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The Role of Functional Integration in Children's Toy Design: Impact on Learning and Play Experiences

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Abstract:

In modern society, with the rapid advancement of science and technology, the continuous updating of educational concepts, and the growing demand of families for the all-round development of their children, the children's toy market is undergoing unprecedented changes and prosperity. This article takes an in-depth look at this trend, aiming to comprehensively analyze the current diversified status of the children's toy category. The findings indicate that educational toys integrating education and entertainment, such as programming robots and STEM-based science experiment sets, as well as futuristic technological interactive toys like smart voice assistants and VR experience devices, each uniquely contribute to children's cognitive development, emotional maturity, and social skills. At the same time, this article also focuses on analyzing the potential value of integrating different toy elements. By combining enlightenment education with technological interaction, toys can not only stimulate children's interest in learning but also cultivate their innovative thinking and practical ability; and the integration of physical training and emotional communication toys can help children improve their physical fitness, build self-confidence and learn to express emotions while enjoying the fun of games. To better guide the development direction of the toy industry, this article proposes a proposal to reclassify and integrate children's toys. In-depth analysis and precise market positioning are anticipated to expand the development potential and growth prospects of the children's toy market.

Keywords: Children's toys; classification; technology interaction; diversification; integration.

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1. Introduction

"Currently, children's toys are becoming more diverse and complex, and parents are paying more attention to their children's growth environment and needs than ever before." [1]. However, children's toys play a vital role in the growth process of children and play a positive guiding role in the enlightenment and development of children's cognition. This study re-sorts and classifies the existing complex and diverse types of toys. So that parents can choose toys suitable for children more accurately according to their own needs. "On the one hand, for children, toys with integrated functions can provide richer experiences and learning opportunities, promoting their cognitive, emotional, social and other developments." [2]. On the other hand, parents can better choose toys suitable for their children and provide strong support for their children's growth. For the toy industry, promoting the integration of toy functions will help improve product competitiveness, better improve existing products, and open up a broader market. It specifically discusses the manifestations of the integrated functions of children's toys, their impact on children's development, and future development trends. The literature analysis method is used to systematically divide and organize existing toy types in order to construct a preliminary toy classification system. By using questionnaire survey and case analysis methods, we deeply analyze the needs of parents of different age groups for children's toys. Toy categories are accurately divided according to demand, and toy categories are continuously improved according to parents' needs, to provide parents with more targeted toy selection references, and also provide strong support for the development of the toy industry.

2. Diversification of Children's Toys

2.1 Diversification of Children's Toys

2.1.1 Diversification of materials and functions

Modern children's toys have achieved great enrichment in materials and functions. In terms of materials, there are many options such as plastic toys, plush toys, cloth toys, wooden toys, metal toys, and paper toys. These toys made of different materials have their own characteristics. For example, plastic toys are brightly colored and easy to clean, plush toys are soft and comfortable and suitable for soothing, and wooden toys pay more attention to environmental protection and sustainability. "In terms of function, toys are subdivided into educational toys, motorized toys, electric toys, electronic toys, and smart toys. Each type of toy can meet the different growth needs and interests of children." [3].

2.1.2 Combination of education and entertainment

Modern children's toys are increasingly focused on combining education with entertainment in design. For example, "educational toys such as puzzles and building blocks can not only train children's logical thinking ability and hand-eye coordination but also stimulate their imagination and creativity." [4]. At the same time, these toys also incorporate basic knowledge such as colors, shapes, and numbers to help children learn while playing. In addition, some scientific experiment toys such as chemistry experiment boxes and microscopes perfectly combine science and entertainment, allowing children to experience the charm of science through hands-on operations.

2.1.3 Environmental protection and sustainability

With the improvement of environmental awareness, green, environmentally friendly, and sustainable toys are becoming more and more popular in the market. These toys pay attention to the environmental friendliness of materials during the design and production process, reducing pollution to the environment. At the same time, some toys also incorporate environmental protection concepts, such as reusable puzzles and plush toys made of recycled materials, to guide children to establish environmental awareness from an early age.

