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General Design Education Practice: History of Design Materials

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General Design Education Practice: History of Design Materials

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Abstract. Based on the universality, democracy and generality of design, this paper constructs the basic framework of general design education based on general education and design education. The general design education is an extension of the field of general education. The role and significance of designing general education are discussed in the paper based on the practice example of history of design material.

1. Introduction

The concept of general education has been widely accepted. General education originated in the United States in the 1950s. It has accumulated a lot of successful experiences and examples, and has a relatively comprehensive and far-reaching impact on education world widely. As the human economy and society enter the new stage of "Industry 4.0" and "Innovation 2.0", new demands are placed on comprehensive and innovative talents with diverse academic backgrounds. Therefore, as an important part of higher education, general education should also be expanded in accordance with the changes in the demand for talents and time changes.

2. General education

With the purpose of cultivating "total people", general education focuses on cultivating people with vision, understanding, liberal spirit, and beautiful emotions, not only on cultivating special or specialization in a certain professional field. General education requires students to comprehensively master the overall state of human knowledge achievement, including history, basic standpoint, and modes of thinking in major fields. They will have the ability of selecting or forming their own development orientation or research area rationally based on existing knowledge reserves and learning experiences. With broad and solid professional foundation, clear and logical cognitive structure, complete knowledge structure, flexible ability structure, noble moral sentiment, and independent thinking and inquiry, students from general education can achieve mastery through a comprehensive study. They participate in social public affairs proactively and effectively. They will be able to understand the most important issues in the current and future society. They will become citizens with a comprehensive personality quality, broad knowledge horizon, and social responsibility. [1]

Differences and links exist between general education and other training models. General education emphasizes combinations between multiple disciplines instead of universal genius education. It educates students to think and analysis from an interdisciplinary perspective, which can deal with problems from a broader perspective of cross-disciplinary and cultural exchange. Compared with Specialized Education, general education emphasizes the formation of a broad and solid knowledge base after extensive knowledge of the main areas of human knowledge, and then forms or selects a



professional direction or field. Specialized education focuses on cultivating a particular field of expertise, knowledge and abilities. Compared with liberal education, general education is the inheritance and transcendence of liberal education in terms of knowledge function, social value and human development model. It is the integration and development of elite education and vocational education. Compared with humanities education, general education includes not only the content of humanities, art, and social sciences, but also the content of natural science and technology, which is broader and more inclusive.

3. General design education

3.1. *Universality and democracy of design*

Design is universal as a specific ability of human beings. As a verb, design is the intentional creation of a plan or specification, using a series of components, for the construction of an object or system or for the implementation of an activity or process. [2] As a generalized behavioural model of human beings, design is a comprehensive outcome of the three human talent abilities: skills of critical thinking, ability of creativity and ability of practice. Therefore, design is a behaviour based on human-specific abilities and is an ability that each of us has full potential to utilize. However, like other human beings, capabilities of design must be stimulated and cultivated. To a large extent, the existence and role of design capabilities depend to the circumstances in which the subject (whether individual or collective) live, and to stimulation and support provided by circumstances. Otherwise, design capabilities will be diminished or misguide to an invalid direction. [3]

The universality of design makes the activity democratic. As a unique problem-analysis and problem-solving ability of human beings, anyone with the motivation and opportunity can participate in design process, rather than the capabilities and activities of professionals engineers or designers. Compared with the professional design activities, the individual design activities in DIY (do it yourself) exist more frequently in amateur fields. They are self-driven and self-directed design or manufacture activities. The whole design process to the design object is more democratic and close to design subject. From the perspective of human history, this fruitful and creative activity enables human to actively participate in the design process at multiple levels and to express more individualized aesthetics through individual production, mass production or passive consumption. [4] Therefore, the democracy of design makes it into an interface and tool for humans to understand and transform nature and all things around. At present, the widespread popularity and application of the Internet has made the modern society more intellectual. The mass innovation design, open innovation design and user participation innovation design gradually emerge. In the future, the democratization of knowledge innovation in the whole society will be more remarkable. [5]

3.2. *Construction of General Design Education*

Branches of design encompasses a wide range of professions. In Chinese subject classification system, according to the *National Standard for the Quality of Undergraduate Professional Teaching in the General Colleges and Universities* promulgated by the Ministry of Education in 2017, the design category (professional code 1305) includes 9 majors in a narrow sense, including art design (130501), visual communication design (130502), environmental design (130503), product design (130504), clothing and apparel design (130505), public art (130506), crafts (130507), digital media art (130508), art and technology (130509T). In a broad sense, many disciplines, including mechanical design, architectural design, light industry, textiles, etc., can be included in the broad scope of design disciplines. A wide range of professional disciplines corroborates the universality, democracy, importance of design knowledge in human knowledge systems. It is precisely because of this, the construction of the general design education framework can not only start from the complicated disciplines, but from the nature and the commonality of design.

