

Interdisciplinary View on Design Education

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With rapid change of the connotation and denotation of discipline development, design is infiltrating deeply into the human society and transforming extensively our design education. However, in order to produce more significant influence to the real world, design is seeking new knowledge and practice at the junctions of different disciplines, which forces us to rethink the cross-culture and cross-discipline directions of disciplines.

With crossing and integration of interdisciplinary knowledge, the paper further analyzes the “knowledge” of design education and then constructs the organic combination of “five-access tendency” of design education—technology access, management access, sustainability access, business thinking access and design innovation access that conform to an interdisciplinary perspective. It is expected to break the barrier among the disciplines of technology, design, economy, environment and sociology. The aim is to create a brand new interdisciplinary open mode of teaching and enhance the quality of modern design education.

keywords: interdisciplinary; innovation tendency; design education knowledge, design education thinking.

I. Historical background of the interdisciplinary development of design education

From the different perspectives, such as discipline, culture, technology and economy, design fell into crisis once more in the 21st century (Bremner and Rodgers, 2013). The crisis of design also gets design education caught in confusion. How to cultivate the designers that the society needs? What kinds of design are required to serve China’s economic transition and satisfy the development demand for knowledge reconstruction? This is the



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question that all related teachers in universities and colleges, all related institutions and enterprises have been discussing.

With the great transition that information technology brings to human life, design and multi-discipline blending is permeating to enterprises, society, culture, economy, zoology, business and other aspects with irresistible influence. The society has an enormous demand for the professionals in design that can handle all kinds of problems under this background.

Under such pressure, on the one hand, the current challenge has exceeded existing designing personnel's coping capacity, and institutions of higher learning have to think about the mode of designing personnel training. An indisputable fact is current designing graduates' ability cannot meet the actual demands of the society and lots of graduates change their profession, causing severe loss of educational resources; however, the society, especially enterprises have been troubled with the difficulty in recruiting appropriate personnel (Zhang and Zhao, 2013). Against such background, the transition of design education, compared with other disciplines, is better to combine the result of current technology, society, economy and industry changes.

On the other hand, the driving force for innovation has turned from technology and market to society and culture. The rapid development of interdisciplinary innovation education creates a new communication site, and also constructs an interdisciplinary platform that spans time and space and is able to encourage co-creation and co-share (Fu, 2014). As an important component of society and culture, art design itself contains the core value necessary for information cognition, dissemination, and artistic expression. Therefore, promoting the integration and blending development of design industry is the inevitable choice of the global knowledge era and the transformation in design education field.

In conclusion, how to promote and guide interdisciplinary knowledge intersection and how to cultivate interdisciplinary open innovative designing personnel in order to drive the development of design discipline has become a pressing topic for discussion of current design education.

II. The fracture in the boundary of design disciplines and multi-disciplinary blending

The orientation of social demand finally drives the multi-disciplinary blending of design discipline education. How to comprehend discipline crossing design in the new age and search for wisdom behind education system is the brand new challenge facing current design education.

As shown in Figure 1, first, the difference of design education objects in different fields results in the different forms of design processes, design tools and expert knowledge. The designers to be cultivated in the future in fact relate closely with social practice development. The design education in the traditional time of design is merely the single technical expertise impartment; however, up to now, in order to meet the demand of mass market, its knowledge construction is increasingly tending to the crossing construction mode in social responsibility, commercial platform mode, system innovation and other directions rather than in a single or multiple disciplines. The development of new social media and new technology makes designers play more roles in the industry in this

transformation period, such as designer, artistic, consultant, strategist, corporate planner, conceptual designer, executor, media workers, information personnel, designer managers...

Second, there is also intersection and crossing between design and many other disciplines. Now, the boundaries of the closed systems of the design disciplines that are previously considered to be independent, such as ergonomics, engineering science and management science, have been broken and continue to dissolve (Bremner and Rodgers, 2013). As shown in Table 1, the key points of the changes in discipline boundary lie in that people have realized there is uncertainty in current occupation boundary, and the mobile employment mode among traditional design disciplines have become a normal state.

