In 1991, the membership of the Association of College Professors of Textiles and Clothing, Inc., voted to change the name of the corporation to the International Textile and Apparel Association. Consequently, the name on the Special Publication Series changed with Number 4. With Number 8, title of the series changed to Monograph. Titles in these series are as follows:


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INTRODUCTION

Acknowledgements

As editor of ITAA Monograph Number Eight, *Computer Applications to Textiles and Apparel*, I would like to express appreciation to my assistant editors, my copy editor and to members of ITAA. Thanks go to Nancy Cassill, Chair of the Publications Policy Committee. Thankfulness is expressed to Sandra Hutton, Executive Director for her encouragement, advice, and guidance during the entire publication process.

Thanks are also extended to Grace Koons and to Ginny and Jim Lohr for extending assistance when called upon. A special debt of gratitude is expressed to my daughter, Alana Polvinen, for the patience, assistance and support she has given me throughout the duration of this project.

Editorial Process

Ninety-eight percent of the thirty-two papers that arrived were received in the last week. A week before the due date when only two or three papers had arrived, plans were underway to postpone the publication until the following year. During the week prior, several people sent e-mail requests for information. These people were notified of the planned-one year extension. When all the papers arrived in the last week, the several e-mail contacts were allowed to submit their abstract a week late.

The abstract review process was determined by the assistant editors. All papers were coded, a cover sheet was added, and separate review packets were made. The editor's abstract was reviewed by outside reviewers (Nancy Cassill and Sandra Hutton) along with the late submissions.

Thirty-two abstracts were submitted in response to the original call for papers. These were then blind-reviewed by the assistant editors. Twenty-four abstracts were accepted for the next review process.

Twenty-three papers underwent a simultaneous second and third blind-review process. The second-blind review was completed by the persons who submitted papers. Every submitter reviewed at least two papers submitted by other authors. The third-blind review was conducted by the assistant editors. The assistant editors did not blind review the editor's paper, it was blind reviewed four times by other people who submitted papers. The results of the second and third blind review were then combined to determine the final seventeen papers to be published.

The editorial committee made the decision to send all participants in the review process the actual reviewed papers along with the review sheet for each paper. This was done to contribute professional feedback and to assist contributors for future publication submissions. The accepted authors were asked to submit final copy with...

Purpose

We all are living in a period of transition. Visual communication and information is fast being transformed into digital images and dialogue. Computer technology is evolving and changing the way we all perceive and learn.

The primary purpose of the editors of this monograph is to share information and experience relating to the integration of technology for education and research in the field of apparel and textiles. Publication of this monograph is intended to facilitate further research the integration of educational technology into the curriculum.

The use of technology for the educational process is varied. Current submissions in this particular monograph range from interactive and stand-alone multi-media presentations to collaborative long distance learning projects and electronic data exchange.
commentary relating to reviewer's or editor's questions or comments.

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### Categories

The category will be placed alongside the footer on each manuscript. The categories were divided up as follows:

**(Primary) Technology Application:**
- CUR: Curriculum Development
- R: Research

**(Secondary) Apparel/Textile Category:**
- PD: Product Development
- AD: Apparel Design
- CAD: Computer Aided Textile/Apparel Design
- TEX: Textiles
- TEXHIS: Textile History
- MER: Merchandising

**(Tertiary) Technology Categories:**
- COL: Collaborative
- ED-IND: Education/Industry
- EEM: Electronic Educational Materials
- EDE: Electronic Data Exchange
- MM-I: Multi Media-Interactive
- MM-SA: Multi Media Stand-Alone

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### Invited Submissions

The editors agreed to request several invited submissions that would facilitate locating resources for readers who wish to further integrate computer applications in textile and apparel programs. The first article, *Establishment of a Fiber, Textiles, and Apparel Information Resource on the World Wide Web*, is an overview of the ITAA Web site. The second article, *Building a Web Site for Education and Business*, contains everything you need to know about designing and creating a Web site for your program. The third invited submission, *CAD a la Mode: What to do Before Buying a Computer for Fashion Design*, will assist you in researching and choosing the right computer for your program. It contains an excellent resource list with contacts. The fourth submission is from the editor; it contains several excellent resources to assist you with textile/apparel technology needs.

Elaine Polvinen, Editor, *Layout, Typesetting & Coverpage Design*
Colleen Frey and Cherry Searle, Assistant Editors
Jeanne File, *Copy Editor*
Part One

Manuscripts
Multimedia Applications in Flat Pattern Design

Kathryn E. Koch
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Abstract

An interactive multimedia program focusing on introductory flat pattern design concepts was developed to supplement and extend traditional instructional methods. In addition, integrating computer instruction into the apparel design curriculum is expected to improve readiness for careers in today's technology-based apparel industry. Development of more advanced multimedia modules to cover an entire semester of flat pattern instruction is warranted based on favorable student evaluations. The ultimate goal of this project is to assess the efficacy of moving from a manual method of flat pattern instruction to computer based instruction.

In an effort to achieve Quick Response and remain competitive in world markets, the textile and apparel industry is making great strides in integrating computerization into all phases of the manufacturing process. Computer-aided-design (CAD) systems have been instrumental in drastically reducing lead times and putting apparel products in retail stores much closer to the time they are needed by the consumer. A recent survey of apparel-related companies indicates that CAD systems have become essential to their design and manufacturing operations (DeWitt, 1994).

With the pervasive computerization of design and manufacturing processes in the textile and apparel industries, it follows that universities who prepare students for careers in apparel design and production must provide a curriculum that not only exposes students to computer-aided-design applications but also integrates computers into the instructional process so that students become comfortable in a technological environment. A number of university apparel design programs have been cited as providing some form of CAD training in preparation for careers in the textile and apparel industries (Belleau, Orzada, & Wozniak, 1992; Frey, 1995; Koch, 1990; and Van De Bogart & Knoll, 1990). However, little is known of programs that integrate computerized instruction into other aspects of the apparel design curriculum. For apparel design students, having the opportunity to gain knowledge of apparel design concepts via computer instruction, may help to provide a readiness for careers in today's technology based apparel industry.

The main objective of this project was to develop a computerized instructional package, using a multimedia approach that could be integrated into the apparel design curriculum. The subject of flat pattern design was selected to provide the content of this package because the visual nature of flat pattern design lends itself well to a multimedia presentation. Instruction in the techniques of flat pattern design traditionally has involved the manual manipulation of basic pattern pieces to create new designs. While very effective in providing a thorough understanding of the design process, these manual methods are repetitive and time consuming. Some schools of thought cling to the belief that a good designer of apparel must have a firm foundation in traditional fold-and-slash methods of pattern design. This
Multimedia Applications in Flat Pattern Design

attitude as well as the general reluctance of apparel designers to computerize the design process (Fraser, 1987) is the reason that CAD use for illustration and pattern development has lagged behind its use in other production processes such as marker making, grading, cutting, and sewing. However, more and more designers report that they are comfortable with CAD and that they experience a greater level of creativity using CAD ("CID: From a Designer's Point of View," 1993; Freeman, 1993). A growing number of companies have been computerizing their pattern design departments. The Haggar Apparel Company is one of several companies which produce a majority of their first patterns by computer (DeWitt, 1994). As the textile and apparel industry continues to move to computer integrated manufacturing, the use of CAD for pattern development will become commonplace. Computer manipulation of pattern blocks will become the norm.

Apparel-specific software for pattern development is currently available so that flat pattern concepts can be taught entirely on the computer with no prior flat pattern knowledge on the part of the student (Sheldon & Regan, 1990). Using a flat pattern design tutorial, based on apparel-specific software used by large apparel manufacturers, Belleau, et al. (1992) found students to be excited and motivated to work on a CAD system.

While the use of industry based CAD packages provide very valuable exposure and experience with actual computer applications, advances in computer technology have opened new avenues for curriculum development that promise alternative approaches to the teaching/learning experience. One of these advancements involves the burgeoning technology of multimedia development.

Multimedia computer programs link text with video, audio, graphics, animations, or other digital data to create interactive instructional packages. With multimedia instruction, there is strong potential to significantly increase learning because the student actively collaborates with the medium to receive information. This is in contrast to the more traditional method of instruction where information is simply delivered by the medium. An important component of many multimedia programs is that of non-linear navigation. Frequently termed "hypermedia," this feature allows information to be linked in such a way that students can choose a path of instruction that is individually suited to their special needs. The multi-sensory learning environment of a multimedia educational package motivates students to become more involved with the learning process largely because students can deal with information in self-determined, manageable chunks. The structure of multimedia allows for better assimilation of information because it tends to match students' non-linear thought processes (Ambron & Hooper, 1990; McDermott & Combs, 1991). Halal and Leibowitz (1994) list several key advantages of interactive multimedia:

1. Students receive training when and where they need it. An instructor does not need to be present. Students can use a multimedia program to initiate learning or for review.
2. Students can begin or leave a lesson at any point in the program and return to it later.
3. Because the learning is individualized, students stick with it so retention of material is enhanced.

With adequate funding and faculty support, it has been predicted that multimedia delivery systems could become the most common form of instructional technology on college campuses by the end of the decade (Lamb, 1992). A growing body of research points to the benefits of multimedia instruction. Students using hypertext networks were found to have an increased sense of control over the learning environment and to have increased levels of motivation to learn when compared to students who used traditional text style materials (Becker & Dwyer, 1994). Other research indicates that students learn more when multimedia instruction is used and that the benefits of multimedia presentations are equally available to students of all learning styles (Pearson, Folks, Paulson, & Burggraf, 1994).

Education is not the only institution to benefit from multimedia instruction. Large corporations such as Hewlett-Packard, Apple, Chrysler, Shell, Xerox, and Ford are finding multimedia training to be the preferred way to teach employees skills needed to handle new jobs. These companies have reported that use of multimedia training has shortened learning time by 50% and retention is increased by 80% (Halal & Leibowitz,
1994). A number of major retailers including Lazarus and Dillard's use multimedia programs for point-of-sale instruction, to provide new product knowledge and for new hire orientation. These retailers report that this form of employee training has led to reduced training time, better retention and lower costs (Robins, 1994).

A review of existing multimedia curricular materials available for purchase through public domain or shareware revealed none that were related to the field of apparel merchandising or design. This area presents many opportunities for the development of visually oriented curricular materials. For this project, an experimental set of multimedia modules, using Hypercard 2.3, on a Macintosh Centris 650 computer, was created to teach selected fundamental flat pattern principles, including basic terminology, dart manipulation and dart equivalents. These hypermedia modules include line drawings, animations, sound, video, and actual photographs of garments which are all interconnected depending on the path a student selects. For example, an introductory terminology module provides the opportunity to click on a number of terms such as dart, center front, sloper, bust point or grainline. Each term is linked to a graphic and text which explains the term. In another module about darts, students can link to information of their choosing about types of darts, dart manipulation, or dart shapes. Where appropriate, actual garment photographs illustrate the concept. In the module about the pivot methods of dart manipulation, animations help to explain the process of tracing around the pattern. The module about the slash method of dart manipulation uses a scissors icon to illustrate where to slash. Students can then view patterns at various stages as the dart lines are overlapped. Sounds are frequently linked to various choices in the modules primarily to complete the multisensory experience. The instructor appears in a brief video to introduce the program. From any card in the modules, students can go to related topics, a glossary, or to the main index. At any point in the program, the student can quit and return at a later time. The inclusion of numerous graphics, animations, sounds, and the video has made it necessary to put the package on CD-Rom.

The increasing sophistication of multimedia packages will necessitate computers with CD-Rom technology.

Student volunteers were solicited to assist in the initial evaluation of the package modules. Students with traditional flat pattern instruction as well as students with no flat pattern instruction participated in the evaluation. Student comments were very favorable and provided valuable input relative to better navigation design, ideas for more photographs, and alternative ways to present content. Students with a knowledge of flat pattern commented that seeing actual photographs of design features was better than line drawings in the textbook. Students with no flat pattern training were surprised at how easy flat pattern techniques appeared. All students who have evaluated this program have been familiar with Macintosh computers. Another round of evaluations is in order for students with no computer background. However, the intuitive nature of the Hypercard platform suggests that little or no computer experience is needed to use it.