Design is the practical behaviour of human creative wisdom applying to material products and spiritual products. The whole process contains the subject, object, law and method. After analysing of

the process model of human practice, we can map to the design discipline model with design thinking, engineering technology and design materials as the core. As shown in Figure 1, the whole process of practice is the process by which a subject (human) subjects the object (natural or man-made). The most important thing in the practice is the thinking of the subject. In the process of practice, the subject gradually accumulates and masters the laws and methods. And the object is the material. The thinking, laws, methods, and materials map into the framework of design, evolve into design thinking, engineering technology, and design materials, which construct the core model of design discipline. Differences exist between the narrow and broad design disciplines. These differences can't change the reality that, human beings utilize design thinking to construct design ideas and frameworks, and process design materials with engineering techniques, and finally create artificial objects or forms that meet the human requirements. Therefore, the core model can basically summarize the core knowledge structure of the design discipline.

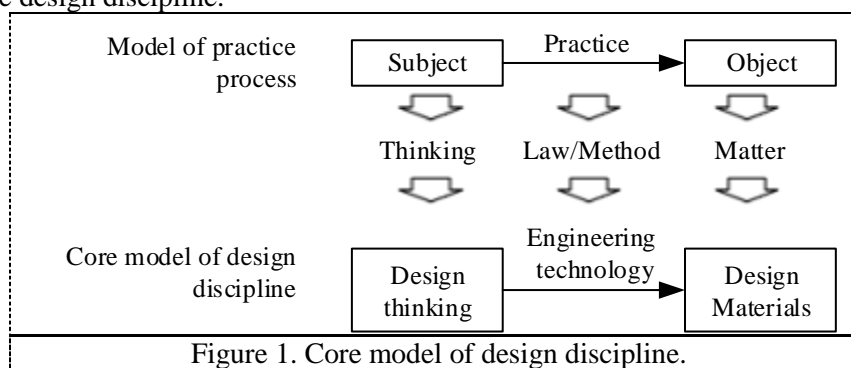


Figure 1. Core model of design discipline.

As the core knowledge of design discipline, design thinking, engineering technology, and design materials will be the main content of general design education. On the basis of the core model of the design discipline, the basic knowledge framework of the design discipline is summarized by combining the relevant knowledge of the discipline. As shown in Figure 2, in the design discipline knowledge system, design thinking, engineering technology and design materials are core, relevant knowledge categories have different focuses on application needs and practical issues in different fields, and can be gradually extended to design procedures and methods, innovative design methods, engineering design, and ergonomics, design cognition, materials and techniques, design expression. This system can basically cover the subject knowledge framework for entity design.

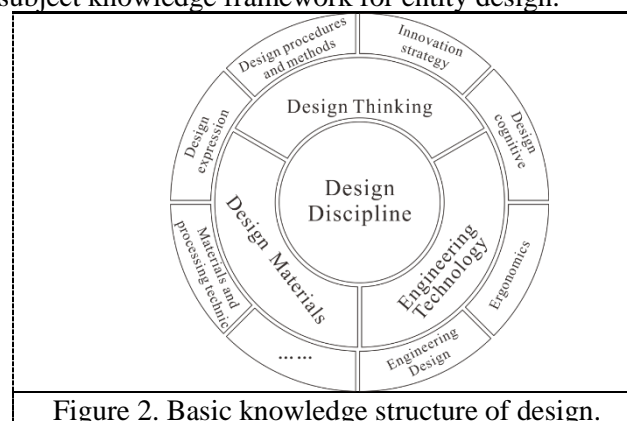


Figure 2. Basic knowledge structure of design.

3.3. The significance of designing general education

3.3.1. General design education provides individuals with more possibilities for development potential.

The total development of the individual is the embodiment of social progress. The broader understanding of the progress of all aspects of human knowledge is an important basis for the overall development of individuals, which is in line with the fundamental principles of general education. In

China, higher education has been too focused on the cultivation of professional talents for a long time, and neglected the role of general education in the general knowledge structure.

This education model results the disconnection of art and human disciplines with engineering and technology disciplines. As a tool to popularize engineering thinking and knowledge and cultivate comprehensive creativity, design general education can bridge the intercommunication between different disciplines in human practice. Facing complex human social development trends and directions, design general education can promote knowledge construction to a more comprehensive and accommodating framework for individuals, and create more possibilities in knowledge for individual development.