In addition, the infiltration and change by interdisciplinary education to our world is underway. Many appeals of modern design are just nascent in many social fields but haven't reached a mature mode. The project designs, such as those in business, management, environment, interaction and data visualization requires designers' close participation as the core of the projects; at the same time, the supports from different professional knowledge fields are also needed in this process.

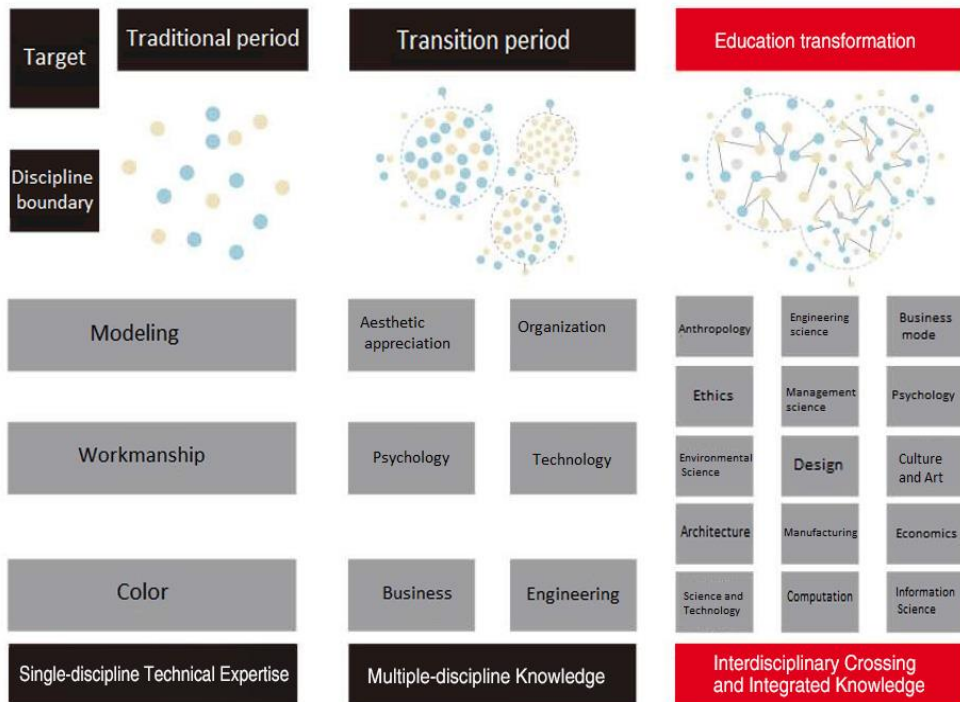


Figure 1 Boundary of design disciplines and core component of knowledge blending construction.

Table 1 Features of designer and discipline under different discipline boundary.

Discipline boundary	Designers' features	Discipline features
Single-discipline Technical Expertise	Individuals are able to understand one group of concepts or a kind of methodology. They can raise questions of knowledge within single discipline scope and make single technical contributions within this field.	It is possible to comprehend the single concepts and methodology that come from practice. It is possible to tolerate problems and only contribute design in this field.
Multiple-discipline Knowledge	Individuals manifest discipline ability and understand that their efforts must link with the efforts of those from other disciplines. Therefore, they set about to comprehend and apply some of the concepts used in these fields.	It is possible to comprehend differences of disciplines and demonstrate the ability to learn from other disciplines.
Interdisciplinary Knowledge	This problem solving mode synthesizes relevant cross-disciplines, for example, design science and engineering science. Some designs include many different fields. Some of the fields are related to integrated disciplines.	It is possible to comprehend the blending and integration of different disciplines, which have been interconnected in different fields of design itself.

III. The design thinking orientation of interdisciplinary design education

The mission and significance of interdisciplinary design education just lie in breaking discipline boundary and integrating the application of multiple-discipline knowledge with design thinking; cultivating excellent talents who have multiple cultural perspectives and interdisciplinary team working ability and who have the courage to solve actual problems and embrace actual challenges; and training versatile talents to serve the demand of service industry (College of Design and Innovation, 2016). What this mission embodies is the discipline construction within the system. This mission emphasizes the result of innovation development more. The demands of design education, design practice and design researches are recognized once more extensively.

