Development and testing of a computer simulation

for use in apparel design

by

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INTRODUCTION

Visual thinking (Arnheim, 1969) is the process of using visual images to process information. Visual literacy is being able to understand and communicate visual images (Ausburn & Ausburn, 1978). Visual learning is the outcome of the visual thinking process. Apparel design students are given the opportunity to think, communicate, and learn visually as part of their education. Textiles and clothing educators are continually looking for new and better ways of enhancing students' visual thinking and communication skills.

Computer Assisted Instruction (CAI), may be one way to teach students how to think and communicate visually. CAI, defined as using the computer to enhance learning, is described in modes of delivery and interaction (Manion, 1985). The most common of these modes are: 1) tutorial; 2) educational game; 3) drill and practice; 4) problem solving; and 5) simulation. Simulations represent real life situations in which the student is allowed to practice problem solving without the cost involved in an real situation. Simulations have been developed for textiles and clothing education, but not for apparel design specifically (Marshall, Hooper, Slaybaugh, 1985), (Mayhew & Gardner, 1983), (Jolly 1984).

Much of the work of apparel design students is visually oriented. Beginning apparel design students are often limited in their ability and willingness to think and communicate visually. Flat pattern is an entry level course designed to teach students the basic principles of patternmaking. In flat pattern, students are given a chance to design garments for the first time. Students in this course are usually faced with two problems: 1) they have limited ability in sketching; and 2) they are limited in their willingness to experiment with a garment design.

It is important for individuals in flat pattern to be able to visualize a garment and communicate that image on paper. Having the image on paper allows the student to evaluate the garment and make the necessary decisions for drafting the pattern for that garment. It is also important for students to be willing to experiment with their design once it has been recorded on paper. Students need to realize that it is sometimes necessary to view a garment in a number of different ways before making a final decision on the design of the garment. However, most beginning students want to create a unique and unusual garment for themselves. This desire keeps them from experimenting with a range of variations of garment design. Textiles and clothing educators need to know how to encourage students to experiment with garment designs and to communicate these visual images on paper.

Computer Assisted Instruction (CAI) is one possible method of encouraging students to experiment with garment design variations. The graphics capabilities of the computer can be applied to the designing process to perform the mechanical functions of drawing and redrawing designs. The students can then spend more time visually critiquing the designs, as well as, exploring other garment design variations. Using the computer involves a new way of thinking about the designing process that may enhance a student's visual thinking and communicating skills.

Research about CAI, in general, is carried out in terms of the effect of CAI versus traditional instruction. Researchers agree that the testing of CAI against traditional instruction is no longer productive (Clark 1985). They suggest exploring characteristics of learners and specific learning situations when testing CAI in the future. Attitudes regarding CAI seem to be dependent upon the previous computer experience of the student (Dence, 1980). The intense negative attitude towards computers some students possess may be explained as computer anxiety. There is little research on testing the effect of attitude and anxiety towards computers on achievement. Apparel design is a "hands on" educational area. Computer technology causes some students great anxiety. Carefully designed CAI may help alleviate some computer anxiety.

Visual thinking is the objective of this research.
Computer Aided Instruction is the method of instruction that is
being developed to improve visual thinking. By using the
computer to experiment with garment design variations, students
will be utilizing a different thought process. Measuring the
number of experimentations is a way to test the capability of
the computer to enhance visual thinking. The use of the
computer may cause anxiety in some students, therefore it is
important to examine the relationship between computer
experimentations and computer anxiety, as well.

The purpose of this research is to develop a computer
program that allows students to experiment with garment design
variations and to test the program by examining the influence it
has on the students' willingness and ability to experiment with
garment design variations. To test the computer program,
students will complete an assignment in the following two ways:
a) using the computer and b) sketching by hand. The assignment
will be designed to measure the amount of experimentation with
garment design variations each student attempts. This
experimentation will be used to evaluate whether the computer
enhances or detracts from the student's willingness and ability
to experiment with garment design variations.

Assumptions

1. The participants in this research will complete the assignments independently, to the best of their abilities.

2. The directions and introduction to the computer program are communicated clearly enough to allow the students to use the computer program with little assistance.

3. The graphics used in the computer program are acceptable representations of the actual garment pieces used in flat pattern design.

Limitations

1. Participants in this research are limited to the use of those garment pieces available in the computer program as it currently exists.

2. The participants' experimentation with garment design variations is limited to the manipulation of structural lines on the garment.

3. The generalizations drawn from the results of this research are applicable only to the participants of the sample group.

Definitions

1. Garment design variations -- those changes in the appearance of the garment that can be produced by manipulating the structural lines of the garment.

2. Computer anxiety -- the fear or apprehension felt by individuals when they use computers, or when they consider the possibility of computer utilization (Maurer & Simonson, 1984).

3. Level of experience -- the number of classes in apparel design, fashion illustration, and aesthetics previously taken by the student participant.

4. Ability and willingness to experiment -- the number of variations in structural lines on a basic body type that the student attempts in his or her completion of the assignments.

5. Structural lines -- the boundaries of the garment and garment pieces that define their shape and size.

Hypotheses

The computer program developed during this research will be used to test the following hypotheses:

Ho: The use of the computer program developed will have no effect on the student's ability and willingness to experiment with garment design variations.

Ho: There will be no relationship between level of experience in apparel design and ability to experiment with garment design variations.

Ho: Students with high computer anxiety will not differ from students with low computer anxiety in willingness and ability to experiment with garment design variations.

REVIEW OF LITERATURE

The literature reviewed in this section begins with the concept of visual thinking as it relates to Computer Assisted Instruction (CAI). This information is followed by relevant research in education dealing with the use of CAI. Finally, CAI is discussed in terms of its use and application in textiles and clothing, emphasizing its use in apparel design.

Visual Thinking

Arnheim (1969) developed the concept cf visual thinking. Visual thinking is processing visual information in a visual format. Arnheim reports that people formulate visual images not only by what they see, but also by incorporating that visual stimulus with the visual image they have stored in their memory. Experience is taken from the individual's memory and is organized and applied to the visual stimuli in order to create new visual images in thought. Receiving visual stimuli is important to the visual thinking process.

Learning to receive visual stimuli is equated to becoming visually literate. Ausburn and Ausburn (1978) describe visual literacy as those skills which aid a person in receiving and processing visual stimuli in order to communicate with them. By thinking visually, one should be able to express his or her

ideas in a visual format and thus transfer information. Hortin (1980) suggests that people who are visually literate should be able to process information in order to think visually as well.

Processing visual stimuli in thought can play an important role in learning. Visual learning is the outcome of the process of visual thinking. Apparel design is one area of academia where the development of visual thinking and learning skills is important. Students in apparel design are constantly faced with the challenge of thinking and communicating visually. Some students have a greater skill in thinking and learning visually than others. Instructional methods that enhance students' ability and willingness to think and learn visually can make a significant contribution to the education of apparel design students.

Computers and Visual Thinking

The use of the computer in apparel design may be one way to stimulate visual thinking and learning skills. Computers have the capability to communicate visually. Learners are exposed to visual symbols and images on the computer screen which reflect real things (Hammond, 1985). The learner serves as a catalyst in drawing out information that is stored in computer memory.

The computer stores all kinds of information in memory, just as people store information in their memories. If the

computer could be used to store visual images for apparel design students they, in turn, would have more time to spend organizing and applying their experience to design ideas. The time saved by recording and storing visual images on the computer, can be used by the student to produce more creative thoughts. The new thoughts can be recorded on the computer quickly, thus allowing a student to contemplate many different ideas. This process, which allows the student to observe many different ideas, gives the student a new approach to thinking and learning visually.

