

Exploration of Tactile-Oriented Toy Design for Visually Impaired Children

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Abstract: With rapid technological progress, the field of children's design has become increasingly significant, accumulating decades of research on child development and continually evolving within this emerging area. Despite the diversity and ongoing development of children's toys, most existing designs primarily cater to non-disabled children, often overlooking the specific needs of visually impaired children. This study adopts a tactile-oriented approach, focusing on the perceptual characteristics and emotional needs of visually impaired children, aiming to enhance the tactile sensory experience of toys. By prioritizing tactility, the toys are imbued with emotional and educational qualities, assisting visually impaired children in enjoying a confident and joyful childhood.

Keywords: Visually impaired children, Tactile perception, Toy design, Inclusive design, Cognitive games

1. Introduction

Toys play a crucial role in children's development, enhancing thinking skills and creativity during their early years. However, most toy designs are based on the needs of healthy children and do not consider the special requirements of disabled children, rendering these products impractical for visually impaired children who rely on visual aids [1]. Due to mobility issues and other limitations, visually impaired children have restricted access to information, making toys a vital cognitive tool. Children use toys to acquire knowledge, develop skills, and foster personal growth. Therefore, designers must consider how to allow visually impaired children to enjoy toys as non-disabled children do, transforming toys into games that bring joy [2]. Through thoughtful toy design, the aim is to enhance tactile perception and cognitive abilities among visually impaired children, ensuring that the toys are not only safe and fun but also positively impact their overall development.

2. Basic Characteristics of Visually Impaired Children

2.1. Physiological Characteristics

Visual impairment is defined as the complete or partial loss of vision, either congenital or acquired, classified into low vision and total blindness [3]. Both conditions significantly impact the daily lives and learning environments of children. In cases of total blindness, children primarily rely on hearing

and touch to perceive their surroundings. While children with low vision can perceive large shapes and colors, they struggle to see details clearly. For these children, special visual aids or specific color combinations are needed to enhance the efficiency of their remaining vision. Therefore, when designing toys for visually impaired children, it is essential to consider tactile and auditory characteristics, using materials of different textures to enhance tactile experiences. Vivid colors and sound effects elements should also be incorporated to ensure that visually impaired children can enjoy the game even without visual cues.

2.2. Psychological Characteristics

Due to the lack of visual information, visually impaired children exhibit certain differences in psychological development compared to children with normal vision. They may experience social isolation during interactions, spending most of their time playing alone and in silence [4]. This affects their emotional management, social skills, and perception and response to the external environment. Some visually impaired children may display passive and dependent psychological states, forming stronger dependencies in interpersonal relationships and preferring to establish closer connections through language and tactile contact. However, in mainstream environments, visually impaired children are often perceived as less socially adept than their normally developing peers [5]. When playing with sighted children, they may feel insecure and lack confidence, leading to negative effects on their physical and mental well-being. Therefore, understanding and addressing the unique psychological characteristics of visually impaired children are crucial for developing personalized education and support measures to promote their comprehensive and healthy development.

2.3. Perceptual Characteristics

Touch, as a non-visual perceptual pathway, offers visually impaired children an alternative way to perceive the world. Due to the lack of visual information, visually impaired children rely more on touch to gather information from their environment, with touch and hearing jointly dominating their cognitive systems. Compared to vision, touch cannot form clear concepts of color, brightness, or three-dimensional space, but it can identify textures, shapes, and sizes through tactile sensations. Research from the Institute of Psychology, Chinese Academy of Sciences, demonstrates that blind children have a high accuracy rate of 82.6% in identifying object sizes through touch, compared to only 52.4% for sighted children. The average two-point threshold for blind individuals' fingers is 1.02 mm, with the lowest reaching 0.7 mm, while for sighted individuals, it averages 1.97 mm. Visually impaired children form their cognition of the environment through the combination of touch and hearing.

3. Issues with Designing for Visually Impaired Children

3.1. Limitations in Educational Functionality

Currently, toys designed for visually impaired children on the market generally lack comprehensive educational design, mostly limited to providing sensory stimulation such as various tactile experiences and sounds, without incorporating effective educational content to promote cognitive development or learning skills. Such toys do not fully utilize multisensory integration strategies to support the holistic development of visually impaired children, resulting in their educational potential being underutilized. Therefore, in the development of new toys, greater emphasis should be placed on integrating educational elements to promote the cognitive and social skills development of visually impaired children [6].

3.2. Incomplete Design Considerations

The design of toys in the market primarily targets children with vision, relying excessively on vision and hearing, which renders the output of the design almost worthless for visually impaired children and may even hinder their sensory development. Successful toy designs should include rich tactile feedback and audio cues to promote the sensory and cognitive development of visually impaired children. For example, Figure 1: Dimpl Duo toy incorporates different textured sections to help children identify through touch and embeds music and speech functions to facilitate learning through auditory assistance. When designing toys, more attention should be paid to detail to create more stimulating sensory experiences for children [7]. By implementing these comprehensive design strategies, the functionality and safety of toys can be significantly enhanced, better meeting the special needs of visually impaired children, and ensuring that they obtain corresponding educational value and sensory training during play.



Figure 1: Dimpl Duo Toy

4. Key Points in Designing Toys for Visually Impaired Children

4.1. Emotional Needs

Due to the lack of visual input, visually impaired children are more eager to establish emotional connections and cognitive environments through other senses. Therefore, toy designs should include elements that can evoke positive emotional responses. For example, the tactile texture of toys should be soft and comfortable to convey warmth and a sense of security. Through play, visually impaired children can feel the respect and care of others. Encouraging parent-child interaction, parents can talk to their children through games, better understand them, and express their feelings and thoughts, promoting connections among family members [8]. Additionally, through enjoyable learning experiences, visually impaired children can stimulate their minds, develop their potential, learn relevant life skills or social knowledge, and cultivate their independence, supporting their holistic development.

4.2. Functional Needs

Parents generally value the variety and educational functions of children's toys. For example, through different tactile structures, toys can help children understand spatial relationships and object characteristics. Toys should also help cultivate children's basic skills, such as stimulating children's sorting and classification abilities through various textured buttons or building blocks, and enhancing children's memory and motor coordination abilities through sound effects combined with actions. For visually impaired children, toys can also help them explore the world independently, improve their self-care abilities and problem-solving skills. By providing entertainment while promoting educational growth, toys serve as powerful tools, integrating play activities with life learning [9].

4.3. Tactile Communication Design

In designing toys for visually impaired children, a variety of textures and materials should be used to stimulate their tactile exploration and sensory learning enthusiasm. Familiar tactile materials in children's daily lives, such as wood, plush fabric, plastic, silk, etc., should be selected to facilitate natural adaptation and acceptance. Based on Figure 2: Toy Design Elements and Standards, a deep understanding of children's tactile responses, interactive experiences, and product perception should be ensured to make tactile elements identifiable and easy to operate. The design process should fully consider children's grasping characteristics, enabling them to easily pick up or place toys [10]. For example, the design of the LeapFrog Learning Lights Letterbug multifunctional musical bug incorporates different colors and textures in each section to meet children's needs.

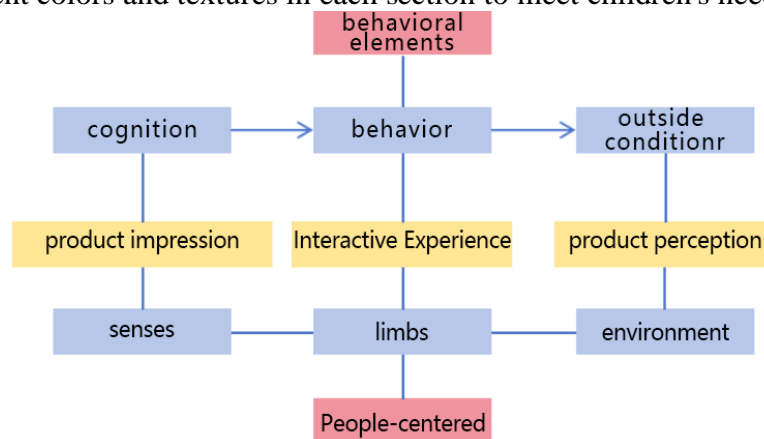


Figure 2: Toy Design Elements and Standards

5. Sample Group

In the design of toys for visually impaired children, participants and responders typically involve the interaction between toys and children. Participants mainly consist of visually impaired children aged 3-12 years in early development stages. Designers consider factors such as age, cognitive level, and interests, addressing children of different age groups to ensure the attractiveness of toys to children of all ages. Responders are the toys themselves, which perceive children's actions, sounds, touches, etc., and respond accordingly, as well as provide positive feedback during the children's experiential process.

6. Conclusion

This paper comprehensively explores tactile-oriented toy design for visually impaired children, emphasizing the uniqueness of their sensory and educational needs. Addressing the limitations of current toy designs, this paper proposes a comprehensive design approach aimed at promoting the holistic development of visually impaired children by enhancing tactile elements and providing educational value. The paper elucidates that toys are not only tools for entertainment for visually impaired children but also essential bridges for them to understand the world and establish social connections. It calls upon designers to create toys that are both safe and educationally meaningful, allowing visually impaired children to enjoy a joyful and developmental childhood.

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