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[Original Article]

Self-observation of the design process

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Abstract

This study aimed to reveal the designer's creative process in the development of clothing designs. The researcher has taken roles both as a design practitioner and an observer. The full process of design development was concurrently documented while working to solve a specific problem. This included noting down the concept, keywords, and detailed scratch ideas, as well as refining the design by collecting sketches and taking photos. Integrated data from the captured design process were analyzed based on Lamb and Kallal's apparel design framework, which included problem identification, construction of preliminary ideas, design refinement, prototype development, and evaluation. The functional, expressive, and aesthetic (FEA) criteria of the entire process were thus assessed. Additionally, five professional apparel reviewers evaluated the design project based on FEA criteria. The results showed the processes for identifying targets and intentions, extracting the main elements from sources, developing the major visual concepts, and making final adjustments. Ultimately, this study revealed how a designer manages each stage of the creative design process. Sharing such detailed observations of the design process can help refine the knowledge involved in each stage of the creative process, and provide guidance for instructors in design education.

Keywords: design process, practice-led research (PLR), design knowledge, apparel design framework

I. Introduction

The designer's thought process has been regarded as an exclusively innate talent. To uncover the designer's thinking process, cognitive approaches to process research have been employed to examine many areas of design since the 1960s (Archer, 1965). In apparel design, researchers who are also designers have shared their design processes in the form of master's theses or PhD dissertations (Kwak, 2015; Lee, 2015). These studies have mainly focused on theoretical backgrounds, design concepts, and final products rather than the designers' thought processes for developing ideas. Some researcher-designers have reported detailed descriptions of their own creative processes (Lee, Hong, Yoon, & Lee, 2010; Lee & Lee, 2010; Parsons, 2015; Parsons & Campbell, 2004; Young, Jirousek, & Ashdown, 2004) while others have examined how other designers develop their ideas. Lee and

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Jirousek (2015) investigated the development process for early ideas with a professional apparel designer. Lee (2012) analyzed and compared eighteen fashion designers' processes, Rothenberg and Sobel (1990) analyzed designers' ideas based on costume designs (historic garments), and Petre, Sharp, and Johnson (2006) studied the idea-development process for knitwear by interviewing professional fashion designers. Despite several efforts to discover the design knowledge present in the idea-development process, what designers think while developing creative ideas remains largely inaccessible in the field of apparel design.

Just as Bye (2010) emphasized the need for a creative design process theory, it is crucial to develop a systematic understanding of how designers think. An understanding of how designers develop their ideas and how to create fascinating designs can provide valuable data for design researchers, educators, and practitioners. The goal of this study is to reveal the designer's idea-development process by analyzing the designer's own process for creating two dresses based on the apparel design framework.

Ⅱ. Background

1. Design knowledge

Designers know something about how to design—that is, they possess design knowledge. Designers generally acquire design knowledge through practice and develop independent strategies by solving a series of design problems. Cross (2006) introduced the phrase "designerly ways of knowing" and articulated the nature/nurture of design, creative cognition in design, and the features of the discipline of design. Design process research attempts to reveal the design knowledge present in the process of idea development in relation to cognitive science (Bayazit, 2004). Design knowledge often includes implicit knowledge that is difficult to translate into explicit knowledge (i.e., written or spoken). Thus, extracting knowledge from a designer, process, or final product has been a challenge in design research.

The sources of design knowledge are people, processes, and products (Cross, 1999). First, people refers to designers or anyone else involved in creating design products. The sources include the designer's abilities, behaviors, or design education. Second, design knowledge can be found within the design process. For example, design knowledge is built as ideas evolve, and such efforts effectively foster the ideas. Investigations of design knowledge through process have been attempted in various domains of design fields, and valuable outcomes for modeling design processes have been introduced (Archer, 1995; Jones, 1970; Snyder & Catanese, 1979). Third, products are a source of design knowledge. This includes analyzing products' visual forms, how they work, and how products communicate with other/outer environments (Cross, 2006). While such categories of sources are divided for the purposes of research, in reality the sources of design knowledge are intertwined, following the nature of design. Accordingly, this study observes data from all sources of design knowledge.