2.1.4 Personalization

The rise of personalized customized toys has brought new vitality to the market."Consumers can customize unique toys based on their needs and preferences."[5]. The charm of this free and creative combination is deeply loved by children and also meets their psychological needs for individuality. Personalized customized toys not only enrich the market product line but also promote the expansion of the entire market toward a broader consumer base.

2.2 Types of Children's Toys

"Educational toys play a vital role in children's growth process. They help children explore the world, learn knowledge, and develop various abilities through games." [6]. Educational toys mainly include jigsaw puzzles, building blocks, and tower stacking toys [7]. Jigsaw puzzles have various patterns, a variety of numbers of pieces, and difficulty, and are made of paper, wood, plastic, etc. They can train children's observation, spatial cognition, patience, concentration, and hand-eye coordination. Building block toys have various shapes and materials including wood, plastic, foam, etc., and are highly compatible. It can stimulate children's creativity and imagi-

nation, cultivate spatial thinking, mathematical concepts and logical thinking, and promote the development of fine hand movements. “A type of toy called a stacking tower, usually consisting of multiple rings or cylinders of different sizes, which are put on the pillars in sequence and are brightly colored.” [8]. It can help children recognize size, color and order, exercise fine hand movements and hand-eye coordination, cultivate patience and concentration, and enhance their understanding of spatial relationships.

“Technological interactive toys are an innovative category of toys that incorporate modern technological elements. They usually have functions such as electronic sensing, intelligent interaction, and virtual augmented reality.” [9]. They not only provide a rich entertainment experience but also stimulate children’s interest and curiosity in technology. For example, with programmable robot toys, children can use programming instructions to make the robot perform various actions and tasks, thus cultivating logical thinking and creativity. There are also smart dolls with touch sensing and voice interaction, which can interact with children, provide companionship and knowledge explanation. Game sets that use virtual reality technology allow children to immerse themselves in a virtual fantasy world to explore and experience. These toys stimulate children’s interest and desire to explore with their unique technological charm and promote the development of children’s various abilities while having fun.

Sports and fitness toys are designed to promote children‘s physical health and the development of their body coordination. This type of toys includes balls, skateboards, bicycles, etc., which allow children to exercise and improve their physical fitness while playing. Nowadays, there are not only traditional ball toys such as basketball, football, badminton, etc., which are suitable for children of different ages to exercise and develop skills. There are also various fitness equipment specifically for children, such as small dumbbells, skipping ropes, fitness balls, etc., to help children improve their physical fitness and strength through games. In addition, innovative sports and fitness toys continue to emerge, such as balance cars and scooters, which not only exercise children‘s balance and body coordination but also satisfy their pursuit of speed and excitement. At the same time, some large outdoor amusement facilities such as swings, slides, climbing frames, etc. also belong to the category of sports and fitness toys, providing children with more options for outdoor activities and physical exercise, and promoting their healthy growth while playing.

“Emotional companionship toys refer to toys that can provide children with emotional support, comfort and interaction, and meet their emotional needs.” [10]. Emotional companionship toys, such as plush toys and dolls, become children’s good friends with their soft, cute appearance and warm touch. This type of toy can not only bring emotional comfort and companionship to children, but also cultivate children’s love and sense of responsibility. Plush toys are still a classic choice for emotional companionship. They give children warmth and comfort with their soft touch and cute images. From traditional bears and rabbits to plush images of various cartoon characters, they meet the preferences of different children. “Smart companion dolls combine technological elements and can not only interact with children through conversations, storytelling and singing, but can also respond to children’s emotions, providing a richer emotional exchange experience.” [11]. In addition, electronic pet toys with cultivation elements are also very popular. Children can take care of virtual pets by feeding, playing, etc., and cultivate a sense of responsibility and love. Such toys add a new dimension to children’s emotional companionship in the digital age and adapt to the diverse emotional needs of modern children. This type of toy can become children’s friends and partners, accompany children through their growing years, help children relieve loneliness and anxiety, enhance their sense of security and self-confidence, and promote the healthy development of children’s emotions.

