

Proposal of Fashion Design Artwork Education Method Using the Three-dimensional Modeling Principle: Basic Education for a University Curriculum

Hyunjoo Kim

Department of Fashion Merchandise Design, Dankook University, Yong-in, Korea

Abstract

Background This study proposes solid design education methods that use step-by-step approach processes by utilizing body – which is a solid modeling convergence design methodology that target students majoring in fashion design.

Methods This study reviewed books, professional academic journals and online data, related to the concept and principles of modeling in order to provide the basic foundation for modeling a curriculum for a fashion design course in higher education. Moreover, we documented the goal of and distinction of education in solid modeling in the fashion design field.

Based on the information above, we proposed a curriculum for an artwork workshop. The workshop develops a solid modeling structure with consideration of a three-dimensional modeling exercise that applies body, light, space, and movements. The following curriculum has been applied, verified, and supplemented as an academic program for two semesters from 2011 to 2013 at Univ. E located in Seoul and Univ. D located in the Gyeonggi Province, South Korea.

Results Four stages of design education methods for fashion design were proposed for education, validation, and supplementation.

Stage 1 is [basic modeling and processing] and Stage 2 is [body analysis] in which the relationships of form, volume, and structure of the human body are reviewed and analyzed. Stage 3 is [cube spacing training], in which formative functions of materials are analyzed for the development of plane to space. Stage 4 applies [integration with human body, application, and deployment], in which theoretical education and practices of defining the data analysis, developing design plans, and delivering design. Through the workshop, students completed comprehensive modeling work through detailed sketches of structures that considered the volume of the human body, dynamic movement, space, and light.

Conclusion Through this research, we developed and proposed a curriculum that combines theory and practice, which allows students who major in fashion design to understand all basic modeling elements as media of the ‘human body’. As a result of applying and supplementing the curriculum for three years, we verified design and aesthetic senses, and self-discovery for each student.

Thus, a more systematic education curriculum of three-dimensional modeling is expected in the fashion design field.

Keywords Fashion design education, Solid modeling, Teaching method, Solid modeling education, Design education

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1. Introduction

1. 1. Research Background and Objectives

In the early 20th century, as human body was liberated from corsets and movements, clothes that concretely expressed the beauty of the human body emerged. In other words, coming in to the 20th century, fashion emerged to become an art genre that contains the aesthetics of the times. In such movements, researches on new cutting technologies and materials became more and more active, and new forms of clothes appeared in the fashion design field. Such movements were even more accelerated being inter-locked with art, and the concept of structure of western fashion was overturned by the emergence of an abstractive form that violated the orthodox modeling of 'body'. For example, like the Japanese kimono that contains extra spaces between clothes, or the introduction of "human body modeling" to create newly-structured clothes.

Thus, in order to respond to the flow of fashion design, design education researches that are based on step-by-step application of three-dimensional principles are needed to contribute in the improvement of creativity. However, researches and preceding data regarding design education and specific curriculums are insufficient. In Korea, "The Study on the Development of Contents in Fundamental Design Education For Fashion Design" by Cho, J.(2010) is the sole research regarding fashion design education based on modeling principles. In foreign countries, most researches regarding design education are focused on integrated design or early design educations for children. Like Korea, not much researches on design education are focused on fashion design.

In contrary to the fashion field, researches and studies of design education based on three-dimensional principles are actively being progressed in other design fields. In "The Study on the Method of Design Education to Improve Cubic Art Creativeness", Park H.(2003) proposed the principles of 3D design education and methodology for improving 3D design creativity. In "A Proposal for Fundamental Design Curriculum at Universities in Korea", Ha, S.(2009) pinpointed the importance of fundamental design education as well as proposing the 3-step curriculum called "IME & H". In "A Study on the Recognition and Importance of Abstract 3-Dimensional Form in Design Education", Lee, Y.(2011) studied the importance of understanding the aesthetics of 3-dimensional forms as a designer.

In addition to such studies, preceding researches regarding fundamental design education include studies from Yin, M.(2012) and Cha, Y.(2012). Like this, researches that propose a specific direction and case for design education and application are insufficient.

On the other hand, solid modeling educations taken place in fashion design schools belonging to higher education institutes in Korea are poor in comparison to major intensive course educations. Most cases of design educations in the fashion design major are focused on simply teaching basic modeling methods of other design fields such as textile rather than creating actual forms and models.