2. Practice-led research (PLR)

Practice-led research (PLR) has been accepted as a research method in the fields of art and design. In this method, the researcher creates the sources of design knowledge while engaging in art/design practice. This was initially called "research through design" (Archer, 1995). Later, Rust, Mottram, and Till (2007) defined PLR as "research in which the professional and/or creative practices or art, design or [architecture] play an instrumental part in an inquiry" (p. 11). Processing design knowledge includes the cognitive process in which the designer intuitively acts and reflects without recognizing the detailed stages of design (Schön, 1983). Capturing and analyzing the design process using this method is considered the best way to demonstrate the cognitive process since designers thoroughly know what they are doing or have done while designing.

Researchers have attempted to use various formats to define the PLR method. According to Mäkelä and

Nimkulrat (2011), "The practitioner researcher not only creates an artifact but also documents, contextualized and interprets the artifacts as well as the process of making them" (p. 1). The main point of using this method is that the designer/researcher creates all documented data while designing the product. Often, researchers choose their own methods to reveal tacit design knowledge by tracking their own design processes. Analyzing the characteristics of fashion and textile PhD dissertations in the UK, Kim (2015) suggested that the format of PLR has yet to be categorized. In the field of apparel design, some researchers have used the PLR method to share their design knowledge. Parsons and Campbell (2004) analyzed their design process for digital apparel design, and Parsons (2015) shared her design process in which she designed one-pattern garments based on an analysis of historical patterns.

3. Framework of the apparel design process

Design processes are generally organized into three or four steps: problem identification and research, concept exploration (idea generation and evaluation), and implementation (solution and communication) (Archer, 1965; Jones, 1970; Snyder & Catanese, 1979). The apparel design process model was developed by reviewing existing creative processes and design processes from other fields of design. These processes were adjusted according to the needs of the specific projects. Watkins (1988) proposed an apparel design process model adapted from Koberg and Bagnall's (1974) theory of creative problem solving. This model included seven stages: acceptance, analysis, definition of the problem, ideation, idea selection, implementation, and evaluation. Watkins's steps were specifically intended to teach student designers to prepare functional apparel design projects. Later, Lamb and Kallal (1992) proposed "The Functional-Expressive-Aesthetic (FEA) consumer needs model," which is a creative process framework that integrates aspects of interaction between designer and client. This model delineates six stages in the creative process: problem identification, preliminary ideas, design refinement, prototype development, evaluation, and implementation. The core of this model involves considering the functional, expressive, and aesthetic needs of users (whether functional designers or ready-to-wear designers) and the culture, making it applicable to any type of apparel design. LaBat and Sokolowski (1999) summarized the three steps of the design process as follows: problem definition and research, creative exploration, and implementation. This model was developed for the purpose of facilitating university teamwork with industry clients in designing textile products. 〈Table 1〉 shows each stage in Lamb and Kallal's model and the corresponding stages from other process models.

These three frameworks for the apparel design process are fundamentally based on creative problem solving processes in the field of psychology. The structures and content of all three design processes are similar. The only differences involve adjustments to the number of stages and to-do lists, which are

<Table 1> Apparel design process models

Process model	Stages of apparel design process				
Lamb & Kallal (1992)	① Problem identification	② Preliminary ideas	③ Design refinement	④ Prototype development	⑤ Evaluation ⑥ Implementation
Watkins (1998)	① Acceptance ② Analysis ③ Definition	④ Ideation	⑤ Selection	⑥ Implementation	⑦ Evaluation
LaBat & Sokolowski (1999)	① Problem definition & research	② Creative exploration		③ Implementation	

specific to their project goals. Lamb and Kallal's (1992) FEA model was adopted for the present study because this study is the target of the model, the model is relatively flexible, and it actively embraces aesthetic attention. This framework remains relevant and is often employed to analyze apparel processes (Adelaja, Salusso, & Black, 2016; Bye & Hakala, 2005; Gordon & Guttmann, 2013; Parsons & Campbell, 2004; Stoke & Black, 2012). The apparel design framework is often used to analyze functional design processes—such as designing sailing apparel (Bye & Hakala, 2005) and protective flight suits (Tan, Crown, & Capjac, 1998)—as well as creative design processes (Young et al., 2004; Parsons & Campbell, 2004).

