Research on Innovative Design of STEAM Children's Educational Toys Based on Interaction Design

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Abstract. At present, there is a lack of innovation in children's educational toys. The STEAM education concept is a comprehensive education concept that integrates technology, engineering, art, and mathematics. Based on the STEAM education concept, this paper focuses on the principles of innovative design of children's educational toys under the STEAM education concept, and designs a "little submarine" based on the principle of physical ups and downs experiments, and interacts with children through the screen. It is hoped that designers can better diverge design thinking, break through the design bottleneck, design highly educational, educational, interesting and interactive products, and promote the development of children's educational game toy design.

Keywords: Interactive design · Children's education · Augmented reality · AR recognition · Learning efficiency · Steam educational concept · Children · Educational toys · Interaction · Innovative design

1 Introduction

1.1 Background

With the rapid development of information technology in recent years, smart products have been used in various fields, and the scale of my country's children's smart toy industry has continued to expand. Since the 18th and 19th National Congress of the Communist Party of China established my country's comprehensive deployment of innovation-driven development strategy, "innovation" has become one of the keys to development, so it has had a great impact on traditional children's education. In order to alleviate the further impact of quality education reform on examination education, it is necessary to incorporate a large number of "innovative" elements into the design of teaching aids. However, in the current children's toy market, most of the children's toy teaching aids are still in a state of ideological solidification, less innovation and stagnant development. On this basis, we designed a children's educational game teaching aid that combines the STEAM concept with the physical principle, and added interaction to the design, so that children have better interaction with the product. It is conducive to product designers to better diverge design thinking, break through the design bottleneck, design highly educational, educational and interesting products, and promote the development of children's educational game toy design.

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1.2 Overview of STEAM Education Philosophy

STEAM is the abbreviation of Science, Technology, Engineering, Art, and Mathematics. STEAM education is a comprehensive education that integrates science, technology, engineering, art, and mathematics [1]. STEAM has evolved from the STEM education program. STEM is an educational program led by the U.S. government that aims to break the boundaries of disciplines, solve practical problems through the comprehensive application of disciplinary literacy, and cultivate comprehensive talents.

1.3 An Overview of the Principles of Interaction Design Interfaces

The interface principle is to give the described behavior and information timely and effective feedback to the users, that is, children, to carry out effective visual communication design of the interactive interface [2]. In order to help children have a better game experience and maximize the meaning of designing teaching aids, designers will spend a lot of effort to help users understand teaching aids. Connect the teaching aids with the user's behavior, and the design of the visual page just satisfies this connection. Including the color, shape, transmitted information, and constituent elements of the interface, etc., can vividly convey the use of teaching aids and game modes to users. Optimize the user experience of product users.

1.4 The Current Situation and Development Trend of Educational Aids for Children

In response to this paper, we have conducted extensive research on educational aids for children at home and abroad, and found that most educational aids for children on the market now focus on subject education, training of hands-on ability, and simple interaction. It is difficult to have children's educational teaching aids that integrate children's intelligence, exercise hands-on ability, interactive learning and interaction, and learning knowledge. There are very few toys designed based on the principle of physical "submersion and snorkeling", especially the users have fewer teaching aids for children. Most of them use its principle to move the submarine, which is extremely difficult and dangerous. Use on children. For children's educational aids, a good teaching aid is to teach children knowledge, and children need to learn and use knowledge through this teaching aid. The design of "little submarine" brings fun and simplicity to children. It increases children's interest in physical learning and makes teaching aids more attractive to them.

2 The Significance of Innovative Design of Children's Educational Toys Under STEAM Education

First of all, the science of STEAM education emphasizes the acquisition of knowledge. In the design of toys, we need to pay more attention to whether the toys can teach children relevant scientific knowledge, so that children can learn knowledge and acquire knowledge in the process of playing games. Pleasure. Secondly, through their own activities, children perceive, observe and operate the surrounding material world, discover

problems and find answers. In this process, they gain extensive scientific experience, learn scientific methods, stimulate curiosity and develop intelligence, and feel their own abilities and success in the process of playing games, get a pleasant emotional experience, and generate interest in learning science And concern and love for nature. It is different from other science education, it avoids the misunderstanding of children's science education entering into scientific knowledge instillation and science education being elementary and adult, reflecting its particularity. Mr. Chen Heqin said that games are children's psychological characteristics, games are children's work, and games are children's lives. In a sense, children's various abilities are acquired in games. Games are the content of the curriculum, the background of curriculum implementation, and the way of curriculum implementation. It integrates scientific knowledge, scientific methods, and scientific spirit into children's life and games, and promotes children's overall and harmonious development.