However, due to the nature of the fashion design field which should consider 3-dimensions including human body and clothes, the correlation between them and even other dynamic movements, the absence of an appropriate solid modeling education in fashion design education may lead to lack of creation, application and thinking ability, and cause decretion of adaptability in the rapidly- changing fashion market.

Thus, in order to foster fashion designers to lead the future, re-establishing of solid modeling educations and strengthening of training is necessary in higher education institutes. Additionally, supplementation of design education and teaching method considering the association with university major subjects is also required.

Accordingly, the objective of this research lies on proposing a solid modeling educational model to improve creative abilities of fashion designers who recognize fashion design as modeling art that realizes on human body beyond a fragmentary approach that simply shows design uniqueness.

1. 2. Research Method and Scope

In this research, the following research methods have been applied to develop a solid modeling education curriculum for fashion design in a higher education.

To start with, a logical understanding stage was preceded on modeling and modeling principle through books, professional journals and related online data and DB. In order to study and understand the basic principles of 3-dimensional forms applied in 2-dimensional forms such as paper, professional books such as 'Modeling Practice-3D form experiment through paper' by Franz, Z.(2008), 'Design Basics' by David L.(2006), 'Understanding of solid modeling' by Kim, M. and Baek, S.(2003), 'Solid Modeling' by Han, S.(2006), 'Paper craft-Design and art with paper' by Robert, K.(2009), and 'Advanced Origami' by Michael, G. & LaFosse(2005) were reviewed. In addition, preceding researches regarding design education of various design fields were reviewed along with online database from writers such as Robert Lang, John Montroll, Akira Yoshizawa, Ilan Garbi, and Eric Gjerde.

Through the literature review based on preceding researches, fashion artwork design education methods based on 3-dimensional principles were proposed. Thus, in order to implant 3-dimensional thoughts that include human body and modeling to the students and future fashion designers, human body-based solid models were continuously manufactured and practiced, and photographs of the outcome models were taken in a studio along with the individual concepts in consideration of the human body, light, and space.

The following curriculum proposed in the research have been applied, verified, and supplemented as an academic curriculum from years 2011 to 2013 in Univ. E located in Seoul and Univ. D located in Gyeonggi province for two semesters each for a total of three years.

2. Solid Modeling Education in University Design Education

2. 1. Concept and Objectives of Solid Modeling Education

Solid modeling education can be expressed through a variety of techniques as a medium of image setting and material expression. It is a working area that controls and coordinates the working elements through physical force, which requires the exact purpose and convergence of various factors. Solid modeling education can be understood as an element of form, color, texture, and space, which can contribute in the improvement of aesthetic tastes. Also, it allows to express emotional gratification or pleasure, harmony and tension at the formative stage, which aims in delivering the exact message. In this context, Naomi, A. (2000) stressed the importance of the education of solid modeling as a professional field to be researched

and educated on common basic important problems in terms of 3D modeling activities throughout a vast range.

The parts which solid modeling education shows difference from modeling education are as follows: In the basic modeling elements, there are point, line, plane, form, color and texture, and we get to concentrate on studies on various problems arising when these elements combine with 3 dimensional forms. Identically for 'Space', a completely different problem arises in a 3 dimensional space and a 2 dimensional space. In addition, unlike a 2 dimensional modeling, there is a model established by the fact, 'move', in a 3 dimensional model. Types of such dynamic modeling have increased and diversified recently. Studying and experiencing the relationship between various situations and forms are very important in solid modeling education, as the illusions in such a fact and form should also be taken into an account.

Ultimately, the main purpose in terms of solid modeling education is expressing the modeling thinking and possibilities of materials and self discovery through the development of modeling sense.

2. 2. Solid Modeling Education in Fashion Design Field

Human beings have 3 dimensional forms, wear 3 dimensional forms, and live in 3 dimensional forms. In particular, in the modern society, fashion design has been expressed as a model morphologic perspective while regarding researches have been constantly conducted.

Fashion completed through patterns and cuttings of fabric lose planarity as it gets worn onto the human body, and is varied into another form met with another human body.

