

# Design Method of Museum Cultural and Creative Products Based on Multi sensory Experience

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**Abstract.** To explore the design method of museum cultural and creative products based on multi sensory experience, improve product level and user experience, and provide new directions for the development of museum cultural and creative design. The method first introduces the cognitive principles and sensory expression methods of sensory experience, and then focuses on the study of three common multi sensory phenomena: multi sensory integration, synesthesia, and sensory compensation. It analyzes their application in the design of cultural and creative products, summarizes the transformation process of user generated multi sensory experience, and establishes a multi sensory experience cultural and creative product design process based on this. Conclusion: Product design with multi sensory experience can bring users a more comprehensive and profound experience, help promote the inheritance and development of museum culture, and improve the serious problem of homogenization in the cultural and creative industry.

**Keywords:** multi sensory experience; museum cultural and creative works; product design.

## 1. Introduction

In the era of experiential economy where people pay attention to spiritual and cultural needs, museum cultural and creative activities, as a carrier for spreading museum culture and education, have begun to receive increasing attention [1]. However, in terms of the current situation of cultural and creative products, museum cultural and creative products with a single form and lack of emotional transmission are difficult to win the favor of consumers, let alone play a role in promoting culture and popularizing knowledge. As the initial source of emotional experience, human senses are the foundation for integrating external information and forming deep cognition. It is worth in-depth research by designers. By utilizing the interaction of senses, users can have a comprehensive experience of products, enhance their interaction experience with products, and elevate sensory cognition to emotional identity, achieving our ultimate experience goal [2].

## 2. Multi-sensory experience theory and sensory expression

### 2.1 Multi-sensory experience and multi-sensory experience design

The human body is a high-level unified whole, and various senses coordinate and cooperate with each other under the command of the central nervous system to achieve the purpose of perception. Multi sensory experience refers to the process in which two or more sensory organs work together to obtain physiological and psychological sensations. Compared with the traditional concept and characteristics of single sensory communication, multi sensory communication has stronger comprehensiveness, wholeness, and richness. It starts from the five senses of humans and can evoke sensory experiences for users at multiple levels.

Japanese designer Yasuo Kurokawa believes that “the 21st century is a design era that reflects the characteristics of the body's senses. In this rapidly changing information age, a single communication mode is insufficient to provide consumers with sufficient information [3]”. Therefore, the concept of "multi sensory experience design" has emerged, which encourages designers to break through the limitations of traditional visual promotion models, starting from human vision, hearing, touch, smell, taste, and touch, and stimulate consumers' sensory functions in multiple aspects [4]. Its core is to utilize multisensory collaboration to help users strengthen their

comprehensive understanding of the product, stimulate deep emotional experiences by triggering their sensory experiences, and thus obtain a user experience and spiritual satisfaction.

## 2.2 Sensory expression

The visual system is the primary sensory channel for humans to obtain external information, accounting for 80% of all sensory information received. In design, the color, shape, and material of a product are all crucial, providing people with different visual experiences and emotional resonance. They are commonly used visual elements by designers. Taking color as an example, red, as the color of flames, always brings a warm and passionate feeling to people; As the color of the sea, blue always makes people feel calm and peaceful (as shown in Fig.1).



Fig. 1 Association triggered by red (self drawn by the author)

As the only sensory system that covers the entire body and cannot be avoided, the tactile system can sense many characteristics of objects, including hardness, texture, temperature, weight, etc. There are two types of tactile sensation: informational tactile sensation and hedonic tactile sensation. Informative touch can help us obtain product information and serve as a guide. For example, when purchasing baby clothing, we often choose soft, skin friendly materials. Hedonic tactile sensation leads us to pursue a sense of pleasure, usually designed with synesthesia. For example, this packaging work of bitter melon juice, which won the Pentawards Gold Award in 2022 (as shown in Fig.2), extracts the texture of the bitter melon skin and uses bionic methods to intuitively reflect the ecological sense of the product on the bottle, allowing users to associate the taste of bitter melon at a glance and touch, highlighting the healthy and natural characteristics of bitter melon, Enhanced the emotional expression effect of the product.