The short term goal of this project is to use the package to supplement the flat pattern text and instructor demonstrations. Students will view applicable modules in conjunction with design assignments. Over the course of the coming year, the modules will be expanded to cover an entire semester of flat pattern instruction. Testing and evaluation of the modules will continue. The ultimate goal of this project is to assess the efficacy of moving from a manual method of instruction to computer based instruction. The development process has been very stimulating and has generated numerous ideas for continued development. Student evaluators have expressed excitement and interest in this approach to flat pattern instruction. These outcomes suggest the value of continued development of multimedia packages of this type.
References

Computer-Based Apparel Production

Computer-based Apparel Production Planning and Costing Tutorial

Mary E. Boni
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Abstract

Designers must understand manufacturing processes so their designs stay within the production capabilities of their companies. In a manufacturing setting, costing of a garment is done at the design stage to ensure the garment is within the price range of the consumer market targeted by the apparel manufacturer. The purpose of this visual, interactive tutorial is to give students an opportunity to "experience" the production flow and the associated costs of mass producing garments in an industrial setting, using the progressive bundling system. The tutorial focuses on production planning and costing issues related to the sewing stage of apparel manufacturing. Three skirt designs are divided into their individual components to determine the production cost, which in a manufacturing setting is based on the number of steps it takes to sew the garment pieces together, the amount of time for each operation, and the rate of pay for the machine operators. Time studies were used to determine the standard average time to allow for the sewing of each step. Times have been randomized within a .5 range to allow for each student to have individualized data. Animated graphics are used to give a sense of the production process. The tutorial offers individualized instruction with immediate feedback and is comprehensive; it includes an introduction, instructions, follow-up discussion, and a calculator. Feedback from students has been overwhelmingly positive. Many students indicated that they were not strong in mathematics, but the visual tutorial helped make the process more real to them; the calculations made sense. Planned extensions for the tutorial include student configurable layouts, typical production problems of employee absenteeism, machine breakdowns, and modular manufacturing systems.

Students enrolling in apparel design programs do so because they are attracted by the idea of producing fashionable clothing. It appears that these students are more inclined toward the artistic than the mathematical. However, in commercial clothing manufacture, issues related to production management arise, leading to the all important question of cost. Designers must understand manufacturing processes so their designs stay within the production capabilities of their companies. In a manufacturing setting, costing of a garment is done at the design stage to ensure that the garment is within the price range of the consumer market targeted by the apparel manufacturer.

Employers expect that entry-level professionals are capable of integrating and applying their educational and training experiences to the demands of the workplace (Steinhaus, 1989). However, students have limited opportunity to experience realistic occupational responsibilities in their college courses. In apparel design programs students typically manufacture only one of each design, completely missing the opportunity to study mass production techniques and their costs. Consequently, many fine designers and technicians graduate from these programs only to fail in business or be overlooked for promotions because of their lack of ability to supervise mass production and optimize costs. Knowledge of and
ability to manage a production setup will strategically place students in an empowering position within the apparel industry (Hudson, 1989). Opportunities to explore production management techniques should exist within the curriculum so that students can gain confidence in this field before entering the work force. Visits to production sites are useful, but stop short of allowing students to design and test alternative production strategies. Setting up assembly lines in the classroom to teach production concepts is impractical and on-the-job training opportunities are limited.

Where realistic learning experiences relevant to the work place are required, computer-based models can be effective learning environments. Computer models can provide the one-to-one correspondence needed between elements manipulated by students and elements in the real world.

The purpose of the Apparel Production Planning and Costing (P & M International, 1995) tutorial is to give students an opportunity to "experience" the production flow and the associated costs of mass producing garments in an industrial setting. The final cost, or price, of a garment, includes the cost of a number of elements: fabric, lining, interfacing, notions, trims, factory overhead, design and production costs, profit margin and markups. The production costs alone include a number of factors, mostly related to labor time that includes the cost of the overall production planning, pattern making, marker making, cutting, bundling, supervision and sewing, and shipping the orders.

There are several production methods used in the manufacturing (sewing) of apparel. The three most common methods are: (a) the Progressive Bundling System whereby each machine operator is responsible for one step in the construction of a garment as bundles of garment pieces move from one sewing machine operator to the next along the assembly line; (b) the Unit Production System (UPS) whereby cut pieces for each garment are hung together on an overhead conveyor system that moves through the assembly setup and is controlled by computer terminals; and (c) Modular Manufacturing whereby sewing machine operators work in teams and each operator is required to do a number of tasks as needed.

Initially, prototypes of a visual computer-based tutorial and a spreadsheet tutorial were developed and their effectiveness were compared using the nonequivalent control group quasi-experimental design approach. The data were analyzed using analysis of covariance. The twenty-seven students in the group that received the visual computer-based tutorial treatment achieved a higher adjusted mean score on a test of production planning and costing, although not statistically significant, than the twenty-five students who received the spreadsheet treatment. The analyses indicated that there may be a directional relationship between students previously identified as visual learners who used the visual computer tutorial as there was a significant increase in adjusted post-test scores. The analyses also indicated that there may be a trend in students previously identified as active learners who used the visual computer tutorial as there was an increase in adjusted post-test scores. Feedback from the students was overwhelmingly positive.

The final version of the visual computer-based tutorial that is described in this article was developed in Borland C++ with the Object Windows Libraries, Version 3.0. The program runs on a 386 IBM compatible and Windows 3.1. The tutorial focuses on production planning and costing issues related to the sewing stage of apparel manufacturing. Three skirt designs are divided into their individual components to determine the production cost, which in a manufacturing setting is based on: (a) the number of steps it takes to sew the garment pieces together; (b) the amount of time for each operation, and (c) the rate of pay for the machine operators.

Apparel industry standards were used to establish the time allotted to the sewing of each step. The average time allowed for each step is referred to as SAM - standard allowable minutes. Times have been randomized within a .5 range to allow for students to have individualized data each time they use the tutorial. Animated graphics are used to give a sense of the production process.

The tutorial offers individualized instruction with immediate feedback and is comprehensive. It includes an introduction, instructions, follow-up
Figure 1. Opening screen of the tutorial.

discussion, and a calculator. It takes about one hour to complete the tutorial. It can be done individually, in pairs or as a group using an overhead projector. A brief demonstration is helpful, but the instructions should be sufficient for students to work through the program on their own. All menu and button selections are made by clicking the left button on the mouse. Students can access the instructions and may exit the program at any time.

The following is a description of the tutorial and how it works. The entire exercise can be completed on the screen. When students have completed the tutorial they may check their answers and print the data for their records.

On the left side of the screen (see Figure 1) is a spreadsheet that lists the steps needed to complete three skirt styles, each a little more complex than the previous style. The first style is a basic skirt (see button labeled "Basic" - Figure 1). The second style is a basic skirt with pockets (see button labeled "Pockets" - Figure 1) and the third style is a basic skirt with pockets and a vent (see button labeled "Pock/Vent" - Figure 1).

When a skirt style such as "Basic" is selected with the mouse, average times to complete each step will pop up. The dotted lines next to two of
Figure 2. Display of the sewing time in minutes for each step of the "Basic" skirt style and the 'Basic Skirt Factory' window.

The steps means those steps are not used for this style. To the right of the spreadsheet is a window titled "Basic Skirt Factory" (see Figure 2). The sewing machines on the factory window represent each step in the sewing process for this style. In a simple factory setting, one sewing machine operator is assigned to each step. The bar gauges next to the machines show garment bundles moving through the system. "Sew" is selected to activate the factory. This animated component is only intended to provide a visual representation of how a factory floor is organized and operates.

The bottom section of the spreadsheet is used to answer the seven questions related to production time and cost. Each question is next to the labeled cells on the left side of the lower part of the spreadsheet. Users select "Q1", read the question, select "Help" if needed and use the on-screen calculator to calculate the answer. The answer is typed into the first cell to the right of "#1. time/unit" (see Figure 3). Questions two to seven are completed in the same manner and the process is repeated for the "Pockets" and "Pock/Vent" skirt styles.
Computer-Based Apparel Production

Figure 3. Display of question and help windows and user data input on the spreadsheet.

The questions included in the follow-up to the mathematical problems (select the "Discussion" button on the right side of the screen) provide an opportunity for a class discussion. Students are asked to: (a) compare the time it takes to produce one unit and its cost for each of the three styles, (b) explain how adding style details to a garment affects its cost, (c) discuss issues that would need to be addressed if a sewing machine breaks down or a machine operator is absent, and (d) outline at least three reasons why a designer needs to understand costing issues and manufacturing processes.

Feedback from students continues to be overwhelmingly positive. Many students indicated that they were not strong in mathematics, but the visual tutorial helped make the process more real to them, the calculations made sense. The enthusiasm displayed by the students and the deep nature of the discussion that has followed has convinced the author that this learning strategy has considerable potential.

In conclusion, the visual computer tutorial can be used in the classroom to supplement instruction in apparel production planning and costing. Planned extensions for the tutorial include student configurable layouts, typical production problems of employee absenteeism, machine breakdowns, and modular manufacturing systems.
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Vancouver, B.C.: Author
Steinhaus, N. (1989). Flat pattern design - an industry/classroom connection [Summary].
[TC]$^2$ Line Balance Decision Trainer

Diana Cone
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Abstract
An interesting field for apparel designers is product development. These people take designs and develop them for the manufacturing production line. One objective is to minimize "through-put" time. The Theory of Constraints is a method of analyzing cause and effect. Garments for mass production can be designed to minimize the negative impact on the production process. Even though it was designed to train industrial supervisors, the [TC]$^2$ Line Balancing Trainer is an excellent computer program that teaches students the effects of constraints on the production line.

This paper relates to the students learning the Theory of Constraints and refers to one case study of how the application of a pattern change improved productivity of sleeve setters at TAM Industries in Glennville, GA. The major points are:
1. A brief overview of the role of product development.
3. A case study of the TAM Project.
4. Utilizing the [TC]$^2$ Line Balancing Decision Trainer as a computer media teaching device.

The focus of this paper is to show that [TC]$^2$ Line Balancing Decision Trainer can be used by classroom instructors to help apparel design and manufacturing majors learn to apply the Theory of Constraints to productivity improvements.

Product Development

An interesting field for apparel designers is product development. Product development managers take designs and develop them for the manufacturing production line. One objective is to minimize constraints on the production process. Even though it was designed to train industrial supervisors, the [TC]$^2$ Line Balancing Decision Trainer is an excellent computer program that teaches students the effects of constraints on the production line.

Discussion of the Theory of Constraints

[TC]$^2$ System Modeling Manager, Barbara Maziatti, says: "By definition, the bottleneck is the location where work spends the largest amount of time. A constraint is an operation that is longer than the operation feeding it and looks like the bottleneck. Improving constraints is like removing rocks in the stream. The first rock to be bigger than the previous ones forms a dam. Once that rock is removed, the water flows until it hits the next rock."

In The Goal, Eliyahu M. Goldratt and Jeff Cox define constraints as anything in the system...
that keeps the system from making more money. Many companies do not consider elements outside the actual movement of material through the process as constraints. However, redesign by the product development department may be the largest constraint in the system -- the bottleneck. This redesign of the product can be minimized if the designer has an intimate knowledge of the manufacturing process.

The Line Balancing Decision Trainer

The [TC]$^3$ Line Balancing Decision Trainer is a DOS based computer program that teaches the problems of line balancing. It was developed by Barbara Maziatti at [TC]$^3$ to train supervisors to evaluate the benefits of the modular manufacturing system, train employees for multiple sewing operations, and to place these employees at the correct location in the process for the reduction of constraints.

While "playing" the [TC]$^3$ Line Balancing Decision Trainer, students get an idea of the frustration supervisors experience in balancing a production line. The objective is to increase profits, decrease work-in-process and decrease through-put time. Some of the simulated sewing techniques will move to different jobs, some will not.

