

Applying the Methods of EGM and AHP to Approach the Preference Factors of Penmanship Seal Carving Imagery

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Abstract: Classical Chinese characters, whether presented in calligraphy, seal carving, or painting, epitomize the multifaceted beauty and essence of Chinese script. They stand as paramount cultural treasures of the Chinese populace. Calligraphy and seal carving, two interrelated components within the realm of traditional Chinese art, have undergone successive transformations across generations. Nevertheless, owing to shifts in lifestyle and the march of modern technology, their initial utility in everyday writing and verification has progressively waned. Instead, they have assumed an increasingly pivotal function in the domain of commercial art.

This study employs the Evaluation Grid Method (EGM) and the Analytic Hierarchy Process (AHP) to investigate the primary preference factors influencing the utilization of calligraphy and seal carving imagery. Departing from conventional 5-point equidistant semantic questionnaires, this research adopts the golden ratio scale of non-equidistant semantic questionnaires, which differentiates the relative significance of adjacent semantic levels. This approach accentuates the weighted importance of visual aesthetics. The objective is to transcend the established conceptions associated with Chinese characters, thereby facilitating more diversified avenues for presenting calligraphy and seal carving culture. The findings of this study contribute reference points and methodological insights pertaining to these culturally profound visual elements, thereby infusing them into the realm of industrial creative design.

The objective is not solely to advance the design industry and refine the quality of individuals' everyday living spaces and aesthetic perceptions but also to elevate the artistic essence of goods and garner public recognition.

Keywords: Miryoku Engineering; Evaluation Grid Method; Analytic Hierarchy Process; Attractiveness Factor; Calligraphy; Seal Carving

1. Introduction

Culture not only serves as a representation of human lifestyle but also constitutes a significant element in the realm of aesthetic economy. Refined arts and cultural creations have become a predominant trend, particularly in the presentation of classical Chinese characters, whether through calligraphy, seal carving, or painting. These forms showcase the distinct beauty and essence inherent in Chinese characters. However, due to changes in lifestyle and advancements in modern technology, the original functions of daily writing and authentication have gradually diminished, replaced by an increasingly significant role in commercial aesthetics. Throughout contemporary industrial design, numerous examples abound where calligraphy and seal carving imagery are widely employed. These examples include the utilization of standard Chinese characters on product labels in supermarkets, an array of signage on streets, lettering on bookstore publications, and titles on magazine covers. These instances reveal the persistence of classical symbols that have transcended thousands of years, enduring the challenges of modernization to find renewed significance within the commercial sphere. This phenomenon not only underscores the survival of these symbols but also prompts intriguing research opportunities. This study employs the Miryoku Engineering Evaluation Grid Method (EGM) and the Analytic Hierarchy Process (AHP) to explore the key preference factors for the application of calligraphy and seal carving imagery. The objective extends beyond propelling the design industry and improving the quality of daily life and societal aesthetic sensibilities. The ultimate aim is to elevate the artistry of com-

modities and cultivate public recognition.

Miryoku Engineering, a concept introduced by Japanese scholars Junichiro Sanui and Masao Inui in 1985, aims to capture personal cognitive concepts by translating them into concrete images, drawing inspiration from psychologist Kelly's concept of personal constructs presented in "The Psychology of Personal Constructs." The Evaluation Grid Method, a vital research approach within Kansei Engineering, constitutes a qualitative research method. It serves to deconstruct and construct the alluring elements of products and services preferred by users. This approach combines statistical assessment and speculative exploration. On the other hand, the Analytic Hierarchy Process (AHP), proposed by Saaty in 1971, is a decision-making methodology particularly useful for problems involving several evaluation criteria, especially when uncertainty is present (Saaty, 1980). AHP analyzes the quality relationships between primary and secondary aspects, providing a clearer framework for selecting the optimal decision plan from proposed solutions.

Through the application of these structural analysis methods, this research aims to diverge from the conventional perception associated with Chinese characters, offering a more diverse mode of presentation for calligraphy and seal carving culture. This study provides both a reference foundation and research methodology for these image elements rich in cultural significance. By doing so, it further promotes their integration into creative industrial design.