As shown in Figure 2, the fundamental objective of interdisciplinary design education is to make students seek new knowledge and practice at the junction of different fields. Namely, it is to improve various complex systems through “knowledge integration” and “knowledge blending” to provide unique knowledge experience for students; to make knowledge blend with the constantly changing environment so as to increase the difficulty for students to solve problems and communicate with others and to enhance students’ design practice, problem solving, teamwork, communication and other abilities and employment competitiveness; to develop passageway to contact with enterprises from multiple fields for students through interdisciplinary knowledge integration and design practice courses and

allow them to get the opportunity to know about enterprise integration operation mode before they join the society; meanwhile, to join relevant innovation contents and provide entrepreneurship cultivation, entrepreneurial knowledge reservation and the entrepreneurial application opportunity at school for students.

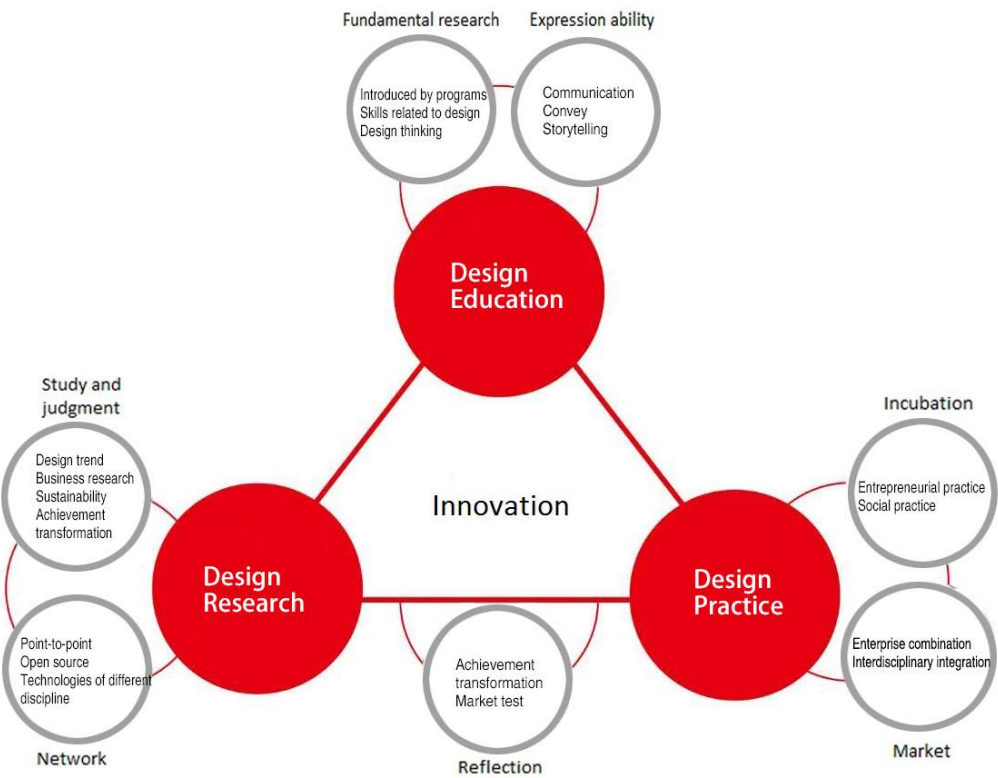


Figure 2 Thinking orientation of interdisciplinary design education.

The knowledge crossing mode of design research is undergoing new changes along with social and technical transformation. To see this clearly, we must consider the emerging situation—open source and point-to-point working method make new education transformation possible (Manzini, 2016). The application of internet and other high-tech technologies will form a system to involve more and more students. In fact, inspired by the point-to-point and open source spirit, various design teams may develop design projects and studies in accordance with their resources and opportunities; meanwhile, it composes design study activities on the grand network together with other similar teams. This is an open design study plan, through which, students may handle some complex issues, and obtain explicit, discussable, passable knowledge integration that can be accumulated (Manzini, 2016).

