Developing a framework for sustainable apparel design: Upcycling knitwear

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Background and Problem

The apparel industry is a major contributor to environmental problems and apparel designers' role in sustainable design has been emphasized. In this regards, designers and educators share unique burden to contribute to the social responsibility of contemporary culture (Hawley, 2006). Various approaches (i.e. upcycling, slow fashion, organic, minimum waste) has been explored, but a limited framework has been developed for sustainable apparel design process. Specifically, emphasizing knitwear and in terms of cradle to cradle approaches (McDonough & Braungart, 2002) is needed due to its attributes of natural fibers and minimum waste. Having a practical sustainable design framework and examples would become important educational materials and allow design students to effectively practice sustainable design methods.

Purpose and Theoretical Underpinnings

The purpose of this study was to document the development and implementation of a new sustainable apparel design framework through a line of women's knitwear. Specifically, it integrates strategies of upcycling post-consumer recycled (PCR) clothing, minimum waste, and computer-aided design (CAD). The design process was grounded in the context of sustainable design movement. The framework was developed based on Cradle to Cradle Apparel Design (C2CAD) by Gam, Cao, Farr, and Heine (2009) and an apparel design framework by Lamb and Kallal (1992).

Design Process and Method

Material selection includes commercially milled and handspun natural fibers, post-consumer recycled knitwear total of 7 pieces. (100% cotton, 60% cotton/40% viscose, 100% cashmere, 70% wool & 30% cotton, and 100% lambswool) and upcycled cotton twill from 3 uniform pants. The process to upcycle yarn requires starting with fully fashioned knitwear which is unlinked into individual pattern pieces. Then, starting with the bound off edge, each piece is unraveled and wound into a cone. Once the garment is unraveled onto a cone, the yarn is skeined into a hank and tied in a few spot to prepare it to be washed. The yarn is then washed in a vinegar and lanolin based soap mix in warm water with little to no agitation. Once dry, it is ready for the knitting process. Using this method, 9 swatches were created on either a single, flat bed knitting machine or by hand knitting (see Figure 1). The swatches were all created using a mixture of the upcycled, handspun, locally or commercially milled to ensure overall color cohesiveness for the collection and incorporated stitch design that was used on multiple pieces. The collection consists 6 complete outfits totaling 20 pieces of knitwear, crochet, and woven. Digitally printed textiles were incorporated into the collection using the Mutoh printer after examining minimum waste layout for digitized patterns.

Figure 1. A sustainable design process of the project

Proposed Strategies and Implications
A total of six ensembles was developed based on the new sustainable apparel design framework. As shown in figure 2, a framework for sustainable apparel design and product development has four main phases: (1) problem identification, (2) design strategies, (3) prototype development, and (4) evaluation. In problem identification phase, designers define problems and conduct consumer needs and market research. Specifically, the design strategies phase has three main sustainable design approaches: (1) material selection (natural fibers, post-consumer recycled product, innovative materials), (2) pattern development (minimum waste and versatility), and CAD (digital textile printing and virtual prototyping). After designers select materials and design strategies, prototypes are developed and evaluated with cost analysis.
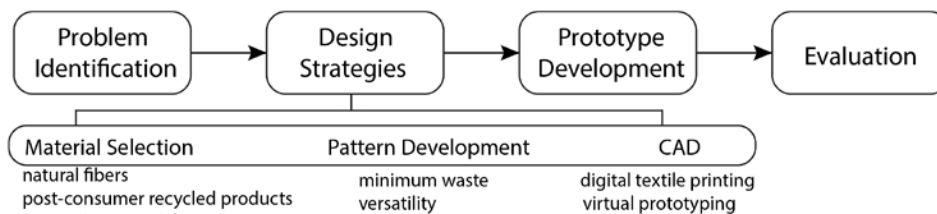

Figure 2. A framework for sustainable apparel design & product development

The presentation includes in-depth explanation of the sustainable design framework with descriptive and visual examples for each phase. The significance of using this method in apparel design courses provides instructors and students with valuable tools to communicate and enhance sustainable design outcomes.

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