3. Case Analysis

3.1 LEGO Education Series Robots

The LEGO Education series of robots is a perfect example of integrated toy functions. These robots not only retain the classic building functions of LEGO bricks but also incorporate programming education elements. Children can learn basic knowledge of mechanical structure and electronic components by building robot models. At the same time, by using the programming function provided by LEGO to make the robot „alive“, children can learn programming knowledge, control the robot‘s movements, behaviors, and reactions by writing programs, and cultivate logical thinking and problem-solving skills. This design, which combines hands-on construction with programming education, not only exercises children‘s creativity and spatial imagination but also cultivates their logical thinking and problem-solving abilities.

The LEGO Education series of robots has received wide acclaim in the market, not only because of their high-quality product design but also because of their unique educational value. For children’s learning development, it stimulates their interest in science, technology, engineering,

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and mathematics (STEM) subjects. While playing, children not only enjoy the fun of building and programming, but also subtly master important scientific knowledge and skills. Socially, children can collaborate to build and program robots, promoting teamwork and communication skills. However, this kind of toy can also promote parent-child interaction and teamwork, providing strong support for the all-round development of children. In addition, during the construction and programming process, various problems and challenges may be encountered, and children need to constantly try and adjust, thus exercising their perseverance.

3.2 VTech Smart Learning Tablet

It has built-in rich learning resources, including content from multiple subjects such as mathematics, language, science, etc., allowing children to learn easily while playing through interactive games and interesting animations. VTech smart learning tablet is a multifunctional children's toy that integrates learning, entertainment, and social interaction. The interactive experience is highly integrated. With multiple modes such as touch operation and voice interaction, children can answer questions, play games, and other learning activities by clicking on the screen, and can also use the voice function to ask questions, follow reading exercises, etc., which enhances the fun and participation of learning.

At the same time, the tablet also supports video calls and photo taking functions, allowing children to keep in touch with relatives and friends far away and share the little things in life. In addition to rich learning content, there are also some built-in entertainment resources such as educational games and animations suitable for children, but these entertainment contents are often combined with educational goals, such as cultivating children's logical thinking and reaction ability through games.

In addition, the VTech smart learning tablet also has a parental control function, allowing parents to understand their children's learning progress and entertainment time at any time to ensure the healthy growth of their children.

VTech smart learning tablet has won the favor of many parents in the market with its versatility and convenience. It provides a convenient and efficient way for children to learn. The rich learning resources allow children to study independently anytime and anywhere, breaking the limitations of time and space. It not only provides children with a personalized learning platform, but also enriches their entertainment life and promotes the development of their social skills. In terms of knowledge acquisition, the diverse content meets the learning interests and needs of different children. From the perspective of educational equity, the children's smart learning tablet provides relatively balanced educational resources for children in different regions. At the same time, the addition of parental control functions also allows parents to let their children use this toy with more confidence, achieving an effective extension of family education. In addition, the interactivity and fun of smart learning tablets also help to improve children's learning enthusiasm and participation. Vivid animations, game interactions and other forms make learning more interesting, reduce children's resistance to learning, and enable them to acquire knowledge in a relaxed and pleasant atmosphere.

3.3 Fisher-Price Smart Music Blanket

The Fisher-Price Smart Music Blanket is a multifunctional toy designed for infants and young children. It combines multiple elements such as music, dance, and tactile stimulation to provide infants and young children with a full range of sensory experiences. The music blanket is covered with various buttons and patterns, and babies and toddlers can trigger different music, light, and sound effects by stepping on, clapping, or touching these elements. This design not only stimulates the curiosity and desire to explore infants and young children but also promotes their auditory, visual, and tactile development. In addition, the music blanket is equipped with a variety of learning modes and game modes, allowing infants and young children to gradually master basic cognitive abilities and social skills while playing.

Fisher-Price smart music blanket has gained a good reputation in the market for its unique design concept and rich functional features. It not only provides a fun and stimulating environment for infants and toddlers to grow up in, but also promotes their all-round development. During use, parents found that this toy not only makes infants and young children more lively and active, but also improves their attention and reaction ability. At the same time, the parent-child interaction function of the music blanket also makes the emotional connection between parents and infants closer.

