# Intelligent Analysis of the Green Design of Comfortable Environments in Children's Activity Center

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**Abstract**—Children's activity center is a multi-functional activity place that can provide activities, education and communication for children after school. At present, the existing children's activity centers in my country have some problems in many aspects, such as incomplete facilities, unclear space division, peculiar smell and weak lighting, etc., which lead to the generally low utilization rate of activity centers. A practical survey of existing children's activity centres was carried out by means of a questionnaire and SPSS calculation and analysis software was used to analyse the importance of different green design factors in the design of children's activity centers. Through the green design of the children's activity center, we hope to promote the sustainable development of children's physical and mental health, and provide new ideas and goals for the design and construction of subsequent children's activities center.

**Keywords**: Sustainable Design;children's activity center;Green Design; calculation and analysis

## 1 INTRODUCTION

A fully functional, comfortable and safe children's activity center brings more selectivity to children's after-school time arrangement, because it needs to meet various functions such as children's after-school learning, communication and play, reading guidance, psychological counseling, and reporting performances. When designing, it is necessary to focus on designing and planning according to the actual needs of children, so that their physical and mental health can have a healthy development. With the development of the times, domestic and foreign children's activity centers have gradually evolved from a single functional space that satisfies children's performances and reports to a multi-functional space that adapts to children's new needs such as children's learning and communication, psychological counseling and counseling [1]. Therefore, in the design and construction of new children's activities, problems such as poor air quality, irregular construction steps, poor safety of decoration materials, and inefficient physical environment design that appeared in the old design should be avoided. This will correspondingly lead to a single idle activity for children, unreasonable space color and pungent smell, flaws in safety and fire protection planning, and long-term exposure of children to an unhealthy place [2].

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Today, when we advocate green development and sustainable development, the design of children's activity center should also closely follow the concept of green design, and design a healthy and comfortable after-school activity place for children in compliance with relevant regulations. The proposal and application of the concept of green design originated from developed countries such as Europe [3]. Combined with the literature summary, this paper tends to focus on the analysis through the concept of green design and foreign excellent cases:(1) summarize the development process and achievements of domestic and foreign children's activity centers, (2) analyze the cases and problems of excellent children's activity centers at home and abroad. As an important reference for the design of domestic green design and sustainable development of children's activity center.

## 2 INTELLIGENT ANALYSIS OF COMFORTABLE ENVIRONMENTS IN CHILDREN'S ACTIVITY CENTER

Comfort is defined as the response to the environment under the strong influence of cognitive and behavioral processes controlled by human habits and feelings[9].A good children's activity center environment is designed to meet the needs of children by combining multiple important environments such as sports, leisure, counseling and assistance [7].Through the research on children's activities and the surrounding environment in 2019,it can be found that children need a comfortable and healthy environment; perfect design and reasonable space to cultivate and meet their after-school activities and learning needs, so as to improve children's moral, intellectual, physical, and aesthetic work. all-round development. It can be seen from the detailed rules in the" Code for the Design of Buildings for Children's Activities such as Nurseries and Kindergartens" that further emphasizes the comfort parameters and size requirements of children's facilities, which can meet the different needs of children of different ages, and can guide children to social, social, Emotional and psychological healthy development, which is also the focus of this study[4].Combined with the different evaluation systems of different countries, the evaluation indexes and weight proportion of each country are summarized (Table 1).

Table 1. Index and weights of national evaluation systems

| Evaluation system | Evaluation indicators and weights |
|---|---|
| America BREEAM | manage12; Healthy15; the sources of energy19; traffic8; water resource 6; material12.5; rejected material7.5; use of land 10; pollute10; innovate10 |
| Canada GBTOOL | consumption20; Environmental burden25; environment quality20; economic evaluation10; manage10 |
| Germany DGNB | environment quality22.6; Economic quality22.4; socioculture22.6; Technical quality22.5; process10 |
| China GTB | optimal land utilization15; energy conservation25; water saving15; Saving materials15; Indoor environmental quality20, service10 |

Through the comfort parameters in the design specification, an appropriate space is designed for children to feel comfortable while learning and playing. To determine whether the space meets the comfort requirements is mainly through the analysis of parameters in four aspects: air comfort, space comfort, light comfort and the aesthetic comfort of the building's indoor environment [4-7].