3 Innovative Design Principles of Educational Toys for Children Under STEAM Education

3.1 Security Principles

Through data research, it is found that the focus of children's toy size research is the safety of children's size and specifications. Products suitable for children under the age of eight must not have edges. Any accessible parts of the toy or accessories, except for the sharp edges required for functional problems on the product, but there must be labels with instructions and warning words for children of sufficient maturity to read and understand these instructions, but this is not until the product There must not be any non-functional edge; in order to prevent children from swallowing, standards are formulated to limit the possibility of being swallowed by consumers and suffocating [3]; the structure is reasonable, strong and resistant to falling, and it is not easy to be broken and broken; in shape It should be easy to grasp, and there should be no sharp parts. It should be suitable for children to play without hurting other children. In the selection of toy materials, it should be non-toxic. In paints, color coatings, plastics, chemical fibers, electroplating Materials that are toxic and harmful, such as metals, require attention.

3.2 Educational Principles

What the STEAM education philosophy highlights is education. In traditional children's games, most of them are simple and easy-to-use ordinary children's toys without educational significance. It is difficult for children to learn and progress from them during use. However, the design of children's educational games uses the STEAM concept to make it easier for children to play The subtle learning in the process of the game improves children's thinking ability.

3.3 Fun Principle

The primary feature of children's game toys is that they must be interesting. Children will insist on playing if they are interested in games. Children's self-control and persistence are far less than adults. If a children's toy wants to attract children's attention, it must increase the fun of the game and the use of the game on the basis of scientific puzzles. Simplicity. In color and shape, it should be designed like a child's inclination.

3.4 Participatory Principleun Principle

In the living environment of children, the company of parents and the communication between friends are indispensable. Therefore, in the process of playing games, if there is the participation of playmates or the accompaniment of parents, it is an important part of the process for children to play games. If a children's game product only requires children to perform some simple operations, then children will definitely lose a part of the sense of participation and experience in the process of using the game product. If the toy can be designed to be simple to assemble and operate the game by yourself, the children will surely increase their interest in the game and greatly improve their hands-on ability. Appropriately adding parts that allow children to operate by themselves in the design of children's educational games can greatly increase the educational and scientific nature of children's games. It can also improve children's ability to cooperate and cooperate with teams.

4 Innovative Design Principles of Educational Toys for Children Under STEAM Education

4.1 Design Brief

"Little Diver" is an educational set game about physical ups and downs experiments. It uses the principles of physical ups and downs and gravity to apply to the existing small submarine toys on the market to upgrade the toy gameplay and is designed as a pipeline game mode. The combination of games and experiments can allow children to learn the knowledge of the principle of ups and downs. By setting a display screen under the base, the clearance game mode is fed back to the children. The image displayed on the screen is the clearance route. Among them, you can also work with parents to increase the sense of interaction between family members. The whole of the toy is a large submarine-shaped outer package, and the inside is the kit needed for the game. There are no sharp points on any part, ensuring the safety of children during use. The material of the toy is made of transparent PC + ABS material to ensure that children can see the inside of the pipe for easy operation (Fig. 1, 2).

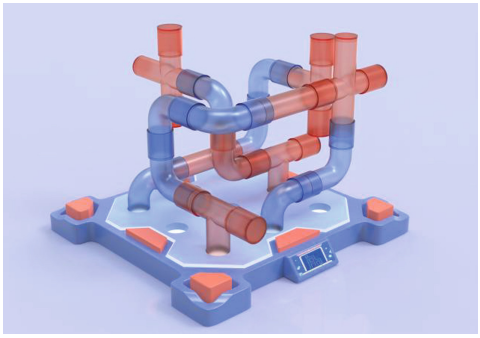

Fig. 1. Product overall renderings (Color figure online)

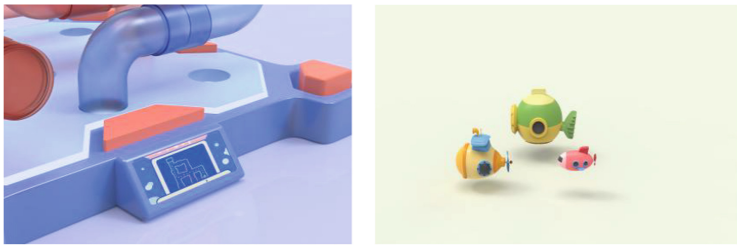

Fig. 2. Pipe material and submarine model (Color figure online)

4.2 Design Description

Pipe Assembly Gameplay. The game is composed of transparent pipes, pipe bases, small submarines, and game process cards (as shown in the figure). The transparent pipes can be assembled freely. Children can assemble them into different pipe forms

Fig. 3. Game accessories and use flow chart (Color figure online)

according to their own needs and assemble them on the pipe base. They can also assemble according to the matching game card prompts (Fig. 3, 4).

