

Research on Practice Teaching Reform of Bionic Concept in Product Design

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Abstract—For the training of professional students of industrial design, it should not only focus on classroom theory teaching, but also pay attention to practical teaching. In terms of training talents, it should take the principle of adapting to the actual needs of society. This paper analyzes the bionic concept and explores its impact on the teaching system and traditional design of product design. In recent years, with the increasingly fierce competition in China's economic market, the development of product design talents faces unprecedented challenges. The product design students are the future product designers, and the lag of design education will directly lead to the overall lag of industrial design in the future society. The placement of a new design concept will positively promote the establishment of a teaching system for industrial design and the deepening of teaching reform.

Keywords—*bionic concept; product design; teaching reform*

I. INTRODUCTION

The natural world is full of living examples of "good design", which is an inexhaustible "design database" for designers. Such as the inanimate mountains and rivers, the living birds and beasts, and the colorful flowers and trees, in addition to the rich shape, the beautiful colors also give people a visually incomparable enjoyment. After the natural evolution of the millions of years of the survival of the fittest, these plants and animals not only fully adapt to nature, but also their evolution is close to perfection. These natural "good design", some of the functions are complete making people impressed; some are exquisite in structure, and reasonable in materials, being in line with the natural economic principles; some are beautiful that people can not put it down; some even evolve according to some mathematical rules, being in line with the requirement of "the least amount of material" to constitute "the most reasonable space." For the cultivation of industrial design professionals, it must not only pay attention to classroom theory teaching, but also pay attention to practical teaching, and use bionic design thinking to stimulate creative inspiration and make the design more human.

II. THE NECESSITY OF BIONIC DESIGN TO THE TEACHING SYSTEM OF PRODUCT DESIGN PRACTICE

The practical teaching system has certain theoretical guidance for the training of professional talents. The training and practical teaching can be reasonably arranged together

by combining the various elements of practical teaching, the overall design and setting up a reasonable curriculum internship. The basic purpose of the practical teaching system, which focuses on cultivating innovative spirit and practical ability, is to train hands-on professionals, including the ability to apply practical basic practical skills in relevant disciplines to solve practical problems and ensure a higher level of innovation.

A. Historical Development of Bionic Design

In the distant years, human beings seem to realize that they can understand the true meaning of their own survival, development and progress from the natural ecosystem. Human beings from the era of obscurity into the civilized era have developed on the basis of imitating and adapting to the laws of nature. In ancient times, people's life production materials were derived from nature, and the artifacts also presented the original abstract natural form. In the ongoing struggle for struggle with nature, the Chinese ancestors formed a simple natural philosophical thought, such as the idea of "the union of heaven and human" and the "five elements living from and against with each other." "The union of heaven and human" means that human is a part of nature. The survival and development of human-beings is based on the symbiosis and complementary with nature. From the myths and legends of the emergence of human beings, to Luban getting enlightened to be aware of the principle of saws from the tooth-shaped edge of the blade of grass in the Spring and Autumn Period and the Warring States period etc., a large number of cases describe the artificial imitation of the external form and function of natural life. They believe that only by achieving the perfect state of harmony between "heaven", "earth" and "human" can perfect artifacts be produced.

B. Application of Bionic Design in Product Design

1) *Morphological bionic design*: The shape of the product carries the designer's design philosophy and it is a bridge to communicate with consumers. Under the concept of returning to nature and green design, morphological bionic design has become the main design method of designers. Philip Stark's alien juicer is like an insect-like slender three-legged, seemingly strange head from outer space creatures, which attracts people's infinite imagination and desire to buy. Morphological bionic design is divided

into figurative bionics and abstract bionics. The figurative bionics directly reproduce and depict the natural biological morphology, which of the form is lively, full of vitality and affinity, and is often used in the design of children's products and household items. Abstract bionics is to simplify and refine the natural morphology. Through the methods of association, exaggeration and deformation, the product morphology is between "like" and "not like", which is interesting and exploratory. Abstract bionics is characterized by simplicity, generality, and imagination. They are highly individualized and creative, and are more in line with the requirements of production processes and transportation packaging.

