Facets of Indigo: Combining Traditional Dye Methods with State-of-the-Art Digital Print Technology, A Sustainable Design Case

Kelly Cobb and Belinda Orzada

Abstract "If indigo was invented today, we would never approve it." Reflecting on this statement by Andrew Olah related to a 2014 *Just Style* publication on environmental textiles for apparel led our team of six apparel design scholars into a sustainable design challenge. Our study offers a collective model of sustainable design wherein faculty in a university fashion and apparel program combined efforts and talents to develop a solution for reducing the environmental impact of indigo (while retaining aesthetic richness) through the integration of traditional and digital design. A case study method is adopted as a specific, unique, and bounded system (Stake 2008) that frames the creative process so as to capture best practice within a collective design working model. Within this model we analyze historic dye processes and relevant literature, as well as emergent technologies to define criteria for the resulting design output. Qualitative data in the form of observations, as well as our personal reflections as designers and educators, are transcribed and analyzed.

Keywords Collaborative design · Digital printing · Apparel design · Sustainability · Innovation · Textile dyeing · Creative design · Design process

1 Introduction

In 2014, the apparel design faculty of Fashion and Apparel Studies at The University of Delaware received funding to explore digital print technology with students through a product development project. The project "LEUCO STATE" engaged student and faculty designers by pairing tradition with innovation through

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S.S. Muthu and M.A. Gardetti (eds.), *Green Fashion*,
Environmental Footprints and Eco-design of Products and Processes,
DOI 10.1007/978-981-10-0111-6_2

the theme of indigo dye. The faculty portion of the grant, which is detailed here, focused on skill-building in print technologies, and the opportunity to conduct research along with the students into textile history and traditional dye methods. We explored ways to combine traditional techniques with innovative applications. Through this project we applied design research into emerging print technology through the lens of the tradition of indigo and developed an opportunity for six faculty members to work collaboratively during the textile and apparel design processes.

Significant to the collaboration was the invitation to the apparel design faculty to think, make, and learn together. As colleagues we "collaborate" to solve curricular and departmental issues; yet, in terms of research, our work is often conducted in solitude. Our ways of working are diverse. As design educators, we have much to teach and to learn from one another. This project challenged us to take that opportunity. The faculty design team consisted of Kelly Cobb, Belinda Orzada, M. Jo Kallal, Adriana Gorea, Katya Roelse, and Martha Hall, all professors and instructors of apparel design at the University of Delaware.

1.1 Background/Context

Throughout history, dyes have been valuable trade commodities, but in many cases have led to horrific exploitations of both people and the environment, as occurred in the indigo and logwood trades (Flint 2008). Indigo-dyed products are part of our global culture. Indigo is one of the oldest natural coloring substances used for textiles. The traditional indigo dyeing process and the subsequent garment laundering (dye residues) distress the environment. Emerging digital textile printing technologies are leading to significant paradigm shifts in design processes and print/surface design aesthetics. New modes of application, production, distribution, and consumption are being introduced. The first section of this chapter discusses the components of our project: indigo dyeing and the environment, digital printing, and collaborative design. This is followed by a discussion of the theoretical framework used in our collaborative design process and how our work fits into this framework. Finally, we share reflections of the experience.

2 Importance of Indigo

Indigo is one of the oldest natural coloring substances used for textiles, a prime source of color. Preparations focusing on indigo are found in ancient chemical documents dating back to 300 BC. At certain periods in history, Indigo has wielded more power than firearms. Kings, poets, and protesters have all donned indigo cloth. Tribal chieftains of Africa, the Middle East, and South America

wore dark blue indigo-dyed robes as did members of the ruling classes of China, Japan, and Indonesia. On the other hand, traditionally faded blue work clothes have been chosen deliberately as an antiestablishment political statement (Gordon 2011). During the American Revolution, cubes of indigo replaced paper currency (McKinnley 2011). The fact that a majority of the people in a majority of the countries of the world are wearing blue jeans on any given day constitutes global ubiquity (Miller and Woodward 2011). Known as a living color, indigo's own process of decomposition yields its color. The process of imparting color from the indigo plant is so powerful that it has its own creation myth, a Liberian legend about how the properties of indigo were discovered:

> In those days the people grew much cotton and the weavers wove much cloth. All of it was white and they had a hunger for color, especially the blue of the sky, but they did not know how to make that blue go far down and come into the cloth and stay there…. The water spirits come to Asi in a dream. They tell her that for blue to come down to earth and stay, these things are needed: salt, urine, and ashes to live with the leaves of the indigo (Dendel 1995, p. 41).

