

Reconstructing the training system of garment engineering education with the characteristics of art engineering

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ABSTRACT: The Ministry of Education of the People's Republic of China issued in 2012 a publication called *Catalog of Majors for Undergraduate Students in Institutes of Higher Learning*. The authors discuss in this article the *apparel major*, as shown in the new edition of the catalogue. Based upon a proposed theory of art engineering and its application to the apparel-related majors listed in the new edition of the catalogue, several important issues have been put forward that should be noted in the direction, structure and training, within an art engineering specialty. The Department of Garment at the University of Minjiang, Fuzhou, featured in this article provides an example.

INTRODUCTION

Without a revolutionary theory, there can be no revolutionary movement. In reforming an academic discipline and building a specialty subject, only continuous innovation guided by theory can lead to the development of a system based on scientific principles, within the time allowed. The knowledge within the discipline must be defined together with the place of that knowledge within the appropriate academic scheme. An academic course in higher education is the basis for training a skilled workforce of professionals. This is where students receive the knowledge and training to develop their capacities in one or more disciplines and, then, to find the right employment as professionals.

After two years spent integrating, combining, renaming and refining, the Ministry of Education in 2012 issued the new edition of the *Catalog of Majors for Undergraduate Students in Institutes of Higher Learning*. This edition relates to plans for the redevelopment of undergraduate education affecting millions of students and thousands of institutions. The categories of disciplines in the new edition have increased, from 11 to 12, with the new category being art. The categories of listed majors have increased, from 73 to 92. The actual number of majors has decreased to 506 from 635; this latter included 249 majors listed in the catalogue and 386 others. The new number of 506 consists of 352 majors listed in the catalogue and 154 others.

The authors of this article address issues to do with the direction of, and training in, apparel-related majors listed in the Ministry of Education's *Degree-awarding and Talent Training Discipline Catalog*, issued in March 2011 and a new edition published in September 2012. The direction and training provided by the art engineering apparel major course, is examined through an example from the Department of Garment at the University of Minjiang. A basic framework is outlined by which local institutions can reform the direction and training provided by apparel majors in line with the new catalogue.

THE DISCIPLINE OF ART ENGINEERING

The Birth of Art Engineering

With social progress and the development of science and technology, there has been a gradual change in the theories underpinning academic disciplines. After the 18th Century, natural science began to be viewed as separate from philosophy and was divided into several branches or disciplines, such as physics, chemistry and astronomy. As science and technology developed, these individual disciplines also began to have second-level and third-level disciplines, e.g. organic and inorganic chemistry are second level disciplines of chemistry. The path to becoming a powerful state during the Renaissance was the development of navigation, and during the Industrial Revolution, it was the railways. The path to becoming a powerful state in the 21st Century must be the development of creative industries. Art as a discipline was

founded in the 18th Century and engineering in the 19th Century. With the progress of science and technology in the 20th Century, as well as the market demand for interdisciplinary talent and skill, art engineering as a compound discipline has emerged [1].

The Ministry of Education's *Degree-awarding and Talent Training Discipline Catalog (2011)* indicates that the degree of art or engineering can be awarded under the discipline of design. The authors point out that the design module (code 1305), is more appropriately named than were the former modules *art design* or *design art*. The design module defines the developments required in the discipline and the demand in the market for its students. It also gives clear direction on training in art engineering at higher education institutions.

The authors have drawn up a guide to the apparel-related disciplines and majors, after analysing the Ministry's catalogues - *Degree-awarding and Talent Training Discipline Catalog (2011)*; the *Catalog of Majors for Undergraduate Students in Institutes of Higher Learning (2012)*; and the *Catalog of Majors for Undergraduate Students in Institutes of Higher Learning and Major Introduction*. The last was edited by the Department of Higher Education, within the Ministry of Education (see Table 1). Note that the Catalog of Majors for Undergraduate Students in Institutes of Higher Learning (2012) also has the special major, 081604T Apparel Design and Production.

Table 1: A guide to apparel-related disciplines and majors.