The program is much like a video game. The simulated sewing technicians are seated at their machines. Work is illustrated by bundles of simulated t-shirts. Operators sew looking at their work. However, when they run out of work they stand up and face the computer screen. The employees are moved from their regular jobs to help out operations that are behind. Operator movement is limited to those operators who are trained on a given operation. Just like in real life, some operators only want to learn one job. You can move the operators as many times as you like. In fact, these simulated sewing technicians are happy as long as they have work.

As work progresses, finished t-shirts are tallied and a dollar figure is posted for the amount of money that is generated in a given day. Only those t-shirts that have completed the last opera-

tion at the end of the day generate money. A manager who lets work build up at a bottleneck has no chance of finishing these bundles in time for the end of the day shipment. Students race to see who can make the most money. None complained about the simulation being boring.

The system is easy to learn. The education package consists of a base lesson and nine "decision" lessons. Allow about 15-20 minutes per lesson. Most students master the complete education package in three, one hour class periods. For the purpose of illustrating the theory of constraints, the sessions six, seven and nine could be eliminated. These lessons allow only four employees for the eight work stations. Actually I thought these lessons were more enjoyable, but harder to master.

The author used the [TC]$^3$ t-shirt line for her data. The eight operations are sufficient to illustrate the problem of an unbalanced assembly line. The line is setup as a "U" shaped module. The Sequence of Operations lists the operations and standard allowed time. The student can see from the exercise that the problem is created by operation 6, attach cuffs, (the bottleneck) and operation 4, set sleeves, (a constraint). Students had many compliments for the program. They much prefer video games to a boring lecture on the Theory of Constraints.

Another benefit of the [TC]$^3$ Line Balancing Decision Trainer is that designers learn manufacturing terms they may not be familiar with. Being able to apply these terms is the beginning toward improving communication between designers, product development managers, and manufacturing managers.

If the simulated company had used the team concept, the employees would request a designer, product development manager, and an engineer to evaluate the constraint problem. In our TAM Industries case example, this is what happened. The designer (Diana) was able to help reduce the bottleneck by a pattern change in the sleeve.
### Sequence of Operations for [TC]² Line Balancing Decision Trainer

<table>
<thead>
<tr>
<th>Operation No.</th>
<th>Operation Name</th>
<th>Std. Allowed Minutes/piece (SAMs)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Join Shoulder</td>
<td>.4200</td>
</tr>
<tr>
<td>2</td>
<td>Attach Collar</td>
<td>.4200</td>
</tr>
<tr>
<td>3</td>
<td>Cover Stitch Collar</td>
<td>.1350</td>
</tr>
<tr>
<td>4</td>
<td>Set Sleeves</td>
<td>.6700 (constraint)</td>
</tr>
<tr>
<td>5</td>
<td>Side Seam</td>
<td>.5400</td>
</tr>
<tr>
<td>6</td>
<td>Attach Cuffs</td>
<td>.8100 (constraint/bottleneck)</td>
</tr>
<tr>
<td>7</td>
<td>Hem Bottom</td>
<td>.2850</td>
</tr>
<tr>
<td>8</td>
<td>Fold and Turn</td>
<td>0.48</td>
</tr>
</tbody>
</table>

---

**Test Case study of TAM Industries Project**

The project at TAM Industries involved the production of women's turtleneck shirts. TAM Industries is involved primarily in contract work for J.C. Penney. They are not involved in the design or development of the pattern or the selection of fabrics or trims, but provide cutting and production services. The production process was carefully observed from cutting and bundling through packaging and shipping.

During the observation of the production process, there appeared to be a bottleneck in the attach sleeve operation. The designer discussed the problem with supervisors and operators and found that the sleeve operation was taking considerably longer to complete than was being allowed by management. Time studies were conducted to substantiate the findings and revealed that the
average operator utilized five to six stops per sleeve. Management was allowing for a maximum of three stops per sleeve.

Further observation indicated that the sleeve cap (a constraint) was too high and rounded, thus requiring additional stops to produce a smooth finished product. The specifications for fit had to be analyzed before any adjustments could be made to the pattern. It was determined that the sleeve cap could be redesigned to provide a lower, smoother cap and reduce the number of stops and still maintain the desired style and fit specified by the company.

The designer altered the sleeve pattern and tested the new style sleeve with the operators successfully reducing the bottleneck during this operation. A more balanced line of production existed once the constraints were removed.

Summary

We found that [TC]^2 Line Balancing Decision Trainer can be used by classroom instructors to help apparel design and manufacturing majors learn to apply the Theory of Constraints to productivity improvements.

References


Resources

Software:
[TC]^2 Line Balancing Decision Trainer
Textile/Clothing Technology Corporation
211 Gregson Drive
Cary, NC 27511-7909

Hardware:
386 PC with a math co-processor or 486 PC
20 megabytes of hard disk space
8 megabytes of RAM
VGA monitor
3 ½ inch floppy drive
mouse
Utilization of CAD in Teaching Product Development

Utilization of CAD in Teaching Product Development for Design and Merchandising Majors

Eulanda A. Sanders

University of Nebraska-Lincoln, Lincoln, NE

Abstract

The purpose of this paper is to describe a senior level class in which CAD was used to create a product development and apparel and market analysis course. The objective of the course was for both apparel design and merchandising students to develop an understanding of and to gain experience in the applications of CAD in the pre-production stages of apparel manufacturing and wholesale operations. A simulation of industry activities was achieved through market and apparel analysis, market research, and hands-on computer experience with AutoCAD for technical drawings and AnimatorPro or Animator Studio for color applications.

The semester project consisted of the following components, all related to a target market randomly selected by each student from a listing created by the instructor. First, a logo/hangtag and label were created for the target market using both CAD programs. Second, two fabric designs were produced employing AutoCAD and one purchased fabric was scanned into the computer; then four colorways for each fabric were developed using AnimatorPro. Third, technical drawings and fabric renderings of five original ensembles were created utilizing both CAD programs. Fourth, drawings from the CAD programs were inserted into spreadsheet programs to aid in producing a line list for marketing the ensembles and to develop specifications and cost sheets for one garment. Finally, presentation boards were constructed to represent each stage of the student’s work.

All the components of each student’s project were compiled into a multi-media presentation on AnimatorPro for documentation purposes. In addition, each student compiled a reference file of visual documentation pertaining to current industry trends each and wrote two abstracts critiquing articles or professional papers concerning technology and market development.

The significance of this course’s content was that it provided an opportunity for students not only to have exposure to CAD, but also to experience many of the computer related tasks they will probably perform upon entry into the apparel industry. Relevant CAD experience, in relation to apparel manufacturing and wholesale operations, increases each student’s personal marketability and confidence during the job search process, for both design and merchandising concentrations.

The purpose of this paper is to describe a senior level class in which computer-aided-design was used to execute product development and market analysis projects. The objective of the course was for both apparel design and merchandising students to develop an understanding of and to gain experience in the applications of CAD in the pre-production stages of apparel manufacturing and wholesale operations. A simulation of industry activities was achieved through market and apparel analysis, market research, and hands-on computer experience with AutoCAD used for...
Utilization of CAD in Teaching Product Development

Figure 1.

AutoCAD Motif  Color in AnimatorPro  Tiled Motif

Figure 2.

technical drawings and AnimatorPro or Animator Studio for color applications.

The class consisted of twenty students majoring in either apparel design or merchandising, with two contact hours per week. Ten computers with AutoCAD and AnimatorPro and five computers with Animator Studio were available during scheduled class time. To accommodate the number of students, class time was divided into two segments which allowed half of the class to develop other assignments such as reference files, garment analysis, and target market research while others worked on the computers. In addition, the class was assigned a teaching assistant who provided support during the class period and the additional six hours of laboratory time made available for students to work.

The semester project consisted of various components, all related to a target market randomly selected by each student from a listing created by the instructor. First, logo/hangtag and label designs were created by each student for the target market selected using both CAD programs. The initial black and white drawings were created in AutoCAD, then they were saved as slides. Next
the slides were imported into AnimatorPro to apply color to each drawing. See Figure 1. Three fabric designs were then created to merchandise the line. The first fabric design was produced by drawing a single motif in AutoCAD then importing it into AnimatorPro. While in AnimatorPro the motif was colored, then repeated over the entire screen to create an overall print by using the fill and tile commands in the program. Finally, three color variations were developed for the print either replacing the initial colors or by changing the red, green or blue components of the colors in AnimatorPro. See Figure 2.

The second fabric was created solely by using the tool commands in AnimatorPro, such as draw, spray, circle, gel, etc., to develop a motif. At that
Utilization of CAD in Teaching Product Development

point the motif, like the first one, was tiled across the screen to create an all-over print and three colorways were also produced. See Figure 3.

The final fabric was produced by scanning a commercial fabric into the computer, then importing it into AnimatorPro or Animator Studio. The students selected an interesting part of the print to tile and created three more coordinating colorways.

The next stage of the project consisted of each student creating technical sketches of the garments in the five ensembles designed for the line, using AutoCAD. The technical sketches were to be clear, accurate and proportionate flat drawings that included all the construction details of the garments. Afterwards, the previously developed fabric designs were placed on the technical sketches along with complementary solid colors. This rendering process allowed the students to experiment with various combinations of fabrics and colors quickly and inexpensively. See Figure 4.

Next the technical drawings were inserted into as spreadsheet to aid in producing line lists and specifications sheets for merchandising the line. This provided the students with the opportunity to work with spreadsheets and organize the line visually. The line list consisted of the following for each garment: style number, name, colors offered, sizes offered, estimated cost and delivery date for the product. The significance of this activity was that it allowed the students to analyze the mix of merchandise in the line. The specification sheets included the technical sketch of the garment, sizes, colors, labels, hangtags, fabrics, measurements and findings for the garment. To facilitate this project, several categories of garments were analyzed by each student to determine construction details. This allowed them to make specific decisions regarding the production of the garments they designed.

Finally, each student prepared a set of presentation boards to illustrate each stage of his/her work. The boards were developed specifically for a portfolio and were presented to the entire class which assumed the analytical role of a sales force. During the presentation the students were encouraged to sell the line to the class by justifying colors, fabrics and silhouettes. In addition, they were asked to share problems and successes that occurred during the process.

All the components of each student’s project were compiled into a multi-media presentation on AnimatorPro for documentation purposes. In addition, each student compiled a reference file of visual documentation pertaining to current industry trends and wrote two abstracts critiquing articles or professional papers concerning technology and market development.

This was the instructor’s first attempt to teach this particular course and to incorporate these software programs used into one course content. The primary limitation was that each student did not have access to a computer during the entire class period. However, the additional laboratory hours provided an opportunity for students to gain proficiency in the application of the software programs for the purpose of product development. Since several programs (none designed specifically for apparel design) were used it was sometimes difficult for students to conceptualize the sequence of procedures needed to complete an assignment. However, once students became comfortable with the programs, they seemed to understand the diverse options available through the synthesis of their knowledge and the tools provided by the software.

The significance of this course’s content was that it provided an opportunity for students not only to have exposure to CAD, but also to experience many of the computer related tasks they will probably perform upon entry into the apparel industry. Relevant CAD experience, in relation to apparel manufacturing and wholesale operations, increases each student’s personal marketability and confidence during the job search process, for both design and merchandising concentrations.

Resources

Software Packages Used:
AutoCAD version 10 by Autodesk
AnimatorPro by Autodesk
Animator Studio by Autodesk
Deskscan II version 1.5.2 by Hewlett Packard
The T-shirt Project

The T-Shirt Project

Susan L. Sokolowski

University of Minnesota, St. Paul, MN

Abstract

In today's university setting where resources are limited, it is often difficult to teach the basic elements of apparel design and include modern technology, such as the use of computers. Limited resources not only include equipment and space, but also include instructors who know how to use computer technology and can effectively integrate it within the curriculum. Although it may be difficult, especially in departments where instructors have taken on new responsibilities, it is our duty as educators to keep students familiar with current computer technology and how it applies to their field. Students who are aware of computer technology can more easily adapt to other types of computer technologies and have an edge over others, especially when entering the competitive apparel industry.