2. Literature Review

2.1 Calligraphy Styles

The evolution of Chinese characters over millennia has been influenced by writing needs and a range of aesthetic considerations. This evolution has given rise to an array of diverse and intricate structures, resulting in the sole surviving logographic writing system in the world today. Beyond their role as tools of daily communication, Chinese characters have acquired a distinct role in the realm of art, distinguished by their unique visual vocabulary. They encapsulate the aesthetic essence of the East and have emerged as quintessential symbols of Chinese culture (Liu et al., 2018). In the words of Centobelli et al. (2019), "Chinese calligraphy transcends temporal and spatial boundaries. Since its inception, it has realized its highest potential, breathing life into words and weaving calligraphy into art. Over its millennia-long journey, it has nurtured a distinctive national character and cultural landscape, blossoming as a radiant flower in the global art scene."

The lineage of Chinese calligraphy spans over three thousand years. Discussing its evolution, Chen & Lin (2019) emphasize that "in ancient times, our wise and diligent ancestors produced pottery onto which they carved simple and spontaneous symbols. This marked the initial emergence of Chinese calligraphy. Subsequently, there were the oracle bone inscriptions of the Shang dynasty, the seal script of the pre-Qin period, the clerical script of Li Si during the Qin dynasty, and the various script styles of the Han dynasty. These laid the foundation for the evolution of Chinese calligraphy. The Wei and Jin dynasties nurtured the regular script, semi-cursive script, and cursive script from the foundation of the clerical script. The evolution of character styles was solidified during the Wei and Jin dynasties."

Balconi et al. (2019) delve into the origin of script styles, stating that "script forms are generally classified into four categories: seal script, clerical script, cursive script, and regular script. Alternatively, they can be classified into five forms: regular script, semi-cursive script, cursive script, seal script, and clerical script. The evolutionary process moves from ancient script to seal script, from seal script to clerical script, and from clerical script to regular script. Semi-cursive and cursive scripts act as catalysts in the progression from seal script to clerical script and from clerical script to regular script. Notably, cursive script stands out." The calligraphy styles encompassing seal script, clerical script, cursive script, semi-cursive script, and regular script have not only fulfilled the role of recording historical texts but, building upon their practical utility, have nourished the aesthetic sensibilities of cultured individuals throughout various epochs.

2.2 Seal Carving Styles

The inception of Chinese seal carving traces back to the Spring and Autumn period, gaining widespread usage during the subsequent Warring States period, as evidenced by ancient texts. Early seals were primarily employed for economic and authentication purposes. Jiang et al. (2019) summarize, "The origin of seals is closely tied to a certain level of socio-economic development. As trade activity intensified, there emerged a need for a form of credit certification to ensure the secure transportation or storage of goods. Seals were thus crafted by the masses to meet this demand." Crolic et al. (2019) speculate that "during the early stages of seal utilization, it can be inferred that socio-economic advancement had progressed to the Spring and Autumn period. Iron tools were in use, and agricultural productivity had seen gradual improvement. These factors fostered the extensive growth of crafts and interstate commerce. Seals, serving as certificates of credit to safeguard the secure transportation or storage of goods, must have been in circulation." Dehghani & Kim (2019) delve into the roles of seals, stating that "in contemporary society, seals serve two functions: the practical aspect for

authentication, and the artistic aspect for appreciation. However, the purposes of ancient seals significantly differ from those prevalent after the widespread use of paper.”

Bettels & Wiedmann (2019) note that seal carving, evolving alongside the transformations in characters across various dynasties, while exhibiting distinct styles, is predominantly rooted in seal script. This is due to the adaptable nature of seal script’s characters, making them suitable for confined spaces. Since its inception before the Qin dynasty, seal carving styles have undergone continuous development. Depending on the dynastic era, they can be classified as ancient bronze seals, Qin dynasty seals, Han dynasty seals, Tang and Song dynasty seals, Yuan dynasty seals, Ming and Qing dynasty seals, and more. These seals, characterized by their blend of red and white, exude an ancient allure. Their evolution has positioned them as an art form that uniquely embodies Chinese culture.