On the other hand, the sharing of this design research information is free, for example, design trend, business studies and sustainable studies, etc.; the most important aspect of

all is it is possible to put forward some valuable untraditional and critical points of view and thus facilitate achievement transformation; in turn, it can promote open research program of courses and the progress in innovation and entrepreneurship. Therefore, the roles schools play shall be guiding traditional design to sustainable development of creative design.

The application in design practice provides design thinking tools and methodology for the open education of students, thus cultivating interdisciplinary creativity and research. It encourages that students' practice shall lay emphasis on "open style interdisciplinary cooperation mode" and it is dedicated to bridging the gap between design research and the change in real world, thus turning existing design practices into a better practice system. In practicing field, experts in and out schools and commercial resources are brought together. Aiming at the innovation works formed during teaching, it is necessary to carry out further development and create socialized and industrialized opportunities for design achievements, striving to hatch and produce independently innovative products that have industry-leading significance (Fu, 2014).

IV. Open innovation tendency under interdisciplinary design perspective

Open creative design and innovation blending are the intrinsic requirement of interdisciplinary design education. It is to construct the "five-access tendency" of interdisciplinary open innovation. The "five-access tendency" includes technology access, management access, sustainability access, business thinking access and design innovation access. The five components shall be integrated organically and thus it constructs the "five-values" of interdisciplinary design, namely: economic value, knowledge value, innovation value, client value and ecological value. (As shown in Figure 3)

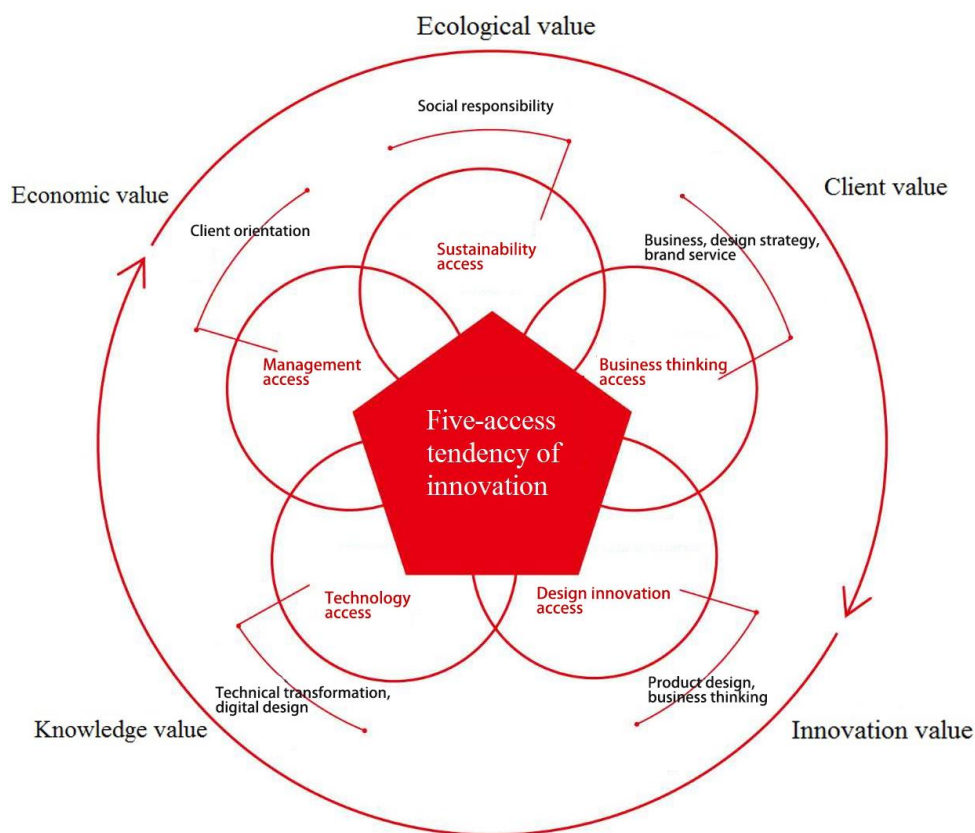


Figure 3 Construction of the “five-access tendency” of design under interdisciplinary perspective.

