# Development Of A Textile Materials Analytical Laboratory Through Funding From The National Science Foundation

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## Project Summary

The purpose of our project was to acquire establish a laboratory, with the appropriate equipment for the physical testing and analysis of materials used in the manufacture of textiles and apparel. The project directly addressed two key themes specified in the National Science Foundation's Curriculum and Laboratory Improvement program (CCLI): integration of technology to produce more effective learning environments for undergraduates and strengthening of undergraduate education by increasing the participation and success of women in scientific and technical programs. As a collateral benefit, faculty development was be gained as a result of interacting with the testing equipment.

The addition of new laboratory infrastructure also facilitated purposeful and substantive linkages between industry and our textile and apparel program. This, in turn, helped create research and educational experiences that enables our graduates to enter the workforce with advanced technological skills on-par with professionals currently working in the industry. Technological preparation is increasingly necessary for graduates to compete for high quality entry level positions in the textile and apparel industry.

Evolutionary changes in how the textile and apparel industry now functions make the advanced development of student technical competency an imperative. In the past decade, retail organizations have moved from buying finished products to creating and producing their own product lines. Students therefore, now need technological skills in product development and testing, in addition to the business skills of management and marketing. The new laboratory now enables the program to meet the new academic imperative of improving student technical competence. Furthermore, as a program primarily serving women, infusion of technology into the curriculum better prepares females to enter the workforce comfortable and capable of performing within a technological and science-based industry.

## Background and Justification

Historically, the textile and apparel industry and related academic programs have been divided upon gender and geographic lines. The textile and apparel manufacturing belt in the South was served by Southern academic programs typically housed in engineering and colleges graduating primarily males to fill entry-level jobs leading to advanced technologically-based positions in the industry. Midwestern programs such as ours were first formed within home economics curricula, and to this date are dominated by female students. With the rapid growth of the retail industry in the 1980's most Midwestern programs focused attention upon graduating students to fill entry-level positions in retail management and merchandising (Avery, 1989). As a result, product specific skills such as pattern-making, fabrication and product development were not deemed important and were often removed from curriculum. Furthermore, technical content, such as in-depth understanding of the physical properties of textile materials, and more than superficial knowledge of the relationship between materials and manufacturing processes were typically down-played (Laughlin and Kean, 1995).

Today, academic programs across the Midwest, and the U.S. for that matter, are facing a relevance crisis because of a significant shift in how the textile and apparel industry is currently functioning. For reasons having to do with improving profit potential, differentiating product, and increasing product control, a large portion of the apparel retail sector is shifting away from purchase of Afinished@ manufactured

goods to development and production of their own Aprivate label@ products (Adams, 1989; Agins, 1994; Fickes, 1993; Fox, 1994). With the movement of industry away from buying and toward product development, there is now required a concomitant shift in curriculum as textile and apparel programs adjust to a changing economic landscape (Wicket, Gaskill and Damhorst, 1999).

As a discipline, our charge now should be to ensure that our students graduate with newly required technological skills necessary to compete for challenging positions in the reconfigured textile and apparel field. The arming of women with advanced product knowledge has the potential to move women into stronger technical leadership positions within textile and apparel organizations. Unfortunately, the evidence indicates that not many, if any, textile and apparel programs in the U.S. have made a proactive curriculum adjustment to respond to the evolutionary shifting of retail business practice (Laughlin and Kean, 1995). The purpose of our project was to help position the University of Northern Iowa as a national leader in textile and apparel curriculum reformation, and to serve as a resource of best methods and practices for those programs that choose to adjust at a later date.

**How The Grant Was Applied**

As a result of changing business practices, employment position descriptions within the textile and apparel industry now often require an increasing technical sophistication not currently offered by many academic programs in the U.S. The historical model of retail organizations depending upon apparel suppliers for merchandise has been permanently altered by enterprises that design and merchandise their own products. Divisions of product development are now increasingly more common in the retail industry which design their own knit, woven and printed fabrics, and then analyze prototype designs to ensure they meet end use requirements from a physical and aesthetic standpoint. These fabric designs are then used to create in-house or Aprivate label@ apparel and home furnishing lines. In a practice commonly referred to as sourcing, manufacturing is generally done abroad using specifications developed in American companies within the product development division. Despite the fact that products are often sourced overseas, U.S. companies must still ensure that the highest levels of quality are produced for American consumers.

