

Innovation Education for Children of FDM 3D Printer Design and Study

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Abstract—From the perspective of FDM 3D printer, the possibility of its application in the field of children's innovation education was discussed. **Methods:** Combined with the education theory of children's innovation, the characteristic mode and method of children's innovation education were discussed, and combined with the research objective, children as consumers were deeply analyzed by users. In the specific design practice, the design is positioned as the design of FDM 3D printer, At the same time, the innovative theory was applied to the design of 3Dd printer. **Results:** Tthe sketch effect diagram of FDM 3D printer was completed. **Conclusion:** The product design of FDM 3D printer aiming at children's innovation education was constructed.

Keywords—FDM 3D printer, Children innovate education, Design and study, User analysis

I. INTRODUCTION

3D printing technology, as a new cutting-edge technology, is known as the manufacturing technology with the significance of industrial revolution. It is not only applied to the mold manufacturing and model making in the traditional manufacturing industry, but also gradually applied to the design research and structural function research in the fields of aerospace, national defense, military construction, construction, automobile, household appliances and other fields. [1-3] Industrial 3D printing technology can be used to directly manufacture products, and some fields, such as jewelry, footwear, cultural and creative products, medical field, are actively trying to apply this new technology into products.[4,5]

II. CHILDREN'S INNOVATION EDUCATION THEORETICAL RESEARCH

Children's innovation education aims to cultivate children's creative potential, its core is cultivating primary and middle school students in the field of basic education in such aspects as consciousness of emotional thinking activity will have the ability to seek new consciousness and the corresponding, both for new things and new ideas, to find a reasonable method, master the law of right, to form a new knowledge system in the field of innovation education, intelligent main research theory constructivism theory of multiple intelligences theory.

The most famous intelligence theory is three yuan, a psychologist at Yale university, sternberg put forward by the United States, he presents a new theory of human intelligence structure, namely the internal composition of human intelligence include intelligence composition mental experience intelligence situation from three aspects of the theory of this theory is different from traditional, we are familiar with tend to focus on the evaluation system of intelligence, the results present academic intelligence, intelligence tests in the form of exam, exam scores are as important basis of evaluation of intelligence according to sternberg's theory, from the situation of intelligence tests often cannot give a correct conclusion, compared with traditional IQIntellectual type of intelligence, situation in real life is more important, in fact, we often see that a result good student at school, after entering the social work, do not always better than those students with poor grades, therefore, we in the children's innovation education, to abandon the existing narrow the validity of evidence, for the validity of other information, in this way, can we make the correct evaluation on students' intelligence.

Multiple intelligence theory is based on neuroscience, cognitive science, combined with culture and human potential research achievements gained by the knowledge, proved that each individual human have different intelligent combination, set in a specific cultural context or community different problem solving personal ability of different types of intelligence can in the appropriate external stimuli and under the condition of individual effort, change and promote the application of multiple intelligence theory framework enables us to redefine the teaching idea and student assessment standards, strengthen director belongs and cultivate a variety of innovative talents [6].

Constructivism theory, is the main representative figure of Swiss Geneva school of a psychologist piaget's constructivism can be regarded as a branch of cognitive psychology, the theory of the core is the psychological activities of the organization structure is defined as the schema conceptual knowledge is not objective, not subjective, but the individual and the environment in the process of interaction of gradually constructed schema this process can be divided into three stages: assimilation hue and balance.

From constructivism theory to study children's innovation education problems, can draw the conclusion that learning should belong to the development of knowledge and not rely on to get a lot of external information obtained, but the learners in the process of cognition of things, through collaborative activities, people get in the understanding of the specific culture background things rule learning goal should be to open, emphasis on the learner's initiativePositivity and creativity, learning is

a kind of social activity, not passive acceptance, but knowledge construction through experience and interaction. That is to say, learning is actually a process of constructing new schema under certain circumstances [7].

A. Feasibility Analysis of FDM 3D Printer in Children's Innovation Education

According to the relevant research on children's innovation of education theory, the feasibility model of 3D printing technology and relevant platform in education application can be found by combining teaching and practice. Maintaining the Integrity of the Specifications.