Fig. 2 Packaging of bitter melon juice

The auditory system accounts for 13% of all sensory systems' perception of external information, second only to vision. From a psychological perspective, people's reactions to loudness, rhythm, and melody often occur unconsciously. Sound has a guiding, repetitive, and reinforcing function on our emotions and consciousness, which can improve product recognition. For example, the record biscuit product launched by Oreo (as shown in Fig.3) uses innovative technology to turn biscuits into small records, matched with six different genres of music such as rock, jazz, and electronics, allowing users to enjoy music while tasting food. By triggering sensory imprints of sound, Oreo's brand recognition in the auditory field is enhanced, achieving the goal of promoting brand culture.



Fig. 3 Oreo Record Biscuits

The olfactory and taste systems are closely related, integrating and interacting with each other. In the absence of olfaction, taste can also be affected, and in some cases, it can be completely lost. In the process of human perception, although they are not frequently used in visual, tactile, and auditory senses, according to the research of British neurobiologist Jay Gottover, "the fading of visual memory can be completed within a few hours to a few days, but once the memory of smell and taste is formed, it is difficult to eliminate it. [5]" Therefore, establishing a connection between the user and the product's sense of smell can awaken the user's pleasant memory and have a positive impact on building the product's image. In recent years, more and more people have fallen in love with purchasing stress relieving toys. The Pinnacle in Fig.4 combines fruit shape with fruit aroma, attracting many customers. This also indicates that products that effectively utilize taste, smell, and other sensory experiences can to some extent enhance the audience's desire to purchase and cause emotional pleasure, which is worth learning from in product design.



Fig. 4 Fruit shaped decompression kneading toy

### 3. The application of multi-sensory experience in cultural and creative product design

#### 3.1 Several sensory phenomena in multi-sensory experiences

When it comes to multi sensory experience design, many scholars usually start from the perspective of synesthesia and study how to apply and reflect the three levels of synesthesia in design. However, as a common sensory phenomenon in physiology, the application potential of multisensory integration and sensory compensation in the field of design is also worth exploring in depth, which can provide us with more possibilities for innovation and application.

In physiology, the process of effectively combining different cue information within the same sensory channel and cue information within different sensory channels into a unified, coherent, and robust perception is called multisensory integration [6]. Moreover, the effects generated by multiple sensory channels at the same time are much greater than those generated by single sensory channels. When modern people watch 4D movies, they can not only see colorful scenes, but also hear the dialogue of characters and feel the vibration of seats. Multi sensory integration allows us to integrate information from visual, auditory, and tactile sensory channels together, thus better understanding the content. Compared to the black and white silent movies of the last century, 4D movies have fully improved the quantity and quality of people's perceptual information. However, multisensory integration has a necessary prerequisite, which is that the information acting on different sensory channels must have consistency to describe the same subject.

In physiological psychology, the phenomenon of a sensory stimulus triggering one or more sensations, forming a composite sensation of both real and hallucinations, is called synesthesia. Generally speaking, synesthesia has three levels: sensory shift, surface superimposition, and image exchange. These three levels are gradually progressing from the surface to the inside [7]. Sensory shift is the most basic form of expression, which refers to the stimulation of one sensation to another, causing sensory stimuli to "drift" in the human nervous system; It can enrich the feedback information brought by a single sensory, deepen the user's impression, for example, when we see red, we may have a warm feeling. Superimposition of appearances can be understood as the expansion and deepening of sensory movement, referring to the resonance and chain reaction of multiple senses caused by one sensation [8];after receiving sensory feedback, people constantly associate and generate new sensations, and use their associative ability to integrate multiple different sensory representations to form a new comprehensive representation, thereby obtaining a more subjective and vivid sensory experience. Image exchange is the highest level of expression of synesthesia, which refers to another sensation generated by the fusion of the original sense with an individual's experience, memory, and emotions after being stimulated by external factors; It is the fusion of objective feedback (image) and subjective imagination (artistic conception), based on sensory displacement and surface superposition, emphasizing the closer relationship between various feelings and their impact on human emotions.

In physiology, when a certain sensory channel is obstructed, other sensory functions will be correspondingly enhanced to compensate for the loss of sensory function, which is called sensory compensation. It can alleviate the impact of damaged senses on perception [9]. For example, the hearing of blind people is often more sensitive than that of ordinary people. They will use the sound of whistles, pedestrians walking, and conversations on the road instead of their eyes to understand traffic conditions and judge traffic lights at intersections. In fact, sensory compensation can be seen as an extreme manifestation of multisensory integration ability.