1. Advanced technology practice be introduced to the design education

Rediscovering new technology is an important education method (Lou, 2015). With the development of knowledge-based economy, the high-tech innovation has not only promoted industrial transformation and upgrading, but changed the business models as well as improved the design education environment. The characteristics and application of science and technology have exerted profound and significant impacts on traditional forms of enterprises and human life styles. When the digital technology combines with daily life, rest and recreation or even education of common consumers, the technology innovation and application exhibit infinite room for development, also leads to unlimited business opportunities for various kinds of creative industries (Lin et al., 2009). As a matter of fact, the successful commercial designs are in need of technology supports which enable the realization of diversification of dissemination forms and performance results for design information, thus meeting the requirements under Social Orientation, Service Orientation and Experience Orientation.

How to apply the technology into relevant design education and whole society, we should focus on the cultivation sector for digital strategy innovation ability (as shown in Fig. 4), digital culture creativity contact, digital experience media strategy, digital virtual experience

of future in order to facilitate students to study and practice multi-dimensional designs in theory as well as in practice level. Following the aforesaid rule, one experience practice system based on “strategy and experience” has been established in accordance with characteristics of different design professionals as well as students’ background knowledge for the purpose of optimizing scientific and commercial development. Within such system, students could understand and experience the whole business models from the analysis of entrepreneurial environment to determination of business forms, even to refined products service modes and product marketing concepts through the combination of technology and actual practice.

This trend could be applied to every sector of education and society accordingly. The Virtual Environment concept mentioned herein: do you have the awfully experience standing in supermarket check line, or waiting in line for fruit weighting? Then the Virtual Environment technology could help you to solve such problems. During the teaching course, the combination of digital virtual experience of future with visual design would enable students to understand and experience the whole procedure of technology-based entrepreneurial, and thus complying with the dynamic trend and education orientation of social development.

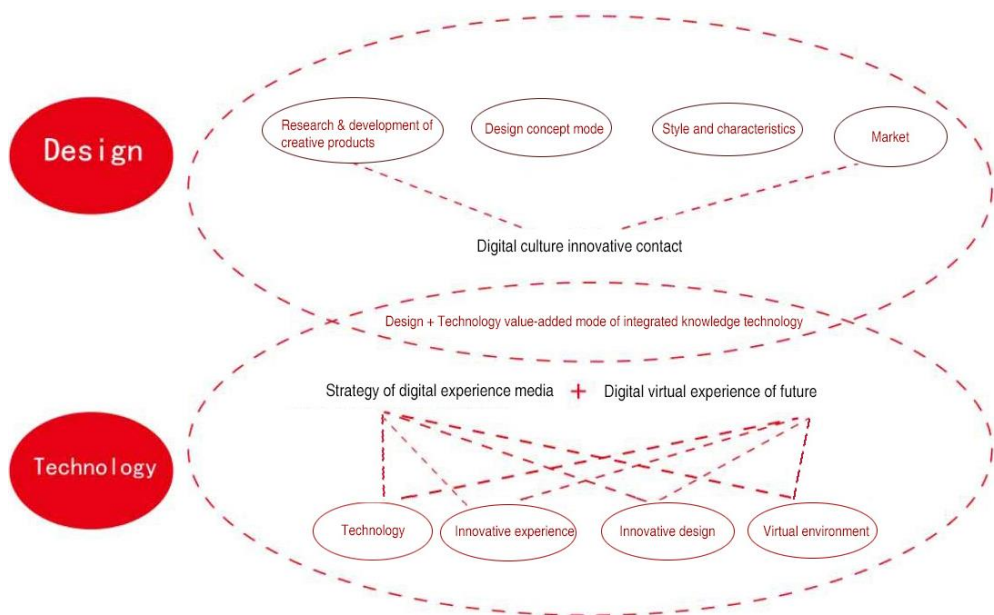


Figure 4 Design + Technology: Interdisciplinary knowledge creates values.