2.1 Indigo Properties and Process

Indigo dye is produced in a vat process in which chemical reactions, including fermentation, reduction, and oxidation occur. It imparts a distinctive blue to cloth that has inspired people around the world for thousands of years. Unlike most dyes, vat dyes are not water soluble and require a chemical process, activating the dye and thus attracting it to the fiber. The process of converting these dyes to a soluble leuco form requires an alkaline, oxygen-reduced bath. In this bath, the vat dye changes from its insoluble form to its leuco form. In its leuco form, the dye color attaches to the fiber and when the fiber is removed from the dye bath, the dye oxidizes on the fiber, returning to its insoluble form and color (Brackmann 2006, p. 133).

2.2 Natural Versus Synthetic Indigo

Dye is extracted from the indigo plant through a process of fermentation involving plant matter and water with the addition of a caustic agent. Fermentation methods were replaced by synthetic indigo in the last century. Synthetic processes were adopted to accommodate the new scale and speed necessary for mass production. The chemicals used in producing synthetic indigo pigment, and throughout the manufacturing process include aniline, sulphur, sodium hydroxide, hydrosulphate, and formaldehyde, which can be harmful both to humans, through inhalation, and to the environment where they are discharged after dyeing (McGinn 2013).

3 Textile Industry Environmental Impacts

The textile industry is a chemical-intensive industry. After agriculture it is the number one polluter of clean water (Cao et al. 2014). According to a 2005 report by the Hazardous Substance Research Center, an estimated 17–20 % of industrial water pollution comes from textile dyeing and finishing treatments given to fabric. Some 72 toxic chemicals have been identified in water solely from textile dyeing, 30 of which cannot be removed. Considering both the volume and the composition of chemicals in textile effluents, such as the massive presence of dyes, salts, additives, detergents, and surfactants, the textile industry is rated as the most polluting agent among all industrial sectors (Anastas and Zimmerman 2003).

3.1 Pollution and Effluents

Dyeing and finishing one ton of fabric can result in the pollution of up to 200 tons of water according to Glausiusz (2008). Textile mills discharge millions of gallons of effluent each year, full of chemicals such as formaldehyde (HCHO), chlorine, and heavy metals (including lead, mercury, and others) which are significant causes of environmental degradation and human illness. Water samples taken downstream from textile plants in Tehuacan, Mexico, a major denim-producing region, have been shown to contain lead, mercury, cadmium, and selenium. Local farmers complain of chemically burned seedlings and sterile soil (Glausiusz 2008). A 2011 internal wastewater study undertaken by Patagonia (Chouinard and Stanley 2013) found that it takes a textile mill about 500 gallons of water to produce enough fabric to cover a couch. To grow the cotton, then weave and dye the fabric for a single Patagonia pima cotton shirt uses over 600 gallons, the equivalent of a day's drinking water for 630 people. And 15 years from now, between a third and half of the world's population will be living in areas plagued by drought. According to Patagonia, pollution of the Pearl River where it flows into the South China Sea is visible as an indigo color on Google Earth. Indigo is the color of denim and likewise of the discharge from the world's major jeans factories upstream in Xingtang (Ibid.).

3.2 Textile Industry Innovations: Digital Printing

"Much creativity consists of a new combination of existing ideas. Where the existing ideas are present in different people, it requires some kind of interaction to produce the combination" (Langrish 1985, p. 12). Combining computer technology with traditional hands-on design methods has become a common practice in textile and apparel design. Garment patterns are designed through draping or flat

pattern methods, then digitized into a CAD system for production. Hand-drawn illustrations are scanned in and enhanced through a computer graphics system.

The idea that computer technology supports or facilitates creativity is supported by many researchers (Bye and Sohn 2010). Polson et al. (2015) note that print-on-demand digital textile printing provides designers, "the potential for economic and creative independence while reinforcing and sustaining cultural identity and craft traditions" (p. 95). In their research on creativity in apparel design, Bye and Sohn explored the use of computer technology and traditional design methods at three different apparel companies. "The personal perceptions of this group of designers indicate a range of feelings regarding how technology and hands on methods influence their creativity. It is a positive promise for the future that the majority believe that they can be creative using both methods, often with a synergistic effect" (Bye and Sohn 2010, p. 215).