### **3.2 The difference between multisensory integration and synesthesia**

Existing research rarely distinguishes between multisensory integration and synesthesia, and even confuses them. The author believes that this is not rigorous. Accurately understanding and distinguishing these two concepts is crucial for product design and providing users with a richer sensory experience.

Firstly, multisensory integration is a normal perceptual phenomenon that most people experience, while synesthesia can be seen as a special perceptual phenomenon. The experience of synesthesia varies from individual to individual, and it is an imagined result. Although they all involve the contributions of multiple senses to information processing, multisensory integration is the synthesis of information from different senses, focusing on improving the quality and quantity of perceptual information; And synesthesia is the fusion of information from other senses in a sensory experience to generate perception, which does not actually exist in any sensory channel. It focuses on the way and degree of integrating other sensory information in sensory experience. For example, when people appreciate a painting, they can simultaneously see the color, shape, and texture of the painting, which is the result of multisensory integration; And feeling the expressions, emotions, and movement characteristics of the characters in this painting is the result of synesthesia. That is to say, multisensory integration belongs to the instinctive sensory response, which can help people have a more comprehensive and accurate perception of new things they have never seen before, and help us better understand and cope with the external environment; Synesthesia, on the other hand, is a combination of reality and virtuality, and triggering associations through accumulated experiences in past life (including memory, spiritual beliefs, aesthetics, etc.) is a necessary condition for generating synesthesia.

Secondly, multisensory integration involves simultaneously stimulating multiple sensory channels, each of which is almost equally important; Synesthesia is a direct experience that occurs when a main sensory channel is stimulated and triggers other senses to produce accompanying

experiences, ultimately merging into a comprehensive experience. This process has a sequence, although the interval is brief and can be ignored.

### 3.3 Design cases of cultural and creative products based on different categories of sensory phenomena

#### 3.3.1 Multi sensory integration

For products designed using multisensory integration, users mainly gain an instinctive exploration experience through their intuitive external expressions such as shape, sound, and aroma. In the mini program of the same name produced by the Palace Museum (as shown in Fig.5), users can not only view the appearance of cultural relics in the "Digital Cultural Relics Library", but also use their fingers to slide the three-dimensional model of cultural relics to fully understand the details of cultural relics without blind spots. Compared to offline exhibitions that can only be viewed from afar but not close to, this method comprehensively enhances users' understanding of cultural relics from multiple sensory levels, including visual and tactile senses. It has created a pleasant viewing experience for users and expanded the viewing mode of museums, making online displays an effective supplement and continuation of offline museums.

"Online exhibition viewing" has become a new way for many people to interact with cultural and creative industries, and the expansion from tangible products to intangible products has also become a development trend in cultural and creative design. More and more museums are using digital means to empower cultural dissemination, utilizing multisensory integration to allow people from all over the world to enjoy a vast collection of cultural relics and architectural beauty without leaving their homes.

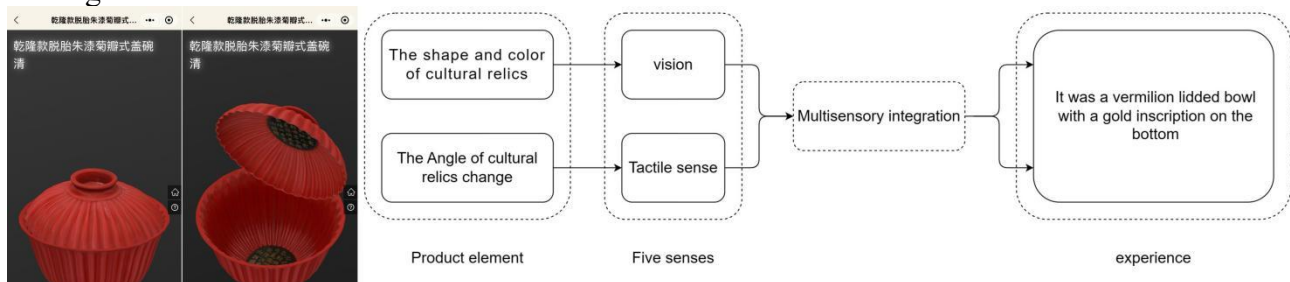


Fig. 5 Sensory schematic diagram of the Mini Program of the Palace Museum (self drawn by the author)

#### 3.3.2 Synesthesia

For products designed with synesthesia, the user experience tends to be more emotional, and this experience is not only derived from the physical properties of the product, but also related to its operating method and the user's personal culture, memory, and emotions.