2.3 Application of Calligraphy and Seal Carving Imagery

In contemporary society, seal carving primarily fulfills authentication purposes for many, as noted by Wang & Hsu (2019). However, researchers contend that this traditional visual element, characterized by its distinctive red and white contrast and unique styles, often serves to enhance the aesthetics of the East. Bhandari et al. (2019) provide examples from traditional paintings and calligraphy, wherein artists strategically use one or more square seals to infuse color into their works, creatively positioning them to achieve balance and vitality. In the realm of art design, when the overall design aesthetic leans toward an Eastern color palette, designers frequently embellish their works with seals, occasionally employing them as logos. Furthermore, the thoughtful incorporation of auspicious phrases from ancient seals into home designs can imbue modern living spaces with a sense of antiquity and fascination, as noted by Martins et al. (2019). Despite the evolving content of calligraphy and seal carving, giving rise to various script styles and seal designs over time, the foundation of these arts remains rooted in characters, with variations built upon the insights of generations of artists who wielded brushes, ink, and knives. While the visual palette predominantly features black, white, and red, this amalgamation of content and color embodies a Daoist concept of “simplicity,” thus bestowing an aesthetic appreciation rooted in minimalism. Leder et al. (2019) elucidate that the interplay of these simple elements often generates a serene ambiance when utilized to adorn spaces with calligraphy and seal carving. This sensation aligns with the concept of “anti-noise” or “anti-clutter,” encapsulating the traditional art notion of “leaving white space.” This effect, wherein less translates to more, underscores the essence of calligraphy and seal carving as art forms that derive beauty from simplicity.

3. Research Design and Methods

3.1 Evaluation Grid Method (EGM)

The Miryoku Engineering originated in 1991 with Japanese scholar Masato Ujigawa, who convened various researchers from a psychological perspective. This method primarily centers on exploring consumer preferences in design, with the aim of uncovering individuals’ genuine needs and serving as a communicative conduit between designers and consumers.

The Evaluation Grid Method (EGM) stands as a pivotal research approach within Miryoku Engineering. First introduced by Japanese scholar Sanui (Masato, 1997), it serves as a technique to unveil the underlying cognition of objects. In the context of Miryoku Engineering research, EGM presents a theoretically grounded mechanism for dissecting the elements of attractiveness. This involves pairwise comparisons of objects to clearly delineate their distinctions. Subsequently, the objects’ characteristics are synthesized. The method proceeds with grouping based on participants preferences to solicit participants rationales for group ordering and ultimately to establish evaluation criteria. In our study, EGM was employed to analyze and synthesize the factors of attractiveness inherent in calligraphy and seal carving. The salient factors identified encompass seal carving font, seal carving colors, font transformation, aesthetic design, thematic content, totem design, poetic and artistic conception, innovative elements, artistic techniques, imagery arrangement, color integration, and visual effects.

3.2 Analytic Hierarchy Process (AHP):

The Analytic Hierarchy Process (AHP), conceptualized by Thomas L. Saaty in 1971, serves as a decision-making model. This multicriteria decision-making method transforms qualitative predicaments into quantitative analysis. AHP organizes intricate decision systems into a hierarchical framework. By utilizing structured levels grounded in objective reality, pairwise comparisons of each factor contribute to the formulation of comparison matrices for quantitative representation. Subsequent application of mathematical techniques calculates relative weights for elements at each level, culminating in the determination of relative weights across all levels and their resultant rankings.

The AHP predominantly employs Professor Saaty’s 1 to 9 relative proportion scale, proposed in 1980 and 1990. However, extensive semantic ranges can provoke logical inconsistencies and issues with maintaining judgment matrix consistency, particularly when factors possess significant disparities in weight. Thus, an alternative to Saaty’s 1 to 9 scale, the golden ratio scale, was adopted. This scale finds common use in economics (Kuo, Hsin-Lin and Li, Suh-Huey 2013), defining relative importance based on adjacent

semantic intensities as follows:

If the importance ratios of two factors of adjacent semantic intensities, W_1 and W_2 , satisfy the condition $\frac{W_1+W_2}{W_1} = \frac{W_1}{W_2} = \varphi$, where φ corresponds to a quadratic equation $\varphi^2 - \varphi - 1 = 0$, the positive solution of which is approximately 1.618. This is known as the golden ratio proportion. The scale aligns with the Fibonacci sequence principle. This non-uniform interval semantic questionnaire, utilizing the golden ratio instead of the conventional 5-equal interval, better captures the weighted significance of visual aesthetics.