2. Advanced management innovation be introduced to the design education

Rediscovering the design management has great influence on economic value, which leads the students to realize their designs and careers in the future would affect economy (Lou, 2015).

The management is used to guide design development. In current society, design interacts with society, environment and business inevitably. Being a significant matter for economy

and acting as the communication tool as well as business strategy, design management has promoted its status dramatically, and pushed the actual potential of design to enterprise's agenda (Best, 2008). Furthermore, the basic goal of management is to improve the efficiency of product development in order to create competitive advantage (Galli, 2016). Enhancing the scientific design management, using the management to ensure optimal results from design; through meaningful change, the management not only drives innovation, but influences enterprise development programs. In terms of education, design management contributes to fostering the students' awareness to be prepared for enterprises' future development, which consequently shaping more comprehensive and strategic education models.

3. Sustainable concepts be introduced to the design education

"Ecological Balance" will lead the green, intelligence and personality characterized by sustainable education. The sustainable design education requires considering the economic, environmental, moral and social problems in balance, pursuing the harmonious development of human and environment, which not only satisfy the needs of contemporary generations, but ensure the sustainable development of descendants; on the other hand, "Social Responsibility" facilitates the structure of interdisciplinary knowledge for sustainable design and education models, which promotes the shaping of sustainable education development models and life styles.

4. Business model thinking be introduced to the design education

The introduction of business model thinking into education is an innovative process, which focuses on the human nature and people-oriented concept in essence. Developing the creative industrial courses based on design thinking, fostering the creative design ability of team and combing the industrial needs to provide design methods in order to support the students to develop brand-new products and enhance their technical ability; during the term, observation, cooperation and quick learning are stressed. Meantime, being a new design education model and teaching method, visualizing the ideas and modelling the quick concept as well as analyzing the business models could promote students to discover the unsatisfied needs and opportunities, thus creating new solutions. Adopting such education method and combining the problems during the courses for analysis is helpful to learn and practice the spiral progressive thinking and working methods

5. Design innovation be introduced to the design education

Design could not only drive the innovation, but promotes the changes of social life style and new economic transformation (Lou, 2015). When starting innovation through design, and using design to intervene into the primary stage of integration education, we could bring the effects of design and multidisciplinary influence into people's daily life which is utilizing the business thinking earlier (Xin, 2015). The promotion of creative products based on design background will becomes one part of the innovative system for design education.

V. Design practice course experiment based on interdisciplinary education concept

For the design courses based on the interdisciplinary concept, the overall objective of the experiment is to foster the idea of "design with the future", to make the designers the

program providers for future challenges, and to let students think on design in encouraging experiments of different projects. Based on this goal, the sustainable design practice curriculum under the background of interdisciplinary education has undergone subversive changes from design tools, design methods, design process and design research. Each student will play a different role in the design process.

First, according to the different subject choice, the course focuses on the "creative design" of the interdisciplinary education of knowledge, and faces the challenges with industrial value and social significance. Through the challenging curriculum, and with the help of cultural design experiment, media experiment, commercial sales experiments, student knowledge will be promoted to integrate and the potential of students will be released. The experimental results will be used to establish a good knowledge base. Cooperation with enterprises is made to increase experiments' benefits and to attain a win-win situation. Besides, in the process of self-learning, students' capacity for sustainability will be developed and new values will be reshaped.

Challenge Method 1: Encourage students to do small projects, give students unique design challenging topics.