Computer Assisted Instruction (CAI)

Computer Assisted Instruction (CAI) is a method of using the computer to teach students. There are many forms of computer assisted instruction. The formal definition and forms of CAI are described in the following paragraphs.

Definition

Computer Assisted Instruction (CAI) is a part of the larger body of computer instruction termed Computer Based Instruction (CBI), (Splittgerber 1979). CBI refers to all aspects of instruction that utilize the computer. CBI is divided into two subcategories: 1) Computer Managed Instruction (CMI), which deals with the management of information and data in a record keeping format; and 2) Computer Assisted Instruction (CAI), which is what will be investigated in this research.

Forms of CAI

Manion (1985), describes CAI in terms of six modes of delivery and interaction: 1) drill and practice; 2) tutorial; 3) educational gaming; 4) problem solving; 5) word processing; and 6) simulation. Drill and practice programs support and reinforce what is taught in a classroom. Tutorials involve the actual learning of information, with the computer assuming the role of teacher. Educational gaming involves applying previously learned knowledge into a game situation. The use of the knowledge then becomes the determinant of whether or not the student wins or loses the game. Problem solving switches the roles defined in a tutorial. Instead of the computer as a teacher, this time the student has the teacher's role and instructs the computer. Manion describes word processing as a new mode of CAI. She suggests that writing is a very important aspect of learning. Word processing facilitates that learning due to the student's ability to manipulate the language.

Simulations

Simulations are imitations of real life situations. Students get the experience of problem solving in a realistic setting that has been adapted to a computer format. Madgison (1978) states "the simulation mode is perhaps the most exciting, for it can allow the student to use the computer as a tool to discover and generate new information...". By utilizing simulations, students are able to make mistakes and learn from

them with no real cost involved. Using a computer to simulate a garment designing experience would allow students to use their visual thinking and learning skills to experiment with designs at no real cost, as well as, give them a realistic situation for designing.

CAI in Educational Research

CAI vs. Traditional Instruction

The focus of research involving CAI in the past has been the comparison of CAI to traditional instruction. Many studies have been completed in various areas of academia that test this idea. Kulik, Kulik, and Cohen (1980) performed a meta-analysis of the findings of 59 studies on the effectiveness of computer based instruction in college teaching. The results of the meta-analysis showed that computer based instruction had a small, but positive effect on the achievement of students in college. Of the 11 studies in which attitude was examined, there was a similar small, but positive effect on the attitudes of students toward computer based instruction and the subject they were studying. The review of recent research involving computer based instruction completed by Kulik and Kulik (1987) reinforces the findings of earlier studies. In general, there is a slight positive effect on learning with computer based instruction.

Clark (1985), on the other hand, makes a claim against the positive information being reported about the use of computer based instruction. He suggests that the achievement gains found in most studies are due to the uncontrolled instructional methods within the CAI, rather than the actual CAI itself. Therefore, he concludes, the same gains could be reported by delivering the same information in other forms. It is his suggestion that researchers refrain from testing whether CAI is as effective in producing achievement as is traditional instruction. He feels time should be spent exploring the cost and effectiveness of computer based instruction as an appropriate mode of delivery for information.

Others agree that CAI should no longer be compared to traditional instruction. They have made suggestions for future research that will test more specific parts of CAI, rather than the whole concept. Roblyer (1985) believed that future research could be focused on achievement broken down into specific categories. One of these categories is computer impact on the level of skill a learner possess in a subject matter. He suggests that more research is necessary to identify if a certain level of skill is more applicable to computer learning than another. In apparel design, students with low skill in visualization and sketching ability are often times at a disadvantage when designing. Their sketching abilities do not

allow them to communicate designs visually with accuracy or speed. The computer would assist those with lower skills.

According to Gillingham and Guthrie (1987), educators need to look at the learning situation and evalute which method of instruction will meet the needs of the students most successfully. In essence they say, the computer does not provide all the answers for any given learning situation, but it can be combined with other instructional components to provide an optimum learning experience. The computer is not the total "answer" to the visualization problem among apparel design students. However, it can aid them in viewing the design process in a new way.

Along the same lines, Hoelscher (1986) admits that "paper and pencil" still work in learning situations. The computer and paper and pencil are both tools for working with information. She believes that the computer can lead students into new thought processes due to the way the computer handles information. With the computer doing all of the mechanical processes, the student is free to do more critical thinking which can lead to new information. Hoelscher states "It may now make more sense to look at things in a number of very different ways before deciding upon one final answer to a particular problem" (p. 25).

This last statement has direct application to the visual thinking and learning involved in apparel design. If a computer simulation is used to foster the student's ability to think and learn visually, it can be of help to the student in two ways. First, it can do the mechanical work involved in representing a design visually. For example, it can sketch a garment relatively quickly and display a picture of that garment on the computer screen. With this part of the design process completed, the student is free to observe the garment on the screen and at the same time think of other variations of that garment. The emphasis in the design process has been placed on the thinking, rather than the sketching. Second, a computer simulation can be used to imitate a tool used in the design world, so the student is able to use his or her experience in a realistic situation.

Attitudes Toward CAI

As reported earlier in the studies of Kulik, Kulik, and Cohen (1980) students' overall attitudes towards computers were found to be slightly more favorable than attitudes towards traditional instruction. Dence (1980) also studied the attitudes of students toward computer use. She looked at attitude as one of ten variables present in the 17 studies she examined. In the three studies that included attitude exploration, Dence concluded that students' familiarity with CAI and their attitudes regarding CAI affected how they viewed CAI

in terms of usefulness. For example, students who had used CAI previously and had been successful with it, felt it was useful as a teaching tool. Likewise, students who had used CAI previously and made many errors, felt it was less valuable.

Computer Anxiety

As Dence reported, student familiarity with CAI may be a factor in the attitudes they have towards CAI and the value of CAI in terms of usefulness. Maurer and Simonson (1984) developed a standardized instrument, the computer opinion survey, to measure computer anxiety among students (see Appendix). Simonson et al. (1987) define computer anxiety as the fear or apprehension felt by individuals when they used computers or when they considered the possibility of computer utilization" (p. 238). They suggested using the computer opinion survey to calculate a computer anxiety score for a student and looking at this score in comparison with achievement. In apparel design, students are accustomed to working with their hands to sketch, make patterns, and construct garments. Using a computer to carry out some of these tasks may cause some level of anxiety. The computer opinion survey would help identify this anxiety and examine the relationship anxiety has on students' willingness and ability to work with the computer.

Textiles and Clothing Use of CAI

Textiles and Clothing educators are utilizing CAI in their classrooms. Each subject matter within Textiles and Clothing has a different idea on how best to use the new technology to achieve its educational goals. Most of the programs developed are making good use of the computer's mathematical and analytical capabilities. Very few have attempted to utilize the graphics capabilities of the computer to teach students. Some examples of computer applications in the areas of textile science, fashion merchandising, and apparel design will be discussed in the following paragraphs.

Textile Applications

Kean and Laughlin (1981) developed a self-paced, programmed instruction package, incorporating computer assisted instruction to help students in an introductory textiles course. Dedic and Hilliker (1982) developed a computer program entitled STAYWARM, to compute the insulation value of clothing.