For my pattern development class, students worked on a project that would not only teach them about knocking off garments, specing, pattern drafting, illustration and production, but also how to use computer technology, specifically the software AutoCAD. The project that I developed was called the "T-shirt project."
The T-shirt project consisted of the following:
1. Knocking off a favorite T-shirt that they owned or liked.
2. Developing specification sheets through the use of AutoCAD.
3. Developing patterns of their T-shirt by hand to understand the basic skills required to draft a T-shirt and through the use of AutoCAD.
4. Developing T-shirt illustrations in AutoCAD.
5. Producing the actual T-shirt, based on the drafted patterns.
6. Checking the finished T-shirt for meeting its specification.

The students not only learned the above, but they also developed portfolio pieces that potential employers can review. Some students independently developed cost sheets and marker layouts for the patterns. Overall, students enjoyed this project and many of them continue to use the software for other classes.

Introduction

In today's university setting where resources are limited, it is often difficult to teach the basic elements of apparel design and include modern technology, such as the use of computers. Limited resources not only include equipment and space, but also instructors who know how to use computer technology and can effectively integrate it within the curriculum. Although it may be difficult, especially in departments where instructors have taken on new responsibilities, it is our duty as educators to keep students familiar with current computer technology and to show how it applies to their field. Students who are knowledgeable about computer technology can more easily adapt to other types of computer technologies and have an edge over others, especially when entering the competitive apparel industry.

For my Pattern Development II class (the second of a series of draping and pattern drafting classes offered during the first year of our program), students worked on a project that would not only teach them about knocking off garments,
The T-shirt Project

specing, pattern drafting, illustration and production but, also how to use computer technology, specifically AutoCAD software. The project that I developed was called the "T-shirt project."

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Method

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Prior to starting the T-shirt project, students were introduced to the computer (DOS based system) and the AutoCAD software package. Basic commands (i.e., grid, snap, line, ortho, erase & copy) were taught and students had a chance to practice these commands. Students were instructed to bring a T-shirt to the next class that they would like to knock-off for the project.

In the next class meeting I demonstrated to the students how to collect specification measurements, so that they could accurately knock-off their T-shirts. The layout of industry specification sheets was also discussed. After showing the class how to set up industry specifications, I drafted (by hand) a T-shirt, so that they could see how a 3-D structure was translated to a flat, 2-D pattern. I then showed the students how to illustrate flat sketches (front and back, by hand) of their T-shirts on graph paper. Students were assigned to collect specification measurements, draft patterns (by hand) and illustrate their own T-shirts (front and back, by hand on graph paper) for the next class meeting.

Students in the next class showed me their work so that I could make sure that they were taking accurate specification measurements, and that their patterns and illustrations were properly executed. I demonstrated AutoCAD commands such as: move, arc, trim, extend and mirror. For the next part of the project an assignment was given to develop specification sheets, flat patterns and illustrations for their T-shirts, using the AutoCAD software. In the following classes, students had time to work on their projects. I also demonstrated how to identify the knit structures of their original T-shirts, so they could purchase fabrics to make the final knock-off. Threading and sewing the T-shirt with a serger was also demonstrated.

On the seventh class day, the T-shirt project was due for what I called the "Shopping Bag Critique." The students were instructed to turn in the following, in a 3-ring binder:
- A specification sheet for their T-shirt (done with AutoCAD).
- A blank (without measurements) specification sheet for their T-shirt (done with AutoCAD).
- Two sets of specification illustrations for their T-shirt:
  - one set done by hand on graph paper.
  - one set done with AutoCAD.
- Two sets of patterns for their T-shirt:
  - one set done by hand.
  - one set done with AutoCAD.

These submissions were also required to be in acetate/plastic folders. At the time of the critique, the binder with the above requirements and the final T-shirt were placed in a shopping bag. The students were divided into four groups, of four students per group for the critique. Each group was assigned four shopping bags and used the form in Appendix A to critique each submission.

My idea of the "Shopping Bag Critique" was to teach students the importance of a clean presentation, following directions, making sure a garment is properly made to its specification and constructed well, and that specification sheets and illustrations need to be clear and concise for others who may need to read them. Figures 1-3 show the AutoCAD work that one of my students submitted for the critique. After each group finished evaluating its assigned shopping bags, all work was turned in to me so that I could evaluate the patterns and make final comments.

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Results

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Overall, students enjoyed this project. Many of the students continue to use AutoCAD for their other classes. The method used to critique the project was an eye-opening experience, because students did not realize how difficult it was to keep a garment to its specification, and the importance of clear communication via specification sheets and illustrations. Many of the students had never worked with knitted fabrics and sergers, so this experience was helpful in teaching
Spec Sheet
Designer: Nadine LeMay
Garment Description: T-Shirt
Fabric Type: Interlock
Fiber Content: 100% Cotton

<table>
<thead>
<tr>
<th>Number</th>
<th>Measurement Description</th>
<th>Measurement</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Length from high point of shoulder</td>
<td>24&quot;</td>
</tr>
<tr>
<td>2</td>
<td>Width 1&quot; below armpit</td>
<td>18 1/4&quot;</td>
</tr>
<tr>
<td>3</td>
<td>Shoulder width (seam to seam)</td>
<td>17 1/2&quot;</td>
</tr>
<tr>
<td>4</td>
<td>Armpit (straight measure)</td>
<td>8 1/2&quot;</td>
</tr>
<tr>
<td>5</td>
<td>Sleeve length from shoulder seam</td>
<td>7 1/2&quot;</td>
</tr>
<tr>
<td>6</td>
<td>Sleeve length from underarm seam</td>
<td>4 3/4&quot;</td>
</tr>
<tr>
<td>7</td>
<td>Sleeve width 1&quot; from armpit</td>
<td>7 1/2&quot;</td>
</tr>
<tr>
<td>8</td>
<td>Cuff opening of sleeve</td>
<td>6 1/4&quot;</td>
</tr>
<tr>
<td>9</td>
<td>Neck width (seam to seam)</td>
<td>8 3/4&quot;</td>
</tr>
<tr>
<td>10</td>
<td>Back neck drop</td>
<td>1 3/8&quot;</td>
</tr>
<tr>
<td>11</td>
<td>Front neck drop</td>
<td>4&quot;</td>
</tr>
<tr>
<td>12</td>
<td>Bottom width (seam to seam)</td>
<td>19&quot;</td>
</tr>
</tbody>
</table>

Figure 1. Specification Sheet
supplemental garment construction techniques. At the same time students developed portfolio pieces that potential employers can review. As a designer in the RTW apparel industry, I know how important it is to show an employer that you are knowledgeable about the entire "life-cycle" of a product. Many of our students know how to design and sew, but many do not know how the cycle works (i.e., conception, to production, to being on the store floor). Some of my students independently developed cost sheets, textile print designs and marker layouts for their T-shirts, using AutoCAD software. Due to its success, this project will continue to be a part of the curriculum for my Pattern Development II class.
The T-shirt Project

Appendix A

DHA 3218: Pattern Development II
Spring 1995
Shopping Bag Critique

Name: ________________________________

Part One: General Submission

Are the following included (circle one):
• Spec sheet for T-shirt? Yes No
  • Blank spec sheet for T-shirt? Yes No
• Two spec illustrations for T-shirt:
  - One on graph paper? Yes No
  - One done in AutoCAD? Yes No
• Hand drafted patterns for T-shirt? Yes No
• A sewn T-shirt? Yes No
• Are all specs and illustrations in
  plastic/acetate covers? Yes No

Part Two: Meeting the Spec

In the apparel industry it is important that garments meet specifications. Often there are errors
made in the cutting and sewing which could lead to garments that are manufactured "off spec" and
cannot be marketable. Thus, for this part of the critique each group will measure how well each T-shirt
meets its spec. Use the empty T-shirt spec sheets for this part of the critique. Each person in the group
will take spec measurements for each T-shirt. Once all of the measurements are collected, average them
together and enter the final number in the empty spec sheet. The general "rule of thumb" for knitted
products is that the measurements fall within a 1/2" below or above the original spec. *Star the
measurements that do not meet this rule.

Part Three: Construction

Answer the following (circle one answer):
• Is the T-shirt finished? Yes No
  • Is the T-shirt generally neat
    (i.e., threads clipped & pressed)? Yes No
  • Is the T-shirt properly made:
    - Are the shoulder seams taped? Yes No
    - Does the underarm seam match? Yes No
    - Is the neckline finished properly? Yes No
    - Are the cuffs finished properly? Yes No
    - Is the hem finished properly? Yes No

• Other comments?
The T-shirt Project

Part Four: Spec Illustration

Due to time constraints in the apparel industry, spec sheets and spec illustrations are often faxed to the factory. Sometimes the workers at the factory receiving your specs may not speak the same language as you, thus, it is very important that spec sheets and illustrations are clear. For this part of the critique your group is now the factory responsible for making the T-shirts submitted to you. Look over each spec sheet and illustration and make sure each measurement is clearly identified on the illustration. If any measurement is not clearly marked, circle it so that it could be returned to the designer for clarification.
Documentation of Historic Quilts Using CD-ROM: Teaching Tool and Preservation Technique

Barbara Oliver
Linda Carlson

Colorado State University, Fort Collins, CO

Abstract

Because of the fragile nature of historic textiles, it is essential to restrict handling and physical manipulation of artifacts so they might be preserved. To expedite such preservation, photographs and written descriptions of pieces are often maintained for use in teaching and research endeavors. By saving such records on CD-ROM, information is quickly and easily accessible.

A project to catalog quilts and quilt blocks belonging to the historic costume and textiles collection has been completed. Pieces were photographed and, along with text that documented fabric type, color, stitching techniques, and historic provenance, were recorded on CD. By manipulating the inventory program on a computer that includes color monitor and CD-ROM capability, individuals may study the series of quilts or one specific item.

The mission of the historic costume and textiles collection stresses the importance of teaching, research, and outreach. The audiences benefiting most from this project have been students and researchers in textiles and apparel who use the collection as a source of inspiration for textile design and construction. Computer technology has provided access to the entire collection of quilts within seconds. CD-ROM is an efficient mode to explore holdings of the collection and better utilize student and researcher time, while protecting actual textiles. By typing in key words, a search can be narrowed to specific construction detail, fabric type, or embellishment feature.

Project results are available through the university library system databases and interlibrary loan. Such availability provides educators and researchers within the historic textile field access to a broader range of examples than they may have in their own collections.

Background

The mission of the Historic Textiles Collection stresses the importance of teaching, research, and outreach. As a teaching and research facility, the Collection offers faculty, students, and visitors the opportunity to explore aesthetic, social, cultural, and physical significance of textiles in their historic settings. As a museum (the outreach capacity), it is our function to collect, document, preserve, and exhibit these artifacts for audiences outside the university community. Each artifact has been collected based on its contribution to the history of the region, its significance as an example of changing values and mores, and its related importance to advancements in technology.
Documentation of Historic Quilts Using CD-ROM

Project Purpose and Objectives

Because of the fragile nature of historic textiles, it is essential to restrict handling of artifacts so they might be preserved. To expedite such preservation, photographs and written descriptions of pieces are maintained to register and manage collections as well as to use in teaching and research endeavors. The purpose of this project was to photograph quilts and quilt pieces within the Collection and store the photographs on CD-ROM. By saving such records on CD-ROM, information is quickly and easily accessible. Two specific objectives of the project were identified:
1. To create an innovative teaching/research device that allows design students and other researchers access to the Collection for efficient use of time and resources.
2. To protect and conserve fragile textile artifacts through limiting their access to physical contact.

