

Research on Innovative Design of Tourist Souvenirs in Luoyang Museum Based on Analytic Hierarchy Process

Ze Shi¹, Sastra Laoakka^{2,*}

514187233@qq.com¹, Corresponding author: Hugna.studio@gmail.com^{2,*}

Faculty of Fine Applied Arts and Cultural Science, Mahasarakham University, Maha Sarakham, Thailand

Abstract. Innovating the design of tour souvenirs in Luoyang Museum can accelerate the spread of Luoyang culture and promote the development of cultural industries in Luoyang. In this paper, the current situation and shortcomings of tour souvenirs in Luoyang Museum are sorted out, as the souvenirs in Luoyang Museum are innovated and redesigned on a basis of the current consumer demands for tour souvenirs. The weighted value of factors affecting consumers' purchase of tour souvenirs are calculated by using analytic hierarchy process, and the first-level criteria, the second-level criteria and the comprehensive weight ranking are obtained. The single-level weights of the first-level criteria are 0.12, 0.50, 0.07 and 0.31 respectively. By using the weight ranking, the emphasis of innovative design of tour souvenirs in Luoyang Museum are gained, and the design ideas and innovative design methods are provided for designers according to the numerical values, which can provide reference for innovative design of tour souvenirs in museums.

Keywords: Luoyang Museum, Souvenir, Analytic Hierarchy Process, innovative design

1 Introduction

Tour souvenirs, also known as cultural products, are an important part of the cultural industry, which account for a large proportion. The General Secretary of China once pointed out that the cultural industry is a sunrise industry, and cultural products have both ideological and market attributes. We must firmly grasp the correct orientation, adhere to upholding fundamental principles and breaking new ground, and ensure sustainable and healthy development of the cultural industry[1]. Tour souvenirs epitomize the cultural industry. In recent years, Chinese tour souvenirs have continued to develop. This shows the passion of users in pursuing cultural consumption, and also reflects the vast development space of tour souvenirs. Tour souvenirs pay attention to form, but they need to pay more attention to "connotation". Excellent tour souvenirs should tell good stories and spread culture.

Since the 21st century, the development of the entertainment industry has caused increasing impacts on traditional cultural undertakings. The entertainment industry has constantly catered to the consumption interests of young people in the modern time, so it developed rapidly. At the same time, the development of traditional cultural industries like museums, has been hindered, mainly because the number of visitors to museums has been decreasing due to a lack of attraction to the public. In addition, museums, as public cultural institutions, enjoy national

financial subsidies. However, in recent years, most museums have had insufficient national financial support, which makes it difficult for museums to upgrade and operate normally. Under this context, the development of souvenirs in museums is the key to solve the current dilemma. Memorial products are an extension of museum culture, and their educational and interesting properties meet the diverse spiritual and cultural needs of the audience. In addition, the sale of commemorative products brings additional benefits to the museum, making up for the vacancy of national financial support, which is an important measure for the sustainable development of museums.

In China, Luoyang is a city with a long history and profound culture. It has also been the capital of 13 dynasties in the history of China. Luoyang is rich in cultural resources, boasting a large number of museums of various types. Original tour souvenirs are on sale in Luoyang Museum, Luoyang Folk Museum and Erlitou Xiadu Site Museum. Famous scenic spots such as Luoyang Planning Exhibition Hall, Luoyang City Meeting Room, Paradise, Mingtang and Shangyang Palace have set up special areas to sell tour souvenirs, and the museum cultural industry has become an essential part of building a "museum capital".

Although Luoyang has rich cultural resources and a large number of museums, there are still some shortcomings in the design, development and sales of tour souvenirs. First, there are problems of homogenization of tour souvenirs and unclear regional characteristics; Second, the product design is short of creativity, and the design concepts need to be updated; Third, the use value of the products is limited, and it cannot be integrated into the daily life of consumers; Fourth, the lack of sales channels can not bring economic incomes to the museum[2].