4. Design Elements for Integrated Functions of Children's Toys

4.1 Both Education and Fun are Important

In the integrated functional design of children's toys, giving equal importance to education and fun is a crucial design element. Educational means that toys should be able to promote children's development in knowledge, skills, cognition, etc. For example, by designing toys with

number recognition and letter learning functions, children can subtly master basic learning content while playing. Then, fun is the key to attracting children to actively participate in play. Interesting toys can stimulate children‘s curiosity and desire to explore, allowing them to immerse themselves in them. For example, learning elements can be cleverly integrated into creative and imaginative game scenarios, such as an adventure-themed toy. Children need to solve various problems in the process of exploring the adventure, and the setting of these problems can involve knowledge such as mathematical operations and logical reasoning. Such children‘s toys can not only satisfy the pursuit of interesting stories and exciting experiences, but also achieve the purpose of education. “Only when education and fun are perfectly combined can children’s toys truly attract children, allowing them to learn happily while promoting their all-round development.” [12].

4.2 Modularity and Scalability

“Modularity and expandability are important means of integrated functional design of children’s toys.” [13]. Modular design allows the toy to be broken down into multiple independent modules, each with specific functions or features. For example, a set of building block toys can be composed of modules of different shapes, sizes, and colors, and children can combine these modules into various shapes, such as houses, castles, robots, etc. according to their own creativity. This modular design not only increases the diversity of the toy’s gameplay but also cultivates children’s hands-on ability and spatial imagination. Expandability gives toys more room for development. As children grow older and their cognitive abilities improve, toys can expand their functions and gameplay by adding new modules or accessories. For example, a basic track toy set can be supplemented with more tracks, bridges, stations, and other accessories of different shapes and lengths, allowing children to build more complex track systems and simulate real traffic scenarios. This design not only extends the life of the toy and meets the needs of children at different stages, but also stimulates their interest in continuous exploration and creation, providing children with a richer and more challenging play experience. Therefore, designers can expand children’s toys in a modular form when designing children’s toys.

4.3 Interactivity and Emotional Experience

Interactivity and emotional experience play a key role in the integrated functional design of children’s toys. Through interaction with children, toys can stimulate children’s sense of participation and belonging and enhance emotional experience. It is no longer a unilateral operation of the children but can give instant feedback and response. For example, some smart toys can communicate with children through voice recognition, answer their questions, tell stories, etc. When children make specific requests, the toys can quickly make appropriate responses. This interaction makes children feel that their behavior is being paid attention to and valued. Emotional experience is to stimulate children’s rich inner emotions through toys. “A well-designed toy can make children feel positive emotions such as happiness, surprise, and a sense of accomplishment during the play process.” [14]. For example, when children successfully complete a puzzle or build a satisfactory model, they will get a great sense of accomplishment. Moreover, toys can also have a certain emotional companionship function. For example, cute plush toys can provide comfort to children when they feel lonely or scared and become the object of their emotional confession. The combination of good interactivity and emotional experience can allow toys to truly enter the inner world of children, not only bringing them happy playtime but also providing emotional nourishment and support, promoting the development of children’s emotional cognition and social skills, making toys an indispensable close partner in children’s growth process. Therefore, designers can make toys more vivid and interesting by adding interactive elements such as voice interaction, touch feedback, light and shadow effects, etc., while satisfying children’s curiosity and desire to explore.

4.4 Safety and Environmental Protection

Safety is the primary principle in the design of children‘s toys. During the design process of integrated functional toys, relevant safety standards should be strictly observed to ensure that the materials are non-toxic and harmless, the structure is stable and reliable, and there are no sharp edges and corners and other potential hazards. In addition, environmental protection is also an important consideration in modern toy design. Designers should choose renewable and recyclable environmentally friendly materials to reduce the impact on the environment. Safety and environmental protection are key factors that cannot be ignored in the integrated functional design of children‘s toys.

Safety is the primary consideration in the design of children‘s toys. Children‘s physical and cognitive development is not yet mature, and their ability to identify and prevent potential dangers is weak. Therefore, when selecting materials for children‘s toys, relevant safety standards must be strictly followed to ensure that the materials are non-toxic and harmless, the structure is stable and reliable, and there are no sharp edges and other potential dan-

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gers. For example, the materials used to make toys should meet strict safety standards and undergo relevant testing and certification to ensure that no harmful substances are released, such as heavy metals such as lead and mercury. At the same time, the structural design should be stable and able to withstand children‘s fiddling and throwing, to avoid damage during normal use and causing harm to children.

