Identification and Comparison of Fabric Properties in the Age of Digital Communication

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The use of technology in apparel and textile sectors has been increasing in both academia and industry. This study was conducted to identify the impressions of fabrics presented in three different media including in-person fabric presentation, flat digital photographs, and draped digital photographs over a dress form, and to compare the differences in the responses to them. The serviceability concept as defined in established literature was used to categorize responses. Ten fabric samples were viewed by sixty-seven college students. They were asked to note their impressions of fabrics through open-ended questions at the beginning and end of the semester, rotating the presentation medium. Responses fell into serviceability categories and patterns emerged that show differences given the presentation medium.

The use of technology in apparel and textile sectors has been increasing in both academia and the textile and apparel industry, allowing less face-to-face interaction to teach, sell, and present the product. In academia, distance education has been increasing and online education has grown at a rapid pace. Doyle (2009) noted that in the middle of the 1990s there were too few courses to count online. By 2002, 1.6 million students were taking at least one online course and in the fall of 2007 there were 3.9 million students. Researchers have tried to enhance and examine the learning experience of on-line education. Lo, Chang, Tu and Yeh (2009) developed a web-based history education system to increase the understandability of history learning materials by testing its effectiveness in learning in terms of perceived ease of use, perceived usefulness, attitude to use, intention to use, recall of websites, and perceived usefulness of assistant tools. Cohen, Beffa-Negrini, Cluff, Laus, Volpe, Dun and Sternheim (1999) reported on the success of a Nutrition Science Online course that included a syllabus, web-links, threaded discussions, e-mails, a resource page, and a place to submit assignments online. The course was successful in increasing secondary teachers' knowledge of nutrition science and comfort in using computers.

Since online teaching has emerged, Family and Consumer Sciences (FCS) professionals have questioned the benefits and drawbacks of online education. Reiboldt (2001) discussed the positive aspects of distance education versus the traditional classroom for FCS educators and students, including increased student interaction with deeper responses via e-mail and greater teacher consideration of questions posed, better student-student interaction, ability to hire a variety of professors with specific expertise, reaching un-tapped audiences, greater profits, and better records of class activities. The drawbacks of online education sited were a possible loss in faculty, costs and energy to transform a class online, lack of face-to face contact, ethical issues (e.g., scams, cheating) emerge, and systems failures. Reiboldt (2001) encouraged FCS teachers to develop online classes despite the drawbacks, calling for professionals to work together in implementing online education.

FCS areas such as interior design, FCS education, foods and nutrition, and apparel design and merchandising focus on skills and knowledge related to physical objects. The FCS competencies demonstrate this focus. In the area of apparel and textiles, FCS teacher competencies requires the ability to evaluate performance features of fibers and textiles; analyze the design, use, care, and construction of apparel and textile products; apply color schemes and theory, relate the psychological, physiological environmental trends; and apply principles and elements (Botine, 2008). Such competencies require accurate depictions of the apparel and textile product regardless of method of communicating (e.g. electronically, in person). Lee (2002) further noted that the apparel and textile companies for FCS professionals should include more construction skills, which requires further knowledge of textile use and properties that aid in construction (e.g. drape ability, mold ability). These characteristics are difficult to communicate online as demonstrated in an online experiment where students preformed a draping task better when the teacher was physically present than when the instructor presented the same instruction by video tape (Saiki & McFadden, 2005).

Online education has been practiced in apparel and textile sectors even though presenting clothing and textiles has unique issues in online presentation, such as its dependency on tactile and visual properties. Teaching through multimedia has been developed and practiced in classes with various textile and apparel subjects including textiles, apparel design and production, and merchandising. Botkin, LaBat and Hokanson (2001) developed computer aided instruction module to teach an advanced apparel construction technique and evaluated participants' performance that resulted in no significant differences between traditional lecture and computer aided instruction module demonstration. Chen (2004) incorporated online teaching for an apparel quality analysis class, and evaluated the students' performance and teaching assessment, and questioned factors that affect students' performance in an online course. These included the independent nature of online learning where students need to investigate information independently. The authors suggest technical training prior to taking the analysis class. With this increase in use of apparel and textiles in digital medium and a need for FCS professionals to understand the many dimensions of apparel and textiles, the question emerges as to how digital media varies from face-to-face, hands-on representation and how the fabric product effectively can be represented online.

There have been many studies that assess textile properties using objective and subjective ways to help choose appropriate textiles for the production of clothing (Luible, Varheenmaa, Magnenat-Thalmann, & Meinander, 2007; Ohta, Saeki, Yamada, & Nishimatsu, 1998). These have been developed with actual access to the textile. Researchers and industry professionals have examined different attributes of the textiles in apparel through different tests that incorporate physical handling of the garment as well as surveying user perspectives (Abraham-Murali & Littrell, 1995; Branson & Nam, 2007; Eckman Damhorst & Kadolph, 1990; Kadolph, 2007). There have been general frameworks created to assess the apparel product as a whole, as well as specific to fabrics. While there has been formal research to identify user perceptions of the apparel product, there has been limited research that has focused on the fabrics of the apparel product (DeLong, 1998; Kadolph, 2007). A small number of research studies that capture attributes focused specifically on the fabric in apparel in the words of the end user have been performed. In addition, while there has been some research regarding presentation- catalog versus physical- influences perception of the apparel product, there exist little, if any research that identifies perceptions of the apparel and textile product characteristics in consideration of the recent and contemporary methods of presentation, such as the Internet. The spectrum of

fabric properties as recognized by fabric and clothing consumers' needs to be explored to deliver the essential properties through digital media and to avoid missing critical user observations for successful learning, presentation, and use of the textile product.

Literature Review

Assessment of textiles and apparel product has occurred in multiple levels of industry. Identifying and categorizing relevant attributes and properties of textiles and apparel products have been examined by multiple researchers. As the presentation style changes, especially due to the development of technology, the product perception becomes an important topics to address. The following review of literature examines research related to current assessment tools of apparel and textile attributes, apparel attributes, fabric attributes, textile serviceability concepts, and the impact of technology on the perceptions of the product presentation.