Ⅲ. Research Method

In this practice-led research, the researcher assumed the roles of both designer and observer while solving the design problem. This design project was assigned for a graduate course titled Creative Problem-Solving in Apparel Design. The goal of the project was to observe the design process as creative problem solving. The scope of the project involved creating any form of garment with no limitations (i.e., no target customer, price level, or apparel category). There were no required targets or variables except that the designer had to create apparel items and trace their thought processes while making them. Detailed scratch ideas were collected, and photos were taken of every significant activity in idea development.

The captured design process was analyzed based on Lamb and Kallal's (1992) apparel design framework. The study followed Parsons and Campbell's (2004) analysis, which employed Lamb and Kallal's model to explain creative fashion design processes. This model adopts features from creative process models, which include problem identification, preliminary ideas, design refinement, prototype development, evaluation, and implementation. Among those six stages, only five were adopted here since production implementation was not necessary for this project. This study focused on investigating the process of initial idea generation. It should be noted that the researcher first created the design garments while capturing the process and then analyzed the process from the collected data based on the framework. 〈Table 2〉 summarizes each stage and its strategies within Lamb and Kallal's apparel design framework.

Schön and Wiggins (1992) noted that the design process is often an "iterative loop" in which designers move back and forth as ideas emerge and they reflect on previous ideas. However, the research process often assumes a linear form, and Lamb and Kallal's (1992) framework is likewise linear. Thus, in analyzing the design process in this study, the documentation included notes taken during the idea-development process but relied to a greater extent on visual data.

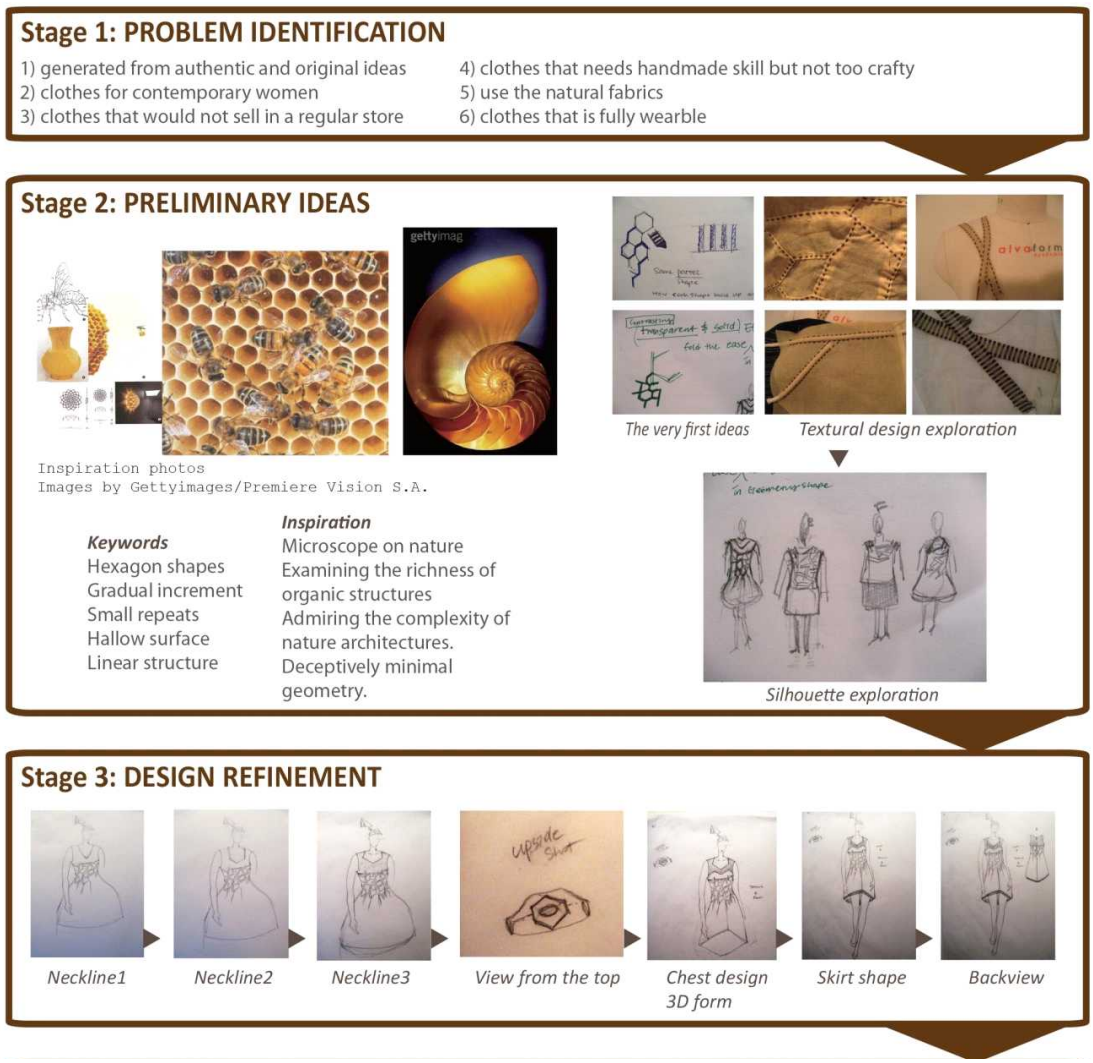
<Table 2> Lamb & Kallal's (1992) apparel design framework