With the encouragement of national policies, the appeal of the people and the actual needs of museum development, the development of museum souvenirs has entered an "imperative" stage and is experiencing an excellent period. Luoyang museum has made some efforts in the development of souvenirs, but the effect is not satisfactory. It has not completely found a way to develop souvenirs that suits it. At present, it is one of the important tasks for Luoyang Museum to explore a way to develop souvenirs according to the actual situation of the museum.

Luoyang has natural conditions and advantages in developing cultural industry, which is also a substantial part of developing cultural industry in Henan Province. In order to help Luoyang tour souvenirs realize high-quality development, we should not only reflect the historical value of local culture and keep pace with the times, but also realize the importance of brand communication and attach importance to the role of e-commerce platforms and network media, spreading culture to make it a symbol for cultural exchange.

2 Luoyang Museum souvenirs status quo

In recent years, Luoyang Museum has continuously promoted the development of cultural and creative industries. However, the souvenir industry of Luoyang Museum as a whole has low-quality development and poor brand competitiveness. Under the background of promoting cultural and creative industries in China recently, tapping the collection culture and promoting the upgrading of tourist souvenirs is one of the important paths for the innovative development

of Luoyang Museum. It is of great value and significance to study souvenirs utilizing this opportunity. Combining the current situation, I found the following advantages and problems.

2.1 Abundant collections

There are more than 21,000 pieces of cultural relics in Luoyang Museum, where many emperors built their capitals and created historical civilization, forming different cultural characteristics in different periods. Among the cultural relics in the collection, bronze ware culture, porcelain jade articles and stone carvings are the most distinctive, and the shape, material, color and ornamentation of each cultural relic have special cultural connotations to explore.

Since its establishment, Luoyang Museum has continuously enriched its collection of cultural relics through collection and excavation. At present, the collection of cultural relics has exceeded 20,300, including cultural relics unearthed from prehistoric civilization sites, cultural relics unearthed in previous dynasties, and modern calligraphy cultural relics. According to the texture, it can be divided into jade, bronze, ceramics, lacquerware, pottery and calligraphy, especially pottery figurines and bronzes, which can provide rich cultural elements for the development of tourist souvenirs. Pottery figurines and bronzes are the most distinctive collections in Luoyang Museum. Luoyang, as the ancient capital of thirteen dynasties, has formed a unique and colorful material and spiritual culture in the long-term production practices and dynasty changes.

Luoyang city shows us the history of China from 21st century BC to 10th century A.D. in an uninterrupted time sequence. Luoyang city reveals the historical, religious, customs and other cultural information of various dynasties, and is the origin of cultural core in developing cultural creative and commemorative products.

2.2 Lack of practical function

In addition to publications, the products sold in Luoyang Museum Store are mostly bronze imitation and peony porcelain plate ornaments, mainly including traditional cultural relics imitation and decorative ornaments. The price of imitations of cultural relics is high. The sales of traditional decorative ornaments are low because of their large size, easy breakage, inconvenient transportation and other reasons, so they are only furnishings when bought back at home. For example, The "Spring Popsicle" in Taiwan Province Yingge ceramics museum uses ceramics to design a fork-shaped popsicle stick. After eating the popsicle, the beautifully designed popsicle stick can be used as a fruit fork, and the ceramic culture is skillfully integrated into the public life through the development of tour souvenirs. It needs to design and develop tour souvenirs that are closely related to people's lives by combining with the cultural relics in the collection and their cultural values, so people "take the national treasure back to home" in order to understand the cultural relics and spread the museum culture in the process of use.

2.3 Serious Homogenization

"In the process of developing most museum souvenirs, the collection of cultural relics is combined with products, and the cultural characteristics are reduced in the display due to the lack of design." An unavoidable problem in the extension and development of museum

souvenirs is the aggravation of "homogeneity", so it leads to the loss of uniqueness of museum souvenirs in the process of development and derivation, which can not play a leading and positive role in the museum souvenir market. Undeniably, "homogenization" will cause that products are flooded by the market too quickly, and the original intention of development and creative planning concept will be lost.