Table 1: Golden Ratio Scale

Scale	Explanation
1	A1 and A2 are equally important
1.618	A1 is slightly more important than A2
2.618	A1 is more important than A2
4.236	A1 is much more important than A2
6.854	A1 is extremely more important than A2

This section also delineates the research's execution involving the participation of 10 expert educators from design-focused departments in southern Taiwanese universities. The AHP method was engaged to navigate the decision-making process, encompassing hierarchy establishment, expert interviews using the golden ratio scale for pairwise comparisons, formation of pairwise comparison

matrices, $R = (r_{ij})_{n \times n}$, computation of weight vectors for diverse indicators, $M_i = \frac{W_i}{\sum_i W_i}$, $W_i = \sqrt[n]{\prod_{j=1}^n r_{ij}}$, $i = 1, 2, \dots, n$

, $j = 1, 2, \dots, n$, assessment of consistency index(C.I.<0.1) and consistency ratio(C.R.<0.1) to ensure decision coherence, and ultimately amalgamation of relative weights across each level to derive the overall priority vector of the hierarchy.

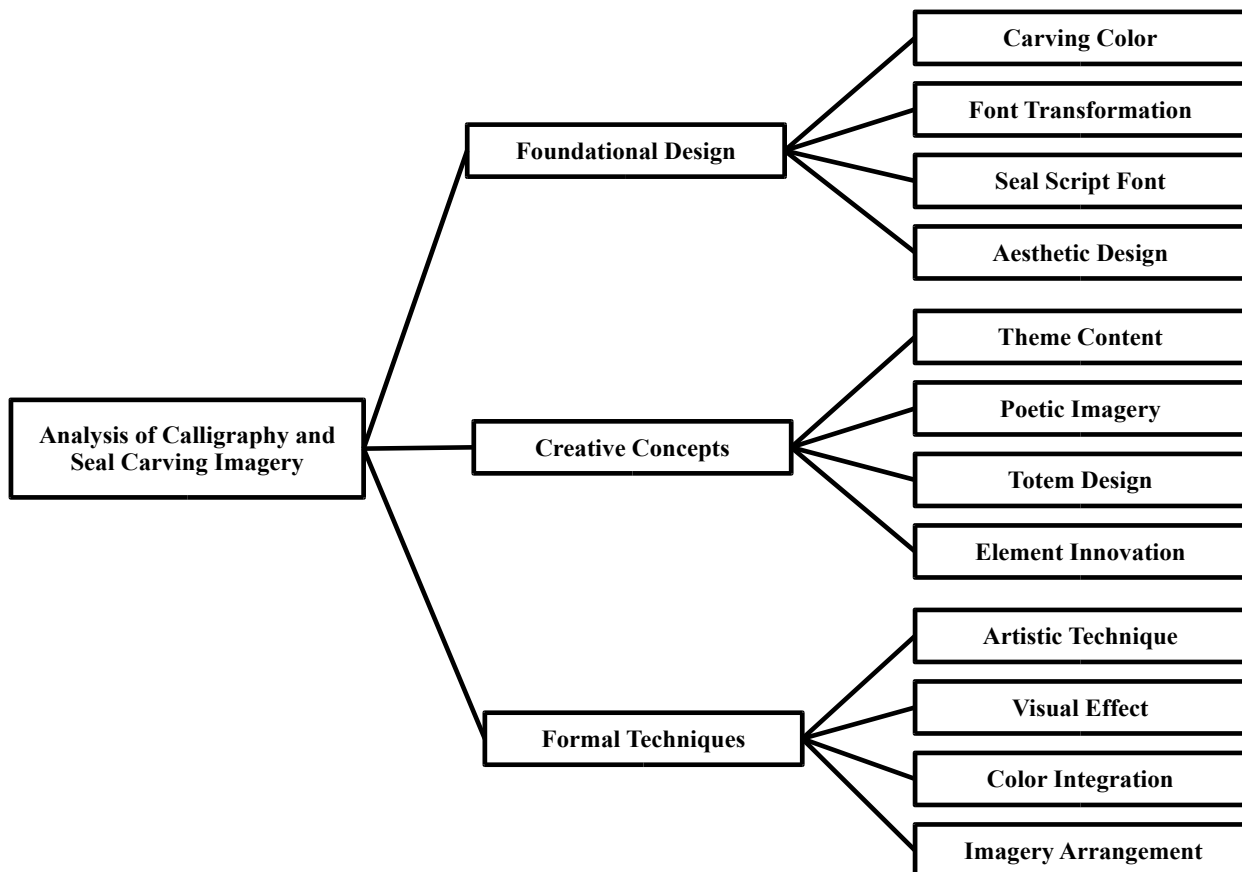


Figure 1: AHP Hierarchical Assessment Indicators

3.3 Establishment of Evaluation Indicators

The research procedure commenced by seeking input from experts across various domains through email correspondence. Initial feedback was gathered, and factors relevant to the application of calligraphy and seal carving imagery were collated. Analogous factors were categorized and presented to experts for their insights. This iterative exchange persisted via email communication, integrating the EGM method to analyze and synthesize original and specific rationales. Conclusively, an expert symposium was convened to construct a dimensional attractiveness factor assessment model. Key categories underpinning the application of calligraphy and seal carving imagery were identified as foundational design, creative concepts, and formal techniques. Subsequent subdivision culminated in the establishment of hierarchical assessment indicators within the AHP framework, illustrated in Figure 1.