Fashion Merchandising Applications

Fashion Merchandising curricula are also making good use of CAI. Kunz and Jezek (1982) developed a computer program as a component of a multi-media instructional unit. The students use the computer to make buying decisions for an imaginary company. Jolly (1984) developed two computer simulations. One simulation allows the student to complete a six month planning experiment

for a store. The other simulation allows students to experiment
with and manipulate stock and sales for a department of a store.
Everett (1985) developed a two-part computer budgeting case
study for students enrolled in her merchandise planning and
control course. She first had students log on to the computer
to work with a previously written budget for a store. This was
to give the students exposure to the computer and how it
operated. The next part of the study asked students to assume
the role of a buyer and to produce a six-month budget for a
newly developed department in a store.

Apparel Design Applications

Apparel design encompasses many aspects of textiles and
clothing. These aspects include patternmaking and clothing
construction, as well as the actual garment designing process.
Currently, there are computer applications available in both the
areas of patternmaking and clothing construction.

<u>Alterations</u>   Mayhew and Gardner (1983) developed a
computerized simulation to make alterations to patterns. The
lesson begins with a tutorial to review the basic rules involved
in making pattern alterations. The student is then acquainted
with the processes that are involved in using the program.
Finally, the student is able to practice making alterations from
an assigned set of problems on the computer or from a personal
pattern alteration.

Patternmaking   In patternmaking, the computer is being
used to draft patterns without the use of paper and pencil.
Woodson (1983) worked with developing basic patterns through the
use of a microcomputer. Students in class used the
microcomputer to generate a basic pattern. They also produced a
basic pattern by hand using the same measurements. She compared
the patterns generated by the microcomputer with patterns
generated by conventional methods. She found that time was not
reduced through the initial use of the computer. However, time
was saved in the storage and retrieval of the patterns developed
on the computer.

Woodson (1985) also developed a computerized system for body
measuring. In this system, she first developed a Body Graph, an
instrument for taking measurements manually, which would measure
the body both vertically and horizontally. The vertical and
horizontal measurements corresponded to the spacing on the
computer through the use of coordinates. These specific
coordinates were used to produce actual patterns from the
computer. The pilot test of this program consisted of 44
measurements for each of five participants who represented a
variety of body types. The measurements were entered into the
program to produce a pattern that could be used to construct a
fitting shell for each participant. The fit of the shells were
rated on a scale of one to ten by two clothing experts. A
rating of one represented the worst fit and ten represented the

best fit. The mean scores for the fitting shells were between 9.0 and 10.0, indicating a good fit for the garments.

Steinhaus and Young (1985) developed a computerized pattern drafting program to help solve asymmetrical or unusually sized figure problems. The participants of the study entered measurements based on body quarters on the computer. These measurements were then integrated and organized in the computer and a pattern was produced using a digital plotter. These computer patterns were then compared to the patterns that were drafted manually using the same set of measurements. The computer patterns and the drafted patterns were within 1/16 to 1/8 of an inch to each other. Error was attributed to the computer's high degree of accuracy as compared to the lower degree of accuracy in manual pattern drafting.

Bodice Editor is a computer program developed by Brackelsberg (1987) that allows students to use the computer to apply principles of flat pattern design to a basic bodice. The basic bodice appears on the computer screen and the student uses a series of commands programmed in to the computer to perform a variety of pattern manipulations. When the student has finished a particular bodice, the computer prints a hardcopy of the bodice. The half scale pattern can be used to draft the final pattern to be used for construction. The student gets the opportunity to experiment with many patternmaking principles

while using the computer and can save these bodices to be
reviewed at a later time.

Clothing Construction   BUYER is a computer simulation
designed to evaluate the construction quality of ready-to-wear
garments in entry level clothing construction classes (Marshall,
Hooper, and Slaybaugh 1985). Marshall was interested in helping
students develop decision making skills by using the computer.
She was also interested in the graphics capabilities available
with computers. The BUYER program contains three graphic
representations of garments that the students are asked to
evaluate in terms of construction quality. The students are to
assume the role of a buyer for an imaginary department store.
The students view all areas of the garment they feel are
appropriate before they make a decision about whether to
purchase that particular garment for the department store. When
the students have evaluated the three garments, they enter the
specific number of each garment to be purchased. The computer
then calculates the hypothetical sales and profits that would be
experienced as a result of the purchase.

Student attitudes toward the BUYER program were evaluated
by Marshall and Slaybaugh (1986). The sample for this study
consisted of 131 students enrolled in entry level clothing
construction classes at Iowa State University during the spring
and fall semesters of 1984. The students were introduced to the

BUYER program and asked to respond to a thirty item questionnaire assessing their attitudes toward the project. The items on the questionnaire were categorized into ten groups, each representing a different attitude being tested. The items were rated on a scale from one to nine, with one representing disagreement and nine representing agreement. Students rated BUYER above neutral on the effectiveness of the computer in teaching the evaluation of ready-to-wear. There were no clear results reflecting which learners were more positive about the computer program. According to Marshall and Slaybaugh (1986), students with more positive attitudes about the computer in general, were also more positive about the BUYER simulation.

Summary

There is little research completed on computer programs for use in apparel design. The computer programs that have been developed are making good use of the computer's ability to work with calculations and mathematical information, but little has been done with the visual information. Using the computer as a visual learning tool is not prevalent in textiles and clothing. The BUYER program was a preliminary attempt at representing garments graphically on the computer screen (Marshall & Slaybaugh, 1986). The success they experienced with representing garments graphically sparked interest in applying computer technology to the apparel design area. By developing a

computer program to simulate the designing process in apparel
design, the graphics capabilities can be used to enhance the
visual thinking and learning skills of the student.

METHODOLOGY

The purpose of the research was to develop a computer program that allowed students to experiment with garment design and to test the program by examining the influence it had on students' ability and willingness to experiment with garment design variations. This chapter will describe the procedure involved in developing and testing the computer program.

Development of the DESIGNER'S SKETCHPAD

The development of the Designer's Sketchpad computer program unfolded in the following series of five steps: 1) idea development; 2) program framework; 3) graphics development; 4) program assembly; and 5) pilot test.

Idea Development

The idea for the DESIGNER'S SKETCHPAD grew out of the need to help flat pattern students visualize garment design variations. BUYER, an earlier simulation that was developed to evaluate the construction quality of ready-to-wear garments, provided inspiration for the development of the DESIGNER'S SKETCHPAD. The BUYER program successfully represented garments graphically on the computer. The DESIGNER'S SKETCHPAD program was planned to contain a library of graphically-represented garment pieces to be applied to a series of standard garment

types used most frequently in flat pattern design courses. The process for visualizing garment design variations involved in the DESIGNER'S SKETCHPAD is similar to the process involved in manipulating clothing on paper dolls.

A project coordinator, a graduate assistant, a computer education specialist, and a computer programmer held brainstorming sessions to further define the idea. The objective of the project was to develop a computer program that would help students visualize basic garments and their design variations. Using the available technology and keeping the objective in mind, the team modeled the computer program as a simulation. The simulation contained four standard garment types. A library of basic garment pieces representing six categories could be manipulated on. the standard garment types. The combination of standard garment types and garment pieces would allow the students to visualize many different garments in a relatively short period of time without having to draw and redraw each garment.

Program Framework

Developing the framework for the mechanical side of the program was the next step of the procedure. The menu driven format was selected to guide the user through the program. The main menu provided the basic functions needed for using the

program and the nested menus continued the program within each function.