Secondly, while having to face the environmental impacts of "homogenization", we can't make a reasonable response quickly. In the process of buying, consumers are constantly having more consideration of products, in other words, which means whether a commodity is necessary to buy or not, and making rational judgments and choices through thinking. In the design of similar products, we should think about whether the characteristics of this museum are different from other museums. For example, the design of products such as pendants, consider whether we can add new ways of experience such as interaction or not. In this way, in the process of tourism and shopping, the audience of the same type of products in the museum can be extended to children and adults at the same time, which is also conducive to the knowledge dissemination of cultural relics in the collection[3].

On the premise of referring to other museums, we should consider the necessity of developing a product and whether it can achieve a balance between artistic beauty and cultural connotations in a short time. If we can't avoid this drawback in time, the elements will be "copied" and "superimposed", which is not good for the static cultural relics in the museum. In developing existing cultural relics, Luoyang Museum should clearly understand the consequences of "homogenization", constantly sum up experience, and develop souvenirs with regional characteristics of Luoyang with scale and integrity.

2.4 Lack of cultural connotation

At present, the collection of cultural relics in Luoyang Museum has spanned from prehistoric civilization to modern times. The shapes, materials, decorations and techniques of cultural relics all reflect the unique cultural connotations of different dynasties in China. At present, the tour souvenirs of Luoyang Museum are of serious homogeneity, and there is no targeted integration of regional and traditional culture into modern souvenir design, thereby lacking cultural genes.

3 Evaluation system construction of souvenir redesign in Luoyang Museum

3.1 Selection of evaluation methods for redesigning tour souvenirs

The evaluation of redesigning tour souvenirs needs to compare various factors. By comparing various factors, the factors with high weight value can be calculated, and according to the calculated weight results, the consumer demands can be judged in an accurate and intuitive manner. The construction of evaluation system plays an important role in design souvenirs subsequently, so it is particularly important to build a scientific evaluation system and choose an effective evaluation method. The commonly used evaluation methods include AHP, fuzzy evaluation, value engineering, grey system evaluation and artificial neural network evaluation. In practice, appropriate evaluation methods are selected according to different design contents

and projects. AHP is a decision analysis method that combines qualitative and quantitative methods commonly used in solving complex problems. By decomposing complex problems into various components and forming a hierarchical structure based on their dominant relationship, the weight of each index is determined by pairwise comparison to assist decision-making[4]. Analytic hierarchy process has qualitative analysis and subjective judgment in the decision-making process, which also has the objectivity of quantitative analysis. In the analysis of souvenir design and evaluation system, there are many indicators, and each indicator is interrelated and difficult to quantify. However, the construction of multi-level analysis structure model and the determination of weights can obtain relatively authoritative evaluation results[5].

3.2 Redesign evaluation settings of tour souvenirs

The souvenir redesign of Luoyang Museum is based on the collection of cultural relics, combining its form, function, culture and other aspects with modern design, so that it can fit in with lifestyle and aesthetic needs of modern people, and at the same time, it can spread the unique cultural connotations of Luoyang. In order to meet the needs of consumers, the redesign of tour souvenirs should be people-oriented, and the in-depth needs of users should be obtained to determine the design elements. The establishment of a systematic evaluation system for the redesign of tour souvenirs can ensure that souvenirs can satisfy people's needs for functions, materials, modeling, aesthetics, technology, culture and individual needs, and determine the evaluation system in combination with the characteristics of tourist souvenirs design. The evaluation system consists of three levels. The target level is the first level, which means the evaluation index of tour souvenir design scheme. According to the design characteristics of tour souvenirs, the user's needs are evaluated from four aspects: characteristic design demand, cultural design demand, emotional design demand and serialized design demand, which constitute the criterion layer of the evaluation index system. These four criteria layers have their own index factors, forming sub-criteria layers (Table 1).