Fig. 4. Game pipeline instruction card

Mainly aimed at children aged 6–8, (as shown in the picture) assemble the pipe according to the instructions on the card, fill the pipe with water, put the small submarine toy and seal the cover, when the small submarine falls to a certain position, press and hold The button next to the pipe controls the movement of the small submarine. There are nine insertion ports on the base of the pipe. The pipe is made of transparent PC material with high visibility. There are four colors of watermelon red, vibrant orange, green apple green and crystal blue. The color matching of the small submarine toy is fresh and natural, which triggers children's ability to distinguish. Increase the intelligence and fun of the product.

Tangible Interactive Mode. When interacting, the display screen on the base of the "Little Diver" product will be divided into levels 1 to 5 according to the progress of the children's game. Children must use the principle of physical snorkeling to pass the "level 1" clearance pipeline route displayed on the screen at that time. When the "submarine" swims in the pipeline route specified on the screen, the bottom of the corresponding pipeline will emit light to guide children's operation and attract children's interest. When the clearance signal given by the screen is completed, the child can click on the screen to perform the "second level" and so on… There will also be corresponding obstacles in the process of passing the level to increase the difficulty of the game. During this time, if the child takes the wrong pipe, the corresponding wrong symbol will appear on the screen on the base to help the child pass the level.

Gameplay Summary. This product uses the principle of physical ups and downs and integrates the steam education concept. A pressing device acts under the gaming device. By pressing the button, the air in the pipe is applied to the small submarine above, making

it go up, releasing the button, the air is drawn out, and it is diving. In different directions of the pipeline, there will be the same pressing device to carry out the up and down of the submarine. At the intersection of each pipeline, a blade that can be adjusted in direction is installed, and the blade is rotated by a hand-operated device to change the advancing direction of the small submarine. Children can replace different pipe sizes according to their own needs. Below the pipe, a product-related base is installed to insert the pipe and operate the button. The button is connected to the vacuum tube in the base for air outlet and suction. A water discharge port is also installed in the base, which is convenient for children to discharge water after playing games, and the operation is simple.

4.3 Aim of Design

The "Little Diver" ups and downs physics toy installation combines art, science and engineering.

It gives more artistic composition in appearance and shape. For example, the choice of color will be more in line with children's aesthetics. Since children are also more sensitive to changes in color [4], bright colors can attract children's attention., to improve children's aesthetic ability to shape and color.

In terms of science, "Little Diver" uses the principle of buoyancy experiment, and uses games to demonstrate the effect of buoyancy for children. It can arouse the curiosity of children, explore the origin of buoyancy, and achieve the effect of enlightenment.

In terms of interaction, children can operate according to the game clearance interface displayed on the screen. After turning on the clearance mode, they can "navigate" according to the corresponding clearance route that appears on the screen to pass the route and obstacles displayed on the screen. The game experience can increase children's freshness of teaching aids and improve children's learning interest.

In terms of engineering, the toy has a variety of ways to play and has strong flexibility. Children can diverge their thinking and assemble freely. The assembly method is like a shortened version of engineering splicing: the splicing between the base and the conduit, and the splicing between the conduit and the conduit all require children to discover the skills. Let the children experience the complete working procedure in the process of splicing, realize the role of each component in the project, and use each component to accomplish their own purposes [5]. Improve children's hands-on ability.

5 Summarize

Games can promote children's physical growth and development, improve children's exploration and imagination, improve cognitive ability, perception ability and thinking ability. Therefore, when designing this game, we are more inclined to better serve children in terms of shape, color, and component design. Users in "Little Diver" target children aged 6–8. Therefore, the design of the outer packaging and the main game equipment are also based on the submarines that children like at this stage. Since children like some natural elements and relatively refreshing tones [6], we also use the color design of the pipes. The colors of pink, blue, yellow and green that children generally like

are used as the main colors. The transparent PC + ABS material is used as the material of the game pipeline to improve the transparency of the pipeline, better assist children to play games, and enhance the sense of experience. The built-in game instruction card and assembly instruction card scientifically assist children to play the game, and try to make the game rules as easy to understand as possible. To the greatest extent, it can meet the requirements of scientific puzzles, improve hands-on ability, strengthen parent-child relationship, etc., and give children a safe and interesting children's educational game.

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