For example, the "First snow Seasoning Jar" series jointly produced by the Palace Museum Food and Tmall (as shown in Fig.6) cleverly integrates the Palace Museum's red walls, golden tiles, Taihe cranes, and majestic stone lions, as well as the various "white snow" from the Forbidden City, into this set of seasoning jars. Many Chinese people naturally associate the usage scenario of this product with the phrase "Where does the heavy snow look like?It's almost like throwing salt in the air." In this example, the "image" is the visual feedback and auditory feedback generated by the "sha-sha" sound of the salt grains when the user uses the seasoning pot, and the "artistic conception" is the user's inner feelings and memories of the first snow in the Forbidden City, and the cold touch of the winter snow. This form of sensory capture of objective information that evokes subjective emotional resonance is a typical form of image exchange. It can create a gentle and subtle atmosphere for users, and use this atmosphere to enable users to strongly and accurately receive the artistic conception and culture that designers hope to convey.

It should be noted that due to the influence of individual experience, cultural background, living environment, and many other factors on the reception and understanding of sensory stimuli, whether a product can evoke user synesthesia and what kind and degree of sensation it can produce

for users vary from person to person. For example, with the mentioned First snow seasoning bottle, foreign friends may not be able to quickly understand the clever idea of "sprinkle salt to imitate snow", and may not necessarily bring up the beautiful scenery of the Forbidden City with golden tiles, white snow, and red walls and silver clothes. Therefore, when using the concept of synesthesia in design, designers must pay attention to the needs of different users and consider whether the sensory stimuli that trigger synesthesia are consistent with the experience of the target audience.

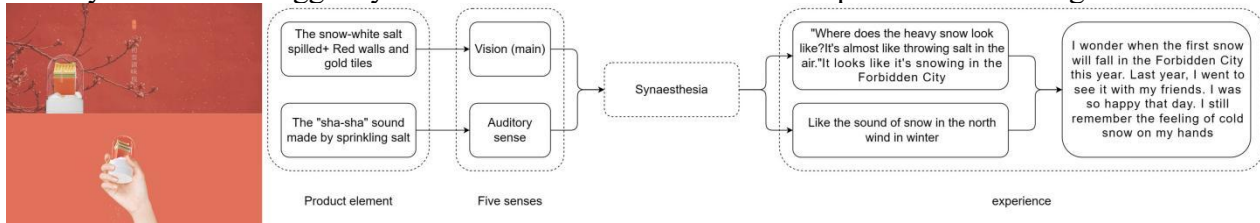


Fig. 6 Sensory schematic diagram of the Palace Museum's "First Snow Seasoning Jar" (self-drawn by the author)

### 3.3.3 Sensory compensation

Sensory compensatory design can be said to be a design method specifically designed for people with sensory impairments, aimed at transmitting information by stimulating other undamaged sensory channels, helping people with sensory impairments understand and use products more easily, and allowing them to feel self actualization and emotional satisfaction in accessible use. DotChess (as shown in Fig.7) is a set of chess designed for both visually impaired and visually impaired individuals. For visually impaired individuals, the pieces are designed in Braille, which helps them easily recognize the meaning of each piece; With the help of the NFC (Near Field Communication) chip of chess pieces, the Braille dot pad next to the chessboard can help them quickly understand the opponent's movements; Important information such as making mistakes or dying during the game will also be broadcasted through side speakers to help correct mistakes and understand the game progress. In this process, the product utilizes tactile and auditory senses to compensate for the visual transmission of information to visually impaired individuals. While improving the gaming experience, it also further exercises their sensory compensation function. And this product can also be used by non visually impaired individuals, which helps to eliminate social isolation to a certain extent.

Due to the limited number of products designed and developed specifically for individuals with sensory impairments, and the limitations of their daily use of products, the threshold for psychological satisfaction seems to be lower. Sometimes, being able to independently understand product functions and use products can provide them with both exploratory and emotional experiences.