Stage	1	2	3	4	5	6
Process	Problem identification	Preliminary ideas	Design refinement	Prototype development	Evaluation	Implementation
Strategy	+Define and analyze the functional, expressive, and aesthetic (FEA) criteria regarding the target of the design problem	+Brainstorming, research, sketching, drawing several possible solutions in verbal and visual formats	+Scrutinizing (modifying, discarding, selecting) preliminary ideas based on FEA priorities	+Creating sample garments or samples of garment components	+Assessing prototypes according to FEA criteria	+Refine for prototype production (consider cost, method, and sales potential) +Adjust/redesign based on client reports on the prototype

After finishing the design creation, the documentation of the idea-development process was organized based on Lamb and Kallal's (1992) stages and added to the discussion of how garments were designed to meet FEA needs. Importantly, the analysis seemed at first glance like a linear process but actually manifested as an iterative process.

Ⅳ. Results and Discussion

This study analyzed the development processes for two dresses created from visual sources of inspiration. The designer began by collecting various visual sources typically used for general design projects. Based on the collected sources, fabric materials and idea sketches were simultaneously explored. After deciding on the first sketch, the first dress was made (Fig. 1). The second dress idea was refined after completing the first dress (Fig. 2). Therefore, the order of the results shown in this section follows the order of the design creation: (1) problem identification, (2) preliminary ideas, (3) design refinement, (4) prototype development of



<Fig. 1> Design process for the first dress

<Fig. 1> Continued

the first dress, (5) design refinement, (6) prototype development of the second dress, and (7) evaluations of the first and second dresses. The design processes for the two dresses are explained according to the stages and corresponding strategies shown in 〈Table 2〉.

1. Analysis of the first dress

1) Stage 1: Problem identification

The problem-identification stage of the design process begins with accepting the situation of the design problem. Although this design project had no requirements for apparel category, target market, or price level, the designer set boundaries for a target customer who 1) values the originality and quality of the design, 2) is a contemporary upper-middle-class woman in her twenties or thirties, 3) enjoys socializing but does not want to stand out, 4) likes visiting art galleries and appreciates art performances, 5) has concern for environmental issues, and 6) prefers work that is handmade but not too crafty. The main strategy of this stage is to reflect on the target customer in relation to the FEA criteria. To fulfill those criteria, the designer considers the purpose of the dress or the situation in which it is worn (Table 3).