2) *Functional structure bionic design*: Functional structure bionics mainly studies on the specific living ability or the special structure inside the body of creatures in the nature. Through technical means, its function and structure can be imitated, the use of existing products or technical systems can be improved, product comfort and convenience can be achieved, and the upgrade of the product can be completed. For example, the Japanese Shinkansen high-speed train uses a noise-reducing design that resembles owl feathers and kingfisher cockroach which makes the driving process is surprisingly quiet. The owl's feathers are arranged in a zigzag pattern. When passing through the night sky, the device is silent. The device connecting the high-speed rail to the upper wire uses this jagged structure. The kingfisher's cockroach makes it minimize the lost of energy when diving from the air to the surface of water. The shape of the front of the train is similar to this kind of shape which helps the train not to produce low levels of sonic boom as it passes through the tunnel.

The nature of product design determines the need to establish a practical teaching system for product design education. Industrial design is the inevitable outcome of industrial modernization. In the market competition, exploring their development is not what a simple art school can conclude. Product design not only involves a series of traditional disciplines, such as material mechanics, structural mechanics and strength theory, but also participates in many emerging disciplines such as ergonomics, value engineering, bionics, and aesthetic design. Therefore, it must be considered of the intersection of art, humanities, natural sciences and social sciences. Product design education can cultivate students' aesthetic ability and artistic modeling ability. Under normal circumstances, the goal of industrial design professional education is difficult to achieve only through classroom theory teaching. It is necessary to go deep into practical training skills in real life.

3) *Color pattern bionic design*: There are ever-changing colors and color combinations in nature. Excellent color and pattern can achieve a certain survival function of the organism. It is the bionic design of color patterns of simulating the excellent color combination and pattern form of nature, and applying it to the appearance of color matching and pattern decoration of products. For example,

the design of imitation animal skin spots and stripes used in bags and furniture fabrics, the imitation of plant colors and veins in home accessories are all bionic designs of color patterns. In addition, the wings of insects such as butterflies present colorful and beautiful fluorescence in the sunlight, which is used in the bionic design of the fabrics to give people a beautiful enjoyment.

4) *Material texture bionic design*: It is called material texture bionics to study the surface texture of natural ecology and the arrangement of material structure, use artificial materials to imitate the composition of natural texture, realize the functional value of materials, and convey the decorative effect of the surface. With the increasingly prominent contradiction between human and nature, being harmonious with nature and the voice of conforming to the laws of nature is becoming louder and louder. Industrial design, as a design discipline that changes the state of human existence and designs a human lifestyle, must respect nature, imitate nature, and take nature as a teacher. As an important design method of industrial design, bionic design will inevitably play an increasingly important role, and even become the design method that designers should consider first.

III. BIONIC DESIGN IN THE FORM OF INDUSTRIAL DESIGN PRACTICE TEACHING

A. Bionic Product Planning and Conceptual Design

Students are primarily involved in early research and bionic concept design of corporate products. Because the designer's thinking mode is vulnerable to the limitations of inertial thinking, the products designed by students may not be directly available to the production company, while they can provide a large number of creative new thoughts and new ideas for the enterprise. Industrial designers can accurately capture the market demand, combine excellent bionic inventions to create the products that people demand, and build a friendly human-machine dialogue platform to create more valuable products at the same time. Industrial designers put forward the idea or concept of a certain product through careful observation and experience summary of natural phenomena, combined with a comprehensive and accurate understanding of market demand. Scientists choose the excellent ones to achieve this bionic technology which make it possible for industrial designers to create such bionic products. Valuable products can be created through the interaction of industrial designers and scientists.

B. Development and Design of Bionic Products

With the deepening of bionics, people not only imitate creatures from shape and function, but also get a lot of inspiration from the strange structure and texture of creatures. In the "bionic manufacturing", people not only learn the nature, but also learn and learn from the natural internal organization and operation mode. Some of the creatures are exquisite in structure, reasonable in materials, and conform to the natural economic principles; some are even formed according to certain mathematical laws, which conform to

the requirement of "the least reasonable material" to constitute "the most reasonable space." These provide models for "good design" for human beings. The development and design research of bionic products is mainly based on the enterprise to guide students and teachers to participate in, and then directly apply the results to actual production. For themes from the company, students can gain insight into the production design across departments. And many students have greatly improved their ability to solve problems through open practical training and become the preferred choice of employers. In the design of modern industrial products, it is rare to simply bionic from one aspect of form, function, structure or material, and more is to integrate bionic design in multiple aspects of form, function, structure and material. It also carries out bionic design from the perspective of nature's survival philosophy, namely harmony and symbiosis, such as green bionic design and sustainable bionic design.