When using sensory compensation features in design, there are two things we need to pay special attention to: first, the product must be easy to operate and use, because people with sensory impairments often lack a sense of security and trust when facing new products due to physical defects. If the product is too cumbersome, it is easy to create a sense of helplessness, inferiority, and the contradiction of whether to seek help from others, and many other negative emotions; The second point is that the sensory stimulation caused by the product must be specific enough and not abstract, because the cognitive pathway of sensory impaired people is opposite to that of sensory able-bodied people. able-bodied people usually observe objects from the whole to the local to generate perception, while impaired people often gradually complete the experience from the local to the whole. If the design is not direct enough, it will cause difficulties in understanding them [10].

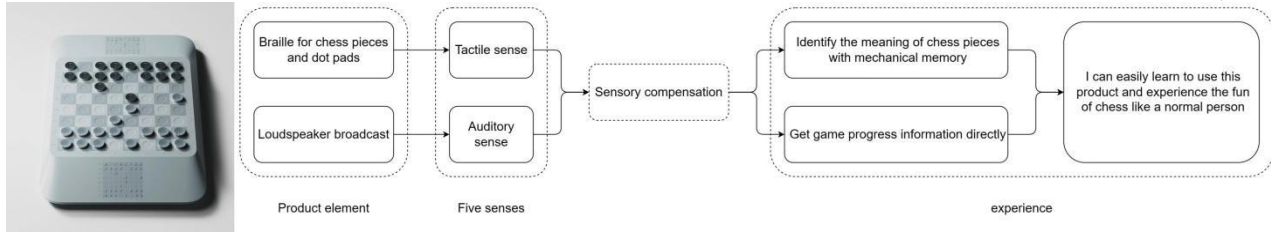


Fig. 7 Sensory schematic diagram of "DotChess - Accessible Chess" (self drawn by the author)

#### 4. A Design Method for Cultural and Creative Products Based on Multi sensory Experience

The use of multisensory experience in product design is actually to integrate sensory phenomena such as multisensory integration, synesthesia, and sensory compensation into product elements. Through the above theories and case studies, we will find that although they are different, the formation of user experience still follows the same cognitive process, which can be summarized as the model shown in Fig.8.

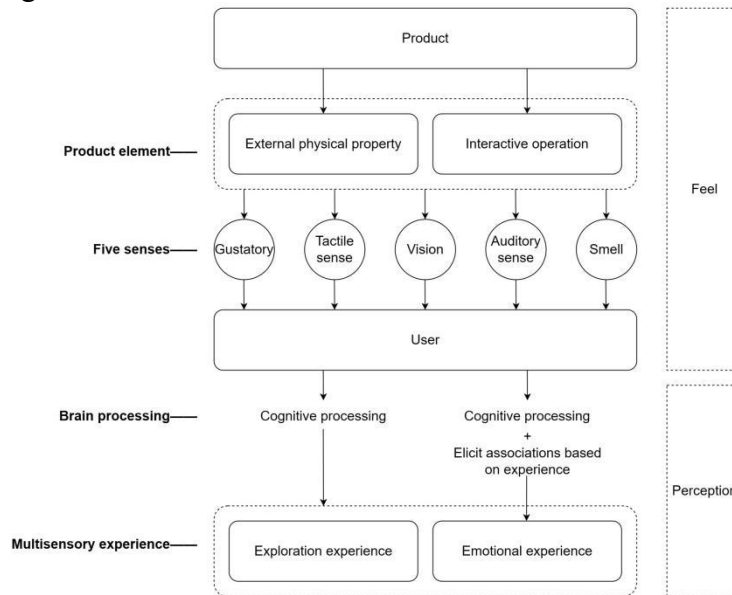


Fig. 8 User Multi-sensory Experience Model (self drawn by the author)

The product design process is basically the opposite of the user's multi sensory experience process, and designers should start with the end and match product elements from the experience. Based on this, a product design process based on multi sensory experience is proposed (as shown in Fig.9).