Assessment of Textile and Apparel Product Attributes

Attributes of textile products can be categorized into 1) objective measurements under controlled laboratory settings and 2) subjective evaluations from an observer. Mechanical properties such as durability are usually measured by objective methods using specific instruments based on developed testing methods such as ASTM standards (American Society for Testing and Materials) and ISO standards (International Organization for Standardization). Visual and tactile properties are mainly evaluated through the feedback of an observer. Subjective criteria are a result of many complex factors including the consumer's underlying values and attitudes, stored information and experience, and various psychological, sociological, and economic influences. Therefore, development of models of the apparel purchase process is a challenge (Jenkins & Dickey, 1976). There are several researchers (Abraham-Murali & Littrell, 1995; Eckman et al., 1990; Kadolph, 2007) who have identified the attributes of apparel and textile products, providing a rich starting point by which to assess the consumer's perspective.

There exist multiple potential groups of people who evaluate the textile properties in the textile and apparel industry. There exist various potential purchase decision makers in the fashion industry from product development and distribution to the consumers. For example, fibers can be purchased by yarn manufacturers or fabric manufacturers who produce non-woven fabrics. Yarns can be purchased by fabric manufacturers to produce fabrics, yarn retailers as a wholesale, or purchased by individual hand-knitter/weavers through retail stores. Clothing manufacturers purchase fabric to make garments, and fabric can be purchased by fabric retailer stores to sell to either manufacturers or individual dress makers. Clothing can then be purchased by either retailers or individual wearers. Figure 1 below summarizes these potential purchase decision makers at each production and distribution stage in the garment product development procedure. As online clothing retailing is increasing, the clothing consumers have frequent opportunities to assess fabric properties based on indirect subjective judgment including browsing photos of flat fabric swatches, fabric swatches in draped form or clothing photos made from that fabric along with additional written product information such as fiber content provided by sellers.

Figure 1. Possible purchase decision makers for fabric and garment merchandise

Garment Product Development Stage	Fiber	Yarn	Fabric	Clothing
Purchase Decision Maker	Yarn manufacturer Fabric manufacturer	Fabric manufacturer Yarn retailer Hand Knitter/Weaver	Clothing Manufacturer Fabric retailer Dress-maker	Wearer Retailer

In educational institutions, especially in fashion programs, the instructors are trying to convey their expertise and knowledge in different subject areas including textiles, pattern making and construction, history of dress, CAD (computer aided design) and so on. There are many opportunities to present fabric and clothing items to the students. As distance education is increasing, the use of digital media to present their expertise is increasing, thus conveying fabric properties through digital media in a manner as close as possible to the in-person presentation is important.

Apparel Product Attributes

There are many descriptive frameworks for analysis of the physical, performance, and aesthetic features of the apparel product (Brown & Rice, 2000; DeLong, 1998; Fiore & Kimle, 2006). There has also been formal research conducted to identify the properties important to consumers when they are making purchasing decisions. Eckman et al. (1990) noted that up to the point in time when the article was published. Much of the literature about the apparel product was descriptive. Using scientific methods, they sought to build a model about how consumers utilize the great amount of information available at the point of purchase. They found across 21 studies, 35 extrinsic and 52 intrinsic characteristics influenced consumers' motivation to purchase. Extrinsic characteristics are properties that when altered do not change the physical product (e.g., price), but may change viewer perception of the product. Intrinsic characteristics are properties that when altered change the physical product (e.g. color), and may also change the viewer perception to the product. The authors identified four categories of product characteristics from a review of literature including 1) product composition, 2) performance, 3) quality, and 4) sex appropriateness. The majority of these studies were quantitative, and most have pre-selected scales. The use of pre-selected scales has been criticized for reflecting what the researcher thinks is important to the consumer rather than allowing the consumer to choose what is important (Webb, Campbell, Schwartz, & Sechrest, 1966). The disadvantage of free response is that the consumers may not be aware of the criteria (c.f. Eckman et al., 1990). Comments by the consumer provides a less biased perspective of product characteristics as there is less reinterpretation of their thoughts into scales (Damhorst, 1985; Ericsson & Simon, 1980; Fishbein, 1971).

Methods of identifying product characteristics have also been examined in that many use stimuli, such as the actual product or a product visual to evoke perceptions. Holbrook (1983) found that the tactile use of an actual sweater was more influential on assessing product characteristics and that some methods could require actual viewing on the body to assess lines, colors, forms, and other visual cues. Holbrook (1983) also discussed the influence of the retail setting in which the product is found. Eckman et al. (1990) asked shoppers to fill out a survey

about a garment they were going to purchase. The participants were asked to try on the garment before filling out the survey. They asked the participants what they liked and disliked about the product. The findings indicated that participants paid attention to intrinsic cues including aesthetics (color/pattern, styling, fabric, uniqueness, and appearance), usefulness (versatility, matching, appropriateness, and utility), performance and quality (fit, comfort, care, and workmanship).They also identified key extrinsic cues (price, brand, and competition at other stores) important to them. Styling, color/pattern, fit, fabric, appearance, and price were most frequently mentioned. The participants were concerned about performance and quality related to fit. Using garments to match a wardrobe, appropriateness, utility, uniqueness, brand and competition were mentioned infrequently. When discussing general purchasing (rather than focusing on a specific item), workmanship and care were discussed often and color/pattern was mentioned less than other characteristics. Fabric ranked fourth in the criteria of purchases and third among non-purchases. The authors developed a model of decision making where at the interest phase, color, pattern, style, and fibers and fabrics attract a customer. At the second phase color and pattern, fit and appearance on the body were important considerations. Country of origin, brand, and workmanship had little influence on purchasing, and the influence of price depended on the store type.

