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Design of a Landscape Device for Children from the Perspective of Embodied Cognition in the New Era

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Abstract In recent years, embodied cognition has ushered in a new research upsurge in the academic field, and has become a hot topic in the field of cognitive psychology. In this paper, from the perspective of embodied cognition, the interaction ways of a landscape device for children were discussed to achieve a more real and harmonious interaction between children and scenes. The research data of embodied cognition used by children was analyzed, and the drawbacks and breakthrough points of current landscape devices for children were discussed. The core characteristics of children's growth period were extracted to establish children's interaction model and summarize the interactive design methods of landscape devices for children. Embodied cognition has become the most intuitive way for children to know and understand the environment, and plays a pivotal role in children's growth. Based on embodied cognition principle and interactive behavior mode, the interactive design of a landscape device for children was studied, and three interactive design modes, including simple and convenient interaction mode, multi-sensory interaction mode and game natural interaction mode were summarized. On the basis of this research, relevant design practice and research were carried out to bring a new vision to the design of children's landscape.

Keywords Embodied cognition, Children's landscape, Device design, Interactive behavior pattern

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Embodied cognition is used to illustrate a theory in cognitive science in the field of cognitive psychology, and emphasizes the significance of obtaining perceptual motor experience by using the interaction between one's body and the surrounding environment, as well s the conceptualized perception obtained[1]. The classical theory of cognition holds that consciousness is derived from abstraction and the processing of modal symbols. Concrete cognitive theory points out that human physical activity is the cornerstone of cognitive world. The interaction between direct perception and movement is indispensable for gaining knowledge and exerting perception[2]. To a certain extent, it highlights the concreteness and contextuality generated by direct perception. According to the special development situation of children, a new vision for creating children's interactive products are put forward.

1 Development of embodied cognition theory

Domestic and foreign scholars have made a deep exploration on the basic theory and methods of embodied cognition. For instance, by searching the keywords "embodied cognition" and "children's landscape" through "advanced search" in CNKI database, a total of 152 corresponding Chinese documents can be obtained. Through the classification of data and literature, on the basis of the study of keyword co-occurrence, combined with synonyms, the selection of hot keywords is realized through the interrelation of keywords. The keywords such as "embodied learning" and "multiple senses" are all hot concepts in recent years. Through summary and induction, it is found that the number of relevant studies has shown an obvious upward trend, and the focus of discussion has gradually shifted from "mass landscape cognition" to "children's natural education".

Embodied cognition theory, as the core idea of the second generation of cognitive science, has attracted extensive attention and research in the field of children's education and product design in recent years. This theory emphasizes the importance of the body in the cognitive process, and believes that cognition is formed through the experience of the body and its activity mode. The body is the source of cognition and affects the cognitive process. This point of view provides a new perspective and method for children's education, and also provides a new idea for the design of children's products. In the field of children's education, the application of embodied cognition theory has achieved certain research results. Researchers have found that children form and develop cognition through interaction with their environment, especially their bodies. For example, in preschool innovative education practice, children's cognitive ability, creativity and learning interest can be effectively improved by using finger flexibility training, games, sports and other methods[3]. These methods can not only help children's motor thinking development, but also promote the improvement of their mathematical ability and innovation ability. In addition, teaching methods such as situational teaching and participatory teaching also reflect the concept of embodied cognition, and can improve the learning effect by guiding children's active participation and personal experience[4]. In the aspect of product design, embodied cognition theory also provides new enlightenment for the design of children's products. Designers begin to pay attention to children's physical behavior and perceptual experience, and improve product usability and users' experience by designing products that conform to children's physical characteristics and cognitive rules. For instance, the design of some children's toys and teaching aids pays attention to children's sensory stimulation and sports experience, and stimulates children's curiosity and desire to explore through the interaction between touch, vision and hearing[5]. At the same time, some educational electronic products have also incorporated the concept of embodied cognition[6], providing more real and rich interactive experience for children through virtual reality, augmented reality and other technologies. With the deepening of research, the application of embodied cognition theory in the field of children's education and product design is also expanding. Researchers begin to pay attention to children's cognitive differences in different situations and how