First of all, can use 3 d printing technology combined with the related arts such as Chinese maths science curriculum knowledge, combined with the theme activity, create a three-dimensional form, or the 2 d images into a three-dimensional form quickly, can also be related to the artistic creation activities and combining the teaching content, through a process from idea to production, strengthen the ability of children, to experience the aesthetic pleasure and happiness. At the same time, created by physical works to strengthen a sense of achievement [8].

Secondly, the teaching methods can be enriched through 3D printing technology. The rapid prototyping characteristics of 3D printing technology can facilitate children's participation in the whole process, create a relaxed and pleasant innovation environment in the process of entertainment, and transform the injection knowledge learning mode into the discussion and exploration knowledge construction mode.

In the end, 3D printing technology and finished products can be used to help students construct small situations related to the learning content to create vivid works, connect with the real living environment, simulate the appearance of real social and cultural life, help students understand the teaching objectives, and ultimately stimulate the improvement of students' various intellectual abilities [9].

From the above analysis, information about the feasibility and application mode of FDM 3D printer in children's innovation education can be obtained, which will be taken as the starting point for design research in the following research, including product design research of FDM 3D printer

B. Target User Group Analysis and Functional Positioning

The target user group analysis of FDM 3D printer service platform is the basis of the design and research of this project. The effective system analysis and definition of users is the starting point of the follow-up work, which can ensure the rationality, effectiveness and availability of the later design.

In order to facilitate the follow-up design and research, and according to the specific requirements of the project, the target users are positioned as children in grade 1-6 of primary school and adults related to children users.

C. Child user analysis

As the main user of FDM 3D printer service platform, the analysis of children is the initial starting point of the project. Here, the characteristics of children's demand for products will be analyzed based on the children's innovation education theory discussed above.

Constructivism theory, the process of children's cognitive development is divided into four stages, sensorimotor stage preoperational stage concrete operation stage and formal operation stage. Sensorimotor stage 0-2 years old children, the main characteristic of this stage is to rely on action to adapt to the environment to stimulate the original action is just simple responses to environmental stimuli, perception and action cannot be in the way of thinking for debugging the second phase in the period of 2 to 6, 7 years old, was known as the preoperational stage, during this period, children have can be done in constructing psychological symbol to the outside world of thinking, and thinking has the characteristics of the jump. They like to listen to fairy tales to build the magical world, in the book and think this is real life we often see this one phase of children and animal plant their own toys and even a stone and dialogue, and regarded them as living things at the same time, this period children self-centered thinking patterns, such as we see in a lot of children, in the same picture show the morphological characteristics of perspective is not the same, but the result of the children watch from different angles. This feature enables children's cognition of things stay in my own world, not very appropriate and realistic situation, combining the cognitive model is still stay on the surface of concrete concrete operation stages of 7 to 11 years of age, children have the abstract concept, can from simple representation schema for the problem of thinking, piaget called this way operation pattern of thinking is reversible. Conservativeness, in addition to the characteristics of self-centered, but you have to notice is that the former operation stage to the concrete operational stage of transition, the children thought it hard by completely abstract concepts, still need to contact the specific things or specific content. Fourth stage for 12 to 15 years old, known as the formal operational stage, children can go beyond the appearance of things, in the form of logical reasoning, understanding the nature of things, this is the wisdom of more mature, children can construct their own knowledge of learning way.

Elementary school children aged between 6 and 13 commonly, according to the above analysis, this period of children is mainly in the concrete operational stage, and has the characteristics of preoperational stage, grade 1 2 and 5 grade 6 children with formal operational stage can be seen from the previous analysis, the characteristics of children's thinking development mode different from adults, and knowledge can not only rely on the abstract theory into, must be combined with the

characteristics of children's intelligence development stage, the stage of children's cognitive characteristics, increase the interest of children, guide the active learning and construct the knowledge system.

D. Adult user analysis

This project determines that adult users may include relevant school teachers, teaching assistants, and parents of relevant social institutions.

Adult users can be used as direct users of products, but also as a product of the auxiliary users according to different relationship with children's users, adult users demand also has different characteristics in front of three element theory and the theory of multiple intelligences, intelligence is proved that the characteristics of children's intelligence and ability will have different performance value according to different characteristics of the adult users on children, adult users in the project can be divided three types, phenotype and comprehensive academic type.