3.3.2. General design education meets the needs of the comprehensive knowledge structure of talents in the era of "Industry 4.0" and "Innovation 2.0".

The requirements of the new era for the knowledge structure of talents are comprehensive, especially in the context of the "Industry 4.0" and "Innovation 2.0" era. "Industry 4.0" is a heterogeneous and customized industry through data flow driven automation technology, from economies of scale to economies of scope, and the cost of homogenization and scale. [6] The traditional science and technology innovation activities are oriented by technology development and scientific research, operated by research personnel in the laboratory or company. The "innovation 2.0" era innovations are user-centered and society-oriented. In the knowledge-based society, "innovation 2.0" focus on people requirements. The challenge of this innovation model is gradually showing its vitality and potential value. [5,7]

The requirements for talents in the era of national innovation, or the requirements for people, are not the characteristics of traditional professionals. They need to comprehensively master all aspects of humanities, science and technology in a comprehensive knowledge framework, and have engineering thinking. On the basis of framework, they create innovation from different professions and perspective. General design education will play an important role in the cultivation of talents in the field of non-engineering. It is a feasible way to popularize and train engineering and systematic thinking, master the basic tools and methods of innovation, and understand the material basis of human production and living.

3.3.3. General design education will meet China's demand for the quality of compound talents in the manufacture upgrade.

The reform and opening up in the past forty years has pushed China to a point where deep transformation in manufacture is needed. China need to step into the next level to the manufacturing countries. In order to adapt to this development appeal, in 2015, China has proposed a series of ideas, plans and programs including the "Made in China 2025" plan, the "new engineering" construction, the "mass entrepreneurship, and the innovation". The core force that supports China's next step is the compound talents that adapt to the needs of development. The "Made in China 2025" document clearly puts forward the guiding ideology to meet these demands, including "taking talent as the foundation", "taking the development path led by talents", and improving the multi-level talent training system. [8]

At present, China's development needs not only a compound talented person with a comprehensive knowledge system, but also a variety of product life cycle related disciplines compound talent system. It includes the comprehensive "new engineering" training program, which cultivates engineering and scientific talents with the purpose of serving the needs of national strategic development and the construction of international competitive advantages. Also, human resource in design, management, human and art fields, with engineering thinking, understanding of design knowledge and integrated innovation capabilities are need. The multidisciplinary and complex talent cultivate system is the foundation of China's competitiveness and the basis for enhancing creativity and innovation. The cultivation of "new engineering" programs are more inclined to output high-level engineering and

scientific talents, while the engineering thinking, design methods and innovative thinking need to be cultivated with general design education.

4. General education of design materials

Materials, information and energy are the core foundation of modern material society, they shape the current human lifestyle. As an important core of design general education courses, the design materials course is of great significance to the design subject knowledge framework in the current popularization, and will assist the development of innovation education.

4.1. The role of design materials

4.1.1. Design materials are the starting point for design activities.

The selection of design materials is the most basic part in the design activity process, and the quality of materials choices will affect the taste of products directly. In the selection of materials, a lot of influencing factors should be considered, including the inherent physical and chemical properties of the materials, the organic combination of materials, people and the environment [9], as well as the appeal of material emotional expression in Immaterial society era.

4.1.2. Design materials are the interaction medium between design and human.

Humans use materials to compose design, create the material-human relationship with the design procedure. The basic function of design materials is the realization of product function. In addition, design materials will impact human in sensory channels, such as vision, touch, taste, hearing and smell. Among them, vision and touch are especially important to human perception. Therefore, the research of physical properties and Kansei Engineering [10] properties to design materials, called CMF(colour, material and finishing), have been developed in recent years. [9]

4.1.3. The iteration of the design material drives the iteration of the design.

Throughout the history of human development, the materials used in different eras determine the state of production and living at that time. From the Stone Age, the Bronze Age, the Iron Age, the Iron Age, the Composite Material Age, to the Nanomaterials era, the distinctive features of each era are reflected in the design materials. Different eras and materials are in the one-to-one relationship. There are no material beyond time to much, only stable developments step by step.

4.2. The generalized value of design materials

Material is the fundamental basis of all human production and living activities. It has always been a symbol of productivity and a milestone in the progress of human society. The ability to comprehend and utilize materials determines the shape of society and the quality of human life. The world is made up of matter. The design material is the matter entity that people use to make certain properties, such as machines, devices, structures, etc. Material is the material basis of human social life. The development of materials has caused changes in the times and promoted human civilization and social progress. Materials, energy and information are listed as the three pillars of modern science and technology in the new era of knowledge economy, and their role and significance are particularly important now and in the future.