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to optimize children's cognitive development by designing different interaction modes and environments. Meanwhile, some interdisciplinary studies also begin to explore the combination of embodied cognition with theories in other fields, such as neuroscience, psychology, education, etc., so as to more comprehensively understand the cognitive process and development rules of children[7]. In the concrete research practice, researchers have adopted various methods to verify the validity of embodied cognition theory. For example, through experimental and observational studies, children's cognitive performance and behavioral response under different interaction modes can be observed. Through questionnaires and interviews, parents' and children's satisfaction and feedback on product design and teaching methods can be investigated. These research methods provide strong support for the application of embodied cognition theory in the field of children.

In general, the research on embodied cognition theory has made some progress in the field of children's education and product design. In the future, with the continuous development of technology and the continuous improvement of theory, embodied cognition theory will play a greater role in the field of children, providing children with more high-quality educational resources and product design.

2 Analysis and construction of embodied cognitive interaction model and framework

There are two main concepts in cognitive psychology: information processing and connectionism[8], and information processing theory is applied to children's cognition. Perceptron is an important model of interactive information. Perceptron sends out nerve fibers from the central nervous system to the surrounding areas by receiving stimulation information under external conditions, and make some active responses. However, the theory of personal cognition opposes this model, arguing that the generation of consciousness comes from the interaction between human body and external environment, and human body, cognition and landscape become a subject[9]. Its essence is that human interact with landscape in the natural environment, and this main organism acquires the cognitive process under the influence of acquired conditions and subtle factors. The basis of personal perception research is the study of cognitive dynamic process, with particular emphasis on the interactive process and the integrity and localization of the interactive model (Fig.1–Fig.2). Interaction design is to establish a symbiotic model between users and products by deeply discovering customer needs.

3 Embodied cognitive characteristics and physical and mental characteristics of children

Age 0–12 is an important period of rapid development of cognition in a person's life. At this stage, children's appearance continues to grow, and there are differences in cognitive ability, psychological characteristics and thinking patterns at all ages. When children are 2 years old, their perceptual system is very prominent. They show curiosity about the surrounding environment, are willing to explore the unknown world, often imagine and imitate things. According to the interaction mode of personal perception, children's understanding of nature mainly comes from their perception and cognition in communication with the external environment[10]. In this study, children aged 2–12 years old are as research objects to investigate the expressive function of their perceptual ability.

Children's growth from 2 to 12 years old has the characteristics of gradual progress, and there are differences in various periods; their feelings and cognition are very intuitive and specific (Table 1). An interactive device for school children aged 3–6 years old can use the size, weight, softness and hardness of the material to promote children's sense of touch, use the tone, purity, brightness and color combination of harmonic colors to affect children's visual feelings, and use music that mimics common objects to influence children's sense of hearing. In the specific design process, with the increase of children's age, the scope of their mastery and understanding is also expanding. Digital intelligent landscape, sound simulation landscape, tactile interactive landscape and other technical means can be used to increase the interest and promote the development of child-friendly landscape.

4 Strategies for the interactive design of children's landscape installation based on embodied cognition theory

4.1 Simple and convenient interaction mode

Children's growth is characterized by a strong desire for knowledge, and embodied cognition is gradual in different stages of children's growth. Children over the age of 6 years old have perfected their sensitivity development such as visual observation, auditory discrimination and tactile perception, and can basically capture changes in external conditions sensitively[11]. In the design process of games and interactive devices, this characteristic of children should be fully considered, and the design method of relatively simple operation should be adopted. The difficulty level of the design should be clear, and the functional interaction should be clear at a glance, which can reduce children's cognitive impairment and increase their use experience. Children can get real interactive experience in simple operation, and their desire to explore and enthusiasm for knowledge can be stimulated to further promote their growth and development. Through carefully designed games and interactive devices, an environment full of fun and learning opportunities can be created for children to help them grow better.