### 2.1 Air Comfort

Because the main users of the children's activity center are children, the indoor and outdoor air quality is very important. Children need playgrounds with good air quality to accompany their growth and healthy development. Therefore, in the new design, we should pay attention to the reasonable design of the fresh air system and the humidity adjustment system, which can effectively improve the air quality, reduce the indoor dust content, and create a healthy and comfortable physical environment for children [4].

Material selection is also particularly important. It is necessary to consider whether it is an environmentally friendly material that conforms to green environmental protection and national safety standards, which is related to the physical and mental health of children. The actual test found that some left-behind children's activity centers had the problem that the harmful substances in the materials exceeded the standard, which caused great harm to the left-behind children. In order to cater to children's preference for color, some children's activity centers use a large number of children's favorite colored paints and artificial boards. Fan Yue found through the field gas test that the TVOC concentration in the material reached 0.35mg/$m^3$. The experiment showed that TVOC concentration <0.2mg/$m^3$ has no effect on the human body, and when the concentration is 0.2~0.3mg/$m^3$, it will cause. The human body will feel uncomfortable. When the concentration is 3.0~25mg/$m^3$, it will cause other adverse reactions such as headache, and the concentration>25mg/$m^3$ will cause obvious toxicity to the human body. Especially in the humid and hot summer, the toxic gas is very volatile. In contrast, more emphasis can be placed on the use of various types of natural and man-made environmentally friendly materials, which can further mask the indifference of modern design while being environmentally friendly.

### 2.2 Space Comfort

According to different design regulations in different countries, the specifications for the space are different. As far as China is concerned, after summarizing and analyzing multiple cases, the children's activity center is divided into three parts: children's activity and leisure area, learning and counseling area and staff area based on the size of the building area, the age of children and the number of people [3].

### 2.3 Light comfort

Comfortable lighting is usually designed by combining artificial lighting and natural lighting. For children's activity centers, there are clear regulations on the position of windows, window opening area, lighting time, and the use of glass materials, so as to better Create a better light and comfortable space for children. In order to reflect the concept of green design and sustainable development, large-area skylights, energy-saving glass and other forms and new

materials can be used, natural light can be better used, and further energy saving and environmental protection can be achieved [6].

In the process of color design of children's activity center, children's favorite colors are selected according to their psychological characteristics. For younger children, their spatial cognition can be improved through simple and easy-to-understand color splicing, thereby enhancing their awareness of functional areas. Resolution [7].

### 2.4 Aesthetic Comfort of Building Indoor Environment

The visual appearance of indoor facilities can also be an auxiliary tool for children's physical and mental development. Therefore, the color combination and facilities in the entire children's activity center must be aesthetically pleasing and visually pleasing, so as to better attract children's attention. For example, the use of design elements in the entire space, the selection of materials, the design of shapes and reasonable dimensions all play a key role. By means of design, these reasonable arrangements can bring children a better sensory experience in terms of vision, touch, hearing and interaction.

## 3 GREEN DESIGN BACKGROUND AND EVALUATION METHOD

Green development is what we continue to pay attention to now, and it can also be called the concept of "sustainable development". The first time this concept is connected with the environment is the publication of the "International Union for Conservation of Nature" in the "World Conservation Program" in 1980.proposed in. And its real wide-ranging impact is known from the 1987 United Nations World Commission on Environment and Development report-Brundtland report, that is, "Our Common Future".

The pace of green design in my country was relatively slow in the last century, but with the continuous development of our country, we have paid more and more attention to the importance of green design to interior space design, and the country has also promulgated a series of green and construction guidelines. For example, in December 2001,the General Administration of Quality Supervision and Quarantine, the Ministry of Health and the State Environmental Protection Administration formulated the "Indoor Air Quality Standard" (GB/T18883-2001),the "Civil Building Indoor Environmental Pollution Control Specification" implemented by the Ministry of Construction in 2002, and 2002 In 2010,10 national mandatory standards such as "Limits of Hazardous Substances in Interior Decoration Materials" and "Limits of Radionuclides in Building Materials" promulgated by the General Administration of Quality Supervision and Quarantine of the People's Republic of China together constitute a relatively complete indoor environmental pollution control system.

### 3.1 SPSS Data File Analysis

The collected data is analyzed by SPSS (Statistical Product and Service Solutions). Chi-square test is a nonparametric test used to determine whether there is a relationship between two classified variables. Chi-square test (cross analysis) and statistical data frequency method was

used to investigate the better use of green design in the design of children's activity center, and whether the differences are significant or not can be inferred from the obtained results, ultimately obtaining the data and information needed for the study. Open the SPSS data file in the data editor, and then select items from the menu to manipulate the data or make statistical analysis.

The specific method is shown in Figure 1. By importing data, screening samples, and analyzing whether there is significance between column(X)and row(Y)(P value is less than 0.05 or 0.01),if there is significance, select the percentage (the value in brackets)and describe the specific differences.

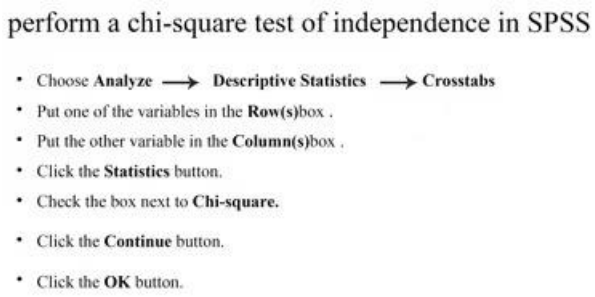


**Figure 1.** SPSS Data File Analysis Process

The final questionnaire was sent out 280 times and 200 valid questionnaires were returned, with an efficiency rate of 71.42%. The questionnaires were used to summarise the indicators under the index and to rank the percentages and grades shown in Table 2 below.

Table 2. Summary of Questionnaire Data

| Age Stage | Number | Proportion | M/F |
|---|---|---|---|
| Primary Schools | 70 | 0.35 | 49/21 |
| Kindergarten | 50 | 0.25 | 33/17 |
| Junior High School | 40 | 0.20 | 16/24 |
| High School | 40 | 0.20 | 20/20 |

The data summary from the questionnaire shows that the data population in this questionnaire is dominated by primary school students, and according to their needs combined with the design specifications, using cross-tabulation analysis, each chapter over there is imported into the arithmetic program, the factors will be detailed data analysis.

### 3.2 Evaluation Eethod of Green Degree

The green degree evaluation method is a method of green design evaluation. It is a systematic analysis method that reflects and expresses people's subjective judgments in the form of quantitative indicators through the comprehensive application of quantitative analysis methods and qualitative analysis methods. And based on the analytic hierarchy process, combined with the questionnaire survey to sort out the data, make statistics through weighted average and regression analysis.

### 3.2.1 Evaluation Index System

The evaluation index system is an organic whole composed of multiple indexes which represent the characteristics of the evaluation objects and are interrelated. Based on the Code for Design of Children's Activity Buildings such as nurseries and Kindergartens, this paper establishes a perfect index system through comprehensive analysis of technical indicators, economic indicators and ecological indicators of space, and uses scientific evaluation methods to evaluate the green degree of children's activity centers. The index system includes stereotypical indicators and quantitative indicators, which can be summarized into a more suitable evaluation system for the design of children's activity center. The evaluation index system of children's activity center is shown in Table 3 below.

Table 3. Green Design Index System of Children's Activity Center

| Primary index | Secondary Index | tertiary index | 4th grade index |
|---|---|---|---|
| Green Design System of Children's Activity Center | Material | National Standard for Green Materials | Anti-insect, anti-mildew, non-toxic, harmless, flame retardant, no harm to human body |
| | illumination | Natural light, artificial light, mixed light | Light direction, intensity, color, primary and secondary light sources |
| | decorate | color, furniture, furnishings, greenery | Psychological feelings of color, selection of furniture, arrangement of furnishings, greening embellishment |
| | energy | Wind, Hydro, Solar | Heating, use of electrical appliances, lighting, hot water supply |

### 3.2.2 Importance Index Setting

First, using the analytic hierarchy process, firstly divide the whole problem into detail according to the index system, and give the corresponding weight according to the national standard, determine the importance of each factor through the comparison between the factors, and obtain different weights through calculation.

Secondly, the 200 questionnaires were collated and the invalid data such as consistent ratings or insufficient data were excluded. yahp software was applied to test the consistency of the judgment matrix of all questionnaires and the overall evaluation weight of the children's activity centre design was obtained through group decision analysis (Table 4).

Table 4. Evaluation Indicator Data Analysis Table

| Metric Layer | Single Layer Weight | rank | Total Weight | Total Sort |
|---|---|---|---|---|
| Anti-insec | 0.0865 | 5 | 0.0640 | 6 |
| non-toxic | 0.1063 | 4 | 0.0348 | 12 |
| Harmless | 0.3584 | 1 | 0.1474 | 1 |

| | | | | |
|---|---|---|---|---|
| flame retardant | 0.3365 | 1 | 0.0879 | 2 |
| Light direction | 0.1083 | 4 | 0.0445 | 9 |
| primary and secondary light sources | 0.0865 | 5 | 0.0356 | 11 |
| Psychological feelings of color | 0.2572 | 2 | 0.0843 | 4 |
| selection of furniture | 0.2636 | 1 | 0.0864 | 3 |
| arrangement of furnishings | 0.1775 | 3 | 0.0582 | 8 |
| greening embellishmen | 0.0736 | 6 | 0.0303 | 13 |
| Heating | 0.1693 | 2 | 0.0696 | 5 |
| use of electrical appliances | 0.2350 | 2 | 0.0614 | 7 |
| hot water supply | 0.1677 | 3 | 0.0438 | 10 |

### 3.2.3 Comprehensive Evaluation of the Greenness of the Children's Activity Center

The comprehensive evaluation of the greenness of the children's activity center only needs to add the index value and weight of each index. According to the corresponding scale value of the index in the green design index system and any index in the green design index, Yij ( i,j= 1, 2, 3... n),by obtaining different index values and weights in the three-level index, Yi (i= 1, 2, 3... n) is obtained, that is (1) (Wij is Yij the weight balue, Yi is the evaluation score). Calculate the green comprehensive evaluation value of the children's activity center through (2). The higher the proportion of each indicator data is aggregated into Table 5, the more important it is in the design.

$$Y_{\mathrm{i}} = \sum_{\mathrm{j}=1}^{n} W_{i\mathrm{j}} Y_{i\mathrm{j}} \tag{1}$$

$$\Omega = \sum_{\mathrm{i}=1}^{n} W_i Y_i \tag{2}$$

Table 5. Hierarchical analysis of the data system

| **Target** | **Intelligentization** | **Rank** | **Green development** | **Rank** | **Comprehensive** | **Rank** |
|---|---|---|---|---|---|---|
| Anti-insec(i/j1) | 60.43% | 2 | 67.35% | 2 | 59.57% | 3 |
| non-toxic(i/j2) | 52.67% | 3 | 48.26% | 4 | 61.12% | 3 |
| Harmless(i/j3) | 69.17% | 2 | 75.88% | 1 | 76.54% | 1 |
| flame retardant(i/j4) | 57.94% | 3 | 91.39% | 1 | 68.63% | 2 |
| Light direction(i/5) | 61.7% | 3 | 56.9% | 3 | 58.97% | 3 |
| primary and secondary light sources(i/j6) | 62.67% | 3 | 48.26% | 4 | 61.12% | 3 |

| | | | | | | |
|---|---|---|---|---|---|---|
| Psychological feelings of color(i/j7) | 59.40% | 4 | 45.55% | 4 | 55.81% | 3 |
| selection of furniture(i/j8) | 60.42% | 3 | 90.9% | 1 | 66.54% | 2 |
| arrangement of furnishings(i/j9) | 51.02% | 4 | 56.23% | 3 | 55.90% | 3 |
| ,greening embellishmen (i/j10) | 40.88% | 4 | 19.41% | 4 | 39.14% | 4 |
| Heating(i11) | 52.69% | 4 | 89.8% | 1 | 65.87% | 2 |
| use of electrical appliances(i/j12) | 66.33% | 1 | 91.34% | 1 | 75.87% | 1 |
| hot water supply(i/j13) | 55.16% | 3 | 67.34% | 3 | 61.52% | 3 |

With the above summary of the questionnaire data, cross-tabulations, weighted averages and other comprehensive data analysis, it was concluded that the different levels of green design affecting the comfort of children's activity center are due to the different needs of different regions and people, and because the construction standards and use of children's activity centres vary slightly due to different time periods of construction.

## 4 IN CONCLUSION

Through research and analysis, four important comfort factors affect the design of children's activity center, namely air comfort, space comfort, light comfort and aesthetic comfort of the building's indoor environment. Although the sample size of this thesis could be improved, it does provide some reference for the use of green design in the comfort environment of children's activity center. For example, based on a comprehensive analysis of the four aspects of air comfort, space comfort, light comfort and aesthetic comfort of the building indoor environment, through intelligent data aggregation and analysis, design solutions with a different focus for different regions and different people with different needs and make it a sustainable multifunctional space [8].

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