"The blurring of the boundaries between production tool and metamedia in the domain of printed textile design is resulting in changes in working processes, development of new hybrid craft techniques and a changing visual language of pattern and colour on cloth" (Tredaway 2004, p. 258). Use of digital printing technology to enhance the textile and apparel design process has been explored by a number of scholars. Campbell and Parsons (2005) share their design method which incorporates photography and personal artwork manipulated using graphic design software, enhancing digital printing with hand embellishment, and manipulation or scaling of the image to fit a garment pattern design.

Digital textile printing has influenced both style and definition of textile printing. Emerging new looks in prints are possible, because design effects can be developed via computer software. Digital printing also provides quicker sampling for mills, and limited runs for small manufacturers and consumers (Ujiie 2001). Digital print-on-demand systems are designed to minimize fabric waste and ink use (Spoonflower 2015). Digital printing allows print-on-demand options for small lengths of fabric, and printing only what is ordered. Therefore, there is no wasted printed fabric. The printing system mixes color as the fabric is printed (from four to six basic colors), as opposed to the screen-printing process which requires colors to be mixed in advance of the print process. Additionally, wet postprocessing is not required in the digital print process therefore no water is consumed during printing.

4 Collaboration

Collaboration is a purposeful relationship (Rubin 2002). This creative and experimental process leads much to more complex design thinking and analysis than is possible with only one designer (Campbell and Parsons 2005). Through collaborative practice there is an opportunity to mesh skills and expertise, offering entry points into meaningful opportunities for shared exploration. Collaborators plan, decide, and work jointly on an activity to generate a shared process that results in the product. According to Poggenpohl and Satō (2009), collaboration is poorly

defined because it exists in multiple domains of exploration resulting in diverse outcomes. In an analysis of the varied definitions of collaboration, key characteristics emerge, including the sharing of knowledge, the bridging of disjointed knowledge, and the production of something not otherwise possible, by reacting, cooperating, and participating in a spirit of trust.

Where contribution prevails, participants' roles are more narrowly defined and ownership of process and product autonomous. By contrast, collaboration is interactive in the sense that ownership of specific aspects is relinquished for the sake of an integrated whole. Collaboration involves working together "through shared decision-making, the give and take of ideas exchanged and explored, the integration of multiple perspectives and a synthesis that integrates hitherto isolated or incompatible ideas" (Poggenphol and Satō 2009, p. 142). In terms of design collaboration Block and Nolert (2005) suggest that collaboration should result in an outcome that could not be achieved alone by individuals, and the work in the end reflects a blending of all participants' contributions. A sock, for example, can be viewed as just one tangible result of collaborative efforts of diverse sectors within the apparel supply chain.

4.1 Collaboration in the Apparel Industry

A recent economic survey of 1,656 executives from 100 countries revealed that collaboration is vital to future successes. A defining feature within a model of sustainable business is the movement from traditional top-down hierarchies to collaborative flat models of organization. Abrams (2005) suggests that contemporary work demands collaboration, communication, speed, interaction, teamwork, and creativity and that the new office demands the networking of intelligent autonomous individuals as a prerequisite to problem solving. Regarding the discipline of design, the designer is not the lone genius "outlier," producing solitarily at a specific stage of business procedure, rather she is an equal stakeholder, integrated with management, shaping what organizations have to offer and express (Jevnaker in Poppenpohl and Satō 2009, p. 29) Designers as equal stakeholders that exist beyond their own creative silo are critical to the industry agenda. A case in point is the recent Outdoor Retailer Summer Market (a comprehensive outdoor buyer demographic for the outdoor apparel market). Their 2015 speaker series, "Can't We All Just Get Along? Great Design Requires Collaboration," focused on the theme of collaboration within the industry and generated dialogue with industry stakeholders seeking to demystify the myth of the lone genius.

4.2 Collaboration in the Creative Scholarship of Apparel Design

Business and social science have different viewpoints on collaborative action; business, in large part, attends to product and procedure, as well as to performance

and output, whereas social science focuses on individual and group insights that lead to social process (Poggenpohl and Satō 2009, p. 137). Surprisingly, collaboration as a topic of apparel scholarship is not well represented in the literature. Collaboration is described in niche models of design (e.g., Dilys Williams' 2014 reference to BOUDICCA in *Fashion Practice*). In academic projects, collaboration refers to interactions between educators, students, and industry partners (Karpova et al. 2011; Byun et al. 2012).

