables 3 to 5.

Table 3: The entropy of the first level, the difference coefficient and the entropy

First-level indicator	Entropy value	Coefficient of difference	Entropy weight
X1	0.9194	0.0734	0.2254
X2	0.121	0.057	0.1897
X3	0.9165	0.0842	0.2522

Table 4: The entropy of the secondary index, the difference coefficient and the entropy

Secondary indicators	Entropy value	Coefficient of difference	Entropy weight
X11	0.9298	0.0799	0.0936
X12	0.9073	0.0746	0.0942
X21	0.9264	0.0795	0.0957
X22	0.9516	0.0755	0.0902
X23	0.94	0.0761	0.094
X24	0.9253	0.0891	0.0993
X31	0.9582	0.0726	0.0933
X32	0.9229	0.0846	0.0902
X11	0.9646	0.0737	0.0959
X12	0.9575	0.0328	0.078
X21	0.9689	0.0412	0.0844
X22	0.9193	0.0741	0.0934
X23	0.9164	0.0809	0.0981
X24	0.9483	0.0784	0.0927
X31	0.9407	0.0751	0.0907
X32	0.9254	0.0897	0.1037

Table 5: The entropy of the three levels, the difference coefficient and the entropy

Tertiary index	Entropy value	Coefficient of difference	Entropy weight
X111	0.8946	0.0779	0.0385
X112	0.9472	0.0699	0.0353
X121	0.9496	0.0716	0.0397
X122	0.8796	0.0681	0.0293
X123	0.914	0.0674	0.0359
X211	0.9525	0.0701	0.038
X212	0.9275	0.0781	0.0445
X221	0.9103	0.0839	0.0367
X222	0.9102	0.078	0.0425
X223	0.8888	0.0966	0.0402
X231	0.8755	0.1162	0.051
X232	0.9085	0.0993	0.0422
X241	0.9663	0.0707	0.0342
X242	0.9098	0.0903	0.0405
X311	0.9607	0.0714	0.0334
X312	0.8911	0.0836	0.036
X321	0.9214	0.0669	0.03
X322	0.974	0.0316	0.0184

(2) Reliability and validity test Reliability test refers to the questionnaire reliability test, test the degree of consistency or reliability of the results. Validity refers to whether the measurement tool can well reflect the real characteristics of the measurement object. In this paper, we analyze the reliability of the questionnaire data with the help of SPSS statistical analysis software and KMO and Bartlett sphericity test. Reliability is generally measured by the Cronbach's α coefficient of the measurement scale. The Cronbach's α coefficient of this questionnaire is 0.832, between 0.8 and 0.9, with good reliability.The KMO value is equal to 0.732, between

0.7 and 0.8, indicating that the data within the questionnaire are well correlated. The significance is 0.000, which is less than 0.01 and presents significance at the level, rejecting the original hypothesis that there is a correlation between the variables.

3.1.3 Consistency test before portfolio assignment

In order to test the appropriateness of combining the weights obtained from the two assignment methods, this paper uses the calculation of Spearman's rank correlation coefficient ρ to test their consistency. When ρ is between 0 and 1, it indicates that the weights obtained from the two assignment methods are consistent. In this paper, Matlab software is used to calculate ρ,Spearman rank correlation coefficient is shown in Figure 4. As can be seen from the figure, all ρ are between 0 and 1. That is, the weights obtained by the two assignment methods satisfy consistency and are suitable for combined assignment.