Table 1 Evaluation Index of Tourist Souvenir Design

Target layer	Criterion layer	Sub-criterion layer
Evaluation index of museum cultural and creative product design	C1 Characteristic design requirements	C11 Embodiment of the cultural elements of products.
		C12 Pleasant modelling and colors.
		C13 Embodiment of regional characteristics.
	C2 Cultural design requirements	C21 Knowledge acquisition.
		C22 Embodiment of the connotation of cultural relics.
		C23 Embodiment of cultural relics symbols.
	C3 Emotional Design Requirements	C31 People-oriented.
		C32 Adding story.
		C33 Satisfying Experience.
	C4 Serialization Design Requirements	C41 Fulfillment of individual needs.

C42 Embodiment of cultural characteristics.

C43 Uniqueness.

4 Analysis of Evaluation System Based on AHP

4.1 AHP scoring rules and calculation steps

Analytic Hierarchy Process (AHP) is an evaluation method which establishes the hierarchical structure of the relevant factors about decision-making problems according to a certain dominant relationship, and obtains the comprehensive weight of each factor to the overall goal (a) through decision analysis. According to the analytic hierarchy process (AHP), each level item is judged and calibrated, and the calibration value ranges from 1 to 6. When two items are equal, the calibration value is 1[6]. When one item is far more important than the other, the calibration value is 6, and the calibration of judgment matrix is shown in Table 2. The 15 design professionals, 10 souvenir consumers and 5 museum employees are invited to set up three evaluation groups. Because the knowledge background and work experience of evaluators in each group are different, the comprehensive evaluation index system of expert qualifications is used to allocate the effectiveness of evaluators from each group. Evaluators in each group compares and scores the demand items of the same level in the AHP model, weights the scores according to the weight of evaluators of each group in the overall evaluation of tour souvenirs, and obtains consistent opinions, thus constructing a scientific and objective judgment matrix. The characteristic equation corresponding to the judgment matrix A , λ_{\max} is the largest characteristic root of the judgment matrix, the characteristic vector W is normalized, and finally CR is calculated to check the consistency of the results. When $CR \leq 0.10$, the consistency of the judgment matrix is acceptable, otherwise, the judgment matrix should be properly modified to make its consistency in an acceptable range; CI is the general consistency index of judgment matrix; RI is the average random consistency index of judgment matrix.

Table 2 1 ~ 6 Calibration Methods

Calibrate b_{ij}	Definition
1	Factor i is consistent with factor j in importance.
2	Factor i is slightly more important than factor j.
4	Factor i is more important than factor j.
6	Factor i is absolutely more important than factor j.
3、5	Median value of two adjacent judgments

4.2 AHP weight calculation

Quantifying the weight of each criterion is the basis of subsequent design practice. See Table 3 for pairwise evaluation of each level item index according to AHP method.

Table 3 Judgement Matrix of Tourist Souvenir Design Criteria Layer

Index	C1	C2	C3	C4
C1	1	1/4	2	1/3
C2	4	1	6	2
C3	1/2	1/6	1	1/5
C4	3	1/2	5	1
Single layer weight	0.12	0.50	0.07	0.31

According to the formula, the maximum characteristic root $\lambda_{\max}=4.034$ of the judgment matrix of the design criteria layer about tour souvenirs is calculated. The consistency of this judgment matrix is tested, and then CR is calculated as 0.013, which is less than 0.1, so the judgment matrix passes the consistency test, and this scheme is effective.

According to the weight calculation results of analytic hierarchy process, it can be concluded that the weight value of cultural design demand was 0.50, ranking first in the evaluation index layer of tour souvenir scheme design; Serialized design requirements ranked second with a weight value of 0.31; The weights of characteristic design requirements and emotional design requirements are close, which are 0.12 and 0.07 respectively. Based on the results of analytic hierarchy process, cultural and serialized design requirements are the main design principles of tour souvenirs.

Construct a comparison matrix and calculate the weights of all secondary demand indicators under the four primary indicators respectively. CR values are: 0.047, 0, 0.061, and 0. All are less than 0.1, all of which meet the consistency test standard.

After calculating the product of the second-level and the first-level weight selection about weight of each demand item, and ranking the levels, then we can get the comprehensive weight of each sub-criteria layer, and intuitively measure the influence of each demand item on consumers. See Table 4 for the results.