The fabric that begins from a plane is varied into a 3 dimensional form as it gets stretched by gravity or meets with the human body.

As the fashion design field should consider not only the human body and clothes but also 3 dimensions including space and other dynamic motions, the stage of understanding each medium and 'harmonizing' each modeling element is essentially accompanied.

According to Lee, Y. (2011), although the empirical side of understanding modeling education as a process of self discovery through actual experiences is necessary, this does not simply imply 'practice' in a narrow sense, but it is understanding the modeling elements that are difficult to understand and acquire just by theory with 'human body' as a medium. Thus, the perspective of treating the process more important than result, and valuing the experiences acquired during the process should be accompanied.

After all, solid modeling education in the fashion design field is able to show vitality when students develop modeling sense through theories and practices that enable to understand all basic modeling elements as 'human body' as the medium. The process of transforming from plane to solid in particular, and recognizing the domain of solid modeling including human body and clothes, space, and movements through the experiences acquired from the regarding processes and fostering the ability of application and creativity can be said as the important key.

3. Fashion Design Artwork Design Education Method Utilizing Solid Modeling Principle

3. 1. Learning Objective

The objective of this class lies on proposing teaching methods for fashion artwork design that are able to foster creativity to express one's idea and boost one's individuality through the medium of human body to future fashion designers, based on modeling principles of design.

A designer requires not only expressing his idea by hands but also the ability to strategically think and express about an idea and information.

Thus, in terms of making various forms of communication regardless the medium, not only the aesthetic side but also the planning side and the technical side should be learned as well. In order to cultivate such ability, this class is to train for robust fundamentals on solid modeling by carrying out solid modeling practices with human body as the medium that combines design planning and the technology at the solid converting stage.

Especially, this course being a solid modeling course for future fashion designers and a course linked to the future fashion design basic courses, is to teach 2~3 dimension modeling ability and expression ability through modeling experiment where a new solid structure is born by the encounter of 'human body' and 'another solid structure'. The ultimate goal lies on acquiring and cultivating pure modeling ability and creativity, and solid modeling abilities essential for fashion design and improving application and creation abilities.

3. 2. Proceeding the Curriculum

3. 2. 1. Time consumed: 3 hours 15 weeks

3. 2. 2. Target grade: Freshmen

3. 2. 3. Method: Theory 20% + Practice 80% 3.2.4. Textbook: Main text 50%, auxiliary test, references 30%, other online DB and data utilization 20%

Table 1 References

Text	Book Name	Author	Publisher	Published yr.
Main	Modeling Practice – 3D form experiment through paper	FRANZ ZEIER, Translated by Younggil Kwon	Naeha	2008
Aux.	Paper craft –Design and art with paper	Robert Klanten	gestalten	2009
Ref.	Design Basics	David A.Lauer	Yegyung	2006
	Understanding of solid modeling	Co-authorship – Meeok Kim, Sookja Beak	Gru	2003
	Solid modeling	Seokwoo Han	Mijinsa	2006
	Advanced Origami	Michael G. LaFosse	Tuttle Publishing	2005

3. 3. Learning content

Four-staged education has been performed in this curriculum as follows.

First, stage 1 as the data collection stage(Discover), I looked at the basic elements and principles of modeling in order to figure out the basic design theories related to basic modeling and solid modeling. Furthermore, I carried out a basic processing workshop with

paper as the basic medium, in order to cultivate sense training with the materials.

Next, for stage 2 [Human body analysis], for recognition of form and volume of a human body, I carried out a workshop by recognizing even to the invisible opposite side and drawing while wrapping the human body into a contour. I lead to recognize the relationship of form, force, and structure.

In stage 3, [Cube spacing training], I conducted as workshop to achieve stylization to a creative form by understanding the concept and stage which a plane becomes a solid, a space, and look for some possibilities to be applied to other solid modeling form and structure.

In this stage, origami techniques were applied to challenge students in understanding the relationship of 2-dimensional planes and 3-dimensional forms by converting planes to forms. Origami technique refers to the creation of various forms by folding of a piece of paper. This origami technique has been recently applied in various fashion design education for teaching structural approaches to design. One of Korea's first curators and critic Kim, H.(2012) stated in a column about the importance of the concept of space in fashion design, stating that fabric acts as the material of the apparel as well as creates form in the overall structure of the apparel. Japanese designer Issey Miyake applied the concept of space in fashion through the origami technique by creating dimensions beyond space and time from 2-dimensional planes.