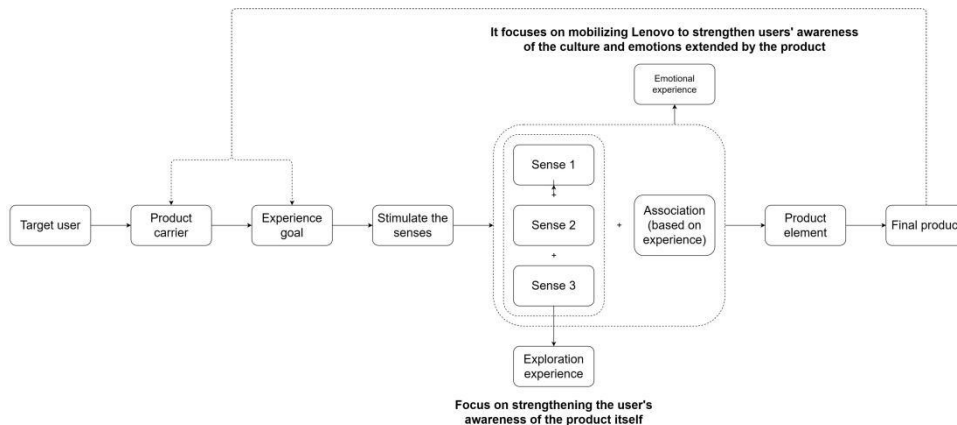


Fig. 9 Design flowchart of cultural and creative products based on multisensory experience (self drawn by the author)

In the design process, we should first determine the target users, whether they are sensory able-bodied or disabled, and what basic characteristics they have (such as age, gender, occupation, etc.). Then, based on the user's needs, we should choose an appropriate product carrier and define the product's experience goals, clarifying the type of perceptual experience we want users to obtain when using the product. If we want users to have an instinctive exploration experience and focus on enhancing their understanding of the product itself, we can choose several sensory channels that need to be stimulated simultaneously; If we want users to have an emotional experience and focus on strengthening their understanding of the culture and emotions extended by the product, we can select a sensory channel as the main sensory stimulation to induce direct user experience of the product. Based on the experience of the target user (including memory, faith, aesthetics, etc.), we can determine the accompanying experience of the product and determine other corresponding auxiliary senses. On this basis, we can determine the product elements based on the determined experience goals and the sensory channels to be stimulated, that is, what physical attributes or interactive operations we will choose to map and match with a series of sensory stimuli, and present the final product.

## 5. Design Practice of Cultural and Creative Products Based on Multi sensory Experience

### 5.1 Product positioning

Based on the above methods of research, the author selected the National Museum of Nature of China as the object for design practice. The National Museum of Nature of China is the only national and comprehensive museum in China, with a total collection of over 370000 items, covering specimens of paleontology, flora and fauna, ancient humans, and geology. It plays an important role in showcasing natural resources, promoting scientific knowledge, and conducting scientific research. Its basic exhibition focuses on biological evolution, with nine exhibition halls including the magical Africa, dinosaur paradise, ancient reptiles, ancient mammals, and invertebrates.

To determine the target users and user needs, the author conducted field observations, questionnaire surveys, and user interviews to investigate and analyze the basic information of self blog visitors, their consumption attitudes towards cultural and creative products, and their preferences for self blog cultural and creative products. The research results show (as shown in Figure.10) that the visitor group portrait is consistent with what Jin Miao, Deputy Director of the Ministry of Education for Self Science Popularization, mentioned in an interview with Global Times, that "more than 80% of visitors to the National Museum of Nature are related to minors (minors and their companions)." Based on the age distribution of the sample, we further narrowed down the scope and identified the target users as "minors aged 6-12".

In addition, based on the Kano model analysis results of user essential needs, we have determined the product type as "digital entertainment products", which must have educational/scientific qualities and provide a sensory experience through visual channels.

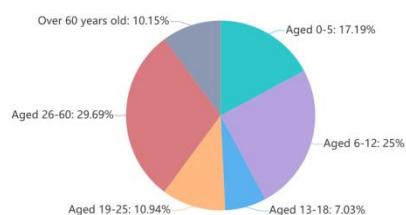


Fig. 10 Age distribution of visitors (self drawn by the author)

Table 1. Visitor Demand Preferences

Kano Stats	Requirement number	Demand details
Prerequisite requirement	R14	Provide digital entertainment products
	R22	Cultural and creative products with educational/popular
	R41	Provide a visual sensory experience
Expectant demand	R23	Cultural and creative products are innovative
	R24	Cultural and creative products have practical/functional attributes
	R26	Cultural and creative products have empathy/commemorative
	R36	Cultural and creative products with the theme of "Amazing Africa"
	R42	Provide tactile sensory experience

## 5.2 Product Design Practice

Based on the above research, taking into account the essential needs of users for educational digital products that provide visual stimulation, the product carrier is determined as a game mini program. The theme of the design is based on the basic exhibition of "Magical Africa" and "Dinosaur Park" at the National Natural History Museum. The game integrates the images of magical African wildlife and ancient dinosaurs from the Jurassic period, allowing children to unconsciously acquire natural knowledge in the game and turn learning into a pleasure.