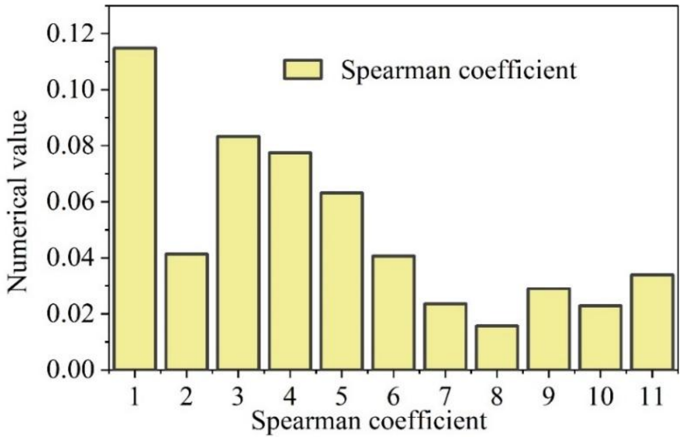

Figure 4: Spearman rank correlation coefficient

3.1.4 Comprehensive Evaluation Indicator Weights for Digital Design Strategies for Non-heritage Ceramic Brands

According to the formula combined with the calculated weighting coefficient, that is, to get the weight of the comprehensive evaluation index of the digital design strategy of non-heritage ceramic brand, the weight of the comprehensive evaluation index of the digital design strategy of non-heritage ceramic brand is shown in Table 6. As can be seen from the table, the weight of the brand information dimension in the first-level indicators is the highest at 0.3562, which proves that extracting the relevant information of the non-heritage ceramic culture and tapping into the highlights of cultural creativity have an important impact on the digital design of non-heritage ceramic brand.

Table 6: The weights of each comprehensive evaluation index

First-level indicator	Weight	Secondary indicators	Weight	Tertiary index	Weight
X1	0.3562	X11	0.1632	X111	0.0914
				X112	0.0527
		X12	0.0765	X121	0.0307
				X122	0.0165
				X123	0.0223
X2	0.2966	X21	0.1365	X211	0.0212
				X212	0.0663
		X22	0.1635	X221	0.0651
				X222	0.0769
				X223	0.0539
		X23	0.2356	X231	0.069
				X232	0.0428
		X24	0.0659	X241	0.0569
				X242	0.0786
X3	0.3472	X31	0.0663	X311	0.0703
				X312	0.0825
		X32	0.0925	X321	0.0333
				X322	0.0696

3.2 Empirical study on the communication effect of non-heritage ceramic brands

3.2.1 Selection of empirical subjects

According to the previous section of the non-heritage ceramics brand digital design strategy evaluation index system analysis, this paper selects a non-heritage ceramics brand design as the object of study, and selects the questionnaire issued by the brand communication experts, respectively, four university scholars, six industry experts a total of 10 people.

3.2.2 Development of scoring rules

The questionnaire to get 10 experts' scoring data situation is standardized into the form of the greater the value of the greater risk, and the score is unified to the [0,1] range, through the inverse cloud generator and the formula to calculate the corresponding cloud digital features of each indicator, and according to the cloud digital features to determine the factor layer indicators to evaluate the cloud. The score and cloud digital features of each indicator are shown in Table 7.

