



## Pedagogical Considerations for Teaching Modern Performance Glove Design

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When we teach students how to be apparel designers, we address the user's needs (performance and aesthetic), body shape and size, ideation, materials selection, pattern development, construction and evaluation to create new products. However, when teaching modern performance glove design, the pedagogical process is undefined. The human hand is a complex interface to create new products for. Literature in the space includes: historical documentation of gloves and glove making, hand anthropometry, methods of evaluating the hand and glove functionality to determine product design opportunities, but the process of linking knowledge together to teach students glove design from start-to-finish, with current tools and technologies is lacking (Redwood, 2016; Tomshinsky, 2011; Greiner, 1991; Hsiao et. al., 2015; Dianat et. al., 2014; Torrens et. al., 2012).

Corriveau (2014), also writes how there is an opportunity to improve the design process for glove designers, through new practices in anthropometric data collection, and developing better tools for designers to create from. He discusses how gloves are often not worn because users refuse to wear uncomfortable or cumbersome products. The Bureau of Labor Statistics (2015) also supports this notion, where 1 million workers in the United States were reported to be treated with acute hand injuries. Seventy-percent of those injured, choose not to wear gloves and the remaining 30% of acquired injuries were from wearing damaged or improper gloves for the job. Performance glove designers have a great responsibility, where they must carefully consider finger flexibility, dexterity, size variations, thermoregulation, support, impact protection and seam placement to enable users to perform tasks accurately and safely. What if similar efforts used to teach apparel design could be utilized to teach modern performance glove design? Could the process develop safer products? This paper will review a pedagogical process that the author created to teach performance glove design.

The pedagogical process includes 10 considerations for students designing new performance gloves:

1. **Glove Anatomy:** introducing students to the different types of performance gloves (e.g., sport, firefighter, military, etc.), typical parts of a glove, function of the parts and where they overlay the hand/wrist. This exercise is completed through artifact analysis of existing glove products that they students can disassemble and study.
2. **Hand Anatomy:** explanation of how the hand is formed (bones, muscles, ligaments, tendons, joints, nerves, skin, etc.), how it moves, and typical injuries that gloves prevent and can propagate.
3. **Hand Scanning and Anthropometry:** presentation of 2D and 3D scan methods, landmarks, proportions and measurements important to glove design.
4. **3D Hand Forms:** how to use scan data to develop hand forms (mannequins) for designing, through 3D printing (resin) and CNC routing (foam and wood).

5. Drawing of the Hand and Gloves: methods to block-out hand and glove drawings based upon anthropometric data, scanning, photography and user performance needs (e.g., grasping and pulling).
6. Glove Ideation: exploration of methods to create functional design features, including but not limited to: flex zones, padding, gussets, touch screen pads and seams on gloves. Methods to design gloves for different activities, including: sports, firefighting, space and military operations.
7. Glove Pattern Making: the process of drafting ergonomic patterns, appropriating seam allowances, understanding fit, sizing, grading and customization approaches.
8. Glove Material Selection: an overview of materials used for gloves to provide impact protection, durability, flame resistance, water resistance, conductivity, dexterity and tactility.
9. Glove Construction: demonstration of the variety of methods used to make modern gloves, including: machine stitching, molding, bonding, dipping, welding and 3D knitting.
10. Glove Testing/Validation: description of the methods used to test glove and user performance while wearing gloves, including: wear tests, and standardized lab tests for dexterity, flexibility, durability and grip strength.

Gloves are important products for users that work in dangerous and hazardous environments. The hand is such a complex part of the body to design for, and with this pedagogical process students are less afraid to approach design challenges, because they have knowledge and tools supporting them throughout the entire design process. By integrating this holistic approach, students of any design discipline (apparel, product and industrial) can understand the complex considerations involved, and create better functioning products that decrease the likelihood of user injury and improve work or sport performance. This process is currently being used to teach a sports product design equipment studio, and as a result students are more thoughtful about their solutions and are able to develop more innovative, relevant and functional prototypes. The author is also interested in using this method to teach sport industry practitioners and other professionals who may need a process to design other products that interface with the hand (e.g., computer tools, phones, and utensils).

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