There is scant research articulating collaborative actions (specific to apparel) among design scholars. Campbell and Parsons (2005) discuss collaborative process within the design process, but they do not define collaboration. As educators of fashion design students we collaborate to solve curricular and departmental issues; we collaborate in the classroom to facilitate learning, yet in terms of research, our work is often conducted alone. The connection here to the myth of the lone wolf is significant but is not elaborated upon except to infer that the notion of the solitary expert creating in an information silo is obsolete in academia as well as business. Collaborative action is the sustainable model moving forward. Academia offers incentives for interdisciplinary interactions with science, the arts, business, and engineering, as the mode of engagement that generates new knowledge while stabilizing the discipline. For the sake of this project, we define collaboration as a shared action involving activities such as sharing, motivation, communication, diversity, support, and problem solving.

5 Theoretical Framework

The theoretical framework for our design process was based on the Design Council's stages of the Double Diamond design process model (http://www.designcouncil.org.uk/news-opinion/design-process-what-double-diamond). The Design Council takes a holistic approach to design, breaking down the design process to four commonalities in the creative process. These are discover, define, develop, and deliver. The visual map of the design process is in the form of a double diamond (Fig. 1). Divergent and convergent thinking are visualized by the broad and narrow areas. Developing a number of ideas or prototypes, then narrowing down the possibilities, happens twice in this iterative process model (Hunter 2015).

The discover stage of the double diamond model is the beginning of the project. Designers explore, research, try out various methods, and keep their eyes open for a broad range of ideas and opportunities. Activities to assist the discover stage are suggested, such as creating a dedicated project space, observation, journaling, brainstorming, being your user, surveys, fast visualization, and more (Hunter 2015). In the define stage, "Designers try to make sense of all the possibilities identified in the Discover phase. Which matters most? Which should we act on first? What is feasible? The goal here is to develop a clear creative brief that frames the fundamental design challenge" (Hunter 2015, np). Activities

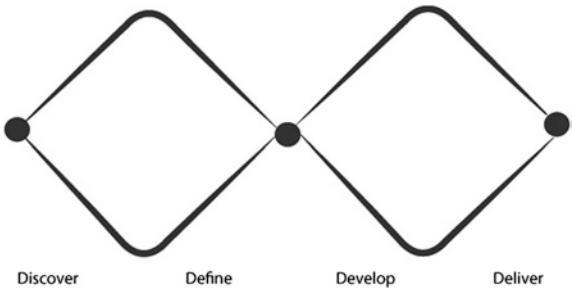

Fig. 1 Adaption of double diamond design model. (Courtesy of Authors 2014.)

recommended in this stage include: holding focus groups, and developing assessment criteria. The develop stage provides designers the opportunity to create solutions or concepts, and is the time when prototypes are tested and iterated. It is a trial-and-error process of idea refinement. Developing use scenarios and physical prototyping contribute to the refinement that occurs during the develop stage. Delivery is the final stage of the double diamond model. In this stage the project is finalized and readied for production, or exhibition. Final testing and evaluation of the project occur here. Designers must evaluate whether the project meets the design and use criteria (Hunter 2015).

5.1 The Design Process

The stages of collaborative design experienced by our team followed Salonen's (2012) interpretation of the double diamond model. Salonen frames his discussion of the discover, define, develop, and deliver stages as a framework for designers to explore, test, and innovate in a collaborative or team setting. Ultimately, we developed an open and flat organizational system in which each designer contributed to the process and developed a portion of the final ensemble. A Google blog site was developed to enhance communication between the designers.

5.2 Discover

Initial goals of our project were to explore the indigo dye process, to be inspired through textile dyeing and surface design opportunities, and to create an opportunity for creative scholarship for the apparel design faculty. The additional opportunity for collaboration was very loosely defined in the beginning and evolved over time.

The designers were each at different levels in their experience with dye processes, surface design techniques, and natural dye knowledge. Our exploration of these began by attending an indigo workshop given by master dyer Christina

Roberts at The Fabric Workshop and Museum in Philadelphia, PA. The designers worked alongside master dyers to formulate two vats to test: an organic fructose vat, as well as a chemically reduced vat, from which basic samples were developed.