In this context, the following research focuses on the application of origami technique in solid modeling design education through workshops that allow students to learn and understand the concept of space and dimensions.

In stage 4, [Integration with human body, application and deployment], I have combined theory and practice to deploy by dividing into data analysis stage(Define), design direction design(Develop) and design stage(Deliver). Firstly, in the data analysis stage, I analyzed the modeling elements of designer works featuring modeling ideas. In the design direction stage(Develop) which was a practice stage, I deployed the concept by sketching a solid modeling using human body. In the design and manufacture stage(Deliver), I completed the final model work piece through detailed sketches and structures in consideration with volume and dynamic movements of the human body, space, and light. Finally, I proposed these in a photograph format taken in a studio as the final output.

Table 2 Curriculum

Main Topic	No.	Sub Topic	Content
Basic modelling and processing	Workshop 1	What is modelling?	Basic elements and principles of modeling
	Workshop 2	Basic processing	Basic hand processing method (Materials and sense training)
Body analysis	Workshop 3	Understanding on curve surface and dynamic movements of human body	<ul style="list-style-type: none"> ·Wrap and draw human body (wrapping) ·Perceiving a motion with lines
Cubic space arrangement training	Workshop 4	From plane to space	<ul style="list-style-type: none"> ·Gradation and retreat using continuous plane ·Solid expression using origami
Integration with human boyd, application and deployment	Workshop 5	Solid modeling and human body, a new space	<ul style="list-style-type: none"> ·Designers' work analysis ·concept development ·Deduce final output

3. 3. 1. Main Topic 1: Basic modeling and processing

2 kinds of methods can be thought of to research the compositions in a 3 dimensional space. First, it is thinking about the composition as ‘element of shape’ classified in a basic modeling principle dimension like point, line, plane and solid. The other one is the exploration of form creation by so-called material of ‘what kind of a form’ can be made by utilizing certain properties of a certain material while focusing on the ‘material’ needed when making a piece.

① Sub Topic 1: What is Modeling?

(Class based on the theory and basic properties of modeling)

Modeling has the meaning of making a specific form or an image by using various different materials. In order to effectively express models, the modeling elements should be understood, and modeling ability should be gained by understanding the elements. The modeling principle is a principle of how to express the modeling elements and how to handle them. As the modeling elements for visual elements, there are shapes such as point, line and plane, and forms such as size, color and texture. For modeling elements there are unification, change, balance, rhythm and motion, and a theoretical lesson was carried out based on these different examples.

② Sub Topic 2: Paper modeling (Understanding the properties of paper)

[Problem posing] A solid composition is making into stylization of creative format seeking possibilities in the physical and chemical sides of processing along with the aesthetic pursue of color and form by exploring the modeling function of the material with the method of destroying common sense through researches on properties, forms, functions and structure using various materials.

[Test|Workshop] Paper is a material with infinite conformal modeling potential, and its properties differ completely depending on how dealt and processed. Thus, with paper selected as the basic material, workshop was carried out along with brainstorming and practices.

Through the workshop, I asked the students about the actions that can change the basic properties of paper, whether it is a coincidental form and an intentional form, or whatever it is, based on the surface texture of paper. The students independently talked about processing actions that came up in their minds, and I wrote the words on the board. Then, I summarized the words grouped based on the modeling elements expressible in the regarding processing actions, and conducted a workshop on basic paper processing.

Table 3 Study on the properties of paper

Expression Element	Processing Behavior
Comprehensive Elements	Cutting, sticking, wrapping, rolling, rolling up, roll and stick, pulling, binding, penetrating, bending, punching a hole, blocking a hole, mixing, dispersing, fixing, dividing, separating, hiding, putting in, filling, pulling, stretching, pulling off, removing, planting
Line Modeling	Dicing, diagonal-cutting, combine-cutting, inserting, braiding, stabbing, drawing, tightening, bouncing, imposing a shock, bullet shooting, arrow shooting, digging a hole (digging a hole and filling in)
Point Modeling	Powdering, grinding, fragmentation
Surface Texture	Pushing, digging out, carving, pinching, scraping, pushing, splitting, rubbing, spilling, coating, baking, corroding, ironing, burning, scattering