<Table 3> Designer's considerations at stage 1

FEA criteria	Consideration
Functional	· The customer should feel comfortable when socializing with friends in casual situations such as shopping, gallery tours, and dining (fitness, movement). · The customer should have no problem donning and doffing by herself.
Expressive	· The selection of the fabric should relate to environmental issues. · At some point, the design should appeal to originality and uniqueness.
Aesthetic	· Handmade skills should be included.

2) Stage 2: Preliminary ideas

The preliminary ideas stage includes collecting visual sources, creating scratch ideas, exploring textural sources, and creating silhouettes. In this study, the designer first viewed and selected the most intriguing images from the sources for inspiration. She wrote down keywords (e.g., hexagon shapes, gradual increments, small repeats, hollow surfaces, linear structures) that helped lead her to richer ideas. She observed the visual sources and developed abstract concepts that became the essential sources for the design. The designer drew inspiration from the natural geometric form of a honeycomb—a mass of hexagonal wax cells built by honeybees. Both the process of building honeycombs and the hexagonal geometric shape of the end product became the main inspiration. The concept of "Natural Geometry" is explained as follows:

> Geometry is all around us; it is in the buildings we live in, in the shapes of leaves, and in the molecules of the water we drink. Undeniably, it is a common feature of natural phenomena and a fundamental law of nature. Geometry is not only present in visual forms but also in processes and in the movement of nature. We see the aligned layers of fish scales, the perfect hexagonal shapes in a honeycomb, and the spiral shapes in seashell. We have experienced the circular ripples of water drops and are aware of geocentric orbits in space. Geometry in nature pleases the human eye and delivers beauty. Nature is curiously charming but also extremely complex in ways that humans find impossible to replicate. However, when we apply our perceptions of geometry to man-made objects, the results can be captivating. I am constantly fascinated by the wonders of natural geometry that embody mystery and instill curiosity. (Lee & Mete, 2009, p. 65)

The designer considered what to extract from the visual sources and how to translate them into design elements applicable to the actual garment. First, the designer started to draw a honeycomb to experience its shape with her hand—how the lines are connected to each other and built in three dimensions. Through this process, the designer thought about the characteristics of honeycombs and how they are built. The salient source elements that could play a surface-level role in design were extracted and applied as design details. Through this process, the designer decided to use hexagonal shapes to create the surface of the garment.

Creating hexagonal shapes then became the new significant problem for the designer. The designer explored actual materials that could mimic the shapes of honeycombs, whether superficial or structural. The designer explored various ways to achieve hexagonal forms using several design elements, such as texture, line, and form. She aimed to follow the rules for the process that creates the honeycomb itself: the growth of shapes. The primary fabric—sheer flax-colored cotton —reflects the texture and color of honeycombs. By superimposing sheer cotton fabric on reflective black cotton fabric, the designer created the illusion of depth in each hexagonal section.

Once the designer determined how to manage the textiles and surfaces, she examined four different silhouettes that might best present the concept: a sag-type dress fully covered by a textural sample, an H-line dress partially and irregularly covered, an H-line dress was emphasized a black-color and an A-line dress with a fitted but gradually expanding hexagonal surface. Among these, the designer selected the first and fourth to design the two dresses. The sketches were created for the designer alone and would therefore be difficult for others to comprehend.

3) Stage 3: Design refinement

In the design refinement stage, the designer scrutinized the preliminary ideas in consideration of the target customer's FEA criteria. The designer began to articulate the details of the dress. While the major design elements or the formation of the dress has been determined, other optional areas remained to be chosen. The designer went back to the original concept of natural geometry.

