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Research on the Science and Technology Museum under the Concept of "Child-Friendly"--Taking the Macao Science Museum as an example

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Abstract: *As an important part of cultural architecture, the Science and Technology Museum bears the needs of the public for viewing exhibitions, exchanges, gatherings, entertainment and other behaviors. It is a space for children to conduct culture, science education and activities, and is an important place for children to learn, play, and rest. . The Science and Technology Museum should give full play to the unique advantages of educational resources, highlight the characteristics of science and technology, and fulfill the responsibility and mission of social education, especially children's education. This article starts with the concept of "child-friendly", through the analysis of children's psychological and behavioral characteristics, proposes the design principles of child-friendly science and technology museums in terms of traffic design, environmental capacity, and architectural design, and evaluates the Macau Science and Technology Museum.*

Keywords: *Science and Technology Museum; Child-Friendly; Psychological Behavior*

1. Introduction

Since the 21st century, my country's urban development has entered a new stage of transformation. Cities have returned from a single-growth mindset to the origin centred on human needs. Cities are increasingly focusing on connotative development and high-quality development. From planning to architectural design, humanistic ideas stand under the urban spotlight of the new era, and the improvement of human-oriented space quality has become the theme of development. People-oriented, children and adults enjoy the same human rights. Children are the future of mankind and an important group in the process of urbanization. In recent years, with the promotion of the three-child policy and the rapid development of urbanization, the number of urban children in my country is currently on the rise. According to the Statistics and Census Bureau of the Macao Special Administrative Region, the total population of Macao in 2019 was 67,900, and the population of children (0-14 years old) accounted for 16.1%, which is close to 1/5 of the total population. The good growth of children and children determines the development of Macao.

2. Meaning of the research

The healthy development of children is of vital importance to any city and society, and an environment suitable for children's growth will be more fair and full of vitality. In the medical field, children in the age range of 0-14 years are regarded as "pediatrics" research objects. All this shows that children aged 0-14 are in a physiological and psychologically immature developmental stage, disadvantaged, more sensitive, and dependent on adults, so children often need special care and protection. At present, many cities across the country have begun to explore the construction of child-friendly cities, such as Beijing and Wuhan. Many planners and architects have conducted in-depth research on child-friendly cities. The concept of child-friendly is that children have the right to enjoy a healthy, protected, caring, educated, encouraging, non-discriminatory, and literate environment; and they have the right to pursue when they are neglected. The concept of a child-friendly city was first proposed at the Second United Nations Conference on Human Habitat in 1996. The conference was based on the Convention on the Rights of the Child (Convention on the Rights of the Child) initiative to regard children's health and well-being as the ultimate indicator of urban development. To incorporate

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the needs of children into urban planning and development. As my country is a signatory of the Convention on the Rights of the Child, this concept is consistent with my country's development and construction policy. Achieving "maximization of social welfare" is the goal of my country's intensive and sustainable development, and to maximize the benefits of public space in urban planning and construction, it is necessary to give priority to protecting children's space interests. We can understand that from the introduction of children's participation in 1992 to the inclusion of children's political priorities in the decision-making system in 2004, children have been paid more and more attention.

Table 1: Child-friendly cities

Year	Symbol	Content
1992	Agenda 21	Define the importance of children's participation in sustainable urban development
1996	Convention on the Rights of the Child	Propose that children have the right to play freely in a healthy and safe environment
2001	Human Habitat Agenda II	Obtained the support of child-friendly cities from the action plan of Agenda 21, encouraging the inclusion of children in the environmental decision-making system
2002	A World Fit for Children	Reiterate the importance of building a "child-friendly city"
2004	UNICEF develops Building Child-Friendly Cities: Framework for Work	Large, medium and small cities and communities should give children political priority and include them in the decision-making system

Data resource: author collation

By consulting the literature, I learned that although the domestic research on child-friendly cities started relatively late, they are getting more and more perfect. However, there is relatively little research on cultural buildings under the concept of child-friendly. From the urban macro scale to the spatial micro scale, child-friendly buildings are the basic unit to implement the child-friendly city construction plan. Cities should make full use of public buildings to benefit children and protect their space interests. This is not only a concern for children, but also a guarantee for the interests of disadvantaged groups represented by children. Therefore, in the context of the development of child-friendly cities and contemporary humanism, the design of cultural public buildings such as science and technology museums is particularly important.

3. Research methods

Observation method: Conduct multiple field visits to the Macao Science Museum during the preparation and writing stages of the thesis, and obtain the most direct and true first-hand information through investigation and analysis.

Disciplinary Comprehensive Method: Systematic analysis, collation and multi-level comprehensive research are carried out on the collected data, research results, practical experience and comprehensive behavioral psychology, urban sociology, architectural design and other related theories.