Table 4 Summary of Weight of Judgment Matrix

Primary criterion	Primary weight	Secondary criterion	Secondary weight	Comprehensive weight	Weighted sorting
C1	0.12	C11	0.2100	0.0252	10
		C12	0.1300	0.0156	11
		C13	0.6600	0.0792	5
C2	0.5	C21	0.2900	0.1450	3
		C22	0.5700	0.2850	1
		C23	0.1400	0.0700	6

		C31	0.1696	0.0119	12
C3	0.07	C32	0.4283	0.0300	8
		C33	0.4021	0.0281	9
		C41	0.5714	0.1771	2
C4	0.31	C42	0.1429	0.0443	7
		C43	0.2857	0.0886	4

Among them, reflecting regional characteristics and cultural elements of products are the most important criteria in the demand indexes of characteristic design, with weights of 0.66 and 0.21 respectively, which should be put emphasis on in the innovative design of tour souvenirs. Among the demands of cultural design, the top two indicators are to show the connotation of cultural relics and acquire knowledge, among which the weight of showing the connotation of cultural relics is 0.57, ranking first. Therefore, on the innovative design of tour souvenirs, the design principles of cultural relics should be embodied and the connotations of cultural relics should be displayed, which can help the local characteristic culture in Luoyang spread more widely. Secondly, it is inseparable for consumers to acquire knowledge in souvenirs and demonstrate connotations of cultural relics. Among the emotional design requirements, the greatest weight is to add story elements and satisfy the experience, with the weight of 0.43 and 0.40 respectively, which should be significantly considered in the innovative design process of tour souvenirs. In the serialization design requirements, satisfying individual requirements is the most important index that users think, with a weight of 0.57. Tour souvenirs should be unique to meet the needs of mass consumption and satisfy the needs of modern teenagers for personality. We should pay attention to the use of popular culture and the expression of traditional culture.

5 Innovative design methods of souvenirs based on AHP in Luoyang Museum

Through the analysis on the comprehensive weight of each index, the innovative design of tour souvenirs is mainly carried out from the aspects of embodying regional characteristics, representing cultural elements of products, displaying cultural relics' connotations, adding story elements, satisfying experiences, meeting individual needs, etc., so that the subsequent tour souvenirs are different from the traditional tour souvenirs, and can reflect regional culture, show the characters of the times and modern creative thinking, and upgrade the user's experience in all aspects.

5.1 Meet the requirements of characteristic design

According to results from the analytic hierarchy process (AHP) analysis, the weights of embodying regional characteristics and cultural elements of products are 0.66 and 0.21 respectively, ranking first and second. Therefore, among the users' demands for characteristic design of tour souvenirs, the embodiment of regional characteristics and cultural elements in

products of souvenirs are the highlights that users are most concerned about, which shows that fully embodying Luoyang's regional characteristics and cultural elements in products are the most important characteristics that consumers focus on. This requires designers to deeply analyze the extracted cultural elements before developing tour souvenirs, fully investigate and study the museum collections, tap the cultural resources behind the cultural relics, while paying attention to the regional cultural characteristics such as human history and political system, extracting representative cultural symbols, and applying them to the functions, shapes, materials, etc. of commemorative products, so as to reflect the museum tourist commemorative products with regional and product characteristics.

5.2 Meet the needs of cultural design

According to the weight of each demand, it can be seen that showing the connotations of cultural relics and acquiring knowledge are important conditions for consumers to meet the needs of cultural design, among which the weight of showing the connotation of cultural relics is 0.57, ranking first. As an attribute of products, culture is essential and occupies an important position in the expression forms of products. The biggest difference between museum souvenirs and ordinary products in life lies in their cultural attributes. It can not only be enjoyed as a material product, but also acquire cultural knowledge, and has the spirit of material and cultural layers that consumers need, which is exactly the double-layer significance of museum tourism commemorative products. Today, with the rapid development of museum cultural industry, when extracting symbols of cultural resources, the design team of museum tourism commemorative products should deeply study the cultural connotations and pay attention to the design output of products in the process of development and design, so as to achieve a systematic and all-round display of museum culture. For example, the application of decorative symbols in the design of tour and commemorative products can be combined with the historical and cultural backgrounds, implications and characteristics of decorative symbols, and loaded on tour and commemorative products, such as tableware, tea sets, stationery, etc. And decorative symbols can also be redesigned to form tour and commemorative products that conform to product semantics.