Computer inventory systems are being developed and used in museums in increasing numbers. These systems replace or augment the registration paper trail necessary to maintain records, including provenance and donor information. Since the late 1980s, museum conferences have included sessions on the development and use of inventory/retrieval systems, recognizing the importance of controlling collections efficiently. What is unique about the Documentation of Historic Quilts Using CD-ROM is its application in the academic community. While meeting the needs of information maintenance, it also provides efficient and expedient access to the Collection for students and researchers.

Development of this project began with a grant from the regional association of Questers International, a group that focuses on education about and study of antiques, and provides funding for preservation and restoration activities. Funding support was limited to under $5,000, therefore, it was appropriate to select a relatively small segment within the Historic Textiles Collection that could be documented in its entirety. The quilt collection was chosen because of its historical relevance within the material culture. Quilts are recognized for their significant contribution to the study of women's history and provide a time line of women's activities. In addition, quilts have been recognized for their practical nature and serve as documents to the skill level of crafters and fabrics of the day. The quilt collection consists of 19th and 20th century artifacts: 15 completed quilts, quilt tops, and comforters; and 17 groupings of related quilt blocks that have not been pieced.

Procedure

Prior to start of the project, each quilt was thoroughly documented by a paid consultant who used a worksheet specifically designed for that purpose. Because of extensive background work and certification of information, we were able to identify precisely which portions of quilts would be necessary for photo documentation and the number of photographs for each quilt.

Two alternatives were available to capture visual images of the quilts for storage on CD-ROM. We could purchase a digital camera and photograph the artifacts ourselves or hire a professional photographer. The latter option was selected to ensure that high quality photographs would be produced to ensure quality reproduction of images on the computer screen. A crucial element for selection of a photographer was previous experience in photographing textiles. Bids were solicited from several local professionals.

In preparation for photography, a mounting system to hang the quilts in front of a backdrop was devised. Each quilt was photographed full view, front and back. Additionally, closeups were taken of specific details of many quilts that represented unique techniques and/or workmanship. Because of the large number of quilt blocks, individual photographs were not taken, but they were photographed as groups or representatives of groupings. Only selected views of quilts and groupings are stored on the CD-ROM inventory records, but notation was made of additional photographs of pieces that may be available.
By manipulating the inventory program on a computer that includes color monitor and CD-ROM capability, individuals may study a series of quilts, quilt blocks, or one specific artifact. Because full front and back views of each artifact are included, along with unique or unusual details, a great deal of information may be accessed relatively quickly. Accompanying inventory text provides additional information about the quilt, including historic provenance and description of details.

The audiences benefiting most from this project have been students and researchers in textiles and apparel who use the Collection as a source of inspiration for textile design and construction. Computer technology has provided access to the entire collection of quilts within seconds. CD-ROM is an efficient mode to explore holdings of the Collection and to utilize student and researcher time, more efficiently while protecting actual textiles. By typing in key words, a search can be narrowed to specific construction detail, fabric type, or embellishment feature.

In addition, multi-media course presentations and "trunk shows" using CD-ROM have been developed for use in the classroom and at remote sites. Sound, text, and pictures are combined to display an overview of the quilt collection and allows access of information to a wide range of individuals. These presentations also focus on the teaching and outreach function of the Collection.

Project results are available through the Historic Textiles Collection at the University and will be made available through library system databases and interlibrary loan. Such access provides educators and researchers within the historic textile field access to a broader range of examples than they may have in their own collections.
Documentation of Historic Quilts Using CD-ROM
Computer Animation as a Teaching Tool for Textiles

Sara J. Kadolph
Linda Schoenberger
Sandra F. Chisholm

Iowa State University, Ames, IA

Abstract

Undergraduate requirements in textiles and clothing include introductory textiles with an emphasis on fabric construction, variations in structure, and common fabric names. These lessons begin with a discussion of loom operation and the primary motions of weaving. Students who learn in a visual way need to see the loom in operation in order to understand the process and integrate factors that influence how fabrics are made and named. To address this need, we produced computer animation sequences to help beginning students integrate these concepts.

The animation incorporates written explanations for loom function, basic weaves, and definitions of common fabrics. Students select the appropriate sequence for study, repeat a sequence as needed, and review the process at their convenience. Our students like it because they can 'see the process in action' and it is more realistic and interesting than other options. We have found that students grasp the concepts more quickly using animation.

The field of textiles and clothing is highly visual in nature as evidenced by courses related to appearance, perception, aesthetics, fashion illustration, and visual merchandising. Although reading may be considered a visual learning method, reading still requires the learner to create a mental image rather than seeing a real image, process, or object. It is no surprise that some textile students are visual learners who gain understanding by seeing rather than by hearing or reading. These students have learning styles that favor more interactive and student centered learning activities rather than traditional lecture techniques (Bonwell & Eison, 1991). These visual learners learn best through watching, seeing, and evaluating what they have seen (Felder & Silverman, 1988). It is important to provide these students with ample visual materials to aid in their processing of information.

Undergraduate requirements in textiles and clothing often include an introductory textiles class. A significant portion of beginning textiles focuses on fabric construction, variations in structure, and common fabric names. Lessons about fabric construction usually begin with a discussion of loom operation and the primary motions of weaving. These concepts and processes are conveyed through printed words in textbooks, diagrams or pictures in books, and, in-class video tapes or films. Students may experience difficulty fully understanding the process of a loom forming sheds and the relationships among shedding sequence, interlacing pattern, completed fabric structure, fabric name, and fabric performance. Thus, students who learn in an active visual way need to see the loom in operation in order to understand the process and integrate the
many factors that influence how fabrics are made
and named.
Faculty have tried to address this active visual
learning style by demonstrating weaving using
table hand looms or other aids such as video
tapes. Hand looms pose restrictions in terms of
visibility for groups of students, ease of operation,
and availability of trained personnel to keep them
operational. Commercial contemporary looms are
too large and expensive for classroom use, operate
too quickly, and incorporate mechanical safe-
guards so that it is impossible to see how the loom
operates. Video tapes usually show commercial
looms in operation, but the shedding and filling
insertion steps cannot be viewed adequately
because of protective coverings or speed of the
operations. Without seeing what is happening,
students cannot appreciate the almost simulta-
neous motions involved in weaving and the pre-
cise, synchronous timing which is needed for the
loom to continue to operate. Because of these
restrictions and our experiences with student
comprehension problems, we produced computer
animation sequences for use as visual aids in a
beginning textiles class so that students would be
able to see and understand loom operation, basic
weaves, and example fabrics.
During the 1994 spring semester, we worked
with multimedia software and a Macintosh com-
puter LC III (operating system 7.1, 4 M RAM, 250
M hard drive) to develop the animation sequences
and operating instructions for student use. We
selected Macromedia Director 4.0 because it is a
powerful tool for creating multimedia produc-
tions. It has a wide array of authoring tools, and
it has potential for interactivity (McClelland,
1994). In this case, interactivity allows the stu-
dent to spend as much time as necessary seeing
the basic shedding and filling insertion sequences,
to repeat sequences as needed, to skip over se-
lected portions, or to quit the program at any
time. The software has a steep learning curve, so
we collaborated with an undergraduate student in
computer science who had experience with other
animation programs to develop the animation
sequences using Director. The cost of develop-
ment was low because our campus media center
provided us with technical assistance. We pur-
chased the software through a package site-license
arrangement with our University; the department
owned the hardware, and the student assistant
received university independent study credit for
this project rather than a salary. Faculty and
graduate assistants reviewed the sequences before
they were shown to a few students during spring
semester. This occurred prior to being used for the
entire class.
Animation sequences incorporate written
explanations for loom function, basic weaves, and
definitions of common fabrics made using these
structures. Simple color graphics facilitate recog-
nition of what is happening during loom opera-
tion. We have created separate sequences for the
following weaves and resulting fabric structures:
balanced and unbalanced plain weaves, full and
half basket weaves, warp-faced and balanced twill
weaves, and warp-faced and filling-faced satin
weaves. With each weave sequence, we also
illustrated and named example fabrics to help
students relate the fabric structure to familiar
fabrics. We have found that being able to relate
fabric structure to common fabrics facilitates the
learning process and reinforces the concepts.
In Director, each image in the animation
sequence is considered a separate cast member in
the program. The program allows each cast
member to undergo a range of motion, evenly
allocated across the designated number of frames
so that the speed of operation is controlled by the
programmer. The script identifies when each cast
member is on screen and the motion allocated to
that cast member in that sequence. To illustrate
this process, the animation sequence for a bal-
anced plain weave has 9 cast members (from front
to back of the screen): cloth beam, even warp
yarns, odd warp yarns, reed, shed, filling yarn,
harness 1 with heddles, harness 2 with heddles,
and warp beam. Major cast members are ones
whose position determines the weave and struc-
ture of the resulting fabric and include even and
odd warp yarns and filling yarns. Warp and filling
yarns are identified by a different primary color.
Minor cast members including both harnesses
with heddles, warp and cloth beams, and the reed
are needed to demonstrate how the loom controls
the role of major cast members. The shed is
identified as a cast member, but it is not color
coded since its existence is due to the position of
warp yarns.

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CUR/TEX/MM-I
In the initial sequence, each character is introduced with a brief description of its role in the production of the fabric. After each character has been introduced, the student initiates the sequence. All characters are present and the student can watch as a harness raises all even warp yarns, a filling yarn is inserted, the filling yarn is beaten or pushed into place by the reed, the change of sheds as harness 1 lowers and harness 2 raises, and the next filling yarn is inserted. The sequence is repeated until the student is ready to see the next image. Our sequence is set up so that the warp beam unrolls additional warp yarn as the reed beats the filling yarn in place and the cloth beam takes up the woven fabric. After students have seen the process with all cast members, a simpler schematic appears showing only the warp and filling yarns. Students can move backward through the sequence and see the loom operation again or move forward and see a colored schematic of a balanced plain weave fabric with color coded to the even and odd numbered warp yarns and the filling yarn. This schematic includes the names of several common balanced plain weave fabrics to aid in comprehension. Once students have seen this sequence, they can elect to move on to other weaving sequences, repeat this sequence again, or quit the program. At this time, the program does not allow the student to stop the motion to study a specific step in weaving.

We use this animation sequence in our beginning textiles course. We introduce loom operation in lecture while lab instructors demonstrate the animation program in lab to smaller groups of students so that they can see the screen. For class demonstrations, we use a Macintosh Centris 650 with a 7.1 operating system, 8 M RAM, 250 M hard drive and an LCD projection system that allows all students in the room to view the animation. We guide our students through the process of using the program and incorporate basic operating instructions in course materials. To run the animation sequences, Director needs to be part of the system's software.

Students have access to the system in the textile lab, the university's library media resource room, and the college's computer lab. Students are able to select the appropriate sequence for study, repeat a sequence until they are comfortable with it, and review the process at their convenience. Although programming the animation sequences is difficult, the resulting packaged interactive sequence is easy to run by student learners.

The animation sequence has been met with enthusiasm by our students. Students stated that the animation allowed them to "see the process in action" and that the animation is more realistic than the table looms we had been using. The animation is also more interesting to students because of the movement involved and because it is unique and different. Students find that "seeing is more interesting and sinks in better than hearing" and that "it gives you a picture in your head that makes the processes easier to distinguish." Students also find that the animation makes a complex process look simple.

Lab instructors have found that students grasp the concepts of fabric structure more quickly using the animation sequence. Students have been positive and enthusiastic in their reception of the animation. Specifically, the animation allowed students to see what was happening as the loom operated. With the interactive component, students can repeat a sequence as long as necessary in order to understand what is happening; thus, they can set their own pace for learning. Students often had difficulty understanding the interlacing patterns of the various weaves, but by watching the animation, they can relate the interlacing pattern in the fabric to what they have seen in the animation. The most beneficial aspect of the animation sequence, as stated by students, is their ability to study the motion and series of steps involved in the weaving process, an aspect that is not available using traditional instructional methods. In the future, we plan to develop additional animation sequences to illustrate the process of producing single and double filling knits and warp knits and make these programs available to colleagues at other colleges and universities.
References


Using Laserdisc Interactive Technology in Textile Science

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Abstract

A beginning textile science class should provide students with sufficient knowledge and experience to recognize fabrics and apply information in determining fabric suitability and predicting performance for specific end uses. We developed an integrated software and laserdisc textile identification system focused on student centered learning activities using images of a wide variety of fabrics to address these expectations. We used an object authoring program to create an interactive computer application. Students work through multiple choice questions relating to fabric identification and performance. With correct answers, students proceed to the next question. With incorrect answers, the program explains why the answer was wrong showing an image corresponding to the incorrect response. Students use the system in the college computer lab and the library's media center to supplement lecture and lab. Students like the laserdisc system because it provides better visuals of fabrics and more focused information. Another beneficial aspect is the immediate feedback that is not available using traditional study methods.