C. Industrial Design Competition

In recent years, many companies have focused on the design awareness of products, and the competitions to improve students' design awareness have been organized by related companies one after another. For some students who win in the competition, many companies have adopted the priority entry method of the winners, which also reflects the outstanding characteristics of industrial design profession and social culture. In addition, the use of industrial design practice teaching can make the results of student internship be applied to the enterprise, providing advice and suggestions for the industrial design of the enterprise, and establishing the decision-making and design style of the enterprise product developer.

IV. REFORM MEASURES OF BIONIC DESIGN IN PRODUCT DESIGN PRACTICE TEACHING

A. Starting from the Actual Situation of Students, Paying Attention to Guiding Students to Learn the Theory of Bionic Design Theory

It must be paid attention to how to combine the "subjects" with the product design practice teaching. It will be necessary to apply the actual subject to the actual teaching process, and the conceptual guidance should be paid enough attention. In addition, it will be needed to systematically summarize after each course is completed. In this way, the subject is the center, and the actual operation is continuously carried out, so that students can understand the importance of the theory in practice and increase their consciously study of professional theoretical knowledge.

B. Starting from Reasonable Arrangements, Paying Attention to the Combination of Different Forms of Product Design Practice Teaching and Theory Teaching

It is known that a series of spiraling product design courses are the focus of the industrial design learning. And the practical teaching should pay attention to the level of arrangement. First, it is necessary to arrange the time series, then cut into the different stages of the course, and finally

combine with different forms. For example, in the concept design, students complete the market research, analysis, and conceptual design in the course (subject). Maybe most of the students complete some research reports or conceptual plan diagrams, and then this type of subject can be arranged in the second grade when the next semester begins. It is known that today's design competitions are generally tailored to the needs of the business, and it will be important to incorporate the propositions of the competition into the senior design curriculum.

C. Starting from Practical Projects, Realizing the Systematization of Subject Knowledge

As two major professional subjects, they should be paid attention to the equal importance of design courses and engineering courses in industrial design disciplines. Generally speaking, many college engineering courses are taught by engineering teachers, and textbooks generally use engineering textbooks. It is difficult for students to find the connection between curriculum and design, so there is no strong interest. In fact, it can be unified these two pieces of content into practical topics, and use practical topics as a support point, so that the systemic and integrity of the student's knowledge structure can be strengthened. Continuously innovation and trying around the subject can be important. It not only can realize the intersection between engineering technology and design courses, but also can achieve cross-school, interdisciplinary, complementary advantages, as well as it is enlightening for the reform of industrial design practice teaching.

V. CONCLUSION

Today, as we live in an era of rapid development of science and technology, learning and utilizing the excellent structure and wonderful functions of biological systems has become a new direction of technological innovation and technological revolution. On the other hand, the magical nature shows the exquisite life form and the colorful and pleasing color living forms to human beings. At the same time, nature still silently explains the philosophy of existence in nature — harmony and symbiosis. This harmonious design philosophy calls for a high degree of harmonious unity between human society and nature. The symbiotic design philosophy calls for the establishment of a reasonable construction between human and machine, ecological nature and man-made nature to construct a dialogue platform of human and nature and machine symbiosis. The use of bionic thinking design not only creates a product with complete functions, exquisite structure, reasonable materials, and wonderful products, but also gives the product a symbol of life, returns the design to nature, and enhances the unity of man and nature.

The future society needs a large number of industrial design talents, and the completion of this important task must rely on education, especially the educational model that can enlighten wisdom and practice. In this way, the education and the talents can be adapted to the needs of the society, so that better application-oriented talents can be cultivated.

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