There are several key elements to a successful product development effort. Nowadays, sophisticated product development software, such as Lectra=s U4ia is commonly used by industry to develop fabric designs. Thus, experience with this software will greatly increase the marketability and job potential of our graduates in the areas of design and product development. Very few academic programs have possession of U4ia, thus the acquisition of U4ia at UNI helped to place the program in a national leadership position. U4ia was integrated throughout the curriculum, and is one of the pillars of UNI=s effort to become a leader in the education of product developers for textiles and apparel.

Our NSF project was aimed at the other pillar of UNI=s effort to achieve national textile and apparel program leadership. This provision focused on the requirement of graduates having a sophisticated understanding of product quality through physical testing and analysis of textile materials. This growth area is almost entirely related to the burgeoning practice of product development in the retailing field. As more retail organizations design their own merchandise, physical testing and analysis is needed to develop adequate prototypes, and to ensure that overseas manufacturers are meeting specifications outlined by product development teams (Wicket, Gaskill and Damhorst, 1999).

In sum, with the successful acquisition of U4ia software and the new analytical laboratory acquired through this project we were able to put into place two of the essential elements required for a

sophisticated textile and apparel product development program. The two related themes of product development and product analysis were integrated throughout courses and projects within the curriculum.

Specific to this particular project, the following two courses in our curriculum was where students were directly exposed to experiences within our new analytical laboratory:

Introduction to Textile Materials

The introductory textile science class in our curriculum provides a basic understanding of the categories and properties of different forms of textile materials. Students gain a beginning appreciation of physical properties of materials through introductory involvement with textile testing equipment. Textile testing equipment in the new laboratory was introduced and demonstrated and/or used by students as they are initially exposed to analysis of textile materials.

Quality Assurance in Textiles and Apparel

This more advanced second level textile science class builds on the previously discussed course. It focuses upon teaching students how to predict the performance of textile materials in the marketplace through assessment of physical properties. Students in this course use testing equipment themselves and are engaged in both testing existing products, as well as attempting to create products that meet specific end uses. Seen in Table 1 is a summary of equipment and test procedures to which the students are exposed.

Student Teaching Assistants

Every semester one to two students works in the new laboratory under the direction of a faculty member. The students earn independent study credit by helping the faculty prepare for and teach laboratory sessions for both the Introduction to Textile Materials and the Quality Assurance classes. In addition, the student assistants conduct laboratory tests on materials submitted to our lab by industry. Earning a berth as a student assistant is competitive and requires outstanding academic performance by the student when they originally took the class.

**Impact of the Project**

During the course of the grant period we generated data to assess the attitudes and experiences of students exposed to our new laboratory facility. At one point we compared the attitudes of students just entering the program, with those students who have completed the upper level course in which they have had extensive hands-on experience in the textile materials lab

Student attitudes were captured qualitatively using participant observations, journals, and interviews of students in the laboratory environment. For purposes of cross reference and confirmation, a quantitative assessment of student attitudes was generated from surveys. The surveys were administered in two courses, one an introductory course that all majors are required to take when initially entering the program, and in the upper level textile testing course, in which students used the textile testing equipment in the new lab. The surveys required the students to rate their level of comfort or interest in science and technology using a 5 point Lickert scale. Attitudes of students entering the major and those seasoned with

a semester of advanced laboratory work were compared for comfort level with, and interest in science and technology.

Our results indicate that our curriculum's evolution toward increasing lab experiences is having a significant impact on female student comfort level in the lab, and with their understanding of lab results. Shown in Table 2 is a comparison of survey results between female students in our introductory textile and apparel industry course and students taking the upper level, laboratory-based course. Students completing the upper level lab course showed higher levels of comfort with technology in general ($p < .05$), working with analytical laboratory equipment ($p < .05$), computers and software ($p < .05$), and finally higher comfort deriving meaning from laboratory results ($p < .05$).

Qualitative journal entries capture the importance of the link between understanding the meaning of the results and confidence level of the student, "The fact that I feel confident in my work and that I now understand why and how these tests are done, makes the class as a whole, more understandable to me . . . in the past I didn't [have that understanding], which gave me negative experiences with a lab situation." The importance of hands-on lab experience on the process of confidence building is captured in this journal entry, "I think that doing the tests on your own is much more effective. For me personally it felt good to have [our teacher] expect *me* to show all my group members how to use the flammability tester and leave *me* to attend to any problems or adjustments with that machine" (CR, 2002).