Volume feeling, space feeling	Inflating, contracting, throwing, floating, overlapping, piling, squeezing, massaging, sinking, blowing, macerating, melting, dehydrating, thin-spreading, slicing, boiling, simmering, marinating, hardening, freezing, putting in, wrapping, bending
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An example of student's output for the workshop is as follows:



Figure 1 Student's Work

3. 3. 2. Main Topic 2: Body Analysis

① Understanding on curve surfaces and dynamic movements of human body

[Problem posing] Observation and analysis of human body form

[Experiment|Workshop]

- Wrapping body with lines; Expressing space through lines
- Express the target's conformal feeling just by a pencil without any disconnection of the line.
- Look at a point located on the edge line of the model.
- Casually hold a pen and put the pen on a piece of paper. Here, you should not take your eyes off the model. Suppose the pencil on the paper is in contact with a point on the picture of the model you are looking at. Imagine a bundle of thread is infinitely wrapping by revolving around the model at the spot of the appearance of the model.
- Observe change and undulation.

An example of student's output for the workshop is as follows:

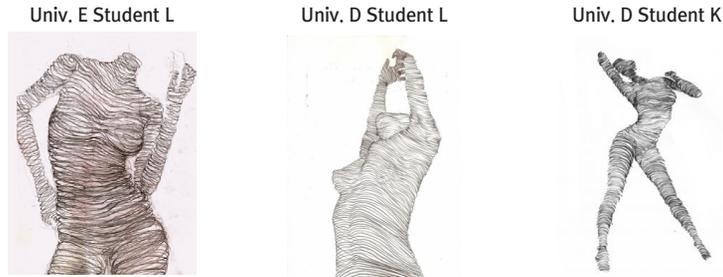


Figure 2 Outcome of human body wrapping drawing practice

3. 3. 3. Main Topic 3: Cubic Space Arrangement Training

[Problem posing] The education goal of 'From plane to space' lies on understanding the process of a plane becoming a solid creating a space, and exploring various interesting ways of making a solid structure. Ultimately, we should be able to understand the concept and methods of a plane becoming conformal and apply to making other solid modeling forms and structures. In other words, we should apply such modeling exploration ultimately to fashion design and other solid compositions and seek for variations to other directions.

① Sub Topic 1: From plane to space (Gradation and retreat using a continuous plane)

[Experiment|Workshop]

- Express 'Gradation and retreat using a continuous plane' in an ectype form by utilizing a piece of paper.
- Make a piece of paper which is a plane into a solid space form with 3D depth through standing, rolling and folding.
- Plan a solid form by using the physical properties of paper, elasticity, reverse force and tension. The modeling methods applying such features are bending, curling, folding, scoring, cutting, cut out, punching, expanding, relating, crush up, laminating, gluing, plucking, twisting, joining, pressing, coupling etc. (Kim, Y. (2005))
- Evaluate if the overall atmosphere has been expressed as intended in terms of arranging the continuous planes.
- Analyze for overall natural harmony of size change and direction of the planes.

An example of student's output for the workshop is as follows:

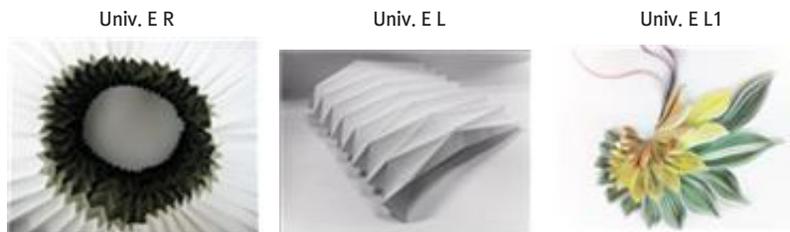


Figure 3 Practice outcome of 'From plane to space'

② Sub Topic 2: Expression of forms through origami (Utilization of self-learning)

[Experiment|Workshop]

- Perform origami-related practices by referring to the text, 'PAPIER' (Franz, Z. (2008))