5.3 Meet the emotional design needs

In the emotional design demands, adding story elements and satisfying experience rank first and second, with weights of 0.43 and 0.40, respectively. Therefore, in the design of tour souvenirs, we should focus on satisfying these two needs. In today's people-oriented era, we still follow in the design of tour souvenirs, that is, "emotional design", "experience design" and "emotional design", and pay attention to people-oriented in the design of tour souvenirs. People often pay attention to the perceptual demands while getting the rational demands of products. The design of tour souvenirs in Luoyang Museum can not only meet the functional needs, but also appropriately add story elements or humanistic feelings and enhance the added value of cultural and creative products. In many cultural commemorative products, it can also increase competitiveness and make cultural commemorative products with emotional colors stand out.

5.4 Meet the requirements of serialization design

Through the analytic hierarchy process, it is known that satisfying individual needs is the most important index for users, with a weight of 0.57. Therefore, a personalized and distinctive tour souvenir is one of the important ways to meet the current young consumers. Serialized design and personalized design can bring great visual impacts to the audience. In the design of museum commemorative products, taking tour and commemorative products as the carrier, extracting valuable cultural symbols from regional culture and cultural relics in the collection, and taking this cultural symbol as the research center to design a series of products aimed at different consumers, types and functions can leave a deep impression on people and make people focus their vision on symbols with regional cultural elements. Secondly, we can establish unique cultural brands, which can quickly distinguish products among many categories of cultural and creative commemorative products, and have a strong sense of brand awareness. Through investigation, we know that the main buyers of museum tour souvenirs are large-scale teenagers who are familiar with online shopping, so personalized demand can meet the consumption desire of this group.

6 Conclusions

The treasures of cultural relics in Luoyang Museum are important cultural resources. The responsibilities of the museum not only include providing a place to display and protect these resources, but also focus on developing and utilizing cultural relics to provide services for the public. Through the analysis of analytic hierarchy process, the weights of cultural design demand and serialized design demand are 0.50 and 0.31, respectively. Therefore, we should pay attention to the cultural and serialized innovation and expression in the innovative design of traditional tour souvenirs at present. Through the analysis of the second-level criteria, the top five are to embody regional characteristics, acquire knowledge, show the connotation of cultural relics, meet individual needs and be unique. Therefore, at the same time, we should focus on these five aspects, and integrate regional culture, individual culture and multiple aesthetics into the design of tour souvenirs to reflect its distinctive times and foresight. Through the above research, it is suggested that Luoyang Museum can refer to this method to design tourist souvenirs.

References

- [1] Xiaozhen, Shu.: Comparative Analysis of Two Scales in Analytic Hierarchy Process. *Journal of Yuxi Normal University*. pp. 39(03):6-11 (2023)
- [2] Yin, Tao.: Research on the status quo of cultural and creative products of Luoyang Museum. *Beauty and the Times (Part 1)*. pp. (08):26-29 (2022)
- [3] Bing, Shen.: Research on the design of cultural and creative products based on the characteristics of young people-Taking Luoyang Museum as an example. *industrial design*. pp. (02):27-28 (2018)
- [4] Vaidya, O. S., & Kumar, S.: Analytic hierarchy process: An overview of applications. *European Journal of operational research*. pp. 169(1):1-29 (2006)
- [5] Saaty, R. W.: The analytic hierarchy process—what it is and how it is used. *Mathematical modelling*. pp. 9(3-5):161-176 (1987)
- [6] Kabassi, K., Amelio, A., Komianos, V., & Oikonomou, K. Evaluating museum virtual tours: the case study of Italy *Information*. pp. 10(11):351 (2019)