Main Menu   For the DESIGNER'S SKETCHPAD one main menu was designed with three sub-menus nested inside. The main menu appears on the right hand side of the screen (see Figure 1). The main menu contains the following five functions: 1) SELECT allows the user to choose one of the standard garment types on which to experiment; 2) EDIT is where the actual experimentation with different garment pieces takes place; 3) SAVE allows the user to store the design in a file on the computer and to review the design at a later date; 4) RETRIEVE is the function that allows the student to bring up a SAVED design for review or further EDITING; and 5) PRINT allows the student to print a hardcopy of the design that appears on the screen.
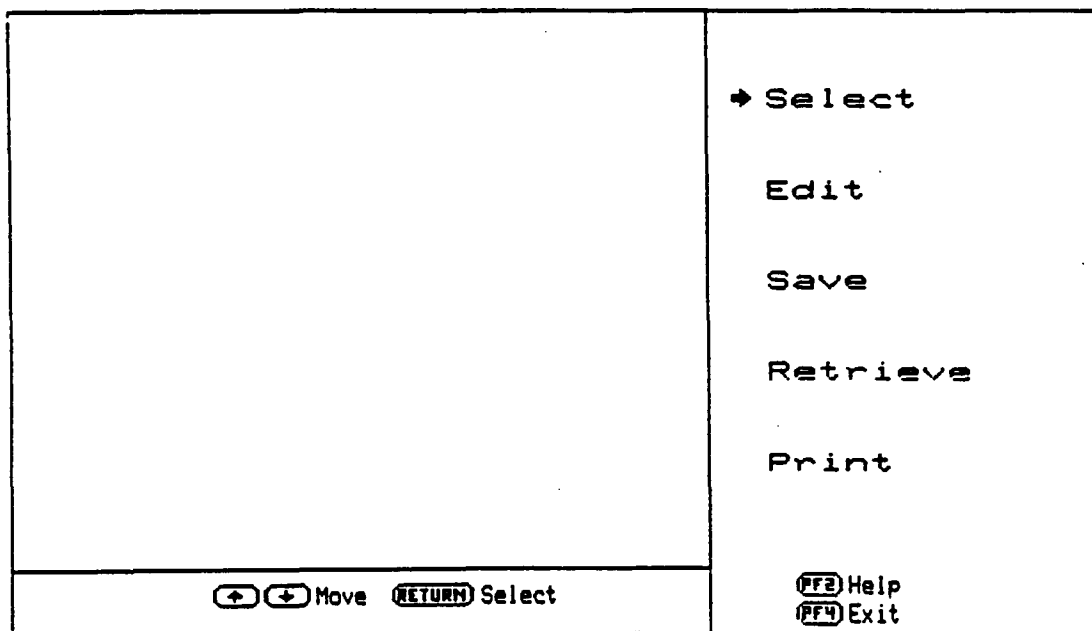

FIGURE 1. Main Menu

Nested Menus   Within two of the functions in the main

menu, a nested or sub-menu appears after a selection is made.

The SELECT and the EDIT functions both support a sub-menu. The

SELECT function leads to a sub-menu consisting of the four

standard garment types: 1) dress with a waistline seam; 2)

dress without a waistline seam; 3) skirt and blouse; and 4)

slacks and shirt (see Figure 2).

```
┌─────────────────────────────────────────────────┐
│                                                  │
│                                                  │
│        ➤ Dress with waist seam                   │
│                                                  │
│                                                  │
│          Dress without waist seam                │
│                                                  │
│                                                  │
│          Skirt and blouse                        │
│                                                  │
│                                                  │
│          Slacks and shirt                        │
│                                                  │
│                                                  │
│                                    (PF3)Help      │
│                                    (PF4)Exit      │
└─────────────────────────────────────────────────┘
```

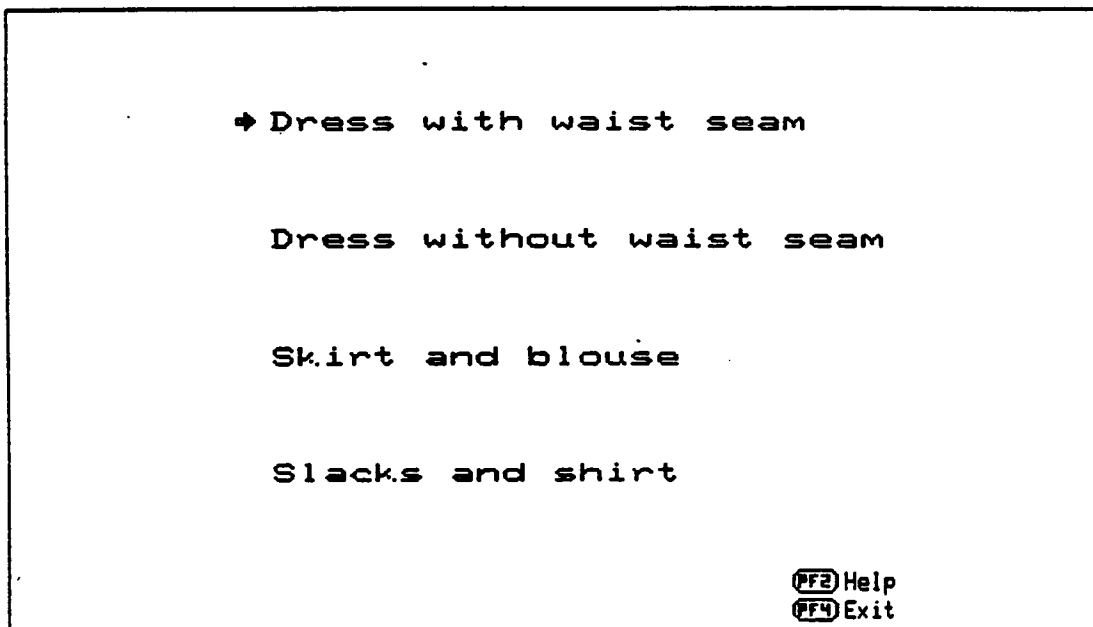FIGURE 2. SELECT Sub-menu

The EDIT sub-menus relate directly to what the student

chooses in the SELECT function. If dress without a waistline

seam is chosen, the sub-menu in Figure 3 would appear. When the

dress with a waistline seam or the skirt and blouse appears, the

sub-menu demonstrated in Figure 4 is shown. When the slacks and

shirt option is chosen, the sub menu in Figure 5 appears.

```
                                          ➤ Dress

                                            Sleeves

                                            Collar/
                                            Neckline




  ⊕ ⊕ Move  RETURN Select             PF2 Help
                                      PF4 Exit
```

FIGURE 3. EDIT Sub-menu, dress

```
                                          ➤ Bodice

                                            Skirt

                                            Sleeves

                                            Collar/
                                            Neckline




  ⊕ ⊕ Move  RETURN Select             PF2 Help
                                      PF4 Exit
```