Environmental protection is equally important. In today‘s era of sustainable development, children‘s toys should also adhere to the concept of environmental protection. Starting from the selection of raw materials, priority is given to recyclable and renewable resources to reduce the negative impact on the environment. During the production process, environmentally friendly processes are adopted to reduce energy consumption and pollutant emissions. Moreover, environmentally friendly toy design can also help cultivate children‘s environmental awareness and let them realize the importance of protecting the environment from an early age. For example, a toy made of biodegradable materials can decompose naturally after use and will not cause long-term pollution to the environment. At the same time, the toy‘s packaging and instructions can also convey environmental protection knowledge and concepts to children.

4.5 Age-Appropriateness and Personalization

Children of different ages have different cognitions and needs for playing. When choosing children‘s toys, age appropriateness and personalization are crucial. “Age appropriateness requires us to choose appropriate toys according to the different age stages of children.” [15]. For example, simple and safe toys such as large-particle building blocks and soft plush toys are suitable for young children to develop basic perception and motor abilities; as they grow older, more challenging puzzles, educational board games, etc. can be gradually introduced to cultivate their thinking and cognitive abilities. Personalization emphasizes the unique interests and development characteristics of each child. Only by combining age-appropriateness with personalization can we choose the most suitable toys for children and help them grow and learn happily.

Therefore, when designing integrated functional toys, full consideration should be given to age appropriateness to ensure that the toys are suitable for the physical and mental characteristics of children in the target age group. At the same time, personalized design is also an important factor in attracting children and parents. Designers can make personalized designs based on children‘s gender, interests, personality and other factors to make toys more attractive and competitive.

4.6 Market Drivers

Diversification of consumer demands. Children of different ages and genders have different demands for toys. Diversification of consumer demands has promoted the diversified development of the toy market. Manufacturers continue to innovate and launch toy products that meet market demand to meet the needs of different consumers.

The advancement of science and technology has made it possible for toys to be intelligent and interactive. Smart toys establish a closer interactive relationship with children through voice interaction, APP control, etc., which enhances the fun and educational value of toys. At the same time, the application of technology also reduces production costs, improves production efficiency, and promotes the rapid development of the toy market.

5. Design Strategies and Suggestions

5.1 Design Strategy

“In order to gain a deeper understanding of children’s needs for toys, we need to observe and communicate with them from many aspects.” [16]. Observe children’s behaviors in different scenarios, such as playing and learning, and see their natural reactions and interests to various toys. Communicate directly with children and ask them in a friendly and understandable way about the types of toys, themes, and ways of playing they like. At the same time, we communicate with parents and teachers to obtain information about children’s performance and interests at home and school and combine this information to fully grasp the children’s needs.

Innovate design thinking, break through the constraints of traditional concepts, and explore the possibilities of toy design from multiple dimensions. Encourage cross-field integration and introduce elements such as technology, art, and culture into toy design. We focus on user experience, take children‘s perspectives and needs as the starting point, boldly conceive novel ways of playing, functions and forms, stimulate children‘s creativity and imagination, and at the same time constantly challenge existing design patterns, pursue uniqueness and foresight, and bring new creative products to the children‘s toy market.

Attention to detail Design requires excellence in every aspect of the toy. In terms of the toy‘s appearance, ensure that the lines are smooth and the corners are rounded to avoid causing harm to children. At the same time, the color matching should be coordinated and in line with children‘s aesthetics. In terms of functional design, the operation should be simple, understandable, and interesting, and the assembly of parts should be stable and durable.

In addition, the material selection of the toy should also be considered to ensure safety, non-toxicity, and comfortable texture. By carefully carving every detail, the overall quality and attractiveness of the toy can be improved to bring a better user experience for children.

5.2 Impact and Suggestions on Children's Growth

Promote cognitive development. Diverse toys provide children with a rich source of stimulation, which helps promote their cognitive development. For example, educational toys can exercise children's logical thinking ability and hand-eye coordination abilities; scientific experiment toys can stimulate children's interest and curiosity in science.