4. Children's psychological and activity characteristics

Everyone has different perceptions of architectural space. Children's perception is different from that of adults and has its own uniqueness. At the same time, children of different ages have complex and different understanding of architectural space. For example, children aged 0-2 years old need adult assistance to move, and have strong perception; children aged 3-5 years old need to move under the care of adults and like to imitate and experience; children aged 6-7 years old need to move within the sight of adults, individual Strong expression; children aged 8-14 can act independently and accumulate cultural information from various sources. At the same time, mainstream developmental psychology pointed out that in early childhood (3-6 years old) and childhood (7-12 years old) children, play and learning are their dominant activities, and they are also the most active age group to participate in activities.

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Based on the research conducted by Chen Tian and Wang Jiayu on children's behavioral characteristics and activity needs in public spaces in combination with child behavioral psychology, the following five main psychological behavioral characteristics can be summarized: ①Love to be close to nature; ②Curious and diverse play space; ③Gathering at the same age, easy to interact; ④Random activities, play at any time; ⑤Exploring and hiding, clever design is more attractive.

Children's psychological feelings will affect their behavior in the architectural space. Therefore, in a child-friendly architectural space, children's mobility needs should be fully considered, and the friendly use of space and safe arrival should be improved to promote the friendliness of the space. The design should follow the principles of accessibility, safety, comfort, interest, and particularity, promote the interaction between children and the natural environment, satisfy children's curiosity, stimulate children's imagination, and achieve healthy physical and mental development.

4.1 Closed space behavior

Closed space refers to a narrow space with a strong sense of boundary, with clear cohesion and centrality. Due to the limited line of sight, the interference from the outside becomes smaller, and people will feel quiet and slow unconsciously. If the enclosed space is improved, the time people stay in it will increase. In such a small space, children mainly focus on static games and rest.

4.2 The influence of play activities on children's psychology and behavior

Play activities have a great influence on the formation of children's personality and emotions. Freud once said, "Playing activities can unite real life and personal feelings." In games, children can develop the ability to deal with various problems. This is why in the children's play environment, the child's psychological characteristics and actions must be considered first, and the problem is considered from the child's perspective, which helps to create a space that promotes the growth of the child.

5. Architectural design principles and evaluation

5.1 Security-spatial streamline organization

The building of the science and technology museum must first ensure the safety of children. Children have low self-protection awareness. In spaces and corners that are invisible to parents, once children engage in dangerous activities, parents cannot detect and stop them in time, and children will be at risk of injury during the activities. Places that cannot be reached safely or have potential safety risks are unavailable spaces. There are many buses in the Science Museum, but after getting off the bus, you have to cross a roadway to enter the Science Museum.

Figure 1 Macau Science Museum bus station

For lively children, the path through which there is a safety hazard, you can consider setting the bus stop at the side of the adjacent venue makes it safer for children to get on and off the car. The museum considers the needs of children's activities, and according to the functional requirements of each exhibition hall, it is arranged according to the visiting flow line to form a spatial settlement, which is connected in series to form a smooth space system to ensure the safety of the visit flow line. However, the entire visit path is a circular gentle slope, which poses a certain degree of danger. For young children, they need the help of their parents to stand safely and run down without gravity.

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5.2 Naturalness-Landscape Capacity Design

It is the nature of children to like to be in contact with nature, and to feel nature. Knowledge of nature is an important part of establishing one's personality. Contact with nature can satisfy children's curiosity about the world, cultivate their own physical stamina and endurance, etc. The beautiful scenery is reflected in the integration of the building and the surrounding natural environment, and the coordination of the architectural design with the topography. Combined with the development of children's activities, these help children liberate their nature in the architectural space, not only improve their knowledge reserves, but also improve environmental awareness and aesthetic awareness. The Macao Science Museum is located between the famous tourist spot "Fisherman's Wharf" and the Macao Cultural Center. It is surrounded by the sea on three sides and has an open landscape. There are seaside walking trails along the coast for visitors to enjoy the scenery of both sides of Macao. There are recreational spaces in the northwest and northeast. The square is also equipped with seats, so you can enjoy the sea view while resting while waiting for the bus.

Figure 2 Location of Macao Science Center

The building of the Macao Science Museum adopts the most basic design elements. Geometry, cones, hemispheres and rhombuses fully illustrate the simple appearance, geometric elements and the importance of architectural space in modern architecture. The exterior wall of the building is made of silver aluminum panels, and the glass curtain wall is designed to introduce natural light into the science museum and make full use of sunlight. There is a heart-shaped tree outside the venue, which is beautifully maintained. It is backed by the Macau Friendship Bridge. The building blends with the surrounding environment and interacts with each other to produce a complementary beauty. However, there is little greening around the main building of the Science Museum. There is only a heart-shaped tree. The rest of the open space is paved with squares. There is no greenery for decorative separation, and there are no small flowers, grasses or potted shrubs, making the Science Museum relatively empty and isolated. More green spaces and plants should be planted on the site, combined with heart-shaped trees to form a complete green space system. Whether from the perspective of environment, aesthetics or entertainment, plant landscapes are an important part of the design of children's places.