FIGURE 4. EDIT Sub-menu, bodice/skirt

```
+ Bodice

  Pant

  Sleeves.

  Collar/
  Neckline



(PF2)Help
(PF4)Exit
```
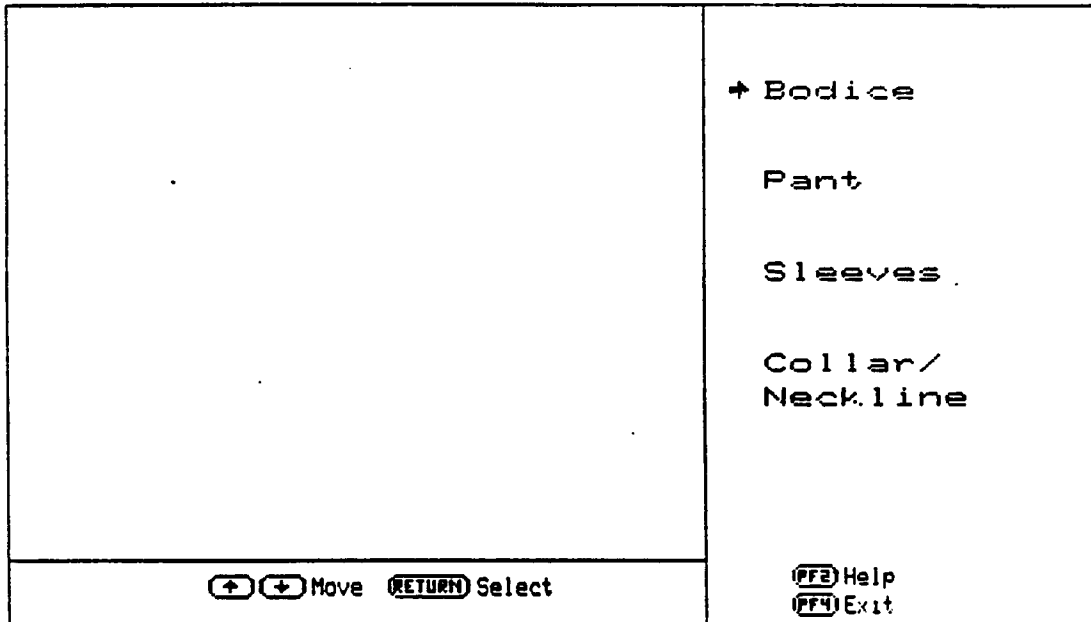
(↑)(↓)Move (RETURN)Select

FIGURE 5. EDIT Sub-menu, bodice/pant

Library   Each sub-menu of the EDIT function has a

library of garment pieces (see Figures 6 and 7). When the

bodice option of the menu is chosen, the library of bodices

appears on the right hand side. The arrow keys on the computer

terminal keyboard are used to page down through the different

bodices in the library to select the one preferred. Once the

student has chosen a bodice and it appears on the screen, if it

is satisfactory, he or she may move on to another section of the

library. If the chosen bodice is not satisfactory, the student

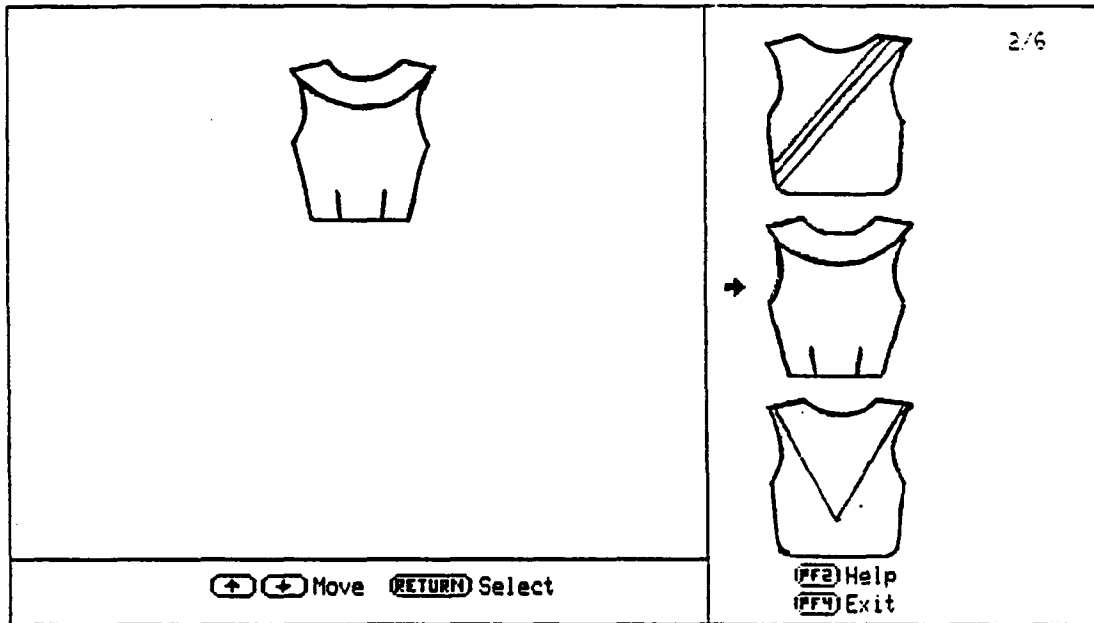may continue to view bodice pieces until a suitable one is

found.

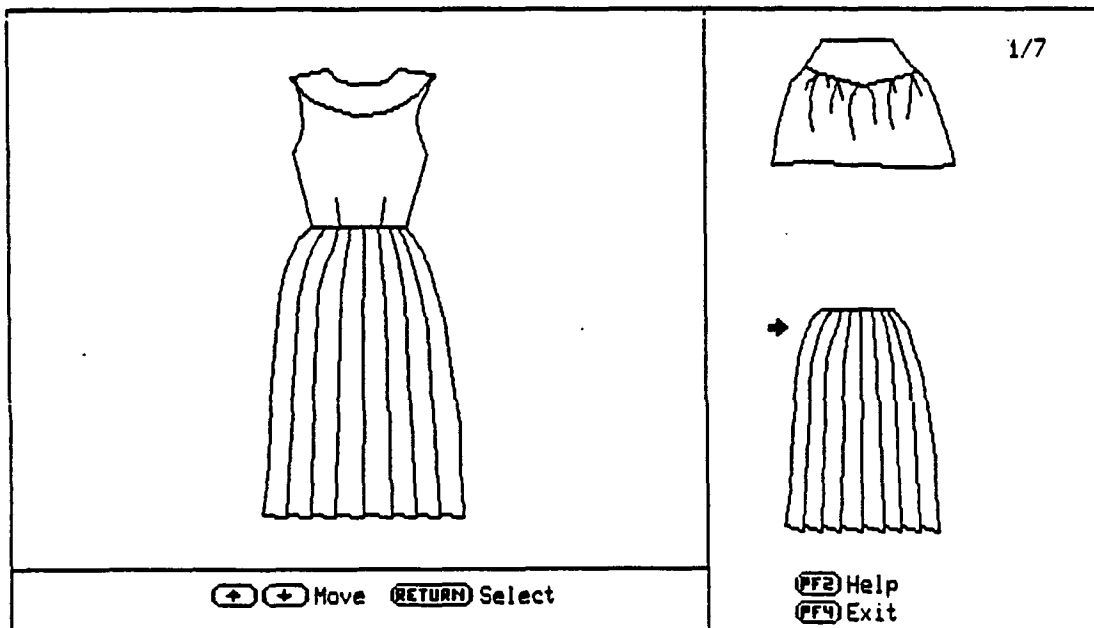FIGURE 6. Garment piece library, bodices

FIGURE 7. Garment piece library, skirts

<u>Printing the designs</u>   The PRINT function creates two
files to prepare the design for printing. The files created are
the P-file and the Q-file (see Appendix). The Q-file matches
the design to specific design questions related to the actual
patternmaking involved in the garment. A set of basic
patternmaking questions was developed for each garment piece in
the library. When the function PRINT is selected these
questions are assembled in a consolidated list and are printed
out under the Q-file name. The P-file prints a hardcopy of the
design.