- with 3 dimensional form experiment through paper as the topic)- Analyze the origami drawing and outcome, i.e. the external structure and grasp the mathematical principle
- Variation of folding, i.e. decorational attempt
 - Watch the documentary [Origami, breaks the barrier of science and art]
 - Check if the student understands about the principle of the model created by the 'folding' method, and he is able to express the solid structure he desires to express using the 'folding' method (Express with the completed model from the sketch)
 - Acquire major origami skills utilizing self-learning video material
 - Origami Magic Ball by Kade Chan (Folding Instructions)
 - Origami Five Intersecting Tetrahedra
 - Origami Spring
 - Origami Tessellation: Tessellation on Bricks by Ilan Garibi
 - Origami Water Bomb Tessellation (Eric Gjerde)
 - Origami Swan in hundreds of pieces (Composing with a unit)

An example of student's output for the workshop is as follows:



Figure 4 Practice outcome of 'Origami'

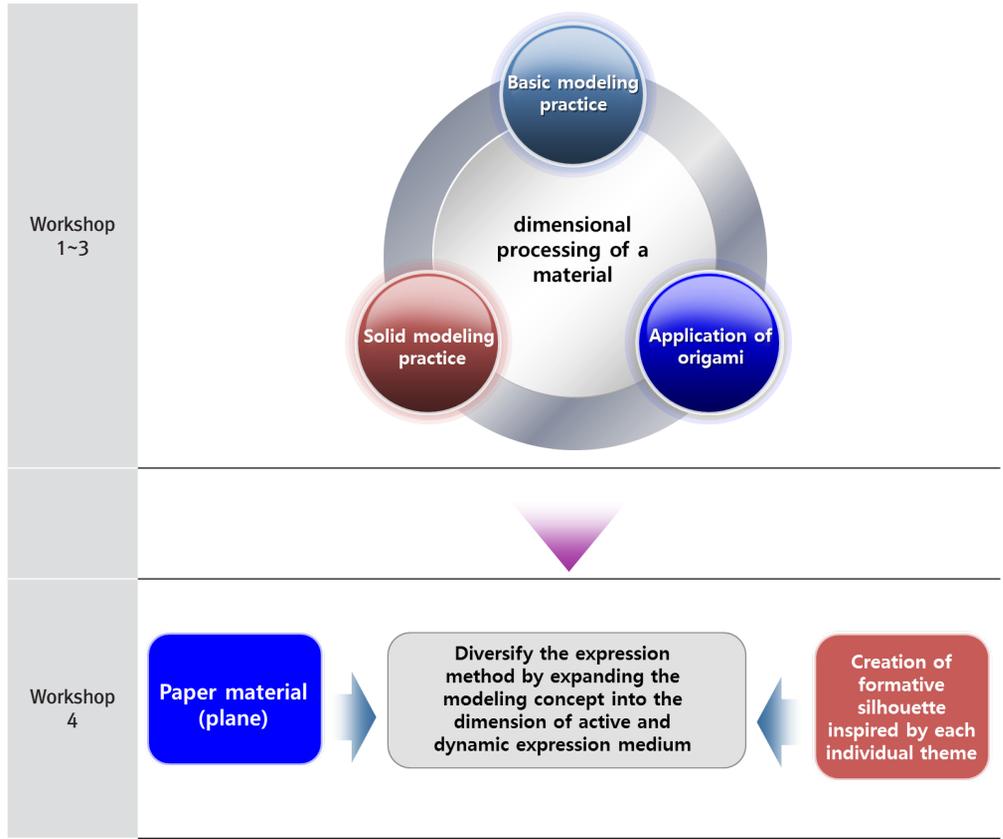
3. 3. 4. Main Topic 4: Integration of Human Body, Application, and Deployment

① Sub Topic 1: Solid modeling and human body, new space

[Problem posing]

- Express on your body or the model's body about the impressive modeling structure from your individual topics by utilizing the paper material.
- Keep the harmony of 'human body, solid, space(light and shadow)', and communication in mind. (Table 4)

Table 4 Goal of the project



- Students are to experience the new formation of space through the basic understandings of properties of materials learned in the previous topics 1-3 and practices of translating the human body forms and the concept of space.
- The specific design process is as shown in [Figure 5]. First, students were required to choose individual concepts followed by idea sketch, modeling of forms, application with human body, editing, and finalizations. The finished works were then prepared for individual photo shoots based on the design concepts of each students.
- Plan the whole thing keeping all items in mind such as model, props, workpiece, pose study, composition, lighting and background until shown as a photograph which is the final product.