Discipline category	Discipline name/major	Major code/Major name	Degree-awarding
Engineering	Textile Science and Engineering Textile	081602 Apparel Design and Engineering	Engineering or Art
Art	Design Design	130505 Fashion Design	Art

Basic Concepts of Art Engineering

Broadly speaking, art engineering could be viewed as a *modern science* devoted to the creative industries and associated technologies. It was born at the end of the 20th Century; hence, with about 30 years of history worldwide. Since its birth, art engineering has been related closely to creative industries that are active in society and promote the artistic development of industry and the industrialisation of art.

Chemistry and chemical engineering are disciplines identified as being science and engineering respectively, although there is a close relationship between them. Chemistry focuses on the details of atoms or molecules in reactions, while chemical engineering mainly studies the process of large-scale industrial production of materials. Chemistry is a basic discipline, while chemical engineering is an applied discipline. Chemistry emerged as a discipline in the 19th Century and chemical engineering at the beginning of the 20th Century. There is no doubt they belong to two different disciplines [2].

Similarly, art is referred to as visual product design in art engineering and engineering in art engineering is the specific application of technology. Visual art design is *plastic*, in that it makes use of lines, colours, forms and materials by which to create artistic images; a process which involves modelling and shapes. Art engineering refers to creative design that relies on forms of plastic art or visual art and which is based upon engineering technology. Art engineering, in terms of narrow definition, refers to the design activity that targets a specific product and makes use of engineering and art to integrate and optimise the shape, structure, function and packaging of the product.

Also precisely, the art engineering outlined in this article is equal to *design* with code 1305 in the *Degree-awarding and Talent Training Discipline Catalog (2011)*. With design (coded 1305), either a degree of art or engineering can be conferred. Art engineering is the combination of art and engineering technology, being interdisciplinary and integrating features of both. It may be characterised as being engineered art or artistic engineering. The majors in undergraduate study that belong to art engineering include apparel design and engineering, fashion design, visual communication design, environmental design, product design, design of public places, digital media art and landscape architecture. It is an integration of art and technology.

The *Catalog of Majors for Undergraduate Students in Institutes of Higher Learning (2012)*, clearly shows that under 081602 Apparel Design and Engineering, either a degree of engineering or art can be awarded. Similarly, under 082803 Landscape Architecture, either a degree of engineering or art also can be conferred. Majors, such as these have features of art and engineering and, hence, belong to art engineering.

It should be noted that, in the Ministry of Education's 2012 catalogue of majors, a Fashion Design major has been added to that of Apparel Design and Engineering. For reference, in the American CIP-2000 (the taxonomic coding scheme called Classification of Instructional Programs), there is no major of Apparel Design and Engineering listed under engineering. Only Textile Sciences and Engineering is listed. In the section for art in CIP-2000, Fashion/Apparel

Design is listed under *Design and Applied Arts*. This is similar to design offered in China. Also Fiber, Textile and Weaving Arts is listed under *Fine and Studio Art*. This is similar to fine arts in China.

According to the degree-awarding reference manual (2005) adopted by colleges in Taiwan, *art* and *design* are names used without differentiation, which implies the merging of art and engineering. To be specific, the core of design is product design because it is the design activity that makes use of engineering and art to integrate and optimise the shape, structure, function and packaging of a product. It is on this basis that the degree of design is awarded in Taiwan.

New Disciplines Added to Catalogues Since 1990

In comparing the *Doctor and Master Degree-awarding and Graduate Training Discipline Catalog (1990)*; the *Doctor and Master Degree-awarding and Graduate Training Discipline Catalog (1997)*; and the *Degree-awarding and Talent Training Discipline Catalog (2011)*, it was found that the number of disciplines over the years has grown (see Table 2).

Table 2: Growth of the number of disciplines.

	1990	1997	2012
Number of disciplines	72	88	110

The following modules are listed under the discipline *design*, which is numbered 1305 and under which the degree of art and engineering can be conferred:

- 130501 Art Design;
- 130502 Visual Communication Design;
- 130503 Environmental Design;
- 130504 Product Design;
- 130505 Fashion Design.