Graphics

The graphics for the DESIGNER'S SKETCHPAD evolved in two
stages: 1) the creation of the graphics and 2) the transfer of
the graphics to computer memory. The graphics for the standard
garment types and the garment pieces were taken from
<u>Patternmaking by the Flat Pattern Method</u> (Hollen & Kundel,
1987). This book was used because it had accurate
representations of the basic parts of a garment. The six
categories of garment pieces in the library are: 1) bodices;
2) skirts; 3) dresses; 4) sleeves; 5) collars or necklines;
and 6) slacks. For each category, several different examples of
basic garment pieces were developed. For example, there are two
bodices with fullness, two bodices with pleats, two bodices with
yokes and so on to give the students a variety without

complicating the basic garment structure. The same procedure was followed for developing the remaining categories of the library.

The graphics were transferred to the computer, by first photocoping them onto transparency sheets that could be taped directly to the computer screen. This system increased the accuracy of the transfer of the garment pieces to the computer. The Regis Graphics Package was used to create the garments on the computer. A computer programmer was employed to do the transfer of the graphics. Each of the graphics developed was coded for use in the assembly of the final program.

Program Assembly

The computer program was constructed in parts and assembled. Once the parts were completed they had to be linked together to create the finished program. Along with linking the parts, a title page, introduction and set of help messages were added (see Appendix). The program also collected certain data for the purpose of this research. Those data were: 1) time spent on the computer; 2) number of logins to the computer; and 3) number of experimentations with garment design variations on the computer.

The programming was completed by a computer programmer using the Digital Authoring Language (DAL). The DESIGNER'S SKETCHPAD runs on the General Image Generator and Interpreter (GIGI) terminals

connected to the VAX 11/780 and is housed in the Courseware
Authoring System.

Pilot Test

The pilot test of the Designer's Sketchpad was initiated to
screen any mechanical errors in the program. This section will
discuss the evaluation instrument and sample, the collection of
data, and results and changes made to the program.

Pilot Test Sample and Instrument   The students used for
the pilot test were juniors and seniors enrolled in the advanced
apparel design and draping courses. Most of these students had
used the computer before. The evaluation instrument, which was
developed was divided into the five following sections: 1)
demographic information; 2) technological evaluation; 3) textile
and clothing content used in the program; 4) student responses;
and 5) student suggestions (see Appendix).

Pilot Test Data Collection   The collection of data for
the pilot test took place on two separate days. The advanced
apparel design and draping classes were introduced to the
computer during a regularly scheduled class time. Introduction
and background information for the program was given to the
students before they began working with the computer program.
After they had spent some time experimenting with the program,
they filled out the evaluation instrument.

<u>Pilot Test Results and Changes</u>   Results were categorized
according to the sections of the evaluation sheets. The
students felt that the technical aspects of the program ran
smoothly and the screen display was accurate and effective.
They suggested that specific instructions be given when the
users logged on on to the VAX system. The content section was
also rated favorably, but the students suggested that the
garment piece library contain more selections.

The students suggested more detailed instructions in the
introduction. Also, the program was taking too long to draw the
garment, because it was redrawing some of the established
garment pieces each time a new garment piece was added.
Overall, the students felt the program was useful for helping
them visualize garment design variations in a shorter period of
time. Changes were made in the program to satisfy the
recommendations of the students.

Testing of the Hypotheses

The formal testing of the Designer's Sketchpad was designed
to evaluate the usefulness of the DESIGNER'S SKETCHPAD in
enhancing the students ability and willingness to experiment
with garment design variations. The steps involved in testing
the hypotheses included: 1) identifying the sample; 2)

developing the assignment; 3) developing the demographic and attitude questionnaires; and 4) collecting the data.

Sample

A convenience sample of students in flat pattern design and experimental apparel design was selected to complete the assignment. The classes were selected because they were both classes in which students actually got the chance to design garments on their own. The two classes presented the opportunity to observe the usefulness of the computer program to two groups of students with different levels of designing skills. Of the 29 students enrolled in the two classes, 23 students chose to participate in the research.

Assignment

In order to test the students' ability and willingness to experiment with garment design variations, an assignment was developed and administered in two different ways. In the first administration of the assignment, students responded by sketching designs by hand. In the second, the assignment was completed by using the DESIGNER'S SKETCHPAD.

In the assignment (see Appendix), students were asked to assume the role of head designer for a major dress manufacturer. They were to design a line of dresses to be presented to their managers for possible manufacture. Students were to use their

best judgment and design as many garments as they felt would be appropriate for the task assigned.

Questionnaires

A demographic questionnaire and an attitude questionnaire were developed to aid in testing the hypotheses.

Demographics

The demographic questionnaire was used to gather general information about the students in the sample, as well as information about their previous computer experience. The student's level of experience in apparel design was identified by tallying the number of classes they had completed from the given list on the survey (see Appendix).

Attitude

The attitude questionnaire was developed specifically to measure attitudes towards the DESIGNER'S SKETCHPAD. The questionnaire consisted of 22 items that were either positive or negative statements about the computer program (see Appendix). The statements were to be rated using a Likert type scale ranging from one to seven.

Computer Opinion Survey

To measure computer anxiety, students were asked to complete the Computer Opinion Survey (Maurer & Simonson, 1984). It is a survey identifying the level of anxiety a student possesses when using a computer. The survey consisted of 26 statements to be rated on a scale of one

to six, one representing strong agreement and six representing strong disagreement (see Appendix).

Human Subjects Review   Once all of the materials for testing had been developed and assembled, the information was sent to the Human Subjects Review Committee for approval (see Appendix).

Data Collection

The data collection took place on four separate days over a two week period. The assignment was administered to each class in the following ways: 1) to be completed sketching by hand; and 2) to be completed using the DESIGNER'S SKETCHPAD. A separate set of materials was assembled for each completion of the assignment by the students. The materials for the drawn assignment included a letter of introduction, a demographic questionnaire, a copy of the assignment, two standard garment types generated by the computer and enlarged, and onion skin paper for sketching (see Appendix). The folders for the computer assignment included a copy of the assignment, a student user card and VAX log on procedure, the attitude questionnaire, and a Computer Opinion Survey (see Appendix).

Assignment   The drawn assignment was completed first. The assignment was introduced and explained to the students in class. They were given one hour to complete the sketches for the assignment. When they finished the assignment, they handed

in all of their designs and working papers in the folders
provided. Each class completed the assignment separately as a
part of a regularly scheduled class period. The computer
assignment was completed a week later. The DESIGNER'S SKETCHPAD
was introduced and demonstrated to the students in a regularly
scheduled class session. The students were free to logon to the
computer as many times as necessary to complete the assignment
and they were to complete the assignment outside of class.

Data Analysis

Data, collected from the two consecutive administrations of
the assignment, were then analyzed in a series of three steps.
First, the data were examined and categorized into units
relating to the nature of information collected. Second, data
were tabulated and coded for statistical analysis. Finally, the
data were analyzed statistically using the SPSSX computer
program.

Data Categorization

The data were divided into categories. The categories
represented different types of information. Demographic data
were organized together to form the first category. The data
collected from the attitude questionnaire were grouped together
as a second category. The final category was composed of data
collected through the completion of the assignments. These data

included the following dependent variables: 1) the garment design experimentation for the hand sketched and the computer assignments (drawn trials and computer trials); 2) the number of designs completed in the hand sketched and computer assignments (drawn designs and computer designs); and 3) the amount of time spent on the hand sketched and the computer assignments (drawn time and computer time).