<Table 4> Designer's considerations at stage 3

FEA criteria	Consideration
Functional	· The designer paid attention to the fitting and closing details: use basic and typical closers; keep the basic silhouette.
Expressive	· To express uniqueness, the hemline of the skirt adopted a hexagonal shape while maintaining a simple silhouette.
Aesthetic	· The design should not include details that are “too crafty.” · The final design focused on the unity of the concept (keeping a similar shape on the neckline, hem shape, and textural details).

The designer explored the idea of an angular neckline and hemline to further emphasize the concept of geometry. Moving from the waist, the hexagonal shapes gradually increase in size and decrease in number, slowly merging into the hexagonal form of the skirt. The focal point is the mid-waistline where the hexagonal surface design is most dense. From there, the eye travels down to the point in the skirt and then the angular shapes around the neckline. In refining other details, the designer searched for a place to incorporate hexagonal shapes in a 3D form. She applied this concept to the skirt shape in which the 2D shape would transform into a 3D hexagonal form. All parts of the garment were explored and determined by adjusting the aesthetic view and its alignment with the main design idea. Necklines, skirt forms, hemlines, and bust areas were constantly edited. A major issue in this process was finding appropriate details for harmony and balance as a whole (Table 4).

4) Stage 4: Prototype development

In the prototype development stage, the designer creates an actual garment. Although the final sketches are completed, the designer keeps making small refinements until the prototype is complete. In this study, the design process followed an organic design process through draping. A large piece of fabric was placed on the body form, and the creases in the fabric were folded to form honeycomb shapes. One section was folded after another, and the designer gradually extended the geometric shapes and varied the sizes and shapes, which also allowed her to mold the fabric to the body’s curves. Eventually, a hexagonal patterned surface design emerged, reflecting the honeycomb building process. The creases making up the hexagonal shapes were topstitched by hand using distinct black thread that accentuated the geometric shapes. While creating the prototype, the designer constantly replicated various designs from the sketches in stage three. In this process, she visually confirmed her decisions that were explored in stage three. Possible forms for the bust area designs and back layers were tested during the end stage.

2. Analysis of design II

1) Stage 5: Design refinement

The second design idea was continued immediately after completing the first dress. Since most of the design ideas and details were confirmed for the first dress, the idea for the second dress was just unfolding. In the process of creating the second dress, the designer did not need to test every option; rather, she visually imagined the possible outcomes without actually making sample details. Therefore, in the sketch process for the second design, the range of exploration was relatively narrow. During this stage, the designer had a dress silhouette in mind. She explored the small details of the sleeve designs and hemlines of the dress. In searching for the sleeve details, the designer tried to apply the hexagon concept to the side view of the dress; she enjoyed navigating every angle to envision the garment

<Fig. 2> Design process for design II

while designing the small details.

2) Stage 6: Prototype development

In making the second prototype, the designer applied knowledge about the movement of sheer cotton fabric from the first prototype; thus, the shapes, sizes, and directions of the hexagon were easier to control. The original intention was to create a hexagonal-like shape as a draping fitted onto the body form and increase the size of the shape. The final outcome of the dress was successful.

3. Evaluation

Five professional reviewers with master's degrees in fashion/apparel design who currently work in the fashion industry or education volunteered to evaluate this design project. All reviewers were given brief instructions about Lamb and Kallal's framework, and asked to fill out a form based on FEA criteria (Table 5).

V. Conclusion

This study attempted to observe the creative design process for two dress designs, and it analyzed that process based on Lamb and Kallal's (1992) apparel design framework. The full process for developing two completed garments was documented with photos, sketches, and note-taking. From the collected data, the creative process was examined beginning to end and categorized following the apparel design framework:

<Table 5> Professional group assessment

Criteria	Detail components	Assessment
Functional consideration	Fit Mobility Comfort (ease of movement) Protection Donning/doffing	· The two dresses have simple styles and silhouettes that might be practical for the target customer to socialize with friends and also to easily coordinate with other items such as a cardigan and a jacket. · Given the lack of elasticity in the design and fabrication of the first dress, there is a concern about mobility and comfort. · Even though the dresses are meant for young women, wearers might feel discomfort because of the short hemlines. This can be resolved by adjusting both sides of the unbalanced hemlines by one or one-and-a-half inches. · The halter neck detail in the second dress seems to make it easy for the customer to don or doff.
Expressive consideration	Values Roles Status Self-esteem	· With the unique textile details, the wearer could feel valuable and confident in terms of audiences' subconscious perceptions of beauty. · Overall, the dresses are intended to look like simple garments, but on close inspection, the artistic and special techniques could be appreciated. · The colors and fabric could make the customer look older, but someone who cares about environmental issues would be satisfied. · The wearer could give a subtle and elegant visual message: she wears something special and unique but in a reserved manner. · The concept of the dresses is a good fit for someone who does not follow fashion trends and pursues an eco-friendly attitude.
Aesthetic consideration	Art elements: lines, form, color, texture, and pattern to create a pleasing design Design principles: body-garment relationship	· The first dress is too simple but has a little bit of a hit with its unbalanced hemline. · The color combination is subtle, making it easy to coordinate with a jacket or cardigan. · The silhouette of the first dress might be too tight, but the second one expresses the beauty of the woman's body while also being comfortable. · The combination of irregular hemlines and a halter neck detail is unique. · In terms of design elements, the dresses could be improved by using regular comb-like shapes instead of irregular ones. · The natural tone colors and fabrics successfully complement the textural effect of the dresses in the completed designs. The voices of the textural effects and fabrics/colors seem balanced. It would be more interesting if there were gradations of color change.

problem identification, preliminary ideas, design refinement, prototype development, and evaluation. In addition, the functional, expressive, and aesthetic (FEA) criteria of this design process were examined.

The designer set the direction of the design problem by limiting the categories of targets and the intended characteristics of the final result. During the preliminary idea stage, the major visual concepts were gathered from visual sources the designer selected. The designer extracted the main elements from the sources and applied the actual garment shapes, lines, forms, and texture. The structure of hexagonal shapes in the inspirational images influenced the designer to create a hexagonal surface and build a hexagonal shape. The garments featured hexagonal textural shapes that gradually changed into a hexagonal form. This unique textural surface design technique was created by folding creases in the fabric and constructing the body silhouette form as well as the texture. Once the core idea for the dress was identified, the design process began to develop. The remaining areas of the dress were constantly adjusted until the final dress design achieved balance and harmony. Recognizing the schemata of the design process provides a funda-

mental understanding of how a designer experiences the overall design thought process. Furthermore, when a certain design activity is observed, it is possible to speculate about the stage (e.g., problem identification, ideation, or evaluation stage) at which the designer is situated. The results of this study show how a designer manages problems during specific stages.

Through the results of this study, the designer identifies that the design process and project could be improved with the prior understanding of FEA criteria to create the most satisfied outcome. The knowledge of each category of FEA could provide the diverse ideas about the design details especially when the designer is stuck with the idea generating situation. Furthermore, the understanding of each stage of creative process would help the designer to flexibly move back and forth with notifying what types of the thinking processes are needed.

This study has certain limitations. First, the design idea and the actual garments were developed before the direction of the research method was determined. Therefore, the data collected from the design project were not fully adequate for an analysis following FEA criteria. Given the nature of this design project, some categories were more suitable than others in the analysis. For example, the scope of the functional requirement was relatively broad while the aesthetic side was weighted. However, this limitation seems unavoidable since a design project has its own goals, which means each category of FEA needs would not be perfectly balanced. Another limitation is that the study was based on only one design project case. Future research should include various cases using different strategies in each stage. Finally, this design process was intentionally and explicitly divided according to a theoretical framework to extract design knowledge in the fashion design process. Importantly, a natural design process is usually more of a constant iterative process.

This study is significant because a detailed design process was analyzed based on a five-step framework developed based on the cognitive process of creativity. The basic knowledge of creativity stages are widely known, but the actual activities in each stage design are rarely addressed in the field of fashion. Sharing detailed observations of design processes can help define the design knowledge involved in each stage of the creative process and help guide instructors in design education.

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