Following these workshops, the designers individually researched surface design techniques in preparation for a planned dye studio day. Each designer explored inspirational images and researched the history and process of indigo dyeing. Several designers were directed to shibori techniques as surface design methods often used with indigo dyeing. Each designer utilized the blog space to share inspirational images, mind maps, sketches, and thoughts about the early direction of his or her ideas (Fig. 2).

Traditional crafts have often been sources of inspiration and appropriated by Western craftsmen and designers (Hedstrom 2000). Our team of designers likewise was inspired by tradition within indigo dyeing. We applied traditional shibori resist methods to develop multiple surface design samples, testing various combinations of technique, material, and process. Within our group the extent to which traditional techniques were explored varied greatly. Gorea and Kallal were very inspired by shibori techniques. After researching shibori techniques, Gorea found herself attracted to many of them and realized she could "incorporate several wrapping styles into something that can look very simple, but otherwise is

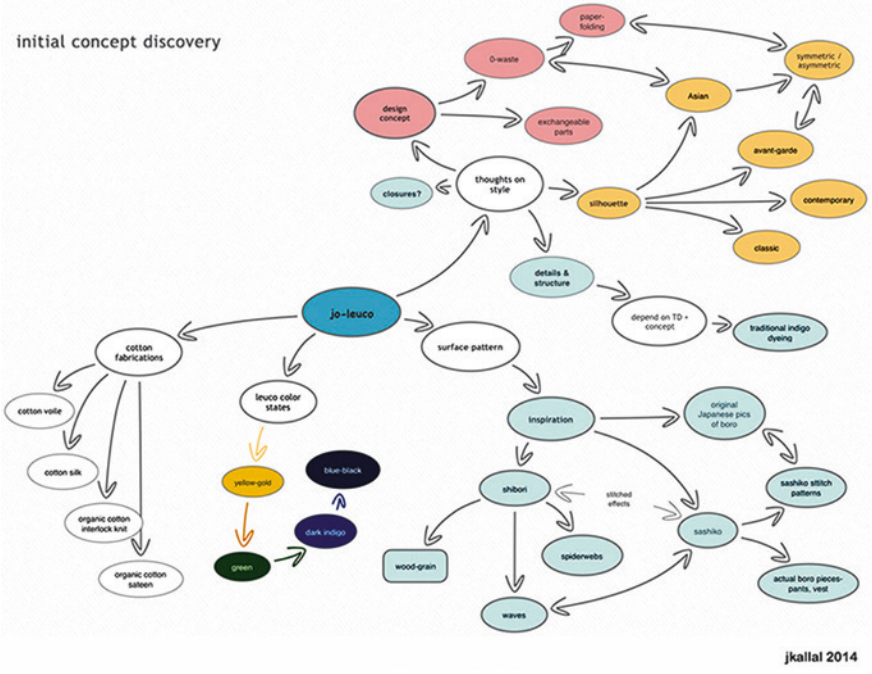

Fig. 2 Concept of discovery inspiration mindmap. (Courtesy of authors 2014.)

very difficult to achieve via traditional techniques." Kallal developed a number of different traditional shibori stitched samples to dye.

Roelse, on the other hand, visualized the traditional techniques as a "process on a pedestal." She sought to keep the "experimental and traditional stage small and contained, and by using these discoveries only as a jumping off point—a seed from which to design new fresh designs—the outcome will only be vaguely reminiscent of its beginning."

5.3 Define

"Collaboration is not a one-dimensional idea. It's the result of using the right tools in a well-thought out process" (Charbin 2010). To facilitate a multidesigner collaboration, we chose to work within the parameters of a clothing "ensemble". Each designer would develop a textile print and a portion of the multicomponent ensemble. The process involved collaborative work sessions in the department textile lab, individual work sessions in personal studios, and interaction within the multiauthored project blog.