Table 7: The scores of each indicator and the cloud digital characteristics

Appraiser	1	2	3	4	5	6	7	8	9	10	Evaluation cloud
X1	0.2	0.2	0.3	0.2	0.3	0.2	0.2	0.3	0.3	0.2	(0.32,0.05,0.01)
X2	0.6	0.3	0.6	0.3	0.3	0.3	0.3	0.6	0.6	0.6	(0.53,0.07,0.04)
X3	0.3	0.3	0.6	0.3	0.3	0.3	0.3	0.3	0.3	0.6	(0.48,0.04,0.01)
X11	0.3	0.3	0.3	0.6	0.3	0.6	0.6	0.3	0.3	0.3	(0.32,0.06,0.02)
X12	0.6	0.3	0.6	0.6	0.3	0.8	0.8	0.6	0.8	0.3	(0.6,0.07,0.03)
X21	0.6	0.3	0.3	0.6	0.6	0.3	0.6	0.3	0.3	0.3	(0.45,0.04,0.04)
X22	0.3	0.6	0.3	0.8	0.3	0.8	0.8	0.8	0.6	0.6	(0.59,0.09,0.01)
X23	0.6	0.6	0.6	0.3	0.6	0.2	0.3	0.3	0.3	0.3	(0.51,0.07,0.02)
X24	0.6	0.6	0.8	0.8	0.3	0.3	0.3	0.3	0.3	0.8	(0.5,0.1,0.05)
X31	0.2	0.2	0.3	0.3	0.2	0.2	0.2	0.2	0.2	0.2	(0.3,0.05,0.03)
X32	0.6	0.6	0.6	0.6	0.6	0.6	0.8	0.6	0.6	0.6	(0.39,0.02,0.02)
X111	0.8	0.6	0.8	0.8	0.8	0.3	0.6	0.8	0.8	0.8	(0.44,0.08,0.01)
X112	0.8	0.6	0.8	0.3	0.8	0.3	0.8	0.6	0.6	0.8	(0.63,0.07,0.04)
X121	0.3	0.3	0.3	0.6	0.3	0.6	0.3	0.3	0.3	0.3	(0.45,0.03,0.02)
X122	0.3	0.2	0.3	0.3	0.3	0.2	0.3	0.3	0.3	0.3	(0.36,0.03,0.01)
X123	0.3	0.2	0.6	0.3	0.8	0.8	0.6	0.6	0.6	0.6	(0.56,0.1,0.01)
X211	0.3	0.3	0.6	0.6	0.3	0.3	0.6	0.6	0.6	0.6	(0.57,0.07,0.03)
X212	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.6	0.3	0.3	(0.41,0.02,0.03)
X221	0.2	0.2	0.3	0.2	0.3	0.6	0.3	0.3	0.3	0.2	(0.55,0.03,0.02)
X222	0.6	0.3	0.6	0.3	0.3	0.3	0.2	0.6	0.8	0.6	(0.51,0.1,0.05)
X223	0.3	0.3	0.6	0.3	0.3	0.6	0.8	0.3	0.3	0.6	(0.2,0.05,0.03)
X231	0.3	0.3	0.3	0.6	0.3	0.3	0.6	0.3	0.8	0.6	(0.26,0.01,0.01)
X232	0.6	0.3	0.6	0.6	0.3	0.2	0.8	0.6	0.2	0.8	(0.49,0.18,0.01)
X241	0.6	0.3	0.3	0.6	0.6	0.6	0.3	0.3	0.3	0.6	(0.65,0.17,0.03)
X242	0.3	0.6	0.3	0.8	0.3	0.8	0.3	0.6	0.2	0.3	(0.46,0.02,0.01)
X311	0.6	0.6	0.6	0.3	0.6	0.8	0.6	0.3	0.6	0.3	(0.38,0.02,0.01)
X312	0.6	0.6	0.8	0.8	0.3	0.3	0.6	0.3	0.3	0.6	(0.58,0.2,0.01)
X321	0.2	0.2	0.3	0.3	0.2	0.3	0.3	0.6	0.3	0.6	(0.58,0.17,0.01)
X322	0.6	0.6	0.6	0.6	0.6	0.8	0.3	0.3	0.6	0.6	(0.32,0.01,0.03)

3.2.3 Determination of the integrated evaluation cloud for the guideline layer

The cloud digital features of a non-heritage ceramic brand communication effect guideline layer indicator are calculated by combining the cloud digital features of the factor layer indicator with the formula. According to the cloud digital features, use the formula to calculate the digital features of the evaluation cloud of the target layer of a non-heritage ceramic brand communication effect, and get its cloud digital features as (0.46,0.03,0.01). The comprehensive evaluation cloud image of the target layer of the communication effect of a non-heritage ceramic brand is drawn by Matlab software, so that the cloud drop n=1000, and the comprehensive evaluation cloud image is shown in Figure 5.

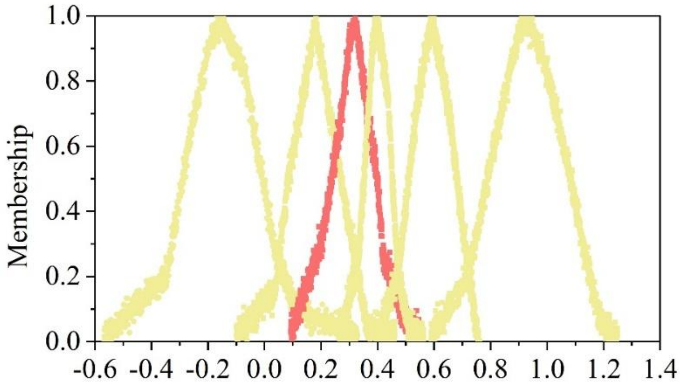

Figure 5: Comprehensively evaluate cloud images

3.2.4 Evaluation results

The similarity between the target layer evaluation cloud and the scale cloud is calculated by Matlab software using Eq. The similarity of the target layer evaluation cloud is shown in Table 8.