Beginning with the British Industrial Revolution, mass production of products has entered the human vision. Based on the low social productivity, rare product selectivity, insufficient consumer purchasing power, and the shortage of goods, consumers pay more attention to the function, structure, price and service life of products when purchasing goods. In the early stage of the function-oriented design thinking, in order to increase market profit and reduce production cost, designers had used materials at the minimal level to fit the function and structural rigidity requirements. At that time the colour and surface finishing process of products were as simple as possible. [11]

With the rapid development of social, economy, culture and information technology, the diversified evaluation criteria of consumers make the decision-making in purchasing no longer simply under the guidance of “function first”. The characteristics of composite personality, aesthetics, experience and brand gradually become important references that influences purchasing decisions. The guidance of human beings’ requirements has gradually moved from "material" level to "spiritual" level. After all, design materials compose all the physical products that in a “spiritual level”. In the context of the human consumption system, whether as a producer, designer, consumer, communicator, bystander or user, all the system participators should understand hand master the material. This is the main significance of design materials in general design education.

4.3. The course of design materials

As the content of general design education, history of design material has two dimensions in knowledge system: the vertical dimension describes the design materials used in different eras, the horizontal dimension describes use of different materials at the same eras. With the two dimensions, the course of history of design material will construct a clear and complete development of design materials history.

The course is based on human history, design history, material technology and history, and lifestyle research. At the view of evolution in lifestyle, the course introduces the materials with the back ground information of society condition, economic characteristics and technology stage. In order to create a comprehensive image of materials, the possibilities and rationalities about materials will be analyzed and discussed in the course. The entire course is promoted layer by layer, according to the following sections:

- The relationship between human and material. This section introduces the development history of interweaving of human and design materials with special topics.
- Design materials of the Stone Age. This section introduces the selection and exploration of materials in the Stone Age, including the production, processing and use of stoneware, animal and plant materials.
- Design materials of farming and nomadic era. This section introduces the selection and use of materials in the farming and nomadic era, the changes happened in this era due to lifestyle characteristics, including the development and use of materials such as wood, metals, ceramics, and biology.
- Design materials of the industrial age. This section introduces the types and characteristics of design materials in the industrial age, including the origins of the industrial era, the discovery, development and use of metal materials, ceramics, polymer materials, new materials and other types of materials.
- Design materials of the information age. This section introduces changes in the use and development of materials in the information age, including the evolution of people's production and lifestyle in the information age, new materials and biological materials.
- Design materials in the post-industrial era. This section introduces changes in the use of materials in new context caused by social structure and social relationships in the post-industrial era, including materials for non-material design, wearable design, and emotional materials.
- Companionship - summary and discussion. This section summarizes materials in the process of the development and progress of human society. Design materials are the foundation of the era and the symbol of civilization. The history of human civilization is a history of using materials, making materials, and creating materials.

4.4. Significance of the history of design materials

This course introduces the historical process of human beings’ discoveries, developments and utilizations of materials in the activities of designing creation. From the perspective of the development of design materials, the course describes richness and colourfulness of human development history. The meaningfulness, characteristics and significance of the material foundation

in different stages of human society development will be the knowledge base in this course. And the course will help the participators to construct a scientific historical materialism and a sustainable development concept.

In the course, students from different majors have learned about the development history, physical and chemical properties, application scope, and twists and turns in development and use of design materials. They will understand engineering thinking and development. The content of thinking, iterative thinking, and historical materialism from course. Combining the original knowledge frameworks of different professional that students already has, the course will enrich their understanding of human society, material world and artificial world, and promote the improvement of their overall knowledge structure.

5. Conclusion

A history of human civilization can be understood as a history of human design, also known as the history of material development. Every new discovery and application of materials technology will promote design progress, which will bring about tremendous changes in social production and human life, and advancement of human society. The framework for designing general knowledge is to sort out the knowledge of design disciplines, and to enrich the general education. A more comprehensive general education will help more people build a more flexible knowledge system, strengthen thinking of design and innovative, and bring more possibilities for people's total development.

As the core of general design education, history of design materials course also serves as an early exploration of general design education. The course has achieved certain effects in improving the knowledge system and knowledge spread of design disciplines. Just like the material civilization and spiritual civilization of the human society moving forward, the history of design materials is constantly updated and iterative. The follow-up plan of this course will be gradually improved according to the development of the discipline and the needs of general education with scientization and, systematization.

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