These small-scale projects are to encourage students to find, and to focus on the achieving. Giving challenging tasks, is to encourage students to learn different skills with their personal strengths, so that they can make their design thinking out of the ordinary. The "knowledge economy" drive effect is used to promote interdisciplinary creative goals. It is the future development trend that students can achieve the growth of knowledge and cultivate unique business thinking. Through "personal interest" and "problem solving", the designers are bringing the traditional design to the "sustainable development". As shown in Figure 5, though for our undergraduates we have no jewellery courses, students with love of jewellery, are combining their base of aesthetics, technology and business model, and developed some creative custom projects of integrated materials jewellery.

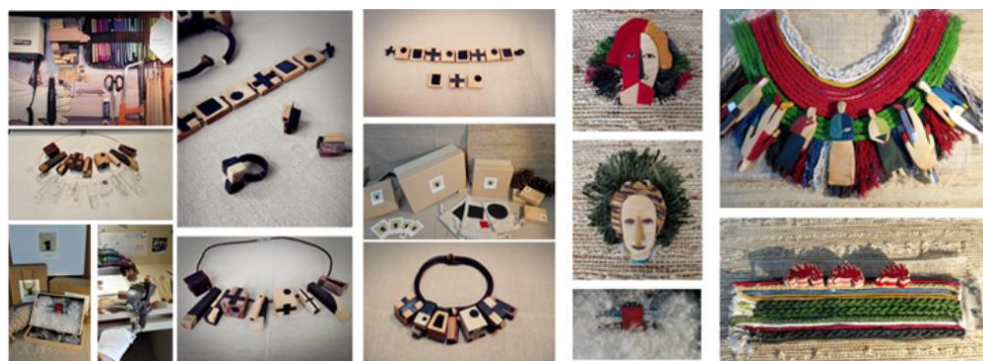


Figure 5 Students' business design products from steps of "personal like", "solution" to "sustainable development"

Challenge Method 2: Integration of teaching practice by combining with the policy of entrepreneurship in Beijing universities.

Based on the Beijing High School Talent Cross-training Program on Entrepreneurship, we encourage students to take innovative discovery and new applications under the national

policy. We select and establish the design direction and objectives through the interdisciplinary policy resources research, and choose topics that are closely related with the course by combining with the content of course teaching. We enable students to experience the design of entrepreneurship education. We add value to design through cultural and creative thinking, and promote entrepreneurship through culture, creativity and design process. In this way, we achieve the goal of combination of technology, creativity, design and business knowledge economy (Lin 2009). In the practical operation, the entrepreneurship must pass the "curriculum" to "the entrepreneurial policy", then arrives at the mode of creative business product under guide of entrepreneurship policy. As shown in Figure 6, one work of 2016 graduates, combined with some related policies of the Beijing High School Talent Cross-training Program on Entrepreneurship, is a product of "paper word only" children's text toy. The main text which is designed with semi-enclosed structure, full structure, up-and-down structure, left-and-right structure, and graphics, can generate more than 1400 characters. Through the plug-in design, it can be used for both literacy education and games like three-dimensional intersection paper toy, word grouping games, integrated games, digital games, games of shape, games of colour and others.