4.2 Multi-sensory interaction form

Multi-sensory interaction form can enrich and promote children's senses, enhance the sense of control and self-cognitive experience, and is the best way to enhance interactive function. The interweaving of multiple channels makes it easier for children to obtain a real human-computer interaction environment at the same level[12], which plays an important role in promoting and promoting children's development. In terms of visual perception, high-saturation colors

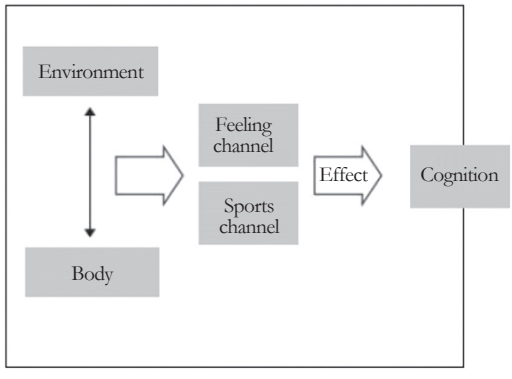

Fig.1 Process of embodied cognition

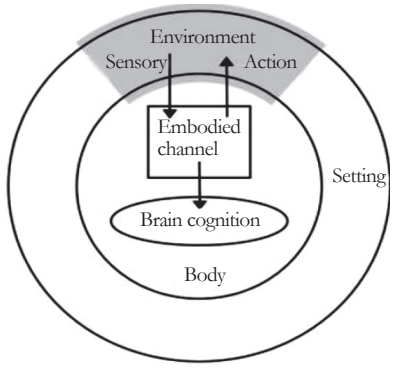

Fig.2 Model of embodied cognition

are easier for children to distinguish. With the growth of age, the visual development is gradually improved, and open three-dimensional children's interactive devices can be developed to stimulate children's thinking imagination and spatial perception. The primary pathway of hearing and cognitive ability is omnipotence, and the design of interactive system can be combined with visual, auditory, and other systems to help children understand and analyze the surrounding information. The tactile sensory response is relatively complex, and the design of interactive devices can provide more tactile stimuli through the use of rich materials and textures, which can be transmitted to the brain through neural capture and output stimulus feedback[13]. The interactivity of the multi-sensory children's interactive device runs through the design, and multiple interactive technologies can be used to add interest.

4.3 Natural interactive behavior of games

Proper game interaction can indeed balance the functions of the body and the brain, so that cognitive activities can be carried out smoothly. Game interaction has a very broad potential development space, and can create a variety of opportunities for children, so that children's enthusiasm for in-depth development is greatly improved[14]. The natural interactive activities of games must strictly follow the principles and characteristics of children's spiritual growth, thinking cognition and behavioral preferences. In the process of children participating in the natural interactive activities of games, it can guide children to carry out positive emotional communication in an invisible way, and effectively achieve the purpose and effect of edutainment. Children can immerse in natural game interaction, not only gaining happiness, but also effectively promoting their physical and mental development, and constantly improving their cognitive ability. Through such game interaction, children can explore the world and learn knowledge in a relaxed and pleasant atmosphere, laying a solid foundation for their future growth.

5 Practice of interaction design of children's products from the perspective of embodied cog–nition

5.1 Design positioning

A landscape interactive device for children with aviation as the theme is designed mainly for children aged 2–12 years old. Children in this age group are at a critical time when they are full of curiosity about the world, eager to explore new knowledge, and actively develop various abilities. In terms of function orientation, it focuses on the integration of knowledge dissemination, ability training and entertainment experience. In terms of knowledge dissemination, through various elements in a game, such as the aviation knowledge quiz on a chessboard, the principle demonstration of a power generation device, etc., children can easily obtain the basic knowledge of aviation field in the play, and their interest in science is stimulated. In terms of ability training, in the process of relay power generation, children need to cooperate with each other, and learn division of labor and cooperation to enhance team cooperation ability. Operating power generation devices and dealing with game challenges can exercise their hands-on skills and problem-solving skills. In terms of entertainment and interactive experience, a variety of game links are carefully designed, such as interesting competitions, surprise rewards, etc., so that children can spend their playing time in joy, making learning interesting and not boring.