The Majors Catalog lists the following two items:

- 081602 Apparel Design and Engineering (Note: a degree of engineering or art can be conferred under this);
- 082803 Landscape Architecture (Note: a degree of engineering or art can be conferred under this).

Both of these majors have art engineering characteristics.

TRAINING FOR APPAREL DESIGN AND ENGINEERING

Introduced in the *Catalog of Majors for Undergraduate Students in Institutes of Higher Learning and Major Introduction*, are the training objectives for the majors, 081602 Apparel Design and Engineering and 130505 Fashion Design.

Training in Art Engineering

After an in-depth study of theory and practice of the reformed art engineering apparel majors, the authors of this article regard apparel design and engineering and fashion design as belonging to art engineering. The art engineering training methods are considered to be engineered art and artistic engineering. The methods are *...a combination of art and engineering and the integration of art and science* [3].

Training for the Art Engineering Apparel Majors

The University of Minjiang insists that the institution's teaching ensures *...the specialty is industry-oriented, teaching [is targeted to] the industry, scientific research is enterprise-related, and the teaching promotes [...] employment*. It centres on the development of the students; regards practical skills development as being at the core of teaching, co-operative education as the main method of teaching and teaching as vocationally oriented. Teaching must *...integrate art and engineering, theory and practice, and teaching and research*. Further it should cultivate applied skills in art engineering, with a strong emphasis on practice, adaptability and innovation.

Training goals: the goals for training students for apparel design and engineering and fashion design are not purely either engineering or art, but a combination with features of both art and engineering.

Goals for Training in the Art Engineering Apparel Majors

The goals are twofold: applied specific skills and higher level skills. At present, the objective for training in the majors of apparel design and engineering and fashion design is at the applied specific level, but not at the higher level.

Knowledge structure: it is recommended that majors in apparel design and engineering and fashion design should offer core courses as outlined in the catalogue, Apparel Design and Engineering. Three examples: 1, 2 and 3, for the core courses in the introduction to 081602 Apparel Design and Engineering are given in the new 2012 edition of *Catalog of Majors for Undergraduate Students in Institutes of Higher Learning and Major Introduction*. This requires that institutions should target training at the demands of local industries noting that the teaching occurs within colleges.

The marketplace demands well-qualified, talented individuals. Rapid development in the apparel industry requires that the apparel majors taught in institutions should meet enterprise demands in terms of professional practice, adaptability and innovation. Other qualities matter too, such as good professional ethics.

In summary, the goals of talent training for Apparel Design and Engineering and Fashion Design in undergraduate majors should: a) meet the needs of social modernisation; promote all-round develop both morally and intellectually; produce the knowledge and capability for apparel design for production and marketing; grasp the fundamental principles, methods and skills of apparel design; b) grasp the principles of apparel composition, grading technology, material application, production technology and management; have good adaptability in the apparel industry; be capable of apparel development and design, production and marketing in enterprises and institutions of apparel design, manufacturing and marketing.

TRAINING METHODS FOR THE ART ENGINEERING APPAREL MAJORS

To promote quality training for the art engineering apparel majors and to cultivate both applied and professional creative skills of art engineering in the apparel industry, the authors propose reforms, as follows:

Reform of Training

This can be done by broadening the approaches to training. For example, use *knowledge, capability, quality and strengths* as guidance and insist that *...the specialty is industry-oriented, [target] teaching at industry; that scientific research [be] enterprise-related to enterprise; and [that the] teaching promotes ... employment*. Practical skills should be at the core of teaching; with co-operative education as the main method and vocational relevance as a basic requirement. High-quality applied art engineering should be cultivated, and with a strong emphasis on practice, adaptability and innovation. This would completely change the way that training is carried out [4].

The 4 Platforms + 4 Modules Training Mode

The training scheme for majors in apparel design and engineering and fashion design at the University of Minjiang closely focuses on applied skills. The training mode of *4 Platforms + 4 Modules* was gradually established. The meaning of *4 Platforms* is that courses in each major should consist of a general basic platform, a discipline-based platform, a specialty-oriented platform and an expanded-specialty platform, while the *4 Modules* consist of cognition, experiments, practical training and social practice. This mode guarantees basic standards, diversity and personality development of the students, and promotes students' adaptability to society.