Despite overall higher levels of comfort with science, the advanced students did not self report a significantly ($p < .05$) higher interest in pursuing a career in science when compared to the introductory students. This is likely due to the overwhelming interest in the fashion field, which draws students into the major. For example, on a 5 point Lickert scale, students entering the curriculum rated their average interest in fashion a very high 4.81. Self-reporting a new desire for a career in science is apparently too far a stretch from the original motivation which caused them to declare a textile and apparel major in the first place. On the other hand, there were qualitative results suggesting some students moved closer to pursuing a lab-based career, indicated by comments such as, "I would say that today, more than any other day may have influenced my wanting to seek a lab job. The more and more we do, I think I may decide that I want to seek this as a profession." Nevertheless, initial impressions of students that they are entering a field in which they will be working with "fashion" remained an overwhelming influence on student career choice, and a barrier to recruiting female students to science and technical careers not in some way linked to the concept of fashion. The product development area, requiring graduates with technical background and understanding of fashion trends, is an ideal match for these students, and is typically where our students are now being placed. Supporting this notion are recent placements which can be found in Table 3.

There is data that also suggests a positive impact upon perceptions of the value of majoring in textiles and apparel at the University of Northern Iowa. Shown in Figure 1 is a graph of student enrollment in the program from Spring semester 1999 to Spring semester 2003. During this time period, enrollment in the major has almost quadrupled. The sharpest increase in enrollment occurred shortly after the grant was awarded and the new laboratory was established. We believe that the laboratory and the experiences now offered to our majors improved perceptions of program value and professionalism, thus contributing in part to rising enrollments.

**Conclusions**

The efforts of the University of Northern Iowa's textiles and apparel program to improve the comfort and

confidence of its students in areas demanding high levels of science and technology appear to have born fruit. Hands-on exposure to state-of-the-art analytical testing equipment in our new materials evaluation laboratory have improved the students' comfort with high technology. Projects creating lab results that students use to evaluate the suitability of a textile for a specific end-use, have been successful in helping them understand the meaning of lab results in the real world of product development. Purposeful mentoring between experienced female students and their less experienced peers created a lab environment which moved women from passive to active roles in the experimentation process.

Our research indicates that most students enter the textiles and apparel field because of interest in clothing and/or fashion, with little understanding that science and technology will be an important aspect to their education. While our research does not indicate high numbers of our students will become full-time scientists, it *does* indicate that many of them are more confident to pursue the many positions within product development that now require background in science as well as an ability to work with fashion trends and theories. In summary, though the students report themselves as being more comfortable with science and technology, and playing active roles in a lab setting, they do not express an interest in transitioning to science careers. On the other hand, it is not speculative to suggest that students entering into the textile and apparel industry will now be much less intimidated by technical and scientific responsibilities that they might encounter in the world-of-work.

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Any opinions, findings, and conclusions or recommendations expressed in this material are those of the author(s) and do not necessarily reflect the views of the National Science Foundation.

Table 1. List of laboratory equipment to which advanced textile students are exposed.

| Laboratory Device | General Test Area | Type of Evaluation |
|---|---|---|
| Sweating Guarded Hotplate | Comfort | ASTM F 1868 Thermal and Evaporative Resistance of Clothing Materials |
| | | ASTM D 1518 Thermal Transmittance of Textile Materials |
| Air Permeability Tester | Comfort | ASTM D 737 Air Permeability of Textile Materials |
| Spectrophotometer | Color Science | Colorimetric Analysis of Dyed Fabric |
| Launder-Ometer | Colorfastness | AATCC Method 16 Colorfastness to Laundering |
| Weather-Ometer | Colorfastness | AATCC Method 169 Lightfastness of Textiles |
| Crockmeter | Colorfastness | AATCC 8/165 Fastness to rubbing |
| Martindale Abrasion Tester | Durability | ASTM 4966 Standard Test for Abrasion Resistance |
| CRE Tensile Testing | Durability | ASTM D 5034 Grab Tensile |
| | | ASTM D 2261 Tear Tensile |
| Flammability Testing | Safety | ASTM D 1230 – 45 Degree Test |
| | | ASTM D 6413 – Vertical Test |
| Video Microscope | Microscopy | Microscopic Defect Analysis |