Develop social skills. Toys that require teamwork, such as building blocks and puzzles, can develop children's social skills. During play, children need to learn to communicate, negotiate and share with others, skills that are crucial to their future development.

Stimulate creativity. Diverse toys provide children with a broad imagination space. Through free combination and creation, children can give full play to their imagination and creativity, and cultivate unique personality and creativity.

Strengthening cross-border cooperation means that toy design should actively break industry boundaries and carry out extensive cooperation with education, science and technology, culture and art, and other fields. For example, we can cooperate with educational institutions to cleverly integrate teaching content into toy design to enhance the educational function of toys; Cooperate with technology companies to introduce advanced technologies such as intelligent interaction and virtual reality to enhance the fun and innovation of toys; Cooperate with the cultural and art circles to tap into rich cultural resources and art forms, give toys unique cultural connotations and artistic charm, achieve resource sharing and complementary advantages through cross-border cooperation, and promote the development of toy design towards diversification and high quality.

6. Conclusion

To sum up, the current types of children's toys are diversified, which is not only a reflection of market demand, but also an inevitable result of scientific and technological progress and increased environmental awareness. Through the analysis of the above three cases, it can be seen that the integration of functions of children's toys has become an important development trend. This trend not only enhances the fun and educational value of toys, but also promotes the overall development of children in many aspects. Diversified toys not only provide children with more choices, but also subtly promote their cognitive development, emotional cultivation and social skills improvement. In the future, with the advancement of technology and the development of society, we have reason to believe that the children's toy market will become more prosperous and diversified. At the same time, parents and educators should fully consider children's interests and needs, as well as the safety and educational nature of toys when choosing toys, to provide strong guarantees for children's healthy growth.

References

[1] Yang Hua, Wang Le. Research on the experience design of children's educational toys. Packaging Engineering Art Edition, 2016, 32(14): 64-66, 70.

[2] Wang Shen, Zhang Yanjuan. Research on the design of children's functional toy products. Chinese Science and Technology Journal Database (Full Text Edition) Social Sciences, 2019 (11): 00141-00142.

[3] Xing Bingjie. Research on the interactive design of children's educational toys. Hebei University of Science and Technology, 2015.

[4] Song Qiuqiu. Research on the design of children's educational toys under interactive mode. Qiqihar University, 2016.

[5] Han Yunlong. The best toys are those suitable for children. Shandong Education: Preschool Education Edition, 2008, (3): 34-35.

[6] Liu Wei, Hao Huaqi, Zhang Xi. Children's psychology and children's toy design. Proceedings of the 2004 International Conference on Industrial Design, 2004.

[7] Yao Lining, Ying Fangtian, Ying Jiawei. Design strategy model for children's smart toys. Packaging Engineering, 2009, (8): 129-131.

[8] Tang Liming. Investigation and research on the selection and use of toys in young children's families. Family Education World: Innovative Reading, 2014 (2X): 6-6.

[9] Wei Xiaochen, Wang Yuan. Emotional analysis in human-computer interaction design - taking parent-child educational toys as an example. Industrial Design, 2019, (3): 128-129.

[10] Deng Weibin, Chen Yuanyuan, Li Xue. Children's emotional toy design. Design, 2015, (12): 132-133.

[11] Fan Lin, Dou Lele. Feasibility study on the application of mortise and tenon structure in children's educational toys. Furniture and Interior Decoration, 2019, 3: 16-17.

[12] Feng Ming, Bao Haimo, Xu Kun, et al. Research on innovative design of children's toys. Art and Design: Theoretical

ISSN 2959-6122

Edition, 2013 (4X): 117-119.
[13] Dong Lili, Chang Qing, Cheng Xiang. Design of modular children's water building toys. Packaging Engineering Art Edition, 2020, 41(2): 218-224.
[14] Bai Lu, Yu Senlin. On the application of multiple intelligence theory in the design of children's outdoor amusement toys. Popular Literature and Art, 2018, 8: 81-82.
[15] Fang Yuan. Research on the bionic design and application of children's toys. Hainan University, 2013.
[16] Zhang Zhiying. Comprehensive toys. Chinese and Foreign Toy Manufacturing, 2014 (9): 50-53.