Adapting the Curriculum to Requirements of Art Engineering and Artistic Science and Technology

The new curriculum breaks away from traditional concepts by highlighting those of art engineering. The curriculum is now built around individualised art courses and modularised engineering courses. It integrates *...art and engineering and [combines] humanities and science*. The curriculum was developed in accordance with the principles of *merging, reducing, cutting, transforming and adding*.

This means that two to three related courses have been merged into a new, single course; some specialised courses with many credits and class hours have been compressed, to make room for new courses; some basic courses have been cut to reduce the numbers and some specialised courses have been transformed into practical or *applied* modules. A number of the new courses added are closely related to industrial development and this will offer opportunities to keep the courses up-to-date by including details of new technologies.

Demands for Diverse Talents

In this diverse, open and competitive era, society not only requires a large quantity of art engineering professionals, it also demands there be a diversity of skills. The authors centred on the demands of the local economy for diverse undergraduate training.

CONCLUSIONS

Reform of academic majors of art engineering, such as Apparel Design and Engineering and Fashion Design, is set to continue. This reform covers the objectives and specification of the major, the training process and the diversity of teaching. Three different methods are suitable for the specific areas.

First, the theory of Art Engineering: art is the basis of art engineering, while art engineering is the specific application of art and technology. Art and, especially art design, is *plastic* art or visual art that makes use of lines, colours and forms to create art images in space through modelling, colours and figures. Art engineering, especially design, refers to creative design that relies on the forms of plastic art or visual art which, in turn, is based upon engineering technology. To speak precisely, art engineering (in the narrow definition of design) refers to design activity that targets the specific product and makes use of engineering and art to integrate and optimise the shape, structure, function and packaging of the product.

Art Engineering is the combination of art and engineering but is interdisciplinary and can be characterised as engineered art or artistic engineering. Undergraduate majors that belong to art engineering include apparel design and engineering, fashion design, visual communication design, environmental design, product design, digital media art and landscape architecture. Art and technology are integrated.

In terms of training in Art Engineering: engineering and art, the focus is not precisely on producing engineering *plus* art, but rather, engineering education accompanied by art education. Art and technology all serve to implement the design. Thus, this type of discipline is particularly suitable for students who wish to major in apparel design and engineering, fashion design, product design and textile engineering (such as textile design). Art education can make the course content, the research and corresponding training *close* to the production of the products.

Training methods for Art Engineering: art and engineering focus on art and engineering education. The tasks are based on art and technology, which are relevant to design. This is suitable for students majoring in apparel design and engineering, fashion design (apparel art design), environmental art design and landscape design. The engineering education component enhances students' designs, in terms of operability, and can bring new perspectives on design possibilities.

Art Engineering training integrates art and engineering with a combination of humanities and science. This is suitable mainly for students majoring in apparel design and engineering, fashion design and product design. Students of art and engineering are often recruited to this type of major. The integration of art and engineering, and the combination with humanities and science is reflected throughout the training.

The goal for specialty curricula is to produce students with high-quality professional skills and who meet the needs of society. To improve the teaching of the apparel major and to cultivate high-quality, professional and applied skills in students with strong abilities in practice, adaptability and with a spirit of innovation, educators must do the following:

- adjust the content and methods to optimise their structure;
- upgrade the training scheme; upgrade the teaching content;
- improve the practical teaching;
- enhance the effects of the teaching.

These, then, gradually fulfil the expectations raised by the higher education's system for teaching the apparel major.

The theory behind art engineering discipline and the construction of related specialties are far-reaching in terms of education. In view of trends in discipline development, it is necessary to deepen understanding of the art engineering discipline and its related specialties. Building on what already has been achieved, further integration is required of the courses of art and technology, and further reconstruction of the teaching of the art engineering apparel major. More research on the discipline of art engineering, and an exploration of the training of the art engineering apparel major would also be of benefit.

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