Table 8: The target layer evaluates cloud similarity

Evaluation Indicators	Bad	Worse	General	Good	Excellence
Propagation effect	0	0.2688	0.3645	0.0042	0

It can be seen from the comprehensive evaluation cloud map of the communication effect of non-heritage ceramic brands and the cloud digital features (0.46,0.03,0.01) that the cloud droplets of the evaluation cloud map of the communication effect of non-heritage ceramic brands are more concentrated, the thickness of the cloud is thinner, and the entropy and super-entropy values of the cloud map are both very small, which proves that the evaluation results have a high degree of reliability and stability. The similarity between the evaluation cloud of the target layer of the communication effect of non-heritage ceramics brand and the scale cloud can be synthesized, and it can be seen that the similarity between the communication effect of the non-heritage ceramics brand and the “medium effect” is the largest, which is 0.3645. As a result, it can be judged that the non-heritage ceramic brand communication effect model based on the combination of empowerment-cloud model evaluates the non-heritage ceramic brand communication effect as “medium”.

3.3 Non-heritage ceramic brand digital communication effect enhancement path

3.3.1 Selection of research methodology

The purpose of this study is to explore the group effect of multiple factors in the digital design and dissemination of non-heritage ceramic brands. The digital design and communication of NRL ceramic brands is the result of multiple factors at different levels, which cannot be fully explained by regression analysis. Therefore, this chapter chooses fsQCA method to further explore how digitalization affects the communication effect of NRL ceramic brands through the synergistic linkage of three dimensions: brand information, brand emotion and user willingness.

3.3.2 Data sources

The samples selected in this section are from listed companies in the list of top 50 Chinese non-heritage ceramic brands. The data source is the 2024 annual report of each sample, which is hand-curated.

3.3.3 Selection of variables

(1) Outcome Variables

The communication effect of the digital design of non-heritage ceramic brands. The measurement of the communication effect of the digital design of non-heritage ceramic brands is consistent with the indicators of the communication effect of the interpreted variable non-heritage ceramic brand digital design in the analysis of this paper.

(2) Antecedent variables

The python algorithm and jieba participle were used to process the data of the selected sample 2024 annual report. The selected variables are consistent with those selected in this paper, i.e., brand information, brand emotion and user willingness variables are selected.

3.3.4 Empirical Analysis of Conditional Grouping Paths to Enhance Firm Brand Value

(1) Variable calibration

According to the characteristics of the selected case samples and with reference to the research of many scholars, this paper calibrates the outcome variable (brand communication effect) and three conditional variables (brand information, brand emotion and user willingness variables) with the help of the calibrate function in fsQCA to transform quantitative or fixed scale variables into fuzzy set scores.

(2) Necessity analysis

Consistency and coverage indicators are used in FsQCA to test whether the conditional variables are sufficient or necessary conditions and explanatory power of the outcome variables. The results of necessity analysis are shown in Table 9, the consistency of each single antecedent condition is lower than 0.9, i.e. none of them satisfy the necessity condition, and the single variables are not sufficient to explain the outcome variables, confirming the complexity of the communication effect of non-legacy ceramic brand, and the high or low effect of the communication of non-legacy ceramic brand should be considered comprehensively in terms of concurrent synergistic effect of the three dimensions of brand information, brand emotion and user willingness variables.