A basic objective of a beginning textile science class is to provide students with sufficient knowledge and experience so that they are able to recognize and describe differences in yarn and fabric structure, coloration techniques, and fabric quality. Students apply this information in determining fabric suitability and predicting performance for specific end uses. These complex concepts rely on trained visual perception and discrimination skills. We find that a majority of our textile students are visual learners. This observation is supported by Felder's study of engineering students where more than 70% are visual learners (Felder, 1991).

Recognition of students' different learning styles is critical in determining teaching methodologies (Claxton & Murrell, 1987). Many students have learning styles that favor more interactive and student centered learning activities rather than traditional lecture and textbook techniques (Bonwell & Eison, 1991). Kolb (1981) described an experiential learning model that assumes that learning should be an active, experience-based process. Kolb's model builds upon two key components of the learning process: grasping the experience (receiving the information) and transforming the experience (understanding the concepts). When receiving information or grasping the experience, some students prefer what Kolb refers to as concrete experience such as that found in a practical exercise, while other students prefer an abstract conceptualization such as found in a textbook or lecture experience. Kolb (1981) found that students differ in the way that they process information. Some students prefer to reflect upon the learning experience abstractly; others prefer
to actively experiment with information (Claxton & Murrell, 1987).

Visual learners prefer to receive information in a concrete manner and process it by active experimentation. As such, it is important to provide students ample sources of experimentation to aid in their processing of information. Students need practice in examining and identifying fabrics, recognizing similar structures in different fabrics, and integrating concepts with end use performance expectations. The cost of supplying individual students with fabric swatches selected to demonstrate a range of structures, techniques, and quality levels is prohibitive. Swatch sets may be located in libraries to facilitate students learning and reviewing materials at their own pace, but these sets are subject to normal wear, loss, and damage. Students do not have access to microscopes or have as broad a range of materials when studying away from the classroom. For these reasons, our textile identification project focused on student centered learning activities incorporating images of a wide variety of fabrics to address the needs of visual learners. The integrated software and laserdisc system provides practice exercises with immediate feedback and experiential practice examining and evaluating fabrics. This was a two-step process: development of the laserdisc with fabric images and writing an application program with a series of questions through which the student accesses fabric images.

In the first step, we developed a laserdisc with images of more than 200 fabrics. We selected fabrics based on fabric name, yarn type, fabrication method, finish, coloration method, and quality level. We replaced any fabric that was dark in color or that did not produce a clear image with a similar fabric but in a different coloration. For each fabric, we included stereoscopic images of the technical face and back with no magnification and with magnification to show yarn structure and interlacing patterns, structural characteristics, or visually detectable aesthetic finishes such as embossing or napping. We used two methods to create the images. For the regular technical face and back images without magnification, we used an Elmo stationary single chip vertical camera attached to a horizontal stage and using external light sources to digitize fabric swatches. We included these regular, non-magnified images so that students could see how a fabric looks to the unaided eye. For the 10X magnified technical face, back, and edge images, we used a video-capable stereoscopic microscope to transfer three-dimensional fabric images directly to a 1/2 inch master video tape. The magnified images allow the student to see fine details of fabric and yarn structure. For most fabrics, we included up to 5 images. We also developed and incorporated graphic images that were digitized from text-book figures or author-created diagrams using Aldus Freehand, Adobe Photoshop, and Color Space Video board. Graphic images help students recognize basic fabric and yarn structure. Students may compare the graphic structures to the real fabric images when they are in need of assistance. We used a 25 inch monitor to preview the clarity of all images before recording them.

We recorded all images for 5 seconds at a video speed of 30 frames per second so that we had several clear frames from which to select examples for the master disc. We identified and edited all images before they were transferred to a master tape and recorded on the master laserdisc. The completed laserdisc is read by a laser beam, providing a superior visual signal for playback. Discs can be referred to as videodiscs or laserdiscs depending on whether the author is focusing on the process of creating or reading the image. The laser beam detects microscopic pits in the disc's surface and image strength is demodulated into visual or audio images. Because there is no direct contact between the disc and pickup, disc lifetime is determined by quality of the materials used to produce it and the player used with the disc. Although we did not use audio technology or motion sequences on our disc, the possibility exists for those applications as well as the visual images we used. Advantages of video/laserdisc technology include random access to information (any sequence of images is possible), large storage space on the disc (up to 54,000 still images), resistance to fingerprints or dust (deterioration with improper handling or storage is minimal), and high resolution images (up to 350 lines horizontal resolution) (Pioneer Communications of America, 1992b; SuperMac Technology, 1991).
For the second step, we used Authorware 2.0, an object authoring program designed to create interactive computer applications. Icons are used to create the application rather than scripts or programming language. Each icon represents a specific set of instructions that Authorware performs to run the application. Use of the program is simplified because the user is presented with a logical, visual representation of procedures on a hierarchical flow chart.

Using the program is an incremental process. The author of an individual application creates a working part and then groups the pieces together. For example, dragging a display icon onto the flow line and double clicking on the icon opens the screen or presentation window. The blank window can be filled with various presentation models available in the program, or it can be manipulated with graphics that are created or imported from another application or text. Once a desirable window is achieved, the author saves it and proceeds to the next presentation window. An initial presentation can be an archetype for further windows by copying and editing the text or graphics. Or, each application frame or window can be created independently.

Decision, interaction, or calculation icons can be used to branch the flowline to corresponding windows dependent upon user responses. Thus, users can choose specific paths or topics from a created menu. By adding buttons to push or “hot spots” to click in the presentation window, correct answers can be recognized immediately and incorrect answers refuted. Calculations also can be included to total correct responses or determine time used to run the application.

Organization of the file can be executed by grouping a series of icons under a single map icon. The entire map icon can be replicated and used for a prototype by copying the map and modifying the original text. In addition, animation, digitized sound, video sequences, or still frames from videodisc players can be added by their corresponding icon.

Anytime during application development, the author may view it by choosing Run from the Try It menu. When adjustments are needed, the structure can be changed by dragging an icon to the new desired location on the flowline. Authorware will snap the icon into place and redraw the flowlines. Several icons can be grouped, mapped, and dragged to their new location.

Basic application design and specific windows can be modified by menus to add “bells and whistles” to any application. Changing color, fades in and out, pop-ups, and layering are some of the options. Menus also allow for format to be changed to fit specific set-up requirements. When a desired configuration is reached, the author can package the file for presentation. A packaged application allows a student to run the application. However, since the package contains no authoring capabilities or menus, student users are not able to alter the basic package.

Our system consists of a Macintosh LC III computer (7.1 operating system, 4 M RAM and 250 M hard-drive), a Pioneer laserdisc player model LD-V4400, a Panasonic 15 inch color monitor model CT-1383-Y, HyperCard, and Macromedia Authorware Professional 2.0. Total cost for hardware, software, and two laserdiscs was approximately $6200. We did not calculate the production costs since our campus media production center provided the equipment and technical assistance at no cost to us. Estimated costs exceed $30,000. We began the planning process in that fall semester, 1992. Selecting the fabrics and developing the images for the laserdisc took us approximately 1.5 semesters. Mastering the software and developing the interactive application program took approximately one year after the laserdisc had been produced.

Students use the Authorware application by selecting a category from a menu and working through multiple choice questions relating to yarn and fabric structure, fabric name, fabric quality, performance, and aesthetic finishes. A correct answer allows the student to proceed to the next question. If a student answers the question incorrectly, the program indicates an incorrect response, explains why the original answer was wrong, and provides images corresponding to the incorrect response. Students can elect to examine additional fabrics with similar structural characteristics to the correct answer before trying the question again.

Authorware provides faculty with an option of assigning questions to each student in the class and recording who has used the system and their success rate. A second option exists where faculty
Laserdisc Interactive Technology

can prepare package presentations for class, other education, or outreach activities. For class presentations, we use an LCD projection system in addition to the set-up described earlier. The LCD system allows faculty to project the image onto a screen so that students anywhere in the room are able to see the image. We find this superior to using traditional slides because of the clear three-dimensional image. When using the packaged presentation, the instructor only needs to enter the image address and the image is projected onto the screen. Access time is almost instantaneous. To familiarize the student with the system, we demonstrate it in laboratory sessions so that they understand the procedure used to access the images and are comfortable when they use it on their own. We have included operating instructions and system locations in the course workbook. Students use the system in the college computer lab and the university library's media center.

At present, we use the system in lecture to demonstrate fabric structure and illustrate that similar structures can be used to produce very dissimilar fabrics. Current enrollment of 50 students is adequately handled with the hardware and software available in the college computer lab and library media resource room. Students use the laser disc for self-study and to supplement both lecture and lab activities. They have been positive and enthusiastic in their reception of the laserdisc system. Specifically, students stated that the visual images are clear and help them when working alone without a microscope. The visual images provide better examples of fabrics and more focused information than are available to students using purchased or in-class swatch sets. The most beneficial aspect of the laserdisc system, as stated by students, is the immediate feedback that is not available using traditional study methods. Students may be frustrated by the diversity of fabrics that they are required to learn. The laserdisc interactive technology allows students to view several different examples of a similar fabric or fabrication, a condition not possible when working with a fabric swatch set. The general consensus of students has been that the laserdisc system "makes studying easier" because of the visual images and direct feedback.

References


Abstract

The importance of the CAD component in textile design education is undeniable. But success requires more than the addition of one CAD course or several computers. Today, the discussions revolve around how to integrate CAD successfully into the curriculum. Assessment has become a valuable tool to measure the effectiveness of any program and therefore must be included from the outset. This paper will share some of the successes and some of the challenges still faced by the Philadelphia program.

Obtaining the CAD hardware and software is ever a challenge, but the key element is how these systems are used. The student should be able to solve design problems using a computer, should understand how to shorten the time from creative ideas to fabric production using a computer, and should be comfortable using several different computers. The student must also realize that he or she is still the designer. The computer will not perform the design.

Just as with the teaching of basic mathematical, writing or drawing skills, CAD must be integrated into every aspect of the program if students are to become competent. Levels for students' growth and proficiency must be determined. Where is each student introduced to the use of CAD to solve design problems in relation to weave, knit and print? Where does each student have an opportunity to do extensive CAD work?

Today, it is fashionable to establish program goals, philosophy statements and assessment programs. The Benchmark process used by the Textile Design program at the College was created to measure how well the program goals are being met as well as the student's progress. Levels - awareness, understanding and proficiency - mark students' advancement through the curriculum. This encompassing examination of students' work also revealed that the critical points for success are 1) actual integration of CAD assignments into the courses by the faculty and 2) enough workstations to provide ample time for each student to learn, explore and grow. An examination of the physical installation, personnel and budgetary support must also be included.

Author's Note

The importance of the CAD component in textile design education is undeniable. But success requires more than the addition of one CAD course or several computers. This discussion revolves around how to integrate CAD successfully into the curriculum. Assessment has become a valuable tool to measure the effectiveness of any program and therefore must be included from the outset. This paper will share some of the successes and some of the challenges still faced by the Philadelphia program.
CAD Textile Design Education

A Midway Appraisal

The importance of the computer assisted design (CAD) component in textile design education is undeniable. But success requires more than the addition of one CAD course or several computers. The focus must be on the successful integration of CAD into the curriculum. Assessment is a valuable tool to measure the effectiveness of any program and must be included. This paper will share some of our successes and some of the challenges still to be faced.