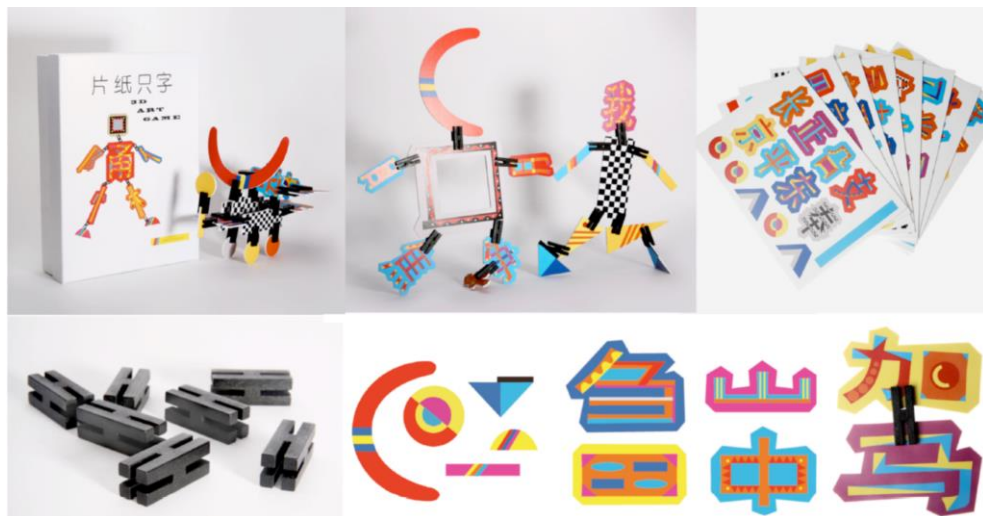


Figure 6 Graduation Design products for the Beijing High School Talent Cross-training Program on Entrepreneurship

Challenge Method 3: Encourage product market feedback and patent application and protection

The course includes interdisciplinary research, creative design and user needs and feedback analysis, product strategy points searching, both business, value creation combining society, environment, and users. It's achieved through a wide range of experience touch points like product experiments and patent protection. In the process, the methods of business model analysis and sustainability assessment are used. For example, before massive production in market, the "paper word only" text toys are tested and analyzed in the New Oriental Bubble Kindergarten for class of kindergarten-to-primary-school transition, and creative courses in Muxidi campus.



Figure 7 User experience and analysis of students' creative work.

Challenge Method 4: Group cooperation and teamwork training and coaching

Students from different areas, e.g. from architecture, business, informatics and so on, are gathered to cooperate with each other. Individual working is changed into teamwork in the form teaching practice. The knowledge is divided into different optional modules: design thinking and technology preliminary, precise development and rapid prototyping, business models and products and services, integrated presentation and publication and promotion. The practical teaching is taken in the form of teamwork, and the corresponding teaching tools are designed according to each module. The students are expected to master a variety of knowledge in the process of module structuring. At the same time, consultants and experts in science and technology, media, business are invited, to provide an extension of the knowledge, so that students can build their own knowledge architecture with their own characteristics.

On the other hand, we encourage the integration of different disciplines of expertise into design and translated it into research results, and actively assist students to develop creative counselling in different disciplines, which finally lead to the potential inner intelligence of students. We are expecting that students have a lifetime learning enthusiasm and motivation.

Challenge Method 5: Actively promote enterprises to join the design teaching

With the media of design, we guide students' business cooperation with enterprises and collaborative innovation work. Students should be able to face and undertake design work systematically and in an all-round perspective. We invited designers and R & D supervisors of related fields to give keynote speeches and to work as project instructor. Students can visit related workshops, understand the product design process, provide samples and prototype for the enterprises and provide technical support for the design. Ultimately, the good programs are chosen for prototype making. In this process, students' creative interests are stimulated, and their sense of accomplishment is produced.

VI. Conclusion

The development, change and confusion that design discipline and design education face are global challenges of the time. Therefore, designers must absorb more knowledge, think more extensively and switch their roles in order to suit the need of social development. Only in this way, can an open, compatible and continuously developing design thinking logic and matching interdisciplinary knowledge system be formed in this age of knowledge economy.

Accordingly, the students are able to suit the demands of design works, researches and innovation in the future.

The change in the demand of design personnel by the society finally requires design education to make corresponding intersection and transformation so as to suit the steps of the development of times. Through the discussion of design thinking and innovation education during design education transformation under an interdisciplinary perspective, this paper realizes interdisciplinary knowledge integration and establishes a mechanism to cultivate the high-quality professionals boasting a wide range of knowledge; as it emphasizes the execution of crossing-design, it also stresses on the integration of students' academic studies, researches and knowledge. It dedicates to fundamentally alter the traditional education mode centring on single knowledge and cultivate new force of designers which does not only comply with the demand of the time but also stay down to earth. Only if the barriers between disciplines are broken and different disciplines are combined together, can the excellent designers who are both professional (Zhu, 2012) and open-minded be cultivated. Further, only in this way, can the diversified demand of different markets be really satisfied so as to give specific benefits and contribution to national economic development.

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