Analysis of Paper Children's Furniture Design Based on 4R Principle

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Abstract. At present, green environmental protection has become a common topic of concern all over the world, and the principle of "low carbonization" is also the focus of designers in the design of paper children's furniture in the future. How to implement the 4R principle into children's furniture has become the most important issue for designers at present. This paper summarizes the design principles of children's furniture, puts forward the design scheme of children's furniture based on 4R principle, and forecasts the future children's furniture market.

1. Introduction
According to the national birth population statistics, in recent years, the population has increased by about 150,000 newborns every year, and the second child policy has been opened. Therefore, the market demand for children's furniture is huge, and many furniture manufacturers have set their sights on the children's market. Now, with the improvement of people's quality of life and the enhancement of parenting concept, the requirements for children's furniture are getting higher and higher, and they will be screened layer by layer from appearance to practicality to material selection. At present, most of the children's furniture materials in the market are plastic, solid wood, fabric and other traditional materials. These materials can hardly be recycled, which is not conducive to the sustainable development of the environment, and the components of some materials may be harmful to children's health. Therefore, children's furniture manufacturers are constantly exploring new environmental protection materials and increasing environmental protection performance on the principle of cost saving.

On the environmental protection of children's furniture, the 4R principle is generally observed. The 4R principle refers to Reduce, Reuse, Recycle and Replace. In addition to children's furniture, the 4R principle can also be extended to people's daily furniture, which will also be a popular trend. By analyzing the characteristics of children's furniture, this paper extends to making children's furniture with a low-carbon and environmentally friendly paper material, which provides a new development direction and commercial value for children's furniture merchants.

2. Design principles of children's furniture

2.1. Security
Small-month-old children are generally naughty and active, like to chew furniture, and are curious and have no sense of safety. In view of such characteristics, the design of children's furniture must pay attention to avoid collision or cut children. When choosing paper, you can choose softer and easier to
bend. In furniture modeling, the corners of children's furniture should be designed to be arc-shaped to avoid children's injuries during playing, and protective covers should be equipped where corners cannot be rounded. Secondly, the furniture should not be too thin, so as not to cut the children. After the furniture design is completed, it must pass the national inspection, and the safety can meet the standard before it can be produced.

2.2. Environmental protection
Children are in contact with furniture almost two-thirds of the time every day, so the environmental protection of furniture is very important. Children's immunity is relatively low, and their ability to resist toxic gases is not enough. Decoration pollution such as formaldehyde generally floats below one meter, which is the position where children's height contacts, so parents now pay great attention to furniture materials. Although paper materials are environmentally friendly, unlike wood and metal, which need volatilization, paper also has advantages and disadvantages, so try to choose paper with better materials. Especially, babies in the craving period like to chew furniture. If the paper is not good, it will be swallowed directly into their mouths, which is very dangerous. Moreover, the long-term use of the peculiar smell produced by inferior paper will affect children's growth and development.

2.3. Interest
Children's furniture is not only a commodity, but also a toy for children. Children will be curious about it when using it, so they can play with it. Paper materials are changeable and random, so the novelty of paper furniture will attract children and make them shine at the moment. Children's furniture is mostly made of bright colors, which arouse children's interest visually, make children like furniture and enhance interactivity.

2.4. Openness
From one to three years old, when children's brain nerve develops fastest, it is also slowly forming, and external stimulation will affect brain development. Therefore, the paper furniture can be more exaggerated and changeable in design, which can stimulate children's imagination and interest in learning.

2.5. Economy
Generally, children's furniture has a short service life. First, because children are destructive, they will break or smash furniture. Second, children grow fast. Generally, a piece of furniture may be too small to be used after one to three years. The cost of paper materials is relatively low, so the price of furniture is not high, which also reduces the financial burden of parents.

3. Design scheme of children's furniture based on 4R principle
From the perspective of the development of children's furniture industry at home and abroad, there is still a big difference between them. At first, the domestic market didn't pay attention to the production chain of children's furniture, but it was mainly used for reference at the early stage of design. The products lacked sense of design and innovation, and were not suitable for the size of Chinese children. However, with the improvement of people's material level, children are paid more and more attention in the family. At present, children's furniture accounts for as much as one tenth of the total furniture, and children's furniture has gradually formed a mature industrial chain. A large number of professional children's furniture designers have emerged. Paper children's furniture products based on 4R principle also occupy a place in the international market.

3.1. Green design concept
Green environmental protection must be the aim of furniture design. The paper of paper furniture is made of trees. If large quantities of paper are used, it will lead to excessive deforestation, which also goes against the original intention of green. The true green concept refers to turning raw materials into
recyclable paper, including books in life and some express cartons, and designing them for reuse, so as to be truly green.

Nowadays, many foreign design companies introduce trade-in business, that is, when old furniture reaches a certain age and cannot be used, it can be exchanged for a new furniture at a reasonable depreciation price. This marketing method not only follows the 4R principle, but also makes the replacer and the merchant achieve a win-win situation. Replacers can buy new products at low prices, and merchants can collect cheap raw materials to re-produce new furniture and sell it to replacements. This cycle mode is a full verification of the green design concept.

From the designer's point of view, this cycle mode is a new attempt, not only to design beautiful and practical new furniture, but also to consider the characteristics of the original furniture and how to form new furniture by cutting and splicing. As shown in Figures 1 and 2, at first glance, there is no connection between the two furniture, but the designer can change 2 to 3. From the design point of view, first of all, they are unified materials, and secondly, they only need to split the original structure and then do the upper arc. Although this model is still in the exploratory stage, it still attracts many young designers to join in it.

![Figure 1. Before transformation](image1)

![Figure 2. After transformation.](image2)

3.2. Reasonably choose materials and use materials

3.2.1. Choose materials. The aesthetics and practicability of every kind of children's furniture are analyzed, and the most suitable materials are found, so as to avoid waste and protect the environment. For example, cribs, most of which are made of solid wood, generally have a service life of about one year, and even many children don't sleep at all, and finally they are used to put aside sundries. But basically, every family will also prepare a crib for newborn babies. The general price is between 1000 and 2000. From buying to idle, it is a waste of materials and money. The appearance of paper cribs just solves this problem. Paper cribs (as shown in Figure 3) generally use corrugated paper as raw materials, which are favorable in price, environmentally friendly in materials, convenient for assembly and disassembly, and suitable for short-time use. Even if paper materials are discarded, they can be recycled.
3.2.2. *Use materials*. Paper materials are basically divided into the following three types: corrugated paperboard, industrial paperboard and honeycomb paperboard. Designers should first choose according to the characteristics of each material, including thickness, hardness and bearing capacity. Seven-layer cardboard is generally selected for the supporting place, and three-layer cardboard is generally used for the decoration place. In the production, the size should be measured to avoid waste of surplus materials as much as possible.

3.3. *Reasonable structural design*

The structure of children's furniture mainly refers to the frame, where it can be supported or connected. Reasonable structural design can save resources, reduce the waste of raw materials and realize the reuse of materials. The structural forms of paper furniture are basically plug-in and folding. Because formaldehyde harmful to human body exists in the adhesive, children's paper furniture is adhered with glue as little as possible, but is connected by card slot or stretched and folded by organ. As shown in fig. 4, this kind of furniture can be split into each unit block or stacked into one piece, which saves space and is convenient to carry when not in use. Paper furniture is their best choice for people who often move. With the gradual maturity of the furniture market, it is necessary to establish a standardized industrial standard, and the size of each unit needs to be accurately measured by the designer. The standard of the connecting parts of the card slot must be standardized and accurate, so as to realize batch production, reduce the production and labor costs, and reduce the environmental pollution and labor waste caused by production.

3.4. *Accurate design positioning*

Most children are very sensitive to the colors in the environment, so children's furniture needs not only a stable structure but also color design. Rich colors are the popular trend in children's furniture market,
especially in modern cities, where reinforced concrete is everywhere. These super high-rise buildings are far from the castles and forests that children dream of, so designers need to consider the color matching while designing paper furniture, so that children can find their innocence, make these furniture become a bridge between children and nature, and avoid "faults". In the pursuit of bright colors, we also need to consider catering to the decoration style of the whole house. Now, with the improvement of people's living standards, children have their own children's rooms. First of all, we should pay attention to the relatively independent soft outfits in the rooms, and secondly, we should consider the integrity of children's rooms and other spatial styles. Only when the styles are coordinated can children find a sense of belonging and have a strong interest in furniture. These paper furniture don't need precious wood, the paper raw materials are cheap, and they don't need to be bleached and polished like wood, so they are very convenient to use. Moreover, paper materials are very friendly, children will turn furniture into toys, and the interest and interactivity of design will be increased.

4. Development prospect of paper children's furniture

Therefore, children and adults cannot design furniture according to their taste. In the future, the paper pet furniture should continue to implement the environmental protection concept of 4R, and the following problems should be paid attention to during the development:

4.1. Develop more varieties of paper materials

Corrugated paper and honeycomb paper are commonly used in children's furniture design. These two materials are cheap, environmentally friendly and low in production cost, so they are easily accepted by the market. In the future, designers need to look for more paper materials, study more paper processes and shape more furniture shapes. Other consumers reported that excessive use of adhesives in children's furniture affected children's health and polluted the environment. This requires us to develop an environment-friendly glue that can replace adhesive, or use the slot structure as much as possible in furniture structure.

4.2. Develop more paper furniture for children

Due to the limitation of paper materials, furniture modeling is more complicated in design. Therefore, designers can refer to the design idea of "modular furniture" for adult furniture, and turn the original furniture into this group, so that putting it into children's room is both interesting and integral. The flexibility of children's furniture modeling is also very high, and the variability of modeling is stronger. These requirements for the future development of children's furniture need further research and extension by children's furniture designers.

5. Conclusions

In recent years, children's furniture market has developed rapidly and has gradually become an important branch of furniture industry. According to the research results of children's furniture market, children's furniture has great prospects. However, children's furniture developed late in China, and the market is still in the exploratory stage, which requires designers to design according to China's national conditions and living habits, combined with market demand and 4R principle. This is of great significance to the development and innovation of children's furniture market in the future.

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