Data Coding

Data were tabulated and coded for each category. The coding of the data was performed to meet specifications for use with the SPSSX statistical program. The amount of experimentation for each student in each assignment was tabulated using the following procedure. The hand sketched garment design experimentation was tabulated by first counting the number of structural variations from the basic garment type which the student selected. This was done by placing the student's sketched design over the basic garment type and counting the variations. Variations beyond the basic garment type were possible in the following areas: 1) a neck or collar; 2) a sleeve; 3) a bodice; 4) a skirt; and 5) a dress. The number of variations for each design were summed to give the total number of drawn trials.

Students were given a maximum of one hour to complete the drawn assignment. As the students turned in their work, the time they spent on the assignment was recorded on their folder.

Computer assignment data, collected by the computer, were tabulated and coded in the same manner as the data for the drawn assignment. A computer print out of data collected for each student was used to tabulate specific information, The computer was programmed to count the number of log-ins, the number of experimentations with garment design variation, and time spent on the computer. The computer trials were counted from the computer print out. Each time a student began experimenting with a new design, the number of variations experimented with for that design was counted. The data set was entered into the computer.

<u>Statistical Analysis</u>   The data were analyzed using SPSSX computer program. Pearson correlations and paired t-tests were performed on the variables involved with the hyptheses. The findings and discussion of the statistical analyses are discussed in the following chapter.

FINDINGS AND DISCUSSION

The findings and discussion will be reported in the following order: 1) a description of the sample; and 2) an analysis and discussion of the hypotheses.

Description of the Sample

The total enrollment of the beginning flat pattern design and the advanced experimental design classes was 29 students. Of those 29 students, 23 chose to participate in this research. Table 1 summarizes the descriptive analysis of the data. Approximately half of the students were in the beginning class and half were in the advanced class. All but three of the students in the classes were apparel design majors. Of the five remaining students, three were textiles and clothing/related science majors, two were majors outside the textiles and clothing area, and one was a special student. Most of the students in the advanced design class were seniors. There was a wider mix in classification among the beginning class, which included sophomores, juniors, seniors, and one special student. The only male in the sample was a part of the beginning class.

The majority of the sample were students in textiles and clothing, however, they were different with respect to their computer experience and use. To represent computer use, students were categorized into frequent and infrequent user

Table 1

Textiles and Clothing Students by Classification, Major, and Computer Use

N=23	Enrolled	Classification				Major			Computer Use	
		Sr.	Jr.	So.	Sp.	AD	TC/RS	other	Freq.	Infreq.
Flat Pattern Design	13	3	5	4	1	8	2	3	3	9
Experimental Design	10	9	1			9	1		3	7

groups according to the amount of time they spent using the computer. Six students qualified for the frequent user category, using the computer on a daily or weekly basis. Infrequent users represented the remainder of the sample, using the computer bi-monthly, monthly, or not at all. For the most part, students with more computer experience were distributed evenly in both classes. Nearly three-fourths of the sample were categorized into the infrequent user group.

The students in the sample had a common interest in apparel design, but were differentiated by their level of experience. Level of experience was operationalized as the number of courses completed in apparel design. The courses involved in determining level of experience were: 1) flat pattern design; 2) aesthetics; 3) illustration I; 4) illustration II; 5) draping; 6) fashion design; and 7) advanced design. This definition addressed the level of experience in terms of formal education. The program was expected to help those students who had little previous formal training in drawing. As would be expected, the advanced class contained students completing five or more courses, indicating a higher level of experience in apparel design. Most students in the advanced design class had completed both of the courses in illustration. The beginning class included those who had completed four or fewer courses in apparel design. There were only four students in the beginning class who had completed any illustration courses.

Analysis and Discussion of the Hypotheses

.   The independent variables in the hypotheses were: 1) method of instruction (CAI or hand sketched); 2) level of experience; and 3) computer anxiety. The dependent variables were: 1) trials (amount of experimentation with garment design variations); 2) designs (number of completed designs per assignment); and 3) time (the amount of time spent completing the assignment). The results of the manipulation of each of the independent variables will be discussed in the following paragraphs.

Hypothesis One: CAI

Hypothesis one states the use of the computer program developed will have no effect on the students' ability and willingness to experiment with garment design variations. To test the relationship between the independent variable of CAI and the dependent variable trials, a paired t-test was run comparing means of drawn trials with the computer trials. The t-value of -.96 was not significant, thus the null hypothesis was accepted. A Pearson correlation coefficient was also calculated to explore the relationship between the independent and dependent variables. Table 3 shows no relationship between computer trials and drawn trials.

Table 2
Summary of Data for Dependent Variables

| Assignment | Trials | | | Designs | | | Time (minutes) | | |
	Range	Mean	S.D.	Range	Mean	S.D.	Range	Mean	S.D.
Drawn	13-89	32	18	6-27	11	5	25-51	40	7
Computer	4-93	38	25	1-10	5	3	05-165	54	31

Table 3
Pearson Correlation Coefficients for Independent and Dependent Variables[a]

	1 dtrial	2 ctrial	3 ddesign	4 cdesign	5 dtime	6 ctime	7 exp.	8 att.	9 anx.	10 lo
1	1.0	.0370	.9656**	.2406	-.5550*	-.0580	-.0548	-.1143	-.0569	.0166
2		1.0	.0235	.1849	.3925	.5165*	.1149	.1652	.2166	.3427
3			1.0	.2703	-.4561	-.0351	.0586	-.1272	.0060	.0122
4				1.0	.1011	.6212*	-.2244	.0616	.0385	.2943
5					1.0	.2912	.0586	.0029	.0982	.2145
6						1.0	-.1962	.3354	.1989	.6680*
7							1.0	-.3347	-.0212	-.3686
8								1.0	-.2730	.4496
9									1.0	.1945
10										1.0

[a] 1 dtrial = Number of experimentations on the drawn assignment.
2 ctrial= Number of experimentations on the computer assignment.
3 ddesign = Number of completed designs on the drawn assignment.
4 cdesign = Number of printed designs on the computer assignment.
5 dtime = Amount of time spent on the drawn assignment.
6 ctime = Amount of time spent on the computer assignment.
7 exp = Level of experience (number apparel design courses completed).
8 att = Score from the attitude questionnaire.
9 anx = Score from the Computer Opinion Survey.
10 lo = Number of logins.

* Significant at p >.05.   ** Significant at p >.01.

It was expected that students would experiment more with the computer than they would when drawing. Looking at the means for drawn trials and computer trials (see Table 2), the mean for computer trials is slightly larger than the mean for drawn trials. The standard deviation for computer trials is also high, indicating the trials were not clustered together around the mean. The individual who had only four computer trials was not the norm and could be influencing the mean and standard deviation for that group.

Designs   There is a highly significant relationship between drawn designs and drawn trials, with a Pearson correlation coefficient of .9656 (see Table 3). As the amount of experimentation with garment design variations increases, the number of completed drawn designs increases. On the other hand, the relationship between the amount of experimentation with garment design variations on the computer and completed computer designs is not significant. This result may be attributed to the process involved in printing a design from the computer. Students could experiment with garment design variations at any GIGI or VT240 computer terminal, but in order to print, they had to be logged on to the VT240 located in the LeBaron computer laboratory. Students may have also experienced hardware problems that they could not control when trying to print their designs. These problems and procedures associated with using the computer would not occur in the drawing assignment.