At present, there are many studies on children's entertainment landscape facilities, but there are relatively few studies on interactive design specifically for children by taking aviation as the theme and having both educational and entertainment functions. With its unique creativity and rich connotation, the amusement device with aviation as the theme aims to meet the parents' expectations for the all-round development of their children, and provide children with a different amusement choice. Compared with traditional amusement facilities, it pays more attention to the combination of knowledge and entertainment, as well as the cultivation of children's comprehensive ability, aiming to provide parents and children with a new high-quality amusement choice to meet their needs for edutainment.

5.2 Design expression

The exterior design is committed to creating a fun space full of futuristic and technological charm. The whole system uses smooth lines and dynamic forms, liking a spaceship about to set sail (Fig.3). The game board is a huge round, and has a smooth surface and delicate texture, symbolizing the vastness and mystery of the universe. The appearance of the propeller generator highly mimics the real aircraft engine, and the metal texture and cool lighting are very attractive. In the use of color, the main color is deep blue, which represents the vast sky and endless universe and gives people a sense of tranquility and mystery. The auxiliary colors are vibrant green and passionate orange, of which green symbolizes life and hope, and orange represents enthusiasm and creativity, inspiring children's active participation. In terms of functional design, the power generation device provides two modes of operation (foot and hand) to adapt to different children. The checkerboard covers a lot of content, and has beautiful patterns and simple text instructions. There are various interactive elements, and reaching the power output standard or completing the task will trigger music, lighting and other effects to enhance the fun. In terms of scene planning, aviation-theme background walls can be arranged around to show the development history of aircraft. The play area, rest area and viewing area are reasonably divided to meet the needs of children's activities and parents' companionship and provide a good play experience. In short, the design of a landscape interactive device for children with aviation as the theme is committed to creating a fun world full of fun, knowledge and challenges for children, so that they can grow up in happiness and make progress in exploration.

6 Conclusion

The design of a landscape interactive

Table 1 Embodied cognitive characteristics and perceptual characteristics of children

Age stage	Cognitive characteristics	Perceptual features		
		Vision	Hearing	Tactile sensation
2–7 years	Their vision is gradually developing, but they are difficult to concentrate. They have strong curiosity, and enjoy exploring the world through auditory and tactile senses	Color recognition	Sound recognition, and learning imitation	Identifying physical attributes
		Stimulating visual development	Auditory development gradually improves	Distinguishing the size, volume, and weight of objects
7–12 years	Their association and imagination are rapidly developing, and logical thinking is key to development. They have a strong interest in adventure and fantasy cognition	Improved ability to distinguish colors	Enhanced auditory comprehension ability	Their sensory integration is approaching maturity
		Enhanced visual memory ability	Greatly improved expression ability	