Philadelphia College of Textiles & Science is a private college founded by the textile industry 110 years ago. Today, with 2300 students, there are 36 majors for a Bachelor of Science degree and 7 for the Masters level. Approximately 550 students are in textile & apparel related programs with 130 in Textile Design, 80 in the B.S. program and 50 in the M.S. program. We face the same challenges as many institutions: funding for new equipment, declining student enrollment, and a shortage of qualified technical faculty.

The undergraduate textile design curriculum is shown in Appendix A (page 44). Throughout the College, forty percent of every major is general studies which includes science and mathematics. Our designers take the technical textile core courses with the engineering and marketing students and the design courses with the fashion designers. Textile designers are required to understand all three areas -- weaving, knitting and printing (surface design) -- before concentrating in one. The textile design graduate degree is comprised of approximately one and a half years of studio work in either weave design, knit design or print design.

Our attempt to evaluate growth in student learning began with the verification of program goals and philosophy statements and the creation of an assessment process. One designated skill area is computer competency. The faculty agreed that each student should: (1) be able to solve design problems using a computer, (2) understand how to shorten the time from creative ideas to fabric production using a computer and (3) be comfortable using several different software systems. All faculty agree, and continue to emphasize, that students must understand that they are still the designers. Computers are only tools and will not perform the design.

Just as with the teaching of basic mathematical, writing or drawing skills, CAD must be integrated into every aspect of the program if the competency goals are to be met. Levels for students' growth and proficiency are identified. Where is each student introduced to the use of CAD to solve design problems? Where does each student have an opportunity to do extensive CAD work? A spreadsheet of the program requirements is marked with "awareness" (A), "understanding" (U) and "proficiency" (P) designations to indicate the students' progress through the curriculum. This activity was part of a college-wide process. Appendix C: 2 and 3 (page 47) include expectations for each CAD system by textile design area, for undergraduate and graduate students respectively.

In the sophomore year, textile designers have a required course in generic CAD software and hardware technology. Graduate students without previous experience take a similar course in their first semester. Students apply basic skills of computer drawing, color generation, scanning, printing and information transfer to print, weave and mapping exercises. This course allows subsequent instructors to assume student proficiencies in certain skills. The general CAD Lab has 10 identical PC workstations with Corel Draw 5 and in-house weave and paint software packages. Appendix B (page 45) has the complete listing of our present CAD facilities and Appendix C: 1 (page 47) indicates applicability.

As sophomores, textile designers take Weave I with the other textile majors. This same general CAD Lab is used for students (20-30 per semester) to create dobby chains suitable for three industrial looms with draw and color blankets. The dobby software has been generated in-house by Professor Wolfgang. Data are transferred by computer disk to a CDL paper dobby chain punch. Students must be creative within narrow parameters. Learning is accelerated through the use of computers since repetitious tasks are eliminated and feedback is prompt. Ideas can be explored before weaving. Re-working becomes a viable option. Weave theory, fabric analysis and production are combined in the learning process. Lab
reports include graphic printouts, fabric simulations, loom information and actual finished fabric. Brief assignments introduce students to the advanced Info Design and CIS dobby software.

Weave I represents the most aggressive and successful integration of CAD into an established course. But it has taken a number of years to evolve, a significant amount of faculty dedication and the continual communication between instructor and software designer. Success depends heavily on detailed updated instructions for each lab assignment.

In Weave II, students continue with assignments on the same CAD equipment and looms. Jacquard is introduced. Both weave courses use in-house spreadsheet software as part of fabric analysis. These courses represent the "understanding" level in the learning process since computers must be used to run the looms. But to fully achieve our program goals, much more work is needed in other areas such as the technical knit courses which do not currently use CAD.

As Textile Design students complete the fundamental technology and design courses, they begin in the textile design studios. Studio faculty seek ways to eliminate tedious tasks and increase creativity through the use of computers. Knit students get a demonstration of Stoll Sirix and create a sweater design on CADTEX. Print students scan their own designs into Info Design and produce additional colorways. Weave students do documentation on both AVL and in-house software. Undergraduate students must complete all three studios.

Advanced studios have more open assignments and smaller classes. Faculty must still prepare workable assignments, relating CAD to the expected coursework. Knit majors use the Shimatronic for one course and the Stoll Sirix for the other. Since CAD is the only means to interface with these V-bed machines, this is a "proficiency" skill level. Weave majors use new and renovated AVL hand looms and several different AVL software packages. Both Jacquard looms are electronic and students begin with Viable software. Interested students are shown EAT and Info Design but they must use their own time to learn these systems. Print majors have access to Info Design but have no required assignments. Appendices B and C (pages 45-47).

To further CAD utilization, an advanced CAD elective was introduced. Lectures present detailed information on color systems, hardware, printers and data transfer file formats. Students rotate lab assignments on the advanced commercial systems: EAT, Info Design, Viable, Millitron, CIS and CADTEX. Enrollment is limited to 6 students. Two sections were offered last summer to accommodate growing undergraduate and graduate interest.

Graduate textile designers have freer class schedules, smaller class sizes and concentrate in one area. The additional time on the CAD systems is reflected in their work. Print grads create on Athena and Info Design. Weave grads use EAT, Info Design and Viable Jacquard software programs and the AVL compudobbies. Knit grads do most of their collections on the Stoll Sirix. The focus remains on exploration and creation, not on the computer.

In order to minimize the frustration time as students start to employ CAD in their work, we defined four distinct personnel areas of responsibility. (1) Each faculty is responsible for preparing assignments, doing the initial class instruction on a system and writing up support materials. Faculty receive training on all new systems. (2) A full-time CAD technician works with students (and faculty) as they begin the learning process. He/she schedules the facility and receives training on all software. (3) The CAD professor is the hardware expert. There is a growing need to link various systems to limited support pieces such as scanners and printers. Data transfer of large files poses additional technical problems. As equipment ages, maintenance has become more problematic. (4) Graduate students with CAD experience complete the staffing by allowing us to keep the CAD studios open 7 days a week until late.

The importance of having faculty dedicated to the whole integration process must be stressed. Faculty have the primary responsibility to incorporate CAD into their own courses. They must be given time to learn a system before they can realize its usefulness. It must be recognized that this represents a major commitment of personal time, often without compensation. As software is updated, assignments must be continually modified. Faculty who refuse to do the necessary work
for whatever the reason jeopardize progress in their area.

The Textile Design Benchmark Program was adopted to (1) measure curriculum effectiveness and (2) enhance the student's presentation skills. Undergraduates present their portfolios to a faculty panel at the end of their first year, again midway through their third year and then prepare a final exhibition before graduation. The same evaluation form is used for all three reviews. The senior evaluation includes outside assessors. Graduate students present their work to the graduate faculty every semester and also have a final exhibition. But it is the process itself that provides an excellent monitor of what students are actually doing in their courses.

A suitable program can be planned, faculty and support staff trained, and still there can remain a major bottleneck for computer time. A facility plan must include growth considerations. Designers average 8 hours per design once they understand how to use the system. As a program begins to achieve the objective of increased usage, the need for workstations escalates. Having inadequate workstation capacity is a devastating setback for zealous beginners. Budgets for consumables and for maintenance also increase. This can become serious when the goal is to have a number of textile designers who are CAD proficient, with demonstrated work in their portfolios.

Decisions must be made whether to acquire multiple workstations of one software type or to diversify. Each choice has advantages and disadvantages. It is certainly easier to train, update, and write assignments for a single software. But students are limited in their flexibility and there is a greater tendency toward dependency on the computer for basic skills. We feel strongly that flexibility is important since no school will be able to afford all the latest programs. But maintaining hardware, upgrades and training for an increasing number of systems does present continual challenges. There is no lane for complacency on the technology highway.

Whatever the approach, the acquisition of CAD hardware and software requires a significant amount of time and money. We have no institutional budget. Vendors have donated software to our program with upgrades, training and installation costs negotiated. Hardware is acquired through textile industry donations. Partnership agreements where work is exchanged for hardware or upgrades, are increasingly effective. One involves a textile company setting projects for students to generate designs from the company's archives. Two others involve the generation of design libraries on special topics.

Industry recognition and supportive alumni are very effective. Faculty articles, presentations and exhibits, innovative projects and active participation in major conferences, organizations and competitions are all important, not only to update faculty but to maintain the institution's visibility. During the last two years, we sponsored a Visiting Artist Jacquard program where internationally known fiber artists worked in residence on the CAD equipment and electronic Jacquards. The final exhibition will be held this spring.

How critical is the incorporation of CAD into Textile Design education? Should program goals be reassessed? Why not just go back to teaching good design principles with traditional skills? Why not let "The Industry" teach our students about computers? It certainly would be easier and less expensive. To Philadelphia College of Textiles & Science, the answer is clear: over the last five years, we have averaged 94% placement with most going into the jobs directly related to textile design. When recruiting, industry still wants to see good design, still wants a good color sense, still wants exhibited creativity, still wants the strong technical background. But CAD has become a paramount factor in the industry. CAD links design, simulation and manufacturing. CAD flexibility and knowledge have been added to the list of obligatory qualifications.

Philadelphia Textiles would seem to be a success story and this is a good point to end the paper. But it is through the Benchmark examinations of students' work that we have realized what is not happening: (a) actual integration of CAD assignments into the courses beyond a demonstration level and (b) enough workstations to provide ample time for each student to learn, explore and grow. This information must be folded back into the program in order for us to progress. Working within the limits of institutional staff, program and budget constraints is a challenge for everyone. Increased
CAD Textile Design Education

physical capability, recommitment of individual faculty, institutional recognition of faculty efforts and institutional budgetary support are all needed to achieve the goals we have stated for the program. The importance of computer technology is expanding at every institution. There is no turning back, but we are only midway toward our goal.
## Appendix A: TEXTILE DESIGN  Bachelor of Science Requirements

### YEAR 1

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<thead>
<tr>
<th>Fall</th>
<th>Spring</th>
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<tr>
<td>Survey of Textile Manufacturing</td>
<td>Yarn Manufacturing</td>
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<tr>
<td>Design Foundations I</td>
<td>Design Foundations II</td>
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<tr>
<td>Drawing</td>
<td>Earth Science</td>
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<tr>
<td>Finite Math</td>
<td>Introduction to Calculus</td>
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<td>Freshman Writing Seminar</td>
<td>Historical Understanding</td>
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<td>Professionalism</td>
<td>Physical Education</td>
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### YEAR 2

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### YEAR 3

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### YEAR 4

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Concentration Options -- select one

A. Knitting
   - Knitting Studio II
   - Advanced Weft Knitting

B. Printing
   - Print Design II or Screen Printing II
   - Textile Printing Technology

C. Weaving
   - Jacquard
   - Weave Studio II
Appendix B: TEXTILE PRODUCT DEVELOPMENT AND DESIGN CENTER

GENERAL CAD LAB

10 Intel based Pentium computers with Cannon 4000 printers.
Software: CorelDRAW, AVL Generation II, Professor Wolfgang's in-house weave and color software.
Linked to industrial dobby looms via floppy disk transport to CDL paper chain punch equipment.

ADVANCED CAD STUDIO

*Milliken's Millitron System*
Software for print and mapping.

*Info Design's Vision3 System*
IBM 486 workstation; shared Cannon FP510 printer; Sharpe scanner Wacom digitizer pad & pen.
Software for print, dobbby, jacquard woven, and knits.
Linked to electronic dobbby and jacquard looms via disk transport.

*CIS's Design 3*
Silicon Graphic workstation, shared Cannon FP510 printer, Kyocera F-1000A printer.
Software for dobbby, mapping.
Linked to electronic dobbby loom via disk transport.

*EAT's DesignScope System and Editing Station*
Data General work station, Cannon CJ10 Scanner/Printer/Copier, Wacom digitizer pad & pen.
Software for jacquard woven.
Linked to electronic jacquard looms via disk transport.