<u>Time</u>   The relationships between trials and time spent on the assignment provide some interesting results. There is a negative relationship between drawn trials and drawing time (see Table 3). The same relationship is observed regarding drawn designs and drawing time. The more time students spent on the drawing assignment, the fewer experimentations and the fewer finished designs they attempted. This may be attributed to the fact that half of the students in the sample group had not completed an illustration course. Without the skill required to sketch quickly, they used more time on fewer designs.

The relationship between computer trials and computer time is significant at $p > .05$ (see Table 3). In other words, the more time the students spent on the computer, the more computer experimentations they attempted. This relationship is a positive reflection of the computer's ability to perform the mechanical functions of drawing and redrawing designs. Students are able to look at a variety of garment design variations in a short period of time with no cost involved. Once they have sorted through the variations they have created, they can critically analyze the designs and select the best one. The emphasis has been taken off of the drawing involved in the design process and placed on the critical evaluation of the variations. Whereas in the drawing assignment, once the student begins to sketch a design, it is unlikely they will abandon that design variation. The time involved in sketching the design is

great enough that they will skip the sorting and evaluation process.

Hypothesis Two: Level of Experience

Trials   Hypothesis two states there will be no relationship between level of experience in apparel design and ability and willingness to experiment with garment design variations. The two relationships involved in this hypothesis were: 1) level of experience as it relates to computer trials; and 2) level of experience as it relates to drawn trials. There is no relationship observed between these variables, thus the null hypothesis was accepted (see Table 3).

In these two situations, it was expected that students with a high level of experience in apparel design would be less likely to experiment with garment design variations on the computer, due to the simplistic nature of the computer program. The beginning students, on the other hand, would experiment more due to their lack of experience in apparel design. Level of experience was defined in this study as the formal training an individual had received in apparel design. What becomes apparent is that level of experience includes not only formal training in apparel design, but the personal level of experience associated with that individual, as well. Some students possess those characteristics that make visualization and communication of a design very easy, while others do not. Since the

operational definition did not take this into account, personal level of experience in apparel design may be influencing the students' willingness and ability to experiment with garment design variations.

Hypothesis Three: Computer Anxiety

Computer Anxiety   The Computer Opinion Survey (Maurer & Simonson, 1984), generated a set of scores that were used to indicate computer anxiety among students in the sample. According to Simonson et al, (1987), an average computer anxiety score for college students was 62, with a standard deviation of 17. Higher scores indicated a higher level of computer anxiety. The range of possible scores was 26 to 156.

Computer anxiety and trials   Hypothesis three states that students with high computer anxiety will not differ from students with low computer anxiety in willingness and ability to experiment with garment design variations. The range of scores for computer anxiety among the sample was 37 to 113. The average anxiety score for the sample was 66 and the standard deviation was 16. There is no observed relationship between anxiety scores and computer experimentation (see Table 3). The clustering of the scores about the mean indicates that the sample did not exhibit the behavior of computer anxiety to any great extent. The special student in the sample, who had never

used the computer before had a score of 76, which is not indicative of highly computer anxious behavior.

It was expected that as computer anxiety was reduced, the amount of experimentation with garment design variations on the computer would be increased. Students who feel more comfortable with the computer could relax and use the computer to experiment with garment design variations. It is possible that we are dealing with students who have had more opportunity to be exposed to the computer as they were growing up. As computer use in elementary and secondary schools increases, the amount of computer anxiety among college students may be less prevalent. The relationship between time spent on the computer and the student's computer anxiety is not significant, again, possibly due to the lack of computer anxiety among the sample.

<u>Attitude</u>   The attitude instrument developed for this study was used to get feedback from students on how they viewed the DESIGNER'S SKETCHPAD. The range for scores possible on the instrument was 22 to 154, with median score of 88. Student scores on the instrument ranged from 73 to 130. The mean attitude score was 102 and the standard deviation was 17. The mean score for the sample group was 12 points higher than the mean for the possible scores. This indicates that the students had a generally positive attitude toward the DESIGNER'S SKETCHPAD.

One could expect that those with favorable attitudes would experiment with more garment design variations, as well as spending more time on the computer. As shown in Table 3, there is an indication that a relationship exists between attitude and time spent on the computer, however, this relationship is not significant. There is no relationship between computer trials and attitude.

Summary

The three hypotheses tested in this study were accepted. Hypothesis one looked at computer trials as compared to drawn trials. The mean for computer trials was higher than the mean for drawn trials, however, the standard deviation for both variables was also high. The high standard deviation indicates there were outlying scores that may have affected the means. In hypothesis two, level of experience did not influence the amount of experimentation by the students. In this case, defining level of experience in terms of formal training in apparel design did not take into account personal level of experience. This personal level of experience present in an individual may have influenced his or her willingness and ability to experiment with garment design variations. Hypothesis three examined the influence that computer anxiety had on a student's willingness and ability to experiment with garment design variations. Computer anxiety scores for the sample were fairly average, thus

it was difficult to interpret whether computer anxiety was really affecting experimentation. Recommendations for future research and development will be discussed in the following chapter.

RECOMMENDATIONS

The focus of this research has primarily been the development of a computer program to help students in apparel design visualize garment design variations. The results of the research suggest areas for the further development of the software and additional research on the use of the computer program in the classroom. Recommendations will be made for the following areas: 1) the DESIGNER'S SKETCHPAD computer program; 2) the DESIGNER'S SKETCHPAD in the classroom; and 3) the DESIGNER'S SKETCHPAD in future research.

The DESIGNER'S SKETCHPAD Computer Program

The DESIGNER'S SKETCHPAD was developed for use in teaching flat pattern design. The central objective of this study was the development of a computer program as a tool to aid students in designing garments. Improvements for the program in the future should be directed at the further development of more detailed standard garment types and more numerous basic garment pieces in the library. As the program exists, there are four standard garment types. These garment types deal with basic styles for women only. The program needs to be expanded to include more standard garment types, including men's and children's clothing. As the program grows there will be more opportunity for variations on the standard garment type other than the four basic types currently represented.

The library of garment pieces also needs to be expanded to include men's and children's garments. With the increase in the number of pieces in the garment piece library, it may become tiresome for users to page through so many choices. One suggestion to resolve this problem is to display more choices on the screen at one time. This can be acccomplished by dividing the space on the screen differently, devoting more space to the garment library than currently exists. This change would leave a bigger part of the screen to display 12 or 16 choices where currently only three variations are viewed at a time. By increasing the number of bodices displayed on the screen, more choices can be viewed in a shorter period of time.

Developing and expanding the standard garment types and garment pieces in the library is one way to approach the improvement of the DESIGNER'S SKETCHPAD. The program could also be improved by allowing the student to control more of the experimentation. Advanced computer technology, involving the use of a mouse, would give the students the opportunity to draw on the screen in order to create garment design variations. This approach is more interactive and would allow greater personal expression in creativity and experimentation.

The DESIGNER'S SKETCHPAD in the Classroom

The standard garment types and garment piece library are directly related to the visual communication involved in the computer program. To make the program more valuable in the classroom, a set of questions relating to flat patternmaking was developed to help students to consider functional aspects of design which affect the final drafting of the pattern. Even though these questions were developed for use in the flat pattern design course, they could be changed to meet educational objectives for other areas of textiles and clothing. The development of new question sets could be used in such areas of textiles and clothing as: 1) fashion merchandising; 2) clothing selection; 3) clothing construction; and 6) apparel production.

Fashion merