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Design and Research of Multi-sensory Integrated Picture Books for Visually Impaired Children

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Abstract

Picture books are an important way for visually impaired children to acquire knowledge and understand the world. After field research, we observed and analyzed the current situation of the existing visually impaired picture books, and found that there were problems that ignored the cognitive level and monotonous sensory experience of the visually impaired children, and did not clearly classify the visually impaired groups. In order to break the single form of visually impaired picture books, improve the reading interest of visually impaired children and enrich their reading experience, the definition of multi-sense integrated picture books based on the theory of "five-senses", and puts forward design suggestions for designing multi-sensory integrated picture books for visually impaired children from the five sensory experiences.

Keywords

Visually Impaired Children; Multi-sensory fusion; Picture Book Design.

1. The Shortage of Existing Picture Books for Visually Impaired Children

In recent years, the domestic and foreign research of visually impaired children and the visually impaired picture books has made certain achievements, in the domestic visual impaired picture books also gradually introduced into the blind school classroom, but in Hangzhou library and Zhejiang school for the blind research process, through the interview library and blind school teachers, field research library visual impaired picture books found in the design of the visual impaired picture books still exist many problems, lead to the visually impaired children lack of interest in reading.

1.1. Ignoring the cognitive level of the visually impaired children

According to the research, the existing visually impaired picture books are mainly made of "restructuring" of ordinary children's picture books given by others. The basic method of reform is to translate the text in the picture book into Braille, tie or print it on transparent braille paper, and then paste transparent braille paper with Braille on the original page[1]. Although some of the existing visually impaired picture books are braille translated Chinese characters and illustrations, for children who have not systematically learned to read and understand Braille, these dense blind spots do not make them understand the story content in the book and have no effective practical value.

1.2. A monotonous sensory experience

Compared with ordinary children, visually impaired children are relatively slow, especially it is difficult to present a complete imagination of abstract things in their mind and lack initiative. Therefore, they need to invoke other perceptual systems to perceive the world. However, most of the existing visually impaired picture books are based on touch, and only a small part is supplemented by auditory sensory stimulation to help visually impaired children read, which

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leads to monotonous sensory experience for visually impaired children, lack of cognitive form and lack of interactive sense from picture books.

1.3. No clear classification of the visually impaired groups was made

According to the 《Chinese Practical Assessment Standards for Disabled Persons》, the classification of visual disability is shown in Table 1. According to statistics, total blindness only accounts for 10% of the total, and children with low vision account for a large proportion. In terms of cognition, there is actually a big difference between the two. Children with low vision can make use of residual vision and read picture books with the help of visual AIDS, so children with low vision are more inclined to read picture books with large-character Chinese characters. However, in the investigation, it is found that the existing visually impaired picture books do not clearly divide the visually impaired groups, and there are few large-character picture books made for children with low vision on the market, which cannot meet their reading needs.

Table 1. Classification of visual disability

Visual disability category	Level	Best corrected vision
blind	Level 1 blind	<0.02-no light sensation; or visual field radius <5 degrees
	Level 2 blind	0.02- <0.05; or radius of visual field <10 degrees
low vision	Level 1 low vision	≥0.05-0.1
	Level 2 low vision	≥0.1-＜0.3

In field research provincial library and blind school, in view of the current visually impaired picture books design problems, design more sensory fusion picture books, try to make full use of the visually impaired children five senses, break the monotonous touch reading, innovative multi-sensory reading experience, all mobilize the visual impaired children each senses participate in reading.

2. The Design of Multi-Sensory Integrated Picture Books Under The Concept of "Five Senses"

Multi-sensory integrated picture book refers to the visually impaired picture book based on the concept of "five senses" that can mobilize multiple senses to read together and thus give a variety of sensory experience.

Huang Zhen once explained that the design of "five senses" is a design way to combine the five sensory organs to penetrate, connect and blend the information, and transmit the combined information to the recipient in an orderly way[2]. Japanese book binding art master Yashei Sugiura tried for the first time to apply the five senses to the book design, and formed the concept of "five senses", the core content is that a book needs to have five senses. This theory not only breaks through the visual limitation of the book binding aesthetics, but also injects new ideological sources into the book design, and gives a distinctive texture to the design works[3].

Therefore, multi-sensory integrated picture books adopt this concept to try to break through the phenomenon that touch is basically covered in the design of visually impaired picture books, and to develop the full-sensory reading experience of visually impaired children. In the design

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process of multi-sensory fusion picture books, not only value touch, designers should put the visual impaired children vision, hearing, taste, smell and other perception system into the visual impaired picture books, thus the original single reading form into multidimensional information transmission process, improve the visual impaired picture books readable, interactive and interesting, to improve their cognitive imagination of surrounding things and even the world.

2.1. Visual function

Vision is a positive exploration, which is highly selective, not only for the things that can attract it, but also for any one of the things you see[4]. Although specific and clear pictures and information cannot be obtained, most visually impaired children can use their residual vision to perceive bright and bright colors, and even the shape and outline of objects.

Therefore, in the design process of multi-sensory fusion picture books, color is a necessary part, and the particularity of visual senses, and colorful illustrations should be used to enhance the stimulation of visual senses.

When designing the 《Dream of Blue Starry Night》, Japanese designers specially used the contrast between bright yellow and dark blue to give strong visually impaired children visual experience, as shown in Figure 1. The readers move from bottom to top, and the bright stars in the picture book appear one by one in the dark blue night, creating a concrete situation in which the night falls and the stars shine.

Figure 1. 《Dream of Blue Starry Night》 page

2.2. Tactile action

Due to the physiological characteristics of visually impaired children, they mainly feel the world and the surrounding environment through non-visual perception, among which the most memorable one is tactile perception. This is because the visually impaired population is more sensitive to tactile perception than the ordinary person, a phenomenon that is scientifically known as sensory compensation or compensatory[5]. Based on the more sensitive tactile response than ordinary people, visually impaired children can identify the shape, materials, materials and size of picture books through the tactile "eyes". At the same time, visually impaired children can also learn to obtain cognitive information through touching the drawing book, and exercise their touch and reading ability.

Therefore, in the process of designing multi-sensory integrated picture books, the reading habits of visually impaired children should be taken as the starting point, and the targeted text design and touch texture technology should enhance their sense of interaction and reality with picture books, so as to show a colorful and vivid world for visually impaired children.

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2.2.1. Text design

Ordinary paper Braille is usually formed by pressing out on special thick paper by a braille printer or a manual Braille reader. Although traditional Braille is easy to produce, visually impaired children will read visually impaired picture books repeatedly out of interest. Too many reading times will lead to serious Braille wear and tear, resulting in the problem of unclear reading. Therefore, in the design process of multi-sensory fusion picture books, it is appropriate to use glue point Braille that can adapt to various surface types. In addition, based on the durability of Braille sites, designers can use surface protection technology to use transparent and wear-resistant coating or coating to protect the Braille site that is not easily worn, but under conditions that do not affect Braille.

In addition, whether the contents of picture books conform to the reading habits of visually impaired children and whether they can exercise their reading ability should be taken into consideration. Visually impaired children read and understand the visually impaired picture books from top to bottom, from part to the whole. Therefore, the text of the visually impaired picture book should be arranged at the top of the page. In order to prevent the error of the translation, and to facilitate the reading of children with low vision, on the basis of retaining the original meaning of Chinese characters, the number of words should be concise and the font is large.

2.2.2. Touch texture technology

When the visually impaired children have certain ability to read, they will consciously look for significant features in the graphics, such as corners, bumps, lines, etc., while the preschool visually impaired children without reading experience will only read along the outline[6]. So in the process of design multi-sensory fusion picture books, should be based on the visually impaired children touch reading habits, through embossing, bump, punching, surface craft art, combination of different forms and materials, to show picture touch texture, to make visually impaired children feel or rough, or smooth, or hard, or soft, or cold, or warm a variety of different texture, to enhance the picture books of reality and interactive, close the distance between the two, and exercise its touch reading ability.

In 《A Black Book on Color》 of the use of embo, convex technology, falling feathers, maple leaves, flying in the sky kite, falling rain, rough waves, let the visually impaired children through the touch of the finger in mind construct three-dimensional picture, to "see" the colorful in the book of black, as shown in figure 2. The use of this touch-texture technology can help the visually impaired children to form a rich and diverse sensory stimulus of the overall cognition and perception of things.

Figure 2. 《A Black Book on Color》 Touch the texture

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2.3. Auditory function

Sound is generated by vibration, and the vibration sound waves stimulate the eardrum to respond to the brain[7]. Due to the lack of visual function, visually impaired children are particularly sensitive to the sounds around them, and the body sound perception function is particularly sensitive. Therefore, so they can clearly distinguish very small sounds and timbre, and capture different information.

In multi-sensory integrated picture books, modern science and technology such as point reading pen can be used to interpret the story content of picture books, so as to improve the sensory experience of visually impaired children. Visually impaired children can also feel the "immersive" reading experience through the different sounds produced in the picture books. These sounds mainly use the recorded sound, music and other sound principles and the natural sound (such as insect and bird sound) with noise reduction and audio compression through the acquisition equipment. In addition, according to the more acute auditory and sensory characteristics of visually impaired children, special music theme picture books can be designed to add simple songs or melodies to the key points of the story, and encourage children to sing or imitate to improve the sense of participation and memorize the story plot.

In the picture book 《This Is Not My Hat》, the pictures and the text have a strong contrast with dramatic tension, which is tense and exciting. The designer can insert a more compact sound drum, making the atmosphere more tense. Finally, the sound stops, and the fish is hidden in the blank space of a large, high and dense water plant... under the design of the sound effect, visually impaired children can use it as an important clue to think deeply about the story.

2.4. Olfactory action

Smell is the human senses in early childhood, one month old children will react to the smell of the object; three to four months can smell the smell; seven to eight months smell will become sensitive, will produce emotional to fragrant fragrance[8].

"Olfactory connection memory" refers to the nose can activate the olfactory memory once stored in the brain[9]. In the memory of visually impaired children, the olfactory memory is the longest, even more impressive than the visual memory. Picture books for visually impaired children can make visually impaired children have different sensory cognition and thinking associations through different smells and aroma types, and some fragrances can also affect the emotional cognition of visually impaired children.

In the design process, the sensory stimulation of smell can be realized through the fragrance ink printing technology.《Come, Smell Nature》 shows a variety of typical flavors in a series, such as sweet strawberry, pungent onion, and fragrant mint, as shown in Figure 3. When children look through the picture books and touch the illustrations, they will release the corresponding aroma. Under the dual sensory experience of touch and smell, the visually impaired children will form a more correct and three-dimensional cognition of the content of picture books. Finally, the flavor ink printing technology can achieve a long flavor retention time and a high durability.

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Figure 3. Sour book 《Come, Smell Nature》

2.5. Taste action

Taste refers to the stimulation of food to the chemoceptive system of taste organs in the human mouth. In sensory psychology research, the senses between the interaction, originally is a channel stimulation can cause the feeling of the channel, now is the stimulation at the same time caused the phenomenon of another channel feeling, this phenomenon is through to one or more sensory stimulation trigger another sense, namely "couplet" phenomenon.

In multi-sensory fusion picture books, the effect of taste is closely related to the function of smell and touch. It is not directly integrated into the design of picture books, but indirectly gives the taste experience of visually impaired children through the phenomenon of "synesthesia". Taste plays an indirect and auxiliary cognitive role in visually impaired children when reading picture books.

For example, designers can use materials similar to bark to design and touch the texture of tangerine peel, and then print it through fragrance ink to give it a mellow fragrance. While touching the rough and hard texture, the visually impaired children can smell the rich flavors such as orange, mint and jujube fragrance, thus indirectly harvesting the fragrant and slightly bitter taste senses. The addition of the appropriate "synesthesia" phenomenon can also increase memory points, enriching and compensating for the last component of the "five senses" design.

3. Suggestions for the Designers of Picture Books for Children with Visual Disabilities

The designers of visually impaired picture books should design visually impaired picture books according to the cognitive characteristics and perceptual characteristics of visually impaired children, break the single form of picture books for visually impaired children, and realize the diversified integration of senses, so as to enrich the reading experience of visually impaired children and enhance the reading value of visually impaired picture books.

First of all, considering the safety problems and grasping ability of visually impaired children, the picture book of visually impaired should use rounded corners design or soft materials such as cloth and natural fiber, so as to prevent sharp edges or small parts from scraping the skin of visually impaired children. In addition, highly durable materials are selected to extend the service life of picture books, so as to prevent the operation mechanism, three-dimensional

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pictures and audio buttons in the books from being damaged or even scrapped under children's frequent hands-on reading.

Secondly, because the visually impaired children have not systematically carried out Braille learning, the tactile training, and the touch ability is also in the primary stage. Therefore, designers should use the form of more pictures and fewer words in the design of picture books, that is, mainly to touch graphics, and braille to assist Chinese characters for annotation. In order to make the features of things more obvious, the lines of touch figures should also be as simplified and clear as possible. At the same time, the touch graphics can also be hollowed out to integrate three-dimensional design elements, so that the visually impaired children can have a richer tactile feeling. Visually impaired children can accumulate some experience of reading by reading tactile figures, which lays a foundation for learning Braille reading. However, attention should also be paid to the appropriate use, which should be based on whether it can accurately convey the essential characteristics of specific objects. If excessive use, it will not only confuse the cognitive accuracy of visually impaired children and increase the cognitive burden, but also distract children's attention and make picture books lose the core value of telling stories.

Finally, the designers should follow the current trend of modern science and technology, and effectively introduce advanced science and technology in the design of the visually impaired picture books, so as to assist the visually impaired children in reading the picture books, and help them to form a complete cognition. For example, the electronic 3D-book bbook made by foreign designers can transform the existing two illustrations into three-dimensional models. The dynamic Braille "page" on the right can rise and drop the Braille points as the text changes. In addition, it contains audio components that can be read aloud and tactile buttons that allow visually impaired children to jump forward or backward as needed, as shown in Figure 4.

Figure 4. Electronic 3D-book bbook

With the help of visual products produced by modern science and technology, children with low vision can better develop and utilize residual vision by reading picture books. While exercising the sensitivity and flexibility of visual functions, they can learn ordinary Chinese characters, so as to improve their intelligence and cognition.

4. Conclusion

Multisensory integrated picture books break the single touch reading form of visually impaired children, try to integrate new science and technology by scientifically mobilizing the five senses of visually impaired children, so that visually impaired children can realize from passive acceptance to active acceptance, and improve their creative imagination and thinking in diversified sensory experience.

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