Table 9: Results of necessity analysis

Antecedent variable	Result variable			
	High propagation effect		Low propagation effect	
	Consistency	Coverage	Consistency	Coverage
High brand information	0.6924	0.7859	0.497	0.5659
Low brand information	0.6127	0.5376	0.8086	0.7313
High brand emotion	0.6193	0.6802	0.6009	0.6585
Low brand emotion	0.679	0.6276	0.7106	0.6531
High user will	0.7909	0.8185	0.471	0.5004
Low user will	0.5188	0.4962	0.8262	0.7927

(3) Conditional grouping analysis

In order to ensure the reliability and validity of the study, the conditional grouping paths provided by the intermediate solution are selected in compliance with the requirements of consistency and coverage indicators. In this study, the frequency is taken as 1, and the threshold is set to 0.9, which results in 4 types of grouping paths to enhance the effectiveness of the company's brand communication, and the grouping results of the brand communication are analyzed as shown in Table 10, in which the big circle indicates the core conditions, the small circle indicates the marginal conditions, and the blank indicates that the conditional variables are not important to the results. The consistency of the intermediate solution is 0.84, i.e., 84% of the brand communication effect cases that satisfy the 4 types of conditioned groupings show higher brand value. The coverage of the solution is 0.78, i.e., the 4 conditional groupings can explain 78% of the high brand communication construction cases. The consistency and coverage of the solution in this study exceed the critical value, and the consistency index of the 4 types of conditional grouping paths is distributed between 0.86-0.90, which is greater than 0.8 and satisfies the sufficiency condition. In conclusion, the empirical analysis of this study is valid.

Table 10: Analysis of configuration results of brand communication

	Digital-enabled type		Digital non-dominant type	
	1	2	3	4
Brand Information	●	●		
Brand Emotion	●	●		●
User Will		●	●	●
Consistency	0.89585	0.89405	0.87143	0.86843
Raw coverage	0.58598	0.39725	0.52383	0.62143
Unique coverage	0.03167	0.02487	0.02535	0.07771
Solution	0.83659			
Consistency				
Solution	0.77989			
Coverage				

The digital design of the company's non-heritage ceramic brand is combined with its own advantages, and the brand spillover effect is increasingly prominent. 2 of the 4 group paths show that the level of digitization empowers the enhancement of brand communication, therefore, according to the size of the important role played by digitization in brand communication, this paper classifies the group paths into digitally empowered and digitally non-dominant types. The digitally-enabled group accounts for 53.75% of the total number of explained cases, and this type of company uses digital resources to varying degrees in brand information, brand sentiment and user willingness, which contributes significantly to brand communication. Digital non-dominant companies accounted for 46.25% of the explained cases, this type of company shows that the level of digitalization in the brand information, brand emotion and user willingness to play a joint role in the enhancement of the role of digitalization of non-heritage ceramics brand communication is not yet significant, the possible reason is that different groups of paths to the company's brand value of the impact of the effect of the different groups of different, the same or the opposite, and ultimately cancel each other out.

This experiment formed 4 driving paths of company's high brand communication, which were categorized as digitization-enabled and digitization-non-dominated. The results of the first 2 groupings show that the level of digital design of the company's non-heritage ceramic brand is a key element in enhancing brand communication, and its role is mainly reflected in the organizational dimension of the brand message (H1) or user willingness, brand emotional co-creation of the coordinated effect (H2), non-digitally dominated branding the two paths show that the digital empowerment of the company's brand value is still potential to be dug. The new enabling role of digitalization is not significant, which also reflects the uneven investment of digital resources and the lack of systematic problems in the development process of digital design of non-digital ceramic brands (H3, H4).

4 Conclusion

Under the perspective of cultural identity, this paper takes advantage of digital means to carry out the digital design of non-heritage ceramic brands and quantitatively analyze the communication effect. The work done is as follows:

Establish the evaluation index system of digital communication of non-heritage ceramic brand, determine the weight of the evaluation system of digital design of non-heritage ceramic brand, and the brand information dimension has the highest weight of 0.3562, which proves that the cultural information of non-heritage ceramics has an important influence on the digital design of non-heritage ceramic brand.

The similarity of communication effect of a non-heritage ceramic brand calculated based on the cloud model is 0.3645, and the evaluation result of its brand communication effect is “medium”.

The empirical evidence uses fsQCA to explore the multiple grouping paths of enterprises in digitalization and coordination of various elements to improve brand communication, and forms four driving paths of high brand communication effect, which are categorized as digital empowerment and digital non-domination.

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