Academic users mainly refer to teachers and auxiliary staff of the school. Their demand for products is mainly to cooperate with the teaching plan of the school. Academic performance indicators are their main concerns.

Phenotype users mainly refer to the staff of relevant social institutions, whose demand for products is to develop children's specialties and pay attention to cultivating the types of intellectual abilities children are good at.

Comprehensive users mainly refer to parents. Their demands for products not only focus on the above two types of demands, but also require products to meet the needs of game experience, emotional communication and other aspects.

Either type of adult users, will make a comprehensive evaluation of product, it has to do with children's different evaluation of comprehensive performance, first of all, for users of products and services provided by the satisfaction of requirements [10], at the same time they also pay close attention to product safety in the production and use of environmental protection and economy degree of the satisfaction of these requirements will affect the user's purchase behavior.

E. Design Function Positioning

FDM 3D printers with children's innovation education, innovation education for children is not only developed a new channel, at the same time try to 3 d printing technology commercialization and industrialization of the road Combining with the former in the face of consumer buyers and market analysis, can the innovation education for children of FDM 3D printers designed to make the early functional description Main function is to provide auxiliary method for children's innovation education, through the combination of hardware and software, to expand the application of the product category, cost-effective way through ascension, the relatively lower product pricesAt the same time, according to the characteristics of different stages of primary school students, through the use of product configuration and supporting software services to distinguish between 6-8 years old children, mainly provide personalized small products such as learning supplies, teaching tools, toys and other printing and simple modeling design;At the age of 8-11, the services provided are mainly focused on the production and design of some teaching-related supplies.At the age of 11 to 13 years old, provide the design guidance and realization of the scheme for the combination and use of creative products.

III. FDM 3D PRINTER DESIGN

A. Creative Sketch Design Exhibition

According to the preliminary design research, the sketch design was carried out by hand drawing, mainly from the following aspects: see figure 1 for the overall shape sketch and figure 2 for details.