As Salonen (2012) notes, collaboration also adds another level of complexity to a project. At different stages in the design process, the structure of the project and the mode of collaboration varied. Collaborators met face-to-face during several

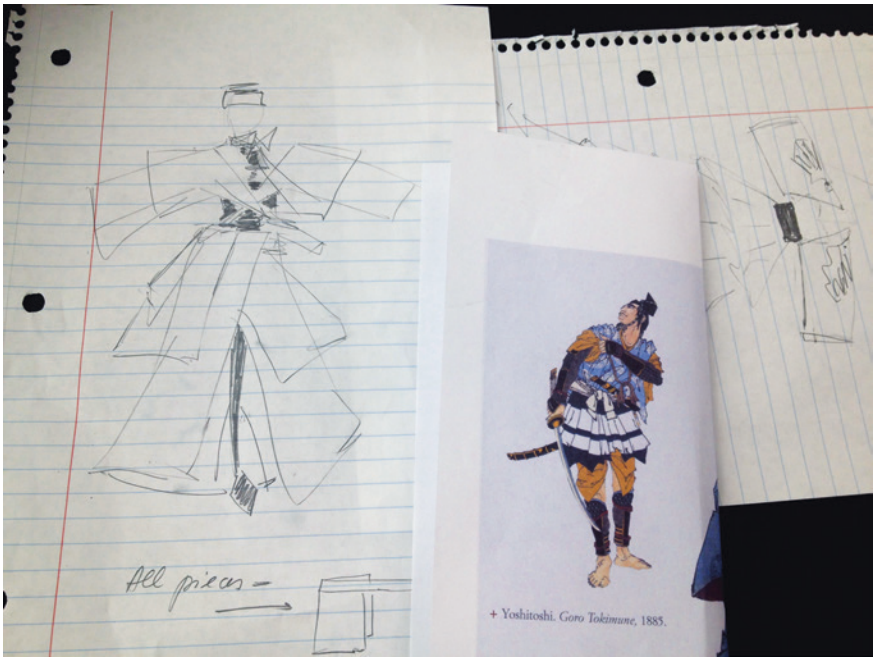

Fig. 3 Preliminary design sketches. (Courtesy of authors 2014.)

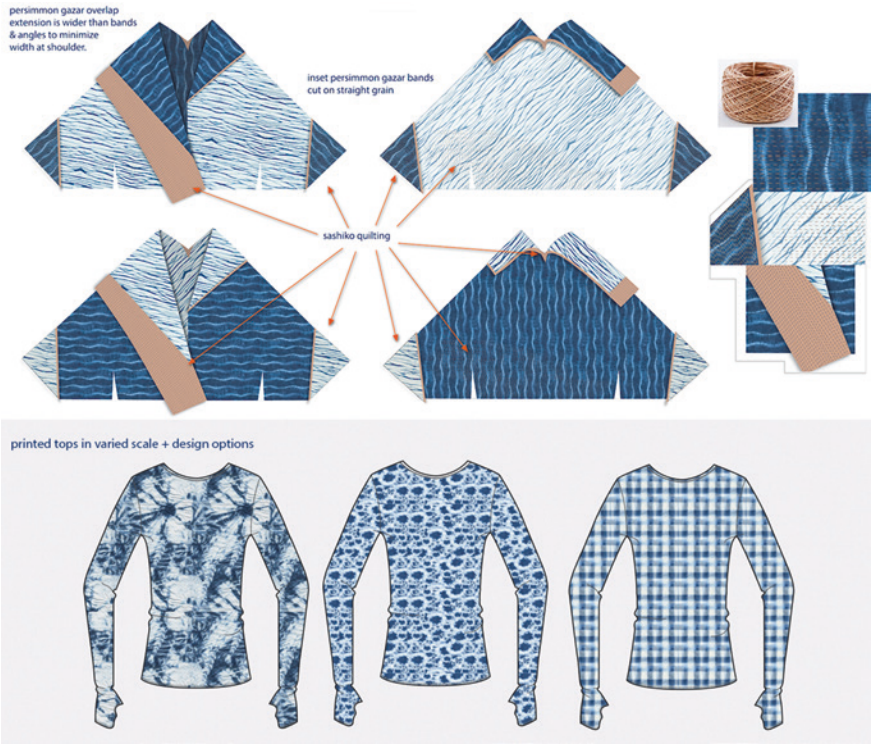

Fig. 4 Garment flat sketches. (Courtesy of Designers 2014.)

site visits and studio days, yet a second, and primary, site of interaction existed virtually on a multiauthored project blog as designers posted regarding inspiration and process and others commented on colleagues' posts. Through these discussions, we shared opinions and worked through design ideas for both our textile design and garment design. Initial sketches of several design ideas were produced (Fig. 3).