In the selection stage of sensory stimulation, the author selected the most easily perceivable visual, tactile, and auditory channels for children. The product will be designed through material layers such as color, sound, and function to provide children with a multi sensory experience. In the stage of determining product elements, each element design is based on children's sensory characteristics. At the visual sensory level, the game selected animals from the African continent, such as the gray crowned crane, African leopard, giraffe, elephant, crocodile, etc., and designed cute cartoon style animal images for them, paired with bright colors. Correctly clicking on the target animal set in the level will trigger the magnifying glass's luminous effect and the overall color refresh of the screen, allowing children to be quickly attracted and interested in the small game, prompting them to further understand the gameplay. At the tactile sensory level, the game uses a magnifying glass as a medium to guide children to drag the cursor to find the target animal hidden in the picture. Clicking on the correct answer will produce a vibration effect, providing positive feedback for children, strengthening their tactile and motor thinking training, and achieving a "play" experience. At the auditory and sensory level, after each correct click, in addition to visual and tactile feedback, the system will also play the names of animals through speakers, allowing children to have an immersive experience; And the knowledge card that symbolizes passing the level includes video introductions. For young children who are not yet fully literate, audio explanations are the biggest way for them to acquire knowledge.

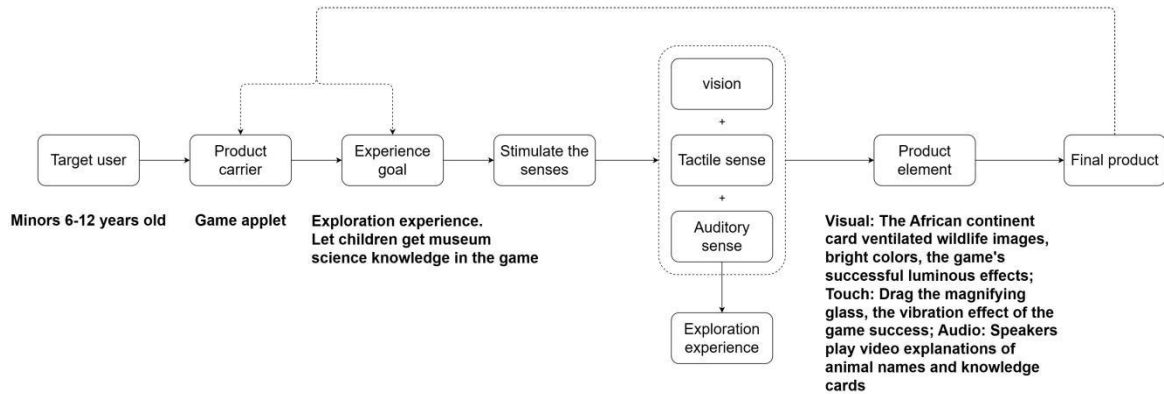


Fig. 11 Design process of the "Nature Exploration Journey" mini program (self drawn by the author)



Fig. 12 One of the levels and gameplay of the "Nature Exploration Journey" mini program (self drawn by the author)

## 6. Summary

This article systematically introduces the cognitive principles and expression methods of the senses, and focuses on studying three common multisensory phenomena. By analyzing cases of their application in museum cultural and creative products, a user's multisensory experience model is constructed, and a product design method based on multisensory experience is proposed to guide practice, providing ideas and references for future multisensory experience product design. Multi sensory products create a richer and more three-dimensional user experience by combining multiple sensory elements such as visual, auditory, and tactile senses. This comprehensive sensory interaction not only deepens the emotional connection between users and products, but also enhances the attractiveness and memory points of the design. Looking ahead to the future, with the growth of technological innovation and personalized demand, multi sensory experience design will play a greater role in enhancing user immersion and enhancing interactivity, becoming an important trend in museum cultural and creative product design innovation.

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