Abraham-Murali and Littrell (1995) conducted five focus groups with 31 female consumers using catalog photographs and narratives as stimuli. The authors sought to generate a comprehensive list of apparel attributes grounded in consumer vocabulary and to arrange them into themes and levels. They also wanted to examine attributes given the different types of retailers, from consumer in-house purchases (on hand purchase) to photographs in a catalog. Four general themes (physical appearance, physical performance, expressive, and extrinsic) and 79 specific attributes were found. In general participants were most concerned about physical appearance and expressiveness. When physical garments were examined, concern for appearance increased and interest in expressive attributes decreased. With regards to fabric, they found that participants paid attention to the fiber content, fabric weight, and construction/structure. These fabric components together were analyzed equally among participants when viewing the garment and examining actual artifacts. The theme, color/pattern/texture, included specific features solid, color, pattern or figure, trim, and touch, and it was observed more often after examining the physical apparel item. Fabric was also noted at the physical performance level. As a category the fabric included shrinking, hanging well, stretching, wrinkling, soiling, irritating the skin, pilling, softness, warmth/cool, appearance after washing, and global evaluation. The extrinsic feature, price, was assessed while examining the actual garment more often than while viewing photographs. Participants tended to make comments about the physical performance while viewing photographs, rather than after examining garments. They also noted the care (washability, dry clean only, cost in care, removing stains without affecting fabric, need for ironing, and easy care) with more comments made while viewing the catalog photographs.

Fabric Product Attributes

Textile properties can be measured through various methods including objective measurement, subjective measurement, assessment instrument, and test methods such as the ASTM and ISO standards. For example, **t**here are primarily two systems for evaluating the overall fabric quality based on mechanical property tests of fabrics including the Kawabata evaluation system for fabrics (KES-F, later named KES, FB) and the FAST system. The former system was developed to predict feel, hand, and appearance of fabrics. The latter system is the

measure of fabric for assurance of specific use by simple testing (FAST) system. It is a simpler alternative to KES (Branson & Nam, 2007), however, the use is limited to textile expertise. In Business to Business practices, it is common to present the visual product images and product information online then send a sample to the consumer as requested. As with the apparel product there is a general framework to analyze textiles. Kadolph (2007) provides guidelines to examine the textile properties in terms of the framework that serve the end-user's needs (see Table 1).

Textile Properties and Serviceability

"Serviceability describes the measure of a textile product's ability to meet the consumers' needs" (Kadolph, 2007, p.11). The emphasis is on understanding the target market and relating needs of the market to product serviceability. The serviceability concepts that are used to organize the textile information are aesthetics, durability, comfort and safety, appearance retention, care, environmental impact, and cost. Descriptions for each of the serviceability properties are shown in Table 1.

Table 1
Descriptions and Sub Properties of Serviceability Properties (Kadolph, 2007)

Serviceability Category	Descriptions (Kadolph, 2007, p.12)	Fabric Properties
Aesthetic properties	Attractiveness or appearance of a textile product. Does the item look pleasing and appropriate for its end use? Does it make the right statement for the target market?	Luster, drape, texture, hand
Durability properties	The manner in which the product withstands use. That is, the length of times the product is considered suitable for the use for which it was purchased. Will the consumer be satisfied with how well it wears, how strong it is, and how long it remains attractive?	Abrasion resistance, flexibility, tenacity, elongation
Comfort and safety properties	The way textiles affect heat, air, and moisture transfer, and the way the body interacts with a textile product. Its ability to protect the body from harm. Is this item comfortable for its end use in terms of absorbency, temperature regulation, hand, etc? Will its comfort change with use or age? How does it feel? Is it safe to use or wear?	Absorbency, heat or thermal retention, heat sensitivity, density or specific gravity
Appearance-retention properties	How the product maintains its original appearance during use and care. Will the item retain its new look with use and aftercare? Will it resist wrinkling, shrinkage, abrasion, soiling, stretching, pilling, sagging, or other changes with use?	Resiliency, dimensional stability, shrinkage resistance, elasticity or elastic recovery

Care properties	Treatment required to maintain a textile product's original appearance and cleanliness. Does the item include a recommended care procedure? Is the care procedure appropriate to maintain the product's new or nearly new look? Are these recommendations appropriate considering its end use, cost, and product type?	Dimensional stability, shrinkage resistance, elasticity or elastic recovery, heat sensitivity
Environmental effect properties	Effect on the environment of the production, use, care, and disposal of textiles and textile products. How has the production of this item affected the environment? Can this product, its components, or its packaging materials be recycled? Does the product or its packaging contain any recycled materials?	Toxicity, sustainability
Cost properties	Amount paid to acquire, use, maintain, and dispose of a product. How much will it cost to care for this product during its lifetime? Is the cost reasonable given the product's inherent attributes?	Cost, price

The Impact of New Technologies on Product Perception

As technology and distribution infrastructure are developing, the presentation method for textile and apparel product is evolving. Consumers are becoming familiar with browsing online images. Luckin (2009) examined technology use among middle school students and found that 74% had at least one account within a social network. These learners tended to primarily share photographs followed by music, while a few said that they uploaded videos. In business practices, more and more consumers in both Business to Consumer and Business to Business are participating in purchasing fabric and clothing merchandise through the Internet. As discussed above, Abraham-Murali and Littrell (1995) found that consumers pay attention to different textile properties and make different purchasing decisions dependent upon the medium by which the product is presented. They found differences in consumers' responses to catalogue images and physical observation of the apparel product. Therefore, it can be reasoned that the Internet images may evoke different observations about the product. In addition, there has been some evidence of the difficulties of communicating physical properties of apparel through an online medium in the e-learning literature. Communicating draping skill on-land versus electronically has been examined by McFadden and Saiki (2005), and the results showed that the on-land instruction resulted in a more accurate completion of a draping task than when a group of students viewed a simulated e-learning version of the task. The authors suggested that e-learning information apparently needs to be supplemented with clear written guidelines, and suggested continual testing of e-learning methodologies.

Methods

Purpose and Objectives

The purpose of this study was to identify the recognizable textile properties from different presentation media and compare the differences among them. The objectives of this research were to:

1) Identify the properties of fabrics presented in three varying media including in-person, flat digital photograph of fabric lying flat (referred to as 'flat photos' here after), and digital photograph draped over the dress form (referred to as 'draped photos' here after), guided by the serviceability frame (Kadolph, 2007),
2) Compare the differences in the responses among the three media, and
3) Compare the number of students' comments for each presentation media under each property category.

Population

The population of this study was a group of students, both novice users and experts of fabrics who had an opportunity to view and assess fabrics presented in different methods.

Sixty-seven college students (mostly majors in apparel design and merchandising) participated in this study at a Midwestern university in 2008. The students were enrolled in three classes; two introductory classes about textiles and an apparel analysis class. These students were chosen because at the beginning of the semester they represented individuals who were novices at textiles and at the end of the semester were experts. In grounded approach methodology, the size of the sample is determined by when the topic discussed by participants has reached theme saturation. Typically 8 to 24 participants have been estimated as the number that results in theme saturation for most topics (Riley, 1996). Each class included 20 to 30 students, which is enough for theme saturation. After collecting open-ended data from students, data were analyzed using a grounded approach.

Three Presentation Media Styles

The three different presentation media styles of selected fabric samples were the independent variables. Ten fabric samples with a wide range of textile properties were selected by the researcher and were prepared in three different ways. The first presentation style was the actual fabric sample. The fabric samples were from one-half to one yard in length. They were shown to the students, so that students could touch and feel the samples. The second presentation style was a digital photograph of a flat fabric sample. To prepare this second presentation style, 10 fabric samples were laid flat on a table and photographs for each sample were taken. Students were able to view these samples. The third presentation style was a digital photograph of a sample draped over a dress form. For this third style, the same 10 fabrics samples were draped on a dress form and photographs of each sample were taken. The description, both flat and draped photos of 10 samples used for this study were presented in Table 2.

Table 2

Ten Fabric Samples Shown to the Participants

Sample	Descriptions	Flat photos	Draped photos
Sample 1	Light blue acetate lining-type fabric		
Sample 2	Red knit velour with attached sparkles		
Sample 3	Green cotton jersey with polka-dots		
Sample 4	Cotton weave with flower print		

Sample 5	Coarse net nylon		
Sample 6	Fluffy grey wool knit		
Sample 7	Natural linen		
Sample 8	Grey wool weave made from boucle yarn		
Sample 9	Sheer nylon weave		

Sample 10 Blue herringbone wool blends  

Procedure

Ten fabric samples with a wide range of textile properties were presented to the 67 students at the beginning and at the end of the semester. At the beginning of the semester, each class was shown fabric samples presented by different methods including, in-person presentation, digital flat photographs of fabric samples, and digital photographs of samples draped over a dress form. Participants were asked to write any kind of impressions they could think about while viewing each fabric sample presented. They were allowed to view the fabric samples as long as they wanted and the instructor was not present when responses were written. At the end of the semester, identical fabric samples were presented in the same manner, but the presentation style among the classes was rotated. Each student group assessed the fabric in a different presentation style (digital draped, digital flat, or in person) at the beginning then at the end of the semester. After collection of the participants' impressions for each sample (multiple comments were allowed), responses were analyzed through an open coding process where word phrases or clusters of word phrases were constantly compared for meaning. Grounded theory methodology was used to analyze data. The grounded theory methodology involves constant comparison of one participant's responses, or in this case, written statements with another to identify themes (Wells, 1995). Similarities and differences were noted, resulting in theme categories to explain the phenomenon or behavior (Strauss & Corbin, 1990).

The seven property categories in the serviceability concept were adopted to categorize the responses from the participants and compare them among different presentation styles as a starting and comparison point in the analysis. Serviceability describes the measure of a textile product's ability to meet consumers' needs in use of textile material and consists of seven categories including aesthetics, durability, comfort, safety, appearance retention, care, environmental impact, and cost properties (Kadolph, 2007, Presented in Table 1). Word and word clusters were placed in an appropriate category under the serviceability framework with a code indicating the participant, the enrolled class, and pre- or post-class completion. Similarities and differences were noted, resulting in theme categories to explain the phenomenon or behavior (Strauss & Corbin, 1990). The ratio of students commented each serviceability property was counted for comparison purposes.

Result and Findings

Identification of Perceived Fabric Properties (objective 1)

Analysis of all of the data together revealed that students placed most of the properties under seven serviceability concepts identified by Kadolph (2007). Overall, the comments from the students were well distributed over six of the seven textile serviceability property categories

that included aesthetics, durability, comfort and safety, appearance retention, care, and cost. The only serviceability property not expressed was environmental effect. There were other comments besides the serviceability properties, and those were categorized into 'other.' The 'other' category included fiber/yarn/fabric content, name, and structure, overall evaluation/ emotional responses about the presented textiles and end use. Specifically, the responses to the open-ended questions, emotional (e.g., happy, yuck), fiber component (e.g., linen, synthetic fiber), fiber structure (e.g., knit, herringbone), fabric name (e.g. denim, muslin), and specific use (e.g. prom dress, fish net) varied from Kadolph's (2007) serviceability properties.

Overall Property Identification. The overall responses were analyzed under seven properties. The responses which cannot be categorized into existing category were listed under "others." Table 3 shows the examples of responses under each property. In general, very diverse comments were collected under aesthetics properties. Comments on the durability properties were less varied and occurred less often than the aesthetic comments. Participants' comments were less varied and less frequent for comfort and safety properties. There were comments directly mentioning "comfortable," "uncomfortable," and "snag easily," and "descent ease", those were placed under "others" category. Resiliency, dimensional stability, shrinkage resistance and elastic recovery were subcategories under appearance retention properties, A few other answers under appearance retention properties including "thermoplastic," "stained," "possibility fade quickly," etc. were listed into others under this category. Specific care methods were mentioned by participants. For the cost properties, extrinsically, students discussed the cost of the fabrics as well as in light of how difficult the fabric was to sew.

There were several clusters of answers besides serviceability categories that were sorted into: fiber/yarn/fabric name, fiber/yarn/fabric contents, fiber/yarn/fabric structure, overall evaluation/ emotional responses, and end use. It was noteworthy to have variety of answers in "others" category. Those comments were very specific and lots of them were based on their previous experience as well. Multiple comments were found directly commenting its' end use.

Table 3
Examples of Responses under Each Property

Serviceability Category	Fabric properties	Responses
Aesthetic properties	Luster	shiny, luster, sparkles flash, dull
	Drape	drapable, drapes well, fluid drape, decent drape, drape not good, can't drape well
	Texture	rough, smooth, fuzzy, uneven, bumpy, wiry, felt like, bumpy, textured
	Pattern	polka dots, floral, pattern, busy, complicated pattern, dizzy lines, fishbone, marble like
	Hand	soft, smooth, soft, itchy, fuzzy, rough, fells like taffeta, velvety
	Color	dull, neutral, white, red, blue, lilac, purple, grey, cream, green, beige, grey, tan, iridescent, orange
	Light	light, heavy

	Thickness	thick, thin, see through
	Sounds	sounds, crunch
	Smell	Smell
Durability properties	Abrasion	abrasion
	Flexibility	stiff, flexible
	Tenacity	strong, tough
	Elongation	stretch
	Others	durable, poor durable, easily frays, don't tear, looks like it could be unravel on the ends, frayed edge
Comfort and safety properties	Absorbency	
	Thermal Retention	warm
	Others	comfortable, uncomfortable, snag easily, descent ease, tight, tight clothing
Appearance-retention properties	Resiliency	poor resiliency, winkles
	Dimensional stability	stable
	Shrinkage resistance	would keep its shape
	Elasticity or elastic recovery	elastic recovery
	Others	thermoplastic, stained, possibility fade quickly
Care properties	Treatment requirement	machine washed, ironing, dry clean only, liquid wash, washable, sensitive to washing and care, hide soil, hard to take of, easy to wash
Environmental effect properties	Toxicity, sustainability	no responses
Cost properties	Cost, price	expensive looking, high quality, moderate cost, moderate quality, less quality, low price, cheap, difficult to sew, cost more money for manufactures, hard to match up seams, be careful of the grain, difficult to work with sewing wise
Others	Fabric name, content	satin, velvet, polyester, nylon, acetate, synthetic cotton, spandex blend
	Fabric structure	filament, staple, loop curl, boucle, knit, woven, pile, velvety, non-woven
	Overall Evaluation/ emotional responses	feel bad, feels alright, decent feel, fun, cozy, hideous, bland, grandma, 1950s, during the 1970s
	End use	dinner placemats, canvas, lining, curtains, bag, dinner placement, summer wear, nurse's uniform

Media Comparisons for Identified Properties (objective 2)

Several remarkable differences among the different media presentation styles were observed in each property category.

Aesthetic properties. For aesthetic properties, observations involving luster, texture, pattern, hand, color, weight, thickness, sound, and smell were discussed among the groups that were presented in-person, flat digital photograph and draped digital photograph presentations. In general, in-person and draped photograph presentations evoked more comments about aesthetics, with pattern, hand, and color. In addition, the comments used words that showed 'assumption' when observing the digital photographs of the draped fabric samples. For example, 'probably' feels rough, 'looks like it could be soft, and 'I would assume would be very soft'. The meanings of the responses in each category were similar among all media. Comments under the category, ***Luster***, were expressed as "shiny," "sparkly," and similar words. A comment such as 'dull' was categorized under ***Luster*** since it indicates a lack of luster. Both in-person presentation and draped photos evoked comments about being dull. There were not remarkable differences in the comments among the three media about ***luster, light, and thickness***. Interestingly, there was not an answer found with the in-person presentation mentioning '***drape,'*** while there were several answers found for both digital versions of the fabric (flat and draped over a dress form). Visual ***texture*** comments were focused on visual roughness. Comments, such as "rough," "coarse," wiry," "felt like," "bumpy" and "textured" were commented in-person presentation. Flat photos and draped photos evoked similar comments. Comments in all three groups were similar in regards to ***pattern*** with all discussing polka dots and the complexity of a print. Also, the complexity of the print was stated as busy or complex and the digital versions and participants who viewed the textiles in person discussed the details of the complexity by discussing "dizzy lines" and a "fishbone" or "busy" pattern. Possibilities for misleading information on pattern were recognized. For example, there was an answer saying "marble-like" for flat photos and "denim/dull" appearance for draped photos, which indicates the optical illusion from the blue herringbone fabric. ***Hand*** was common among comments about the fabric displayed in all three of the presentation media. In all three cases, the smoothness, softness, stiffness, roughness, and itchiness of the fabric was noted. All presentations evoked discussion of parallel fabrics to explain hand, such as "feels like taffeta" or "velvety." However, comments related to the hand for in-person presentation were more detailed and specific. Some comments revealed the properties from the experience such as loops on both side. ***Color*** was discussed in response to the three presentation media. Color in terms of hue was discussed by students who were presented with fabric shown in all three media. However, the in-person and the draped photo presentations prompted more variety in hue including "white," "red," "blue," "lilac," "purple," "grey," "cream," "green," "beige," "grey" and "tan." "Purple" was mentioned once in response to the in-person presentation. "Iridescent" was mentioned in response to the flat photo presentation. Possibilities for misleading information about color were recognized as well. For the color, there were students who answered "orange" for one of the fabric samples even though there was not a fabric sample with an orange color; this happened when they were viewed the fabric digitally (flat and draped versions). The original fabric color was rather red (there was no orange fabric shown for this study), and many students answered "red" for the same fabric for the in-person presentation. ***Lightness or weight*** was noted similarly among three presentations, but was most frequently mentioned by participants who viewed the in-person presentation and

the draped photographs of the fabric samples. The flat and the draped digital versions prompted more comments as well as, a comment about a mid-weight. ***Thickness***, from "see through" to "thick" was mentioned in all three samples. ***Sound*** was not discussed by the group of students who viewed the draped digital photos, even though it was mentioned three times for the in-person presentation. ***Smell*** was mentioned once only in-person observations and noted directly as "smell".

Durability properties. In terms of the durability properties, there were not many distinguishable differences among presentation styles recognized for abrasion, resistance, tenacity, and elongation. There were several comments for all presentation styles for ***abrasion***, ***tenacity***, and ***elongation***, but there were no comments about resistance. Several differences among media were found when discussing flexibility and other properties. For the flexibility properties, there was a comment, "stiff" for in-person presentation, and several similar comments looking at flat photos, but no such comment was found for draped images. Other comments related to durability were categorized into ***other***, and "durable," "poor durability," "easily frays," "don't tear," "looks like it could be unravel on the ends," and "frayed edge" were categorized into "other" properties. Durability was recognized among all three presentation styles, but there was remarkable difference in the comments in that is there were a large number of comments about the edge of the fabric (e.g, "fray)." Two comments were found about fraying issues in responses to the in-person presentation and thirteen comments were found in response to the draped photo presentation while there was no comment about fraying from those who viewed photographs of the flat version of the fabric samples. It could be assumed that the photographs of the flat versions of the fabric did not show the edges of the fabric, while other presentations styles showed the edges (See Table 2), therefore the students did not think about commenting on fraying.

Comfort and safety properties. There were not specific differences among the three presentation styles except "tightness." There were two answers including "tight," and "tight cloth" that were found in the responses to those who experienced the fabric sample in-person.

Appearance retention properties. There were no comments found about resiliency and dimensional stability from either in-person or draped photo presentations. One student commented as "poor resiliency", and two students commented "stable" and "would keep its shape" when the fabrics were shown as flat photos. There were several answers for elastic recovery, and wrinkle for all of the presentation styles, but there was not remarkable difference among them.

Care properties. For the care properties, fabric samples presented in flat photos and draped photos evoked more variety in answers than the in-person presentation, even though the types of answers were similar among one another including "washable," "would show water spot," "collects soil," "hide soil," "machine washed," "ironing," "required special care," "hard to take care of."

Environmental effect properties. There was no particular answer related to the environmental effect properties.

Cost properties. Comments such as "quality," "more expensive," "cheap," and "luxurious" were found among all presentation styles. A lot of cost related comments in terms of production process, such as "difficult to sew," "would need to be tightly woven to be durable," "hard to match seams," "does not need to be hemmed," "be careful of the grain," "hard to sew would need a deep fold hem" were collected, especially from the student group in the production analysis class.

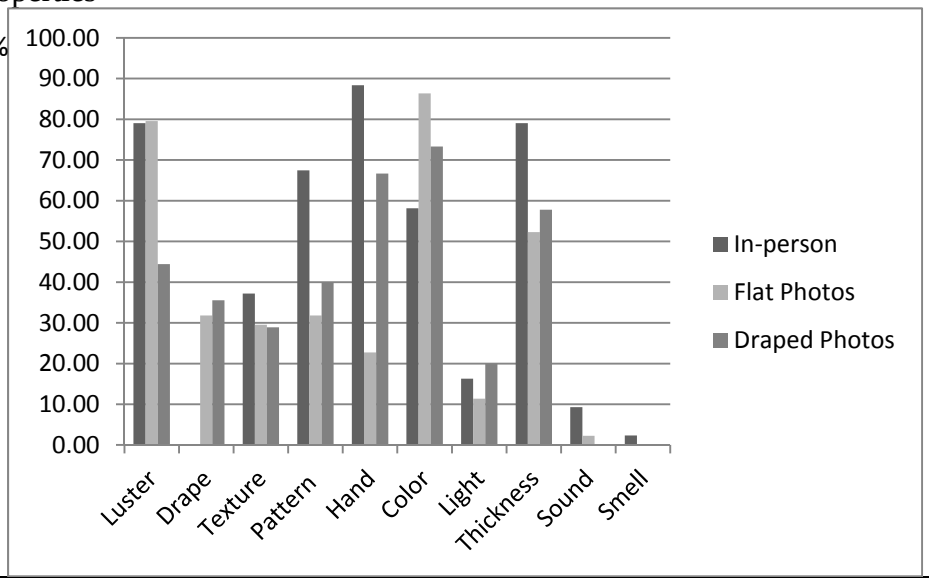
Other. Wide ranges of other properties were distributed quite well among three varying media. There were no remarkable differences among them.

Comparison of Comment Ratio among Three Varying Presentations Media (objective 3)

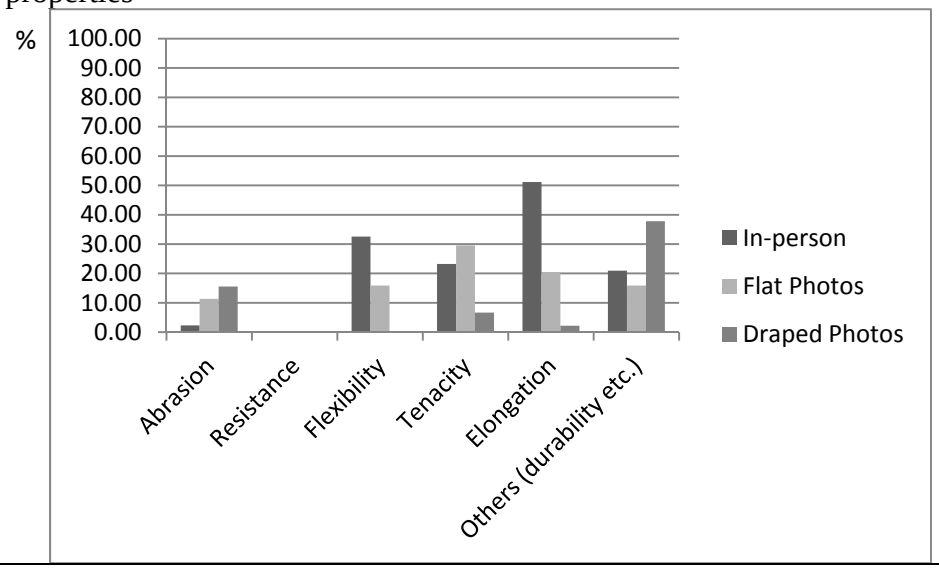
Additionally, the ratio of students answering for each serviceability property categories of comments regarding the fabrics presented in three varying presentations media were calculated to further assess the differences among them. Although a relatively small sample, patterns emerged that show some differences in the media presentation. Figure 2 shows the ratio of students' comments viewing varying media under each sub property category.

Figure 2. Ratio of Comments of Students under Each Property Category

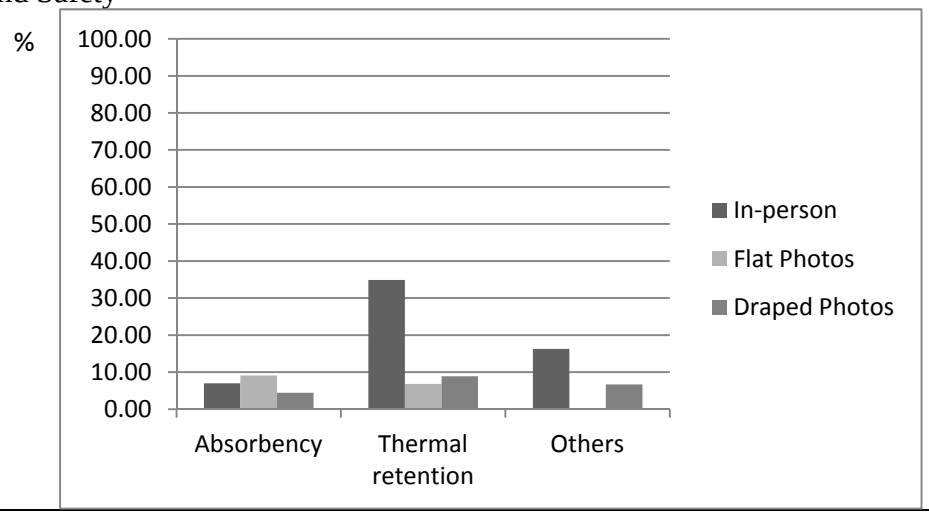
Aesthetic properties



Durability properties

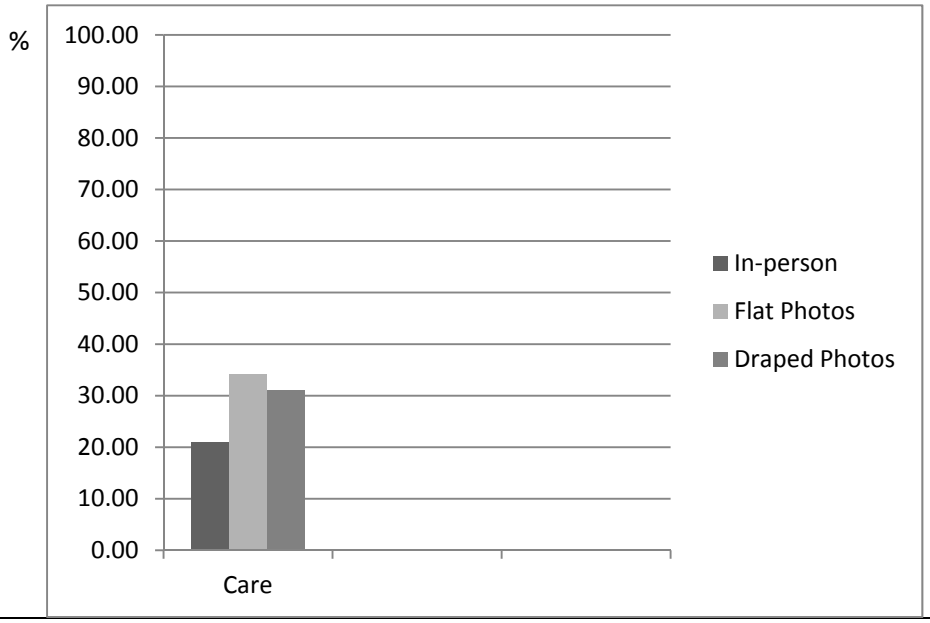


Comfort and Safety

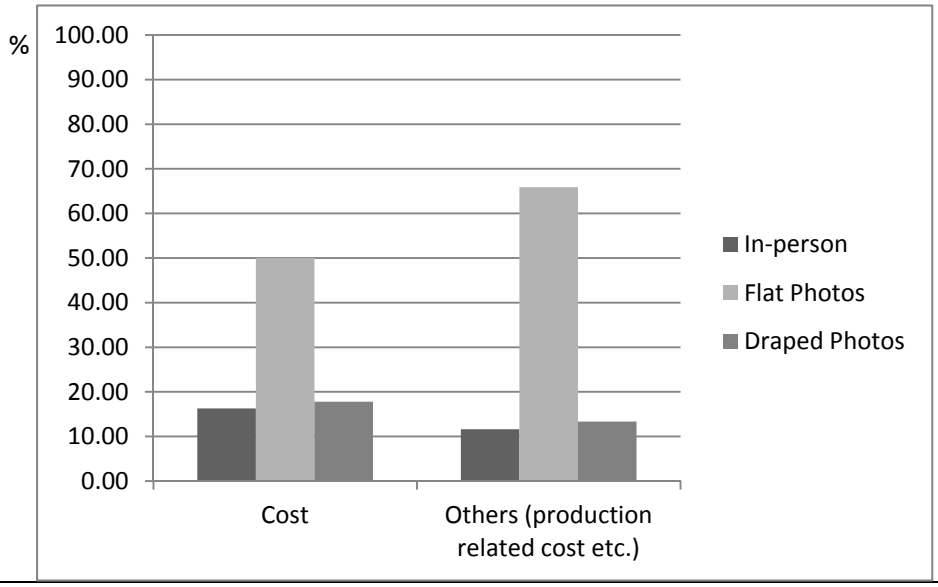


Appearance retention

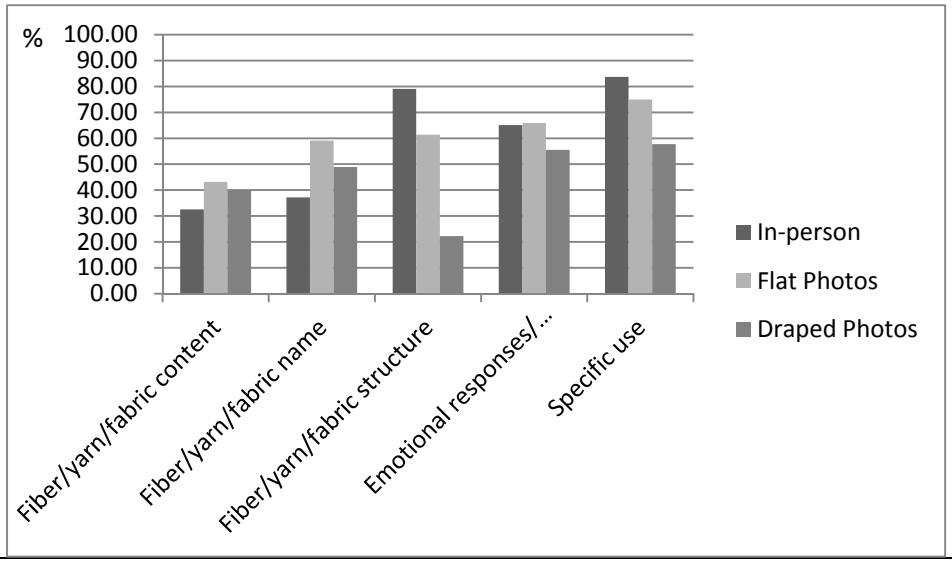
Care properties



Cost properties



Others properties



Note: Environmental properties were excluded since there was no comment in this category.

In general, 'aesthetic properties, and 'others' properties were commented on more than other categories including durability, comfort, appearance retention, care, and environmental effect properties. There was no student comments related to environmental effect. There were several sub categories including drape in the in-person presentation, sound in draped photos, smell in flat photos and draped photos, resistance for all three media, resiliency and dimensional stability in in-person and draped photos, that is inherently consistent to the result of the previous analysis based on the numbers of the comments under each category.

As presented in Figure 2, there were noticeable differences recognized under the aesthetic properties category. More students commented on pattern, hand, and thickness for in-person presentation. Sounds and smell were recognized in very few instances. Sound and smell were mainly recognized when the samples were presented in-person. Flexibility and elongation (stretch), which can be easily recognized in the in-person presentation, were commented on more by students with in-person presentation. Thermal retention (warm, cold and so on) was commented more often for in-person presentation than in other presentation medium as well.

In general, flat photos evoked comments by more students categorized under appearance retention. Elastic recovery and wrinkling properties were commented by more students in flat photos than when viewing fabric draped or in-person. It could be assumed that the flat photos showed detailed wrinkles when the photos were taken as a close shot. There were remarkable differences in cost properties. More students made comments about the cost when the samples were presented in flat photos. A high ratio of students made comments about production related properties, which could be due to the class subject of product analysis.

Conclusions and Implications

Serviceability concepts were useful to categorize fabric properties responses obtained from the open-ended questions. Specific responses including emotional response, previous experience, fiber/yarn/fabric content, name, structure from this pilot study were found other than serviceability category, which also vary from serviceability concepts.

The possibility of leading misconceptions through digital fabric presentation was recognized as well. Multiple students misperceived the blue herringbone wool fabric sample as

denim when it was presented as a flat swatch digital image. In-person presentation evoked experience based comments such as hand, texture, sound, smell, and thermal retention, including warm and cold. In addition, different comments were found depending on the way the fabric samples were prepared and shown. There were no comments of 'fray' for the flat photos since the picture focused on the middle of the fabric, but there were many students who commented 'fray' of edges when the fabric were shown as a whole piece (Figures 2 and 3). Drape related properties were not mentioned when the fabric samples were presented in person. This result illustrates that the presenters need to develop multiple ways to convey the fabric's properties to consumers, in order to minimize the differences between in-person fabric presentation and digital fabric images and to provide full property information that can be missed when it is presented in online.

Identifying critical textile properties from diverse presentation media are important as more FCS classes are taught online. These additional dimensions and associations that viewers have of textiles can be considered in online discussions or in other digital methods of teaching. For example, the FCS teacher could stimulate an online discussion about the emotional response towards the textile and use responses that are analogous to the textile properties to help better explain it.

The instructor in an educational unit needs to try to convey fabric properties effectively through learning materials in different media. Since online presentation has a potential to deliver incorrect information more accurate information and communication methods need to accompany the fabric visual. The FCS instructor can use serviceability concept and other responses besides serviceability concept as a checklist to develop written text that accompanies visuals of textile samples and products. The instructor can also have students answer questions related to the checklist about the fabric samples, so that the FCS instructor can provide the student with the accurate information based on students' feedback. This checklist overlaps with FCS competencies in the apparel and textile areas. Besides collecting textile properties and categorizing them into the serviceability concept, impression frequencies in different property categories were compared. As a result, differences in impression frequencies were found among three media style. Moreover, misperception of textiles was observed when the fabric was presented as flat swatch images (blue herringbone wool fabric sample was recognized as denim).

These results suggest there is a need for instructors to prompt online users to pay more attention to non-visual stimuli either through discussion and/or through written text. The outcomes of the study also suggest that an instructor in an online setting should incorporate a variety of presentation methods of textile samples (flat and draped) to stimulate student responses and that there is a need for instructor's close monitoring of the accuracy of student statements. Levels of education and training were recognized as factors which may influence impressions. Thus, consideration for viewers at different levels of education and training will be needed for further study.

This study has the potential to be developed into a fabric property assessment scale for expert to novice users focusing on serviceability. A larger pool of consumers in various demographic groups including different levels of education, job positions and textile expert vs. novice users can be tested to ensure the reliability of the proposed scale. In addition, different selection of fabric samples can used to confirm the breadth of responses. The information is vital to FCS professionals in adapting their online materials to accommodate middle, high school, college, and graduate student levels.

To further assess reliability, responses to the scales after participants view an actual fabric sample can be compared to the objective measure (e.g. durability) of the fabric sample. These findings can be contrasted to a group that views online representations of the same fabric samples. Such objective measures will identify which fabric characteristics are most affected when presenting textile products online and will further guide which text is needed for clarification of online presentations of textile samples.

The proposed assessment scale can also be used to evaluate effectiveness of learning materials developed by an instructor, as well as the students' achievement after taking certain classes in apparel and clothing areas. This would help to identify effective presentation style in education without missing the critical fabric property information that needs to be delivered to students. The study may also stimulate the development of scales of other FCS topics where the physical object is the focus, such as food, upholstery, and furniture. Such studies are important in understanding similarities and differences in online presentations given the different areas within FCS.

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