Our use of indigo and shibori surface design techniques initially led some designers to Japanese-inspired garment shapes. Further discussion led to each designer sharing his strengths and preferences for developing a certain portion of the ensemble and preliminary decisions on textiles. Kallal and Roelse each used graphics software to scale their shibori prints into garment flat sketches (Fig. 4).

5.3.1 Develop

Developing both textile print and garment designs in a collaborative work and decision process was a key consideration in the design concept and the collaborative process. Indigo-dyed fabric samples using shibori and other surface design

Fig. 5 Digital design variations. (Courtesy of authors 2014.)

techniques were manipulated using graphics software to develop fabric prints. Sample fabric yardage was digitally printed to test color and proportion of the surface design (Fig. 5).

Each designer individually and in collaboration began work on three-dimensional prototype development. Two designers, Kallal (bolero) and Hall (pants), explored zero waste pattern design as an additional sustainable design criterion for their individual garments. They each tested paper and/or muslin prototypes to work through silhouette, fit, and proportion. Orzada (bustier) recycled blue jeans by draping and fitting pant legs directly on a dress form to determine the garment shape. Gorea mathematically planned the pleating process and length of fabric needed for her pleated skirt.

Once we had each reached the prototype stage, we met in the studio to share our work. Visual analysis of the garment prototypes, partially completed garments, and digitally printed sample fabrics allowed us to discuss proportion and final garment details as a group. Cobb had the idea to incorporate another texture in the look by using leather dyed with shibori techniques and Orzada made plans to incorporate a leather strip as the center back lacing of the bustier. Gorea and Cobb collaborated to incorporate Cobb's textile into the skirt design.

There was "give and take" experienced by all during the collaboration process. Hall noted, "[A] danger of working with several talented designers, is that we each want to create something unique and strong. However, speaking for myself, I could see very quickly that I was 'over-designing' and needed to edit my ideas to be in dialog with, rather than fighting with, the other garments in the ensemble." Roelse states, "[T]hinking about my overall approach to the creative process and working in a group, I try and let go of my personal vision and see what is needed instead. It's good practice not to have a 'precious' design."

Gorea found this editing necessary as well; she states "while draping my muslin over Martha's pants I realized I will have to… add fabric fullness." She felt piecing the print in the back would be too predictable, "so I thought of using a strip of the border print vertically to create a wrap like effect (Fig. 6)."

Fig. 6 Image of skirt prototype. (Courtesy of authors 2014.)

5.4 Deliver

Composed of many prints and garments, the result is a visual, tactile, and dynamic form of conversation. The outcome is a creation of one-off garment pieces (in print and silhouette) that work in conversation with each other as an ensemble. The layering of pattern and garment into one "look" is aesthetically significant. Considering the balance of all pieces, Orzada noted that the rawness of the bustier with its frayed edges, ingrained soil, and hand stitching "provides a great balance to the preciseness of other pieces in the ensemble. The solid background was needed as a relief to all the varied prints, and provided a canvas for using everyone's prints to connect them all."

The design team submitted the ensemble to the International Textile and Apparel Association's 2014 juried Design Exhibition. *Cloud Eater* was awarded the 2014 Educators for Socially Responsible Apparel Practices Award for Sustainable Apparel Design (Figs. 7 and 8).

Fig. 7 Final ensemble image, front view. (Courtesy of authors 2014.)

6 Reflections

Designing for sustainability is a daunting task. As designers, the project was an invitation to problem solve issues collectively, experiment with new ways of working, to guide and be inspired by designer collaborators. In working together, the team achieved a sustainable solution that was beyond the scope of individual inquiry.

Through collaborative applied research, the team developed a design solution to reduce the impact of indigo (while retaining the aesthetic richness) through the integration of traditional and digital design. Design scholars developed an applied knowledge of collaborative design that considered the potential of technologies from multiple perspectives. In the collaborative design process, it was important to develop an opportunity for us to be reflective practitioners, engaging in an examination and evaluation of our own work. Establishing an outlet for communication through a blog provided this opportunity. There was varied success to this part of

Fig. 8 Final ensemble image, detail. (Courtesy of authors 2014.)

the design process. Some designers contributed often to the blog, others not as regularly, or in as much detail. This is a potential area for growth in future projects. Deliberate practices could be set up to gain regular insight during the design process.

