Design of educational toys for children based on STEAM education

Zhixuan Zhang, Chuangyang Huang
School of Art and Design, Shenzhen Polytechnic, Shenzhen, Kwangtung, China
registereduser@163.com, 2279730269@qq.com

Abstract
Through the research on the characteristics of children's educational toys and the analysis of application feasibilities of STEAM education concept to children's educational toys, the application of STEAM education concept in children's toy design is discussed, and the scientific nature of STEAM education concept is proposed. Adopting Technical, engineering, artistic and mathematical elements as design principles in children's educational toys.

Keywords
STEAM education; Children's toy design; Educational toys.

1. Introduction
As the launch of the national three-child policy will have an important impact on the social fertility rate, and this will also be accompanied by a wave of baby boomers. More attention will be needed to be on these children. Toys are synonymous with children. The toy market is a potential market with prospects for expansion and development.

There are many types and categories of children's toys, they are divided in accordance to function and age, such as building blocks, chess sets, puzzles, digital games, remote control toys, etc. Age categories are generally 0-1-year-old, 1-3 years old, 3-6-year-old, 7-9-year-old and other older age groups. Therefore, research on children's toys must be carried out in accordance to the target audience & category.

Educational toys are the kind of toys that exercise children’s brain, develop their creativity, and cultivate logical thinking. Educational toys can also cultivate children's interest, shape positive characters, and encourage independent thinking.

Ordinary toys have always occupied the main market for children's toys. Children's educational toys can also be subdivided according to function and age, and educational toys for different types and age groups also have different characteristics. For example, educational toys for infants and young children are usually based on stimulating, entertaining and enlightening them in a positive way. Including music toys and identifying items toys, objects recognition toys, etc. The educational toys of 3-6 years old can have the function of simple calculation or strategy, which is of great significance to the creative cultivation of children. The educational toys in the age group of 6-9 can allow children to realize the functions of toys through some more complex thinking and calculations. Therefore, children’s toys in this category can be said to have the highest requirements. Toys in this category comes with most diversities, functions, and deliver the best experience for children.

STEAM education is a new educational concept introduced in China. STEAM is the abbreviation of the following five words: Science (S), Technology (T), Engineering (E), Arts (A) and Mathematics (M). The STEAM curriculum derives from the US government's proposal to enhance education in science, technology, engineering, arts, and mathematics. STEAM is a more
creative way of education. It uses art (ART) as a tool to teach children science and engineering subjects. The implementation of STEAM allows children to continuously improve their creative ability in the process of learning basic science and engineering knowledge.

The new teaching concept also advocates children to practice with a purpose, allowing children to complete projects that they are interested in and related to their lives. Learn various disciplines and interdisciplinary knowledge from the process.

As an emerging educational concept, STEAM is a very suitable tool for the development of children’s toy which combines education and the fun element in toy functions. In the STEAM concept of education, it is an amalgamation of scientific principles, engineering technology, mathematical calculation, and aesthetics. In the process of developing these toys, it is important they can meet the needs of the different children’s age categories, conform to the STEAM education concept and to the National Safety Standards for children’s toys.

These toys need to be highly playable, fun and in line with children’s educational needs. The followings are five key elements that will contribute to a successful toy in the STEAM approach:

2. **Principles of scientific design in children’s educational toys**

Science is an important element of the STEAM education concept. The letter S stands for Science. Science is the primary element in the design approach required for children’s educational toys. Scientific design is the premise for the realization of all functions intended. Toys with the important goal of developing children’s scientific thinking. Therefore, in the design of children’s toy and their functions, they must achieve the objectives by conforming to scientific laws and principles, as well as recognizing children’s psychological cognitive principals in the design. It is critical to distinguish the age groups of target user.

For example, if the design of the toy intends to develop physical and functional knowledge, the outcome of the design process should allow a child to experience the scientific principles and understand the functions through the design. This will better educate children through science in motion in the form of toys.

3. **Technical design principles in children’s educational toys**

Technology is an indispensable and important part of STEAM education. If you want to realize the functions of children’s educational toys, you must have corresponding technical support. For example, in certain toys, you may need to have remote control capability to achieve specific functions that may include sound and light effects. In these instances, technologies required to achieve these objectives will be necessary. The functional design of this toy must take into consideration the relevance and the availability of the technologies required. In the design process, technology is often inseparable from functionality. In the design process, functional design can first be identified and defined. Subsequently a relevant and suitable technology can be used to achieve its functional objectives. The technology used should be safe and as easy to understand as possible. The playability of the toy is important to enable children to understand the technology behind the toy through their interaction of its operation and functions.

4. **Principles of engineering in children's educational toy design**

Engineering is the core of STEAM education. Engineering is the most closely related to structure in children’s toy design. Toys with good engineering design usually require children to operate, such as building blocks, splicing, combination and construction toys. It can well reflect the engineering thinking. By allowing children to combine some modular structures by themselves,
they can obtain more diverse forms, which greatly increases the fun of the toy. The development of engineering functions is usually combined with the design of modular structures, so it is possible to consider adding modular elements in the functional design of toys, allowing children to splicing themselves to obtain more structural possibilities.

5. Principles of art and aesthetics in children's educational toy design

Engineering is that STEAM education uses art as a tool. Through artistic design and expression, children can better understand science, technology, engineering and mathematics. Art can develop children's imagination and sense of beauty. As a bridge, art can connect technology and life, and can visualize technology. Therefore, artistic expression in the development and design of children's educational toys is essential. In the shape and appearance design of toys, children’s cognitive psychology should be fully considered, and products that conform to children's cognitive habits should be designed. Cartoonization can be used in the modeling design to reflect a sense of roundness. In the color design, high brightness and high purity can be used. The color scheme of the product makes the product shape more close to children and conforms to children's aesthetic cognition.

6. Principles of mathematical application in children's educational toy design

Mathematics is a characteristic of STEAM education. The STEAM education concept attaches great importance to the cultivation of children's rational thinking ability. The exercise of mathematical thinking is the most important process to develop children's brains. Among children's educational toys, chess and card toys and other toys that require calculation or thinking strategies can better reflect mathematics. Therefore, when designing the function of the toy, it can be considered to combine some functions that need to be calculated, which not only improves the challenge of the toy, but also increases the antagonism of the toy and improves the playability of the toy through the functional design of the calculation. What needs to be paid attention to in the design of mathematical functions is to fully consider the age group of target users and design products that conform to children's logical cognition.

Children's toys are the most important products for children in the process of growth, especially educational toys, which carry the important functions of developing children's intelligence, exercising children's logical ability, and stimulating children's curiosity. Therefore, the development and design of children’s educational toys is reasonable. It is very important for the healthy growth of children's body and mind. Integrating the STEAM education concept into the development and design of children’s educational toys can better guide designers to design educational toys that meet children's needs and are conducive to children's growth.

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References