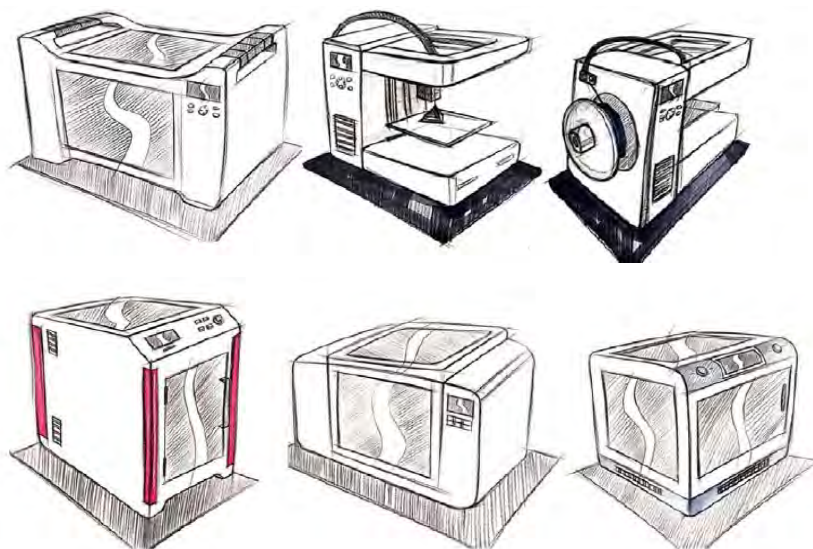


Fig. 1. Overall pattern sketch

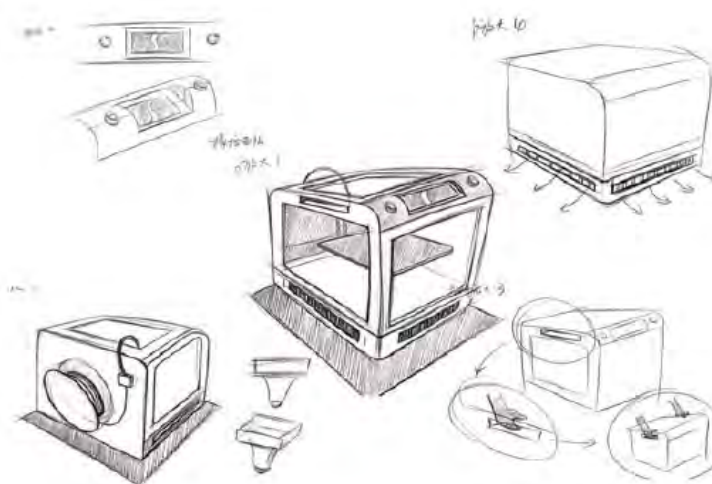


Fig. 2. Product details display

B. Preliminary Program Evaluation

This process is a summary of previous work, in a system, the product design process encountered and need to be solved are more complex than solution of the problem, so from a logical point of view, usually work steps can be summarized as analysis - the process of comprehensive evaluation - decision, preliminary scheme evaluation is to early sketches of all carries on the preliminary screening, remove the obvious and the design goal deviate from the plan, keep accordance with the requirements of the design goal of developmental plan scheme, to make the following work can be more concentrated

According to the usage scenarios analyzed above, we chose the following scheme, as shown in fig. 3.

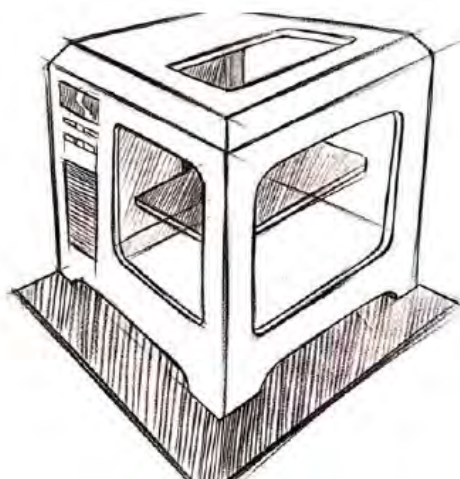


Fig. 3. Final project

C. Final Project Presentation

Effect drawing can convey the intention of the designer, very intuitive and vivid, it has a wide range of universality, is an essential part of the content of the design scheme.

The advantage of computer aided software form is more real and touching, and customer communication has strong persuasive it is using graphics conversion technology, surface modeling technology, the product entity modelling technology, rendering techniques and animation design and other technical ideas to express the designer's thinking a nutshell is to use the graphic images of computer and it equipment to help our workers to finish design, interactive way to express the virtual machine products of choose and employ persons in the natural environment of various states.

The following is the use of computer-aided software for rendering design.



Fig. 4. Final project Final project presentation

The enclosure design of 3D printer adopts the overall closure method, which can reflect the safety of the product in both practice and psychology, so that children dare to be more willing to approach, and parents and teachers can also trust their children to use; The internal full-body metal frame is adopted to ensure the structural stability of printing in the process of handling. Meanwhile, the quality of printing can reduce the product shaking caused by motor movement.

The outer plastic shell of 3D printer is designed to reduce the sense of coldness and distance brought by metal. Meanwhile, the marketing method of colorful shell is realized at a low cost, which facilitates the operation cost in the later maintenance stage.

The operating interface of 3D printer has a 30 degree upward viewing Angle with the product, which facilitates the visual monitoring of children and other users in the process of operation.

Printing material box in the back of the product modeling, due to the installation of the material box behavior, not every time you use to do, so set on the back of the product to prevent impact on daily operation box printing materials with built-in storage mode design, reduced the mechanical sense of distance, increase the safety of visual, increasing the aesthetic of the product.

IV. CONCLUSION

Mainly for children's innovation education FDM 3 d printers modelling design and related supporting services, through the prophase investigation, systematically analyses the technical target users, and according to the analysis results, studied the FDM 3 d printers modelling design method, provides the target customer good children experience based on the service innovation education as a starting point, from the design theory research of design thinking, the FDM process and method of 3 d printing design has carried on the comprehensive research, analyzes the innovation education for children of FDM 3 d printers, and other large. On the basis of the similarities and differences of universal FDM printer, the product design of innovative education FDM 3D printer for children was constructed.

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