7 Mapping and Compositing Our Process

In the process of design, collaborator Jo Kallal modified Newman's "design squiggle" to represent her design process. As a team we adopted the squiggle as a format to view our process of codesign. Specifically, our interest was in capturing how each design process aligned and diverged and as a method for visualizing our collaborative design approach (Fig. 9).

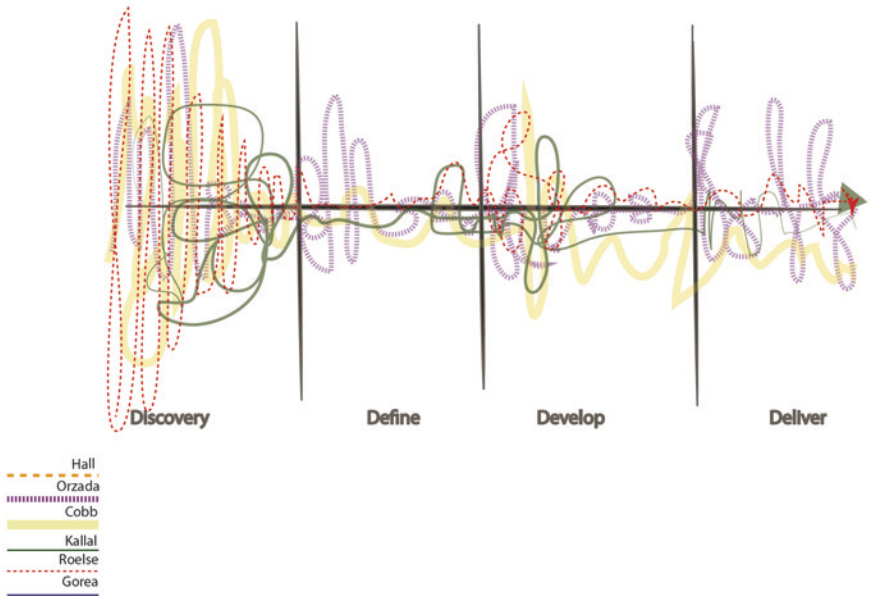

Fig. 9 Facets design squiggle. (Courtesy of Authors 2014.)

7.1 Benefits and Limitations

The Facets collaboration yielded a collection of repeat pattern yardage produced via an "on demand" digital print firm. Innovation of traditional textile pattern creation through resist methods was achieved through digitally iterating smaller scale resist-dyed samples. Our design scholarship involved small batch production of digital textiles, purporting to (1) limit greenhouse gas emissions in comparison with traditional screen printing, as well as (2) generate less production waste (Kujanpää and Nors 2014). Further research (as in a life-cycle analysis) would be necessary to validate claims of sustainability quantitatively. The opportunities and limitations inherent in the scalability of digital printing is another area worthy of further research.

Benefits of the resulting design include retention of the more spontaneous results of hand-dyeing along with the reduction of indigo deposits in water. Innovation of traditional dye methods was achieved with the adoption of digital printing methods, thus lowering the amount of water waste in the dye process. However, digitally printed textiles are pretreated with chemicals, which add to impacts in production. Expanding this initial design study into environmental performance evaluation comparing traditional resist-dye methods with samples digitally integrated into printed yardage would add to the emerging canon of knowledge on digital printing as a sustainable practice.

Digital compositions expand the potential for more quickly developing a complex pattern (i.e., taking a few good "moments" from dye samples and creating patterns in Photoshop rather than producing more yardage using the original technique). Limitations of the design results include the fact that printed fabrics have a white background; this made it difficult to tear/stitch some fabrics or to use the reverse side of the fabric. In our process we missed the tactile qualities of hand dyeing, as some of the complex variations that arise in dye work cannot easily be digitally duplicated. A further study on the aesthetics of traditional hand dye methods in comparison to digital iterations might also prove consequential to the growing field.

Collaboration as a topic of apparel scholarship is not well represented in the literature. We have much to learn by engaging in design with others from different backgrounds within design, different interests and working methods at different stages in one's career. In terms of the collaborative working model, our designers reflected that it was an intriguing opportunity to use like-minded, yet diverse backgrounds, experiences, and perspectives to produce an eclectic look. Each designer was able to gain new skills and experiences, while at the same time draw on her individual backgrounds, textile design, and pattern-making skills to produce results that reflected strong outcomes both individually and collectively. Their contributions balanced their foundation of strengths as apparel designers, and the collaboration required that we push those skills forward and acknowledge the skills of others.

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