Table 2. Survey Comparing Science and Technology Interests Between Students in an Introductory Textile and Apparel Class and Those in an Upper Level Textile Materials Analysis Course.

| Survey Questions | Introductory Course | Upper Level Course |
|---|---|---|
| Comfort with Technology* | 3.58 | 3.90 |
| Comfort with Analytical Laboratory Equipment* | 2.81 | 3.90 |
| Comfort with Computers* and Software | 3.65 | 4.30 |
| Comfort Deriving Meaning from Laboratory Results* | 2.95 | 4.05 |
| Interest in Science | 2.60 | 2.95 |

Note. Data values derived from 5 point Lickert Scale, with 5 indicating maximum comfort or interest.
* statistically significant difference in scoring between the two course, $p<.05$.

Table 3. Summary of Recent Placements of University of Northern Iowa Textile and Apparel Majors

Target Corporation -- Technical Design Internship
Betsy Johnson -- Design and Product Development Intern
Merchandise Testing Laboratory -- Textile Testing Internship
Burberry Limited, London -- Product Development Intern
May Corporation -- Color Analyst
Target Corporation -- Fashion Trend Analysis and Merchandising for Kids
Wal-Mart Corporation -- Product Development Intern
Target Corporation -- Technical Specifications for Newborn / Infant / Toddler
Target Corporation -- Technical Design and Specifications
Cabela's Corporation -- Computer Aided Design
Cabela's Corporation -- Quality Assurance for Product Development
Target Corporation -- Associate Technical Designer for Women and Girls
May Company -- Assistant Technical Designer (2 placements)
Lands' End -- Quality Assurance for Product Development
Wal-Mart Corporation -- Technical Sketch Artist and Product Development
Lands' End – Merchandising
Von Maur Corporation -- Assistant Buyer
Younkers -- Assistant Buyer

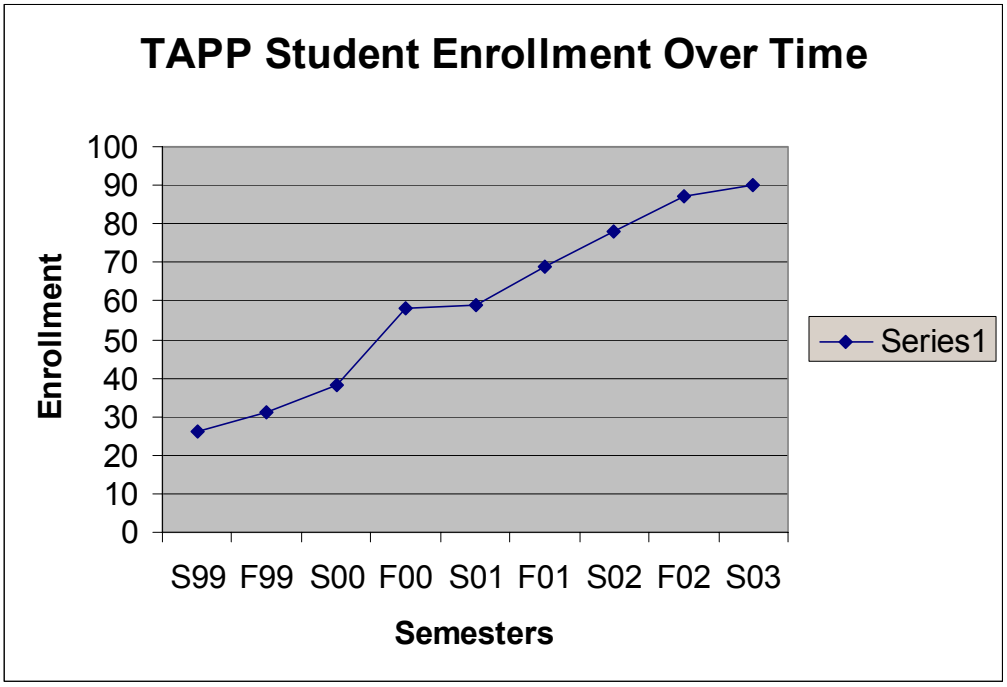


Figure 1. Graph depicting the change in Textile and Apparel Majors at the University of Northern Iowa from Spring semester 1999 to Spring semester 2003.

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