Figure 3 Heart-shaped tree

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5.3 Comprehensiveness-architectural space design

5.3.1 Interesting-architectural function layout

Due to the limitation of physical and psychological development, children's spatial scale perception ability and functional recognition ability are not as good as adults. Therefore, the functional design of child-friendly buildings should be simple, clear, clear and accurate, so that they can be easily recognized and used by children. Internal functional zones should be distinguished by easy-to-identify elements such as colors, and the line of sight within the zone should be transparent and not obstructed. On this basis, combining multiple functions, optimizing spatial functions, and flexibly meeting the needs of different age levels and different activities. The functional layout of the main structure in the Science Museum is clearly defined. There are barrier-free facilities at the entrance and exit, and the nursery room is clearly marked. Create areas of activity that do not interfere with each other but are interconnected. The first floor is the exhibition area of the planetarium. There are a total of 14 exhibition halls on the second to fifth floors. Each exhibition hall uses task-based hands-on games to guide children to learn a variety of scientific knowledge. Children's nature is to play, through fun Sexual games allow children to experience the mysteries of science immersively, learn while playing, and grow while learning.

5.3.2 Comfort-the scale of architectural space

In his book "Design of External Space", Yoshinobu Abara proposed the establishment of spatial order. A positive space means that this space is full of planning, and order is established by modifying the internal space after determining the external boundary.

By providing a clear purpose, a high-quality space is created in terms of scale and texture. Sense of scale is the key to constructing a child-friendly space.

The scale of child-friendly building space should fully consider the physical characteristics of children. Regarding the scale of children, scientists have done experimental studies. Children lack enthusiasm for large spaces, but enclosed spaces-tree houses, tents, etc., they all show infinite love and enthusiasm, because those are their sizes. Psychologically, these are called "fields". During the design, the main line design principle of "border-domain-center" was followed to ensure the accuracy of the sense of scale, and to a certain extent, it also helped to eliminate potential safety hazards. Large-scale buildings tend to make children feel afraid of emptiness and insecurity. Therefore, when dealing with spatial scale issues, the necessary open proportions should be maintained, and the wider space should be appropriately weakened through sketches and paving. For example, in the square, plant more plants and grass, and then through carefully designed paving, define the scope to reduce the sense of openness, and appropriately increase children's play facilities to increase the fun of outdoor activities. Moreover, the spatial scale suitable for perception and the scale of facilities used should be designed according to the physiological characteristics of children. In terms of interactive facilities, the difference between the physiological characteristics of children and adults should be considered, and adjustments should be made according to their actual scales. The dual-scale setting takes into account the common use of children and adults. For example, the standing platform of the Science Museum is about 30cm, taking into account the steps of children and adults. In addition, the auxiliary function space in the venue has been treated with fun, breaking the boundaries of specific functions, and serving as a space for children to play, communicate, and display.

5.3.3 Particularity-elements of building facilities

① Color In the science and technology museum building, the role of color in the child-friendly architectural space cannot be ignored. In the architectural space, the use of different colors will improve children's awareness of the space. It is difficult for children to recognize and use functions. The use of colors in buildings can distinguish different functional spaces. Similarly, taking advantage of children's color-sensitive characteristics, architectural spaces can use rich colors to design markers and signs, which serve as guiding signs for the space, making the flow of children's activities clear and clear. The choice of color tone should be adjusted according to the nature of the space and the type of children. For example, the science museum uses bright colors with warm colors for the entertainment function space used by young children to enhance children's visual perception and create a lively and happy atmosphere; while the training space for young people is mainly made of cool colors and decorated with warm colors. The color matching method creates a relaxed and quiet learning atmosphere. The colors of walls, roofs, floors, and windows are the background colors of the interior of the building. The basic tones of the interior colors of the building are determined. The building scales

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of various functions should be matched with different colors. Furniture is the most frequent indoor facility for children. Colors with high contrast and strong visual effects are selected for the small area in the science museum to enrich children's imagination, stimulate children's curiosity, and cultivate their perception of color. Choose soft and warm colors with low saturation for large-area furniture colors, so that children can feel the warm, warm and safe atmosphere of the activity space.

②Material Touch is also one of the important means for children to perceive the world as they grow up. For architectural spaces, the choice of materials affects children's sensitivity and visual perception, and creates a dialogue with the environment. Therefore, child-friendly architectural spaces should pay attention to the elements of material safety, visual perception, tactile perception, and spatial influence that have an interactive relationship with children. Different material textures bring different psychological feelings to children. At the age of 3-14, children's visual and tactile perception capabilities experience rapid improvement, which is why reasonable materials must be selected for architectural spaces. The handrails and other facilities of the Science Museum are made of metal, which brings cold, serious fantasy to the children. It is recommended to use more natural materials such as wood, with a soft touch, which will make children think of the ecological environment and have free associations.

6. Conclusion

The Macao Science Museum is a qualified child-friendly building, but there are still many shortcomings. It needs to be continuously improved to better serve children and young people. When talking about the basic conditions of play places, Nakamura said, Due to the influence of social changes, children’s play places must be considered as a social system. Therefore, national-level children’s public space design guidelines should also be issued as soon as possible. A unified standard should be formed for all aspects of activity space site selection, functional use, implementation and construction, in order to facilitate nationwide promotion and jointly promote the blossoming of child-friendly cities in the country.

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