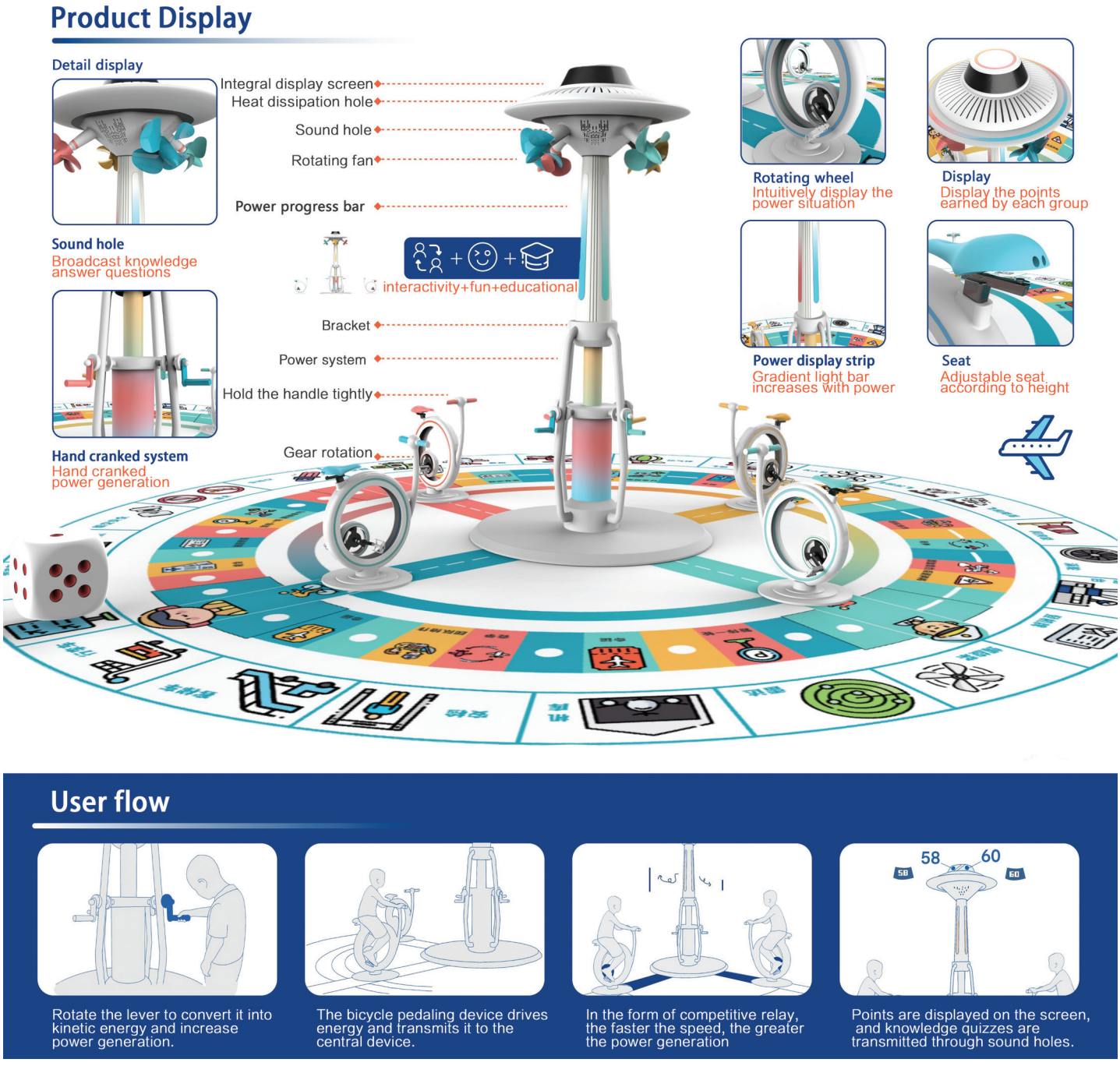

Fig.3 Design of a landscape interactive device for children

device for children is preliminarily understood and analyzed from the perspective of specific perception. According to children's perception ability and development characteristics, the interactive model of children's body perception ability is established, and corresponding design strategies and methods are proposed. In the interactive design of children's landscape installation, simple and convenient interaction mode, multi-sensory interaction form and natural interaction behavior in the game should be adopted to create a benign interactive environment and then promote the healthy physical and mental development of children.

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5 Implications for the development of climate–adaptive urban parks in China

The EVFBS Cemetery Park, a historic burial ground located in the center of Berlin, preserves its cultural and commemorative significance while actively addressing climate change through contemporary planning, design, and technology. This initiative effectively integrates historical heritage with ecological functionality. In China, particularly in numerous cities that exhibit both historical heritage and modern development, historical buildings, ancient trees, and other forms of cultural heritage are extensively distributed across various park green spaces within the city center. However, the majority of urban planning and redevelopment efforts tend to prioritize historical, cultural, and tourism-related functions, often neglecting the ecological value of these green spaces, which can contribute significantly to climate regulation[12]. In the context of the renewal and renovation of urban parks that possess historical and cultural significance, it is essential to preserve their cultural connotations while simultaneously enhancing their ecological functions[13]. By integrating the protection and exhibition of historical and cultural elements with the development of green infrastructure, it is possible to achieve a mutually beneficial outcome that encompasses both ecological advantages and cultural values.

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