*CADTEX's PrimaVision System*
Sony Trinitron workstation Cannon BJ800, Epson ES300C scanner.
Software for knits and dobbby wovens with 2D simulations.

*Viable's Weavette System*
Mitsubishi workstation and color printer, Sharp scanner.
Software for jacquard woven.
Linked to electronic jacquard looms via disk transport.

STUDIO LOCATIONS

*AVL Handweaving Software*
Five different workstations, Macintosh and IBM.
Software packages: four different AVL programs.
Linked to three AVL floor looms and six renovated dobbby head hand looms.

*Stoll's Sirix system*
Silicon Graphic workstation, NEC penwriter, Mitsubishi S340 Thermal Color Printer.
Software for sweater knits.
Linked to Stoll V-bed knitting machine CMS 402.
CAD Textile Design Education

Shima Seiki's Shimatronic System
SDS 100 workstation, Epson printer.
Software for sweater knits.
Linked to Shima V-bed knitting machine.

Athena’s System
Sun S10 workstation, Iris 4021 smartjet printer, AGFA Scanner, Wacom digitizer pad & pen.
Software for print design.

Gerber’s Accumark 300
7 workstations, HP printer, 1 numonics plotter, 1 large digitizer tablet.
Software for patternmaking & grading, marker making for fashion & apparel students.
Appendix C: CAD Software Utilization

1. *Software Capability*

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* To be added Spring 1996

2. *Undergraduate Proficiency*

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3. *Graduate Proficiency*

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CAD Textile Design Education
CAD Textile Design

CAD Textile Design Curriculum Development

Elaine Polvinen
Buffalo State College, Buffalo, NY

Abstract

CAD Textile design is an area that is currently undergoing a metamorphosis and resurgence, due primarily to the development in technology. Computer-aided textile design is a relatively new and increasingly viable professional career choice for apparel and textile design students. On a national level, the general area of textile design has been splintered into fiber art, craft, or apparel, and textile programs that are industry focused. Developments in technology which made CAD textile design possible that have generated recent job opportunities are creating a national resurgence in preparation of students for professional opportunities in the specific area of CAD textile design. The position of CAD textile designer is still relatively new and the job description is currently in the evolutionary stage.

This paper will address in general terms the background research of appropriate CAD systems. Specifically it will focus on the development and implementation of a CAD/Print textile design course into the program curriculum. Students completing the course achieve the ability to implement the basic principles and elements of design into textile design fabrics, apparel and home furnishings collections and apparel/textile presentations.

The Info Design/Vision software used for this course was specifically chosen because it is industry-based. The students learn that in this field particularly, continual adjustment and re-tooling of skills and knowledge is a given. The unpredictability of technology creates a "roll with the punches" attitude and heightens the ability to improvise and adjust to the situation by solving problems creatively.

Testing and evaluation of the course content is in the form of acceptance into various student competitions, internship and employment opportunities, and professional portfolio development. This is a new course that is still in the process of development. The success of this particular course can be measured by the number of CAD textile design national student competition awards received in the past two years (five in 1994 and seven in 1995).

Background

Textile design for industry is currently undergoing a metamorphosis and revival, due mainly to the recent developments in CAD computer technology. Computer-aided textile design is a relatively new and increasingly viable professional career option for apparel and textile design students.

Historically, on a national level, the general academic concentration in textile design has been divided into a fiber art and craft category or apparel and textile programs that are industry focused. Recent developments in color matching technology have made CAD for textile design a reality. New employment opportunities are creating a national resurgence in the education of students in the specific area of CAD for textile design.

The position of CAD textile designer is relatively new and the job description is currently evolving. The current job description is subject to change relating to developments in technology. Presently, CAD textile designers have a variety of educational backgrounds. Formal education ranges from industry-based textile design pro-
grams, to art based textile design, printmaking, fine arts and graphic design programs. There are several job descriptions relating to a CAD textile designer: (a) CAD Print Designer specializing in creating and designing customized print collections, layouts, trend boards and client presentations; (b) CAD Weave Designer specializing in creating and designing customized weave collections in dobby or jacquard weave structure, layouts, trend boards and client presentations; and (c) CAD Assistant Print Designer (textile technician) entry level CAD position that does not involve much designing, with duties consisting mainly of cleaning screen separations, dropping designs into repeat and creating colorways for a client design.

**CAD System Research**

When researching a CAD system for a textile and apparel program, the main software goal should be the maximum "flexibility" and "versatility" possible from one software vendor. Also the decision to purchase commercial or industrial software should coordinate with the campus resources that are presently available. Resources such as current student computer lab hardware available and network capabilities will have a direct impact on the most appropriate, efficient, and economical CAD textile design system to use.

The CAD system chosen for this program was Info Design/Vision. It was specifically selected because it is industry-based. This type of software is still very different from commercial off-the-shelf applications and it is not as user friendly. File compatibility remains a big stumbling block with industrial software. Thus, the possibility of several software packages from one company is a desirable option. The main reason for choosing this particular software was: (a) the firm's international reputation in the CAD textile design industry; (b) a variety of software programs from which to choose; and (c) only one vendor to personally contact and interact with on all software and hardware issues. The specific software chosen for this curriculum were print/presentation, 3D mapping, and dobby weave.

Info Design also produces jacquard weave and knit software.

**CAD Print/Presentation/3D Course**

The Fashion Technology Program at Buffalo State College is presently undergoing major revision changes that will include the additional concentration of textiles for industry. In addition to apparel design CAD/CAM coursework, the current program curriculum only allows for one formal CAD/Print course. This has resulted in a high level intense course that produces graduate level work in an undergraduate program. Upon completion of this CAD course, students gain proficiency in the print program, professional presentation and layouts, trend collections, design boards, and 3D mapping. This one CAD course enables students with a design background and few or no computer skills, to become qualified for an entry level CAD designer position.

In order to fulfill the requirements of the course, a substantial time commitment is expected. In fact, only students who seriously desire to pursue a CAD designer career option are chosen to participate. At present, CAD students are selected upon request by seniority and G.P.A. standing. The students learn immediately that, especially in the CAD technology field, continual adjustment and retooling of skills and knowledge are mandatory requirements. The unpredictability of technology creates a "roll with the punches" attitude and heightens the ability to improvise and adjust to the situation by solving problems creatively. There will always be other systems or new upgrades of the same system to learn. A potential CAD designer does not need to work on a variety of CAD systems to be adequately prepared for a CAD entry-level position. A mandatory requirement is the right professional attitude that includes a constant open mind willing to accept and welcome change. Experimentation with a variety of commercial, off-the-shelf software is encouraged. The internalized concepts gained in this course are interchangeable with other software systems. It's not a particular CAD system that makes a student a successful CAD.
designer. It is: (a) a professional attitude, (b) persistence, (c) commitment, (d) willingness to experiment, and (e) openness to change and flexibility.

The first third of the course is devoted to demonstrating basic program software functions and hardware capabilities along with start-up operations. In short, the technical aspects of the system are divided into modules assigned as repetitive practice assignments to build comprehension and internalization of the individual functions.

The second third of the course is mainly a period of transition and internalization and is a critical point in the learning process. It is composed of completing certain tasks that involve choosing different combinations of functions to achieve desired results. Depending on the individual CAD designer's method of creation, various functions can be chosen to achieve comparable desired results. In other words, there are no easy answers at this junction of the course. Several options can be pursued for each anticipated result. This is also the major input/output learning section of the class. Students: (a) scan designs and motifs at various stages of completion, (b) color separate them, (c) clean the color separation screens, (d) complete the design, (e) set the design into the appropriate repeat, (f) design and create a layout that includes the end product and color chips, and (g) print it out. Students are encouraged to research trends, create designs and scan them in to the software at different points of completion depending on their individual style. Colors are separated and individual screens are cleaned. Designs are dropped into repeat and ultimately mapped on to an illustration in an end product presentation created on the computer.

The time commitment begins to intensify during this second period. This is a frustrating phase in the learning process for both the student and the instructor mainly because every question will have at least three to five different answers. The software will become integrated into the CAD designer's individual and unique creative process through continuous work on the system, as well as through repetition of differing function combinations to create designs and layouts.

Figure 1. Knit sweater colorways with color chips created on print/presentation program. Jasmine El-Beihairy, student CAD textile designer.

During the second third of the course, several letter size (8 1/2" by 11") professional layouts are created (see figures 1-3) that consist of the design, the design in repeat, color chips, and the end product. The student is encouraged to create these layouts in several colorways for their portfolio. The layouts could be for a variety of products such as: shirt, ties, sweaters and scarves.

To fulfill a major course requirement, the rest of the course involves the creation of three textile design boards (see figures 4-5). The challenge of creating a collection for various student competitions is an excellent vehicle for motivating students to achieve a level of professionalism in their work. Students are required to complete a textile collection according to competition specifications, but only the best designs and layouts are selected.

Design presentation boards are required to be a unique creative expression of the individual
CAD Textile Design

Figure 2. T-shirt design with color chips created on print/presentation program. Jennifer Fedeson, student CAD textile/apparel designer.

student designer's style. Each board includes a collection of three coordinated fabrics with color chips. A photograph or an original sketch is often manipulated to create an end product visualization for the fabric collection. The end product is created in the 3D mapping program. It illustrates the fabric design in repeat on the product market category for which it was intended. The board is completed with trend items that inspired the design. The main function and ultimate purpose of these design boards is to prepare the student to present textile fabric collections to future clients. A secondary purpose is for professional portfolio enhancement.

The student designers are always encouraged to blend and balance their technical expertise with intuitive creativity. Evaluations of the boards are based on the achievement of balancing creativity and technical excellence. If artistic creativity is the focal point, visual impact of the fabric collection is lost and defeats the purpose of the design board. The fabric collection loses its focus and becomes secondary to the board as a work of art. One may as well frame the design board and hang it on the wall. It defeats the purpose for which it was intended. If the board is too technical, it risks becoming mundane and boring.

Figure 3. Knit sweater coat design with color chips created on print/presentation program. Dianna Jezioro, student CAD textile/apparel designer.

Cad Course Evaluation

While this course format is still in its developmental stage and continues to evolve, student feedback has been excellent. Testing of the course content is in the form of entrance into various student competitions, internship evaluations and professional portfolio review. Class size is limited to insure individualized attention and adequate computer input and output access time.
Positive suggestions from students and industry continue to be incorporated into the coursework. Evaluation of the success of this course can be measured by the number of CAD textile design national student's competition awards in the past two years (five student awards in 1994 and seven in 1995). CAD course evaluation can also be measured by the several successfully completed CAD internships experienced and the CAD employment positions available to CAD students.

CAD textile design students benefit in several ways: (a) attainment of an excellent portfolio collection to assist in securing an entry level CAD position; (b) competence in the operation of industrial CAD software/hardware; (c) insight into the expectations, responsibilities and demands of a CAD textile designer; (d) ability to translate past skills and knowledge into CAD technology; and (e) self-confidence and professional pride gained from creating a winning textile design presentation. CAD Textile design internships are currently available and are an option for students who qualify to pursue them. Student participation at conferences, trade shows and expositions are strongly encouraged. The students who have successfully completed the CAD course have presently had no difficulty in attaining positions in industry following graduation.

Presently, a workshop is being taught as part of a collaborative grant project with other colleges involving Internet Web publications. Fashion Technology students at Buffalo State College are creating a Web site to add on to the existing Fashion Technology Web site (http://www.snybuf.edu/fashion/home.htm). The student publication will include the CAD student's professional resume and portfolio. The professional portfolio collection will include examples of accumulated skills, such as: (a) fashion illustration, (b) fashion/apparel/textile product flats, (c) computerized patternmaking illustrations, (d) completed garment collections, and (e) textile design collection boards. The target date for completion of this Web publication project is June 1996. This Internet Web publication course will enable the students to additionally qualify for the position of Web publication designer in the apparel/textile industry. This course will be offered as a permanent elective in the revised new curriculum.

Another planned course for the revised new curriculum is CADweave. This course will focus on the Info Design/Vision CADweave program and