	Univ. E Student B	Univ. E Student L1	Univ. E Student L2
Deployment 1			

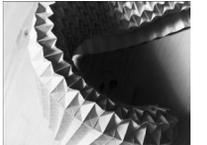
Deployment 2			
Deployment 3			
Result			

Figure 5 Student's Work, Deployment Stage

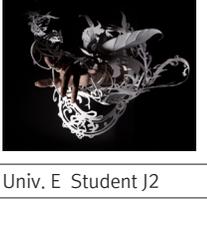
Work			
	Univ. E Student K	Univ. E Student S	Univ. E Student L3
work			
	Univ. E Student L4	Univ. E Student J1	Univ. E Student K
work			
	Univ. E Student L1	Univ. E Student J2	Univ. E Student L5

Figure 6 Work pieces of students of Univ. E

When the curriculum was first applied to the students of Univ. E in the year 2011, each individual models seemed to be relatively passive as it was applied on certain body parts

such as face, hands, and the legs. However, after intensive coaching and teaching on the relationship of space, forms, and the human body in the year 2013 at Univ. D, students started to have an extended view and understanding of the human body as each models were applied on various body parts as seen in Figure 7.

Work			
	Univ. D Student S1	Univ. D Student S2	Univ. D Student L1
work			
	Univ. E Student L4	Univ. E Student J1	Univ. E Student K
work			
	Univ. E Student L1	Univ. E Student J2	Univ. E Student L5

Figure 7 Work pieces of students of Univ. D

Like this, after the application and supplementation of the curriculum over three years, students who have taken part in the class have improved aesthetic tastes as well as discovered their individual styles. Also, according to the class survey results, the following curriculum has been a fundamental basis in allowing students to understand and apply the basic forms and structures needed in the fashion design field. However, for some students, such curriculum was a bit hard to follow in the short period time.

Also, based on the reviews by Professor 1 and Professor 2 in Univ. E, Professor 1 and 2 in Univ. D, Professor of Univ. S, and Professor of S College in England, such curriculum regarding the teaching of planes, dimensions, forms, and space will contribute in enhancing design skills for students majoring fashion design. Especially, Professor of S College in England stated that each outputs resulted from the curriculum show that each students have well-understood the concept of dimensions and forms, and each outputs are excellent despite they are created from young students. Meanwhile Professor 2 of Univ. D pointed out that such curriculum is significant in that it is a new experiment in education and that no other design

curriculum has been so specific and experimental.

5. Conclusion and Proposal

I have recognized the importance of education for solid modeling based on students in fashion design major university curriculum. Therefore, rather than modeling related lessons remaining as the role of assisting the fashion practice design territory, I was to propose model plans for fashion design artwork design education with indefinite expansion by vertically and horizontally colligating the broad design professional territory with itself having the dynamics.

As the result of the research, I have proposed a fashion design artwork design education method through the four-staged process.

Firstly, stage 1 was [Basic modeling and processing], stage 2 was [Body analysis] which enabled to recognize the relationship between form, volume and structure of human body, and in stage 3, [Cube spacing training], I sought for ways to deploy a solid from plane to space by exploring the modeling possibility of materials.

Lastly, in the [Integration with human body, application and deployment] stage, I combined theory and practice to deploy by dividing into data analysis stage(Define), design direction design(Develop) and design stage(Deliver). Through the workshop, students completed their final modeling works through detailed sketches of structures in consideration of volume and dynamic movements of human body, space and light.

Limitations of the following study are as follows. The following curriculum regarding the utilization of principles of fashion artwork design education was applied and supplemented in a total of six semesters. However, there were no verification processes or tools that could test and compare students who have taken the class and have not taken the class. Therefore, tools that can analyze the contents of the curriculum and verify its practicality should be developed in the future studies.

Through this research, I expect to improve the achievements in studies related to fashion design subjects, as more systematic 3 dimensional modeling education is more intensively educated in terms of the solid modeling education in the fashion design field. Additionally, I wish such educations would boost competitiveness and quality of our design education and ultimately contribute to foster creative fashion designers of the future.

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