4. Data Analysis and Conclusion

4.1 AHP Analysis Results

The analysis conducted through the utilization of the EGM method unveiled three principal dimensions: foundational design, creative concepts, and formal technique quality. These dimensions underwent further segmentation, yielding 12 pivotal attractiveness factors encompassing seal carving colors, font transformation, seal carving font, aesthetic design, thematic content, poetic and artistic conception, totem design, innovative elements, artistic techniques, visual effects, color integration, and imagery arrangement. Table 1 elucidates the outcomes of the AHP comparison questionnaire, employing a 5-level golden ratio scale. The computed hierarchy weights for the three primary dimensions are presented in Table 2.

The most accentuated dimension, “Foundational Design,” holds a weight of 0.605. This signifies that, as per the collective viewpoints of the experts, over 60% of the factors contributing to the successful application of calligraphy and seal carving imagery find their basis in a robust foundational design. Following in precedence are the “Creative Concepts” dimension, bearing a weight of 0.271, and the “Formal Techniques” dimension, with a weight of 0.124. The soundness of this hierarchical configuration, demonstrated by C.I. = 0.039 and C.R. = 0.067, both of which fall below 0.1, aligns with the requisites for consistency.

Table 2: Hierarchy Weights of Main Dimensions

Main Dimensions	Hierarchy Weights	Importance Ranking
Foundational Design	0.605	1
Creative Concepts	0.271	2
Formal Techniques	0.124	3

This section offers a presentation of the AHP analysis outcomes. It outlines the three core dimensions alongside their corresponding key attractiveness factors. The distribution of weight for each dimension, as gauged by expert perspectives, is elucidated. Additionally, the structural consistency of the hierarchy is verified, thereby affirming the results’ credibility.

(1) Foundational Design Factors:

Within the domain of “Foundational Design,” the evaluation indicators are ranked as follows: Seal Script Font (0.411), Carving Color (0.292), Font Transformation (0.204), Aesthetic Design (0.093). This ranking underscores that “Seal Script Font” is regarded as the most pivotal evaluation criterion within the “Basic Design” category. The consistency of this level’s structure stands at C.I. = 0.051, C.R. = 0.057, both of which fall below 0.1, signifying adherence to the consistency prerequisite.

Table 3: Weight and Importance Ranking of Criteria in the “Foundational Design” Aspect

Key Attractive Factor	Weight	Importance Ranking
Carving Color	0.292	2
Font Transformation	0.204	3
Seal Script Font	0.411	1
Aesthetic Design	0.093	4

(2) Creative Concept Factors:

The assessment indicators within the “Creative Concept” realm are ranked as follows: Theme Content (0.475), Totem Design (0.266), Poetic Imagery (0.167), Element Innovation (0.092). This ranking underscores that “Theme Content” is regarded as the paramount evaluation criterion within the “Creative Concept” dimension. The structural consistency at this level stands at C.I. = 0.049, C.R. = 0.054, both of which fall below 0.1, affirming compliance with the consistency requirement.

Table 4: Weight and Importance Ranking of Criteria in the “Creative Concept” Aspect

Key Attractive Factor	Weight	Importance Ranking
Theme Content	0.475	1
Poetic Imagery	0.167	3
Totem Design	0.266	2
Element Innovation	0.092	4

(3) Formal Techniques Factors:

In the context of “Formal Techniques,” the evaluation indicators are ranked as follows: Artistic Technique (0.528), Imagery Arrangement (0.258), Color Integration (0.143), Visual Effect (0.071). This ranking underscores that “Artistic Technique” is regarded as the paramount evaluation criterion within the “Formal Techniques” dimension. The structural consistency at this level stands at C.I. = 0.056, C.R. = 0.062, both of which fall below 0.1, affirming compliance with the consistency requirement.

Table 5: Weight and Importance Ranking of Criteria in the “Formal Techniques” Aspect

Key Attractive Factor	Weight	Importance Ranking
Artistic Technique	0.528	1
Visual Effect	0.071	4
Color Integration	0.143	3
Imagery Arrangement	0.258	2

(4) Overall Weight Analysis

Upon culmination of the hierarchy weights from Table 2 to Table 5, the proportional distribution of selection criteria indicators is based on the significance ratios of evaluation criteria across each level. This offers insights into the comprehensive importance of key attractive factors within the entire assessment system. The overall weights for the selection of success factors in the application of calligraphy and seal carving imagery are synthesized and presented in Table 6.

Table 6: Overall Weight Summary of Success Factors in Calligraphy and Seal Carving Imagery Application

Aspect Level 2	Weight	Level 2 Rank	Key Attractive Factor Indicators	Overall Weight	Overall Ranking
Foundational Design	0.605	1	Carving Color	0.176	2
			Font Transformation	0.124	4
			Seal Script Font	0.249	1
			Aesthetic Design	0.056	7

Creative Concept	0.271	2	Theme Content	0.129	3
			Poetic Imagery	0.045	8
			Totem Design	0.072	5
			Element Innovation	0.025	10
Formal Techniques	0.124	3	Artistic Technique	0.065	6
			Visual Effect	0.009	12
			Color Integration	0.018	11
			Imagery Arrangement	0.032	9

The relative weights of each indicator are illustrated in Figure 2. The amalgamation of questionnaire data for assessing key success factors in the application of calligraphy and seal carving imagery reveals the overall weights of key attractive factor indicators. Among the 12 evaluation indicators, the top 5, in terms of importance, are as follows: Seal Carving Fonts, Seal Carving Colors, Theme Content, Font Transformation, and Totem Design.

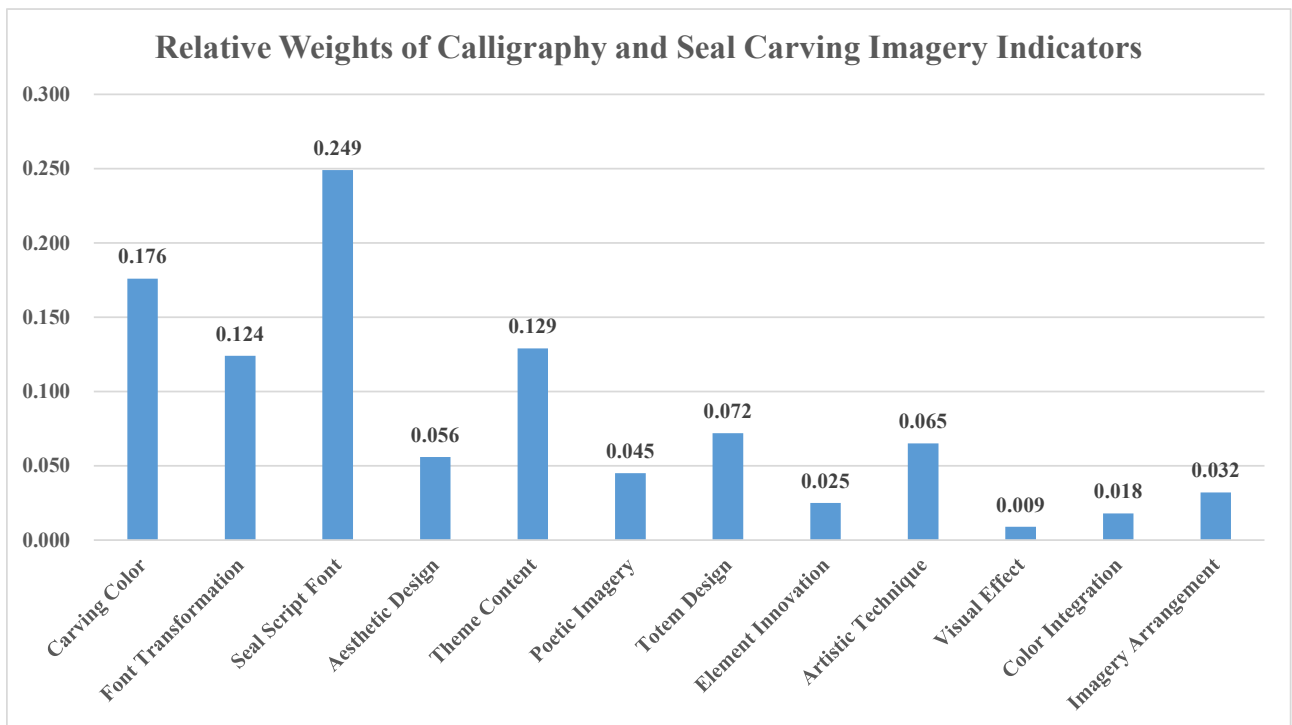


Figure 2: Relative Weights of Calligraphy and Seal Carving Imagery Indicators

4.2 Analysis and Discussion of Results

Drawing from the analysis presented in **Tables 2 to 6** and **Figure 2**, it is evident that the compiled questionnaire responses from experts underscore the paramount importance of “Basic Design” as the cornerstone for a successful application of calligraphy and seal carving imagery. Within this realm, “Seal Carving Font” emerges as the most critical indicator, constituting nearly 25% of the total importance. The implementation of the Evaluation Grid Method in delineating these three dimensions and twelve indicators reveals deeper insights through a lens of cultural creativity: “Basic Design” signifies an artist’s fundamental

skills, “Creative Concepts” accentuate their innovative ideas, and “Formal Techniques” emphasize external modes of expression. The outcomes of this research reinforce the notion that fortifying fundamental abilities indeed forms the bedrock of all creative endeavors. However, viewed from an alternative perspective, this research also beckons contemplation. Despite the constraints of these findings, they accentuate the potential for dialogue between seal carving or calligraphy artists and the general public. Such a discourse could involve expressing their “Creative Concepts” and utilizing “Formal Techniques” as vehicles to connect with art enthusiasts.

Another significant point of discourse is that, among the twelve evaluation indicators, the top three, in descending order, are “Seal Carving Font,” “Seal Carving Color,” and “Theme Content.” These elements all hinge on the principle of quality over quantity within the domain of calligraphy and seal carving. For instance, color’s significance has been explored in various studies (Tang, Da-Lun, 2005; Hung, Po-Sung, 2009). Within the realm of seal carving, color palettes often remain subdued, occasionally even restricted to a single hue. These conclusions underscore the idea that artistic imagery demands time and accumulation. Even in the absence of elaborate external embellishments, the cultural profundity nurtured through time’s passage frequently holds greater weight.

5. Conclusion and Recommendations

5.1 Conclusion

This study employed the Miryoku Engineering Evaluation Grid Method and Analytic Hierarchy Process to investigate the key preference factors for the application of calligraphy and seal carving imagery. Based on the limited research outcomes, the following conclusions can be drawn:

1. The Evaluation Grid Method and Analytic Hierarchy Process effectively extracted significant factors related to calligraphy and seal carving imagery as perceived by expert scholars. These two methods could also be applied to extract and analyze core concepts in other types of artistic creations.

2. Based on the analysis results, the importance of the three dimensions in order of priority is as follows: foundational design, creative concepts, and formal technique quality. Among the 12 evaluated indicators, the top 5 indicators are respectively: seal carving font, seal carving colors, theme content, font transformation, and totem design.

Through the application of these structural analysis methods, this research aimed to break free from the established impression associated with Chinese characters, offering more diverse ways of presenting calligraphy and seal carving culture. The study provides reference points and research methodologies for these image elements rich in cultural significance, further enhancing their infusion into creative industrial design.

5.2 Recommendations

The value a society places on its traditions reflects the cultural self-confidence of the entire community. While embracing and learning from Western strengths, it is essential not to underestimate or abandon one’s own traditional heritage. In an era dominated by Western perspectives, this challenge tests the collective wisdom of our society. Taking Japan as an example, their steadfast emphasis on tradition amidst modernization serves as a harmonious blend of Eastern and Western influences, old and new. In the context of traditional calligraphy and seal carving, the development of these arts faces marginalization as their practical roles in writing and authentication are gradually supplanted by other tools.

This research asserts that the essence of calligraphy and seal carving embodies the dual aspects of Chinese character artistry – one through brush and ink, and the other through carving with knife and stone. Their emphasis on simplicity in color application, content selection, and structural layout exemplifies Eastern aesthetics of achieving more with less. By recognizing and harnessing the value of these two arts, and adeptly integrating their deep cultural imagery into daily life or commercial applications, it is expected to have a subtle yet profound impact on enhancing individuals’ quality of life, elevating society’s overall aesthetic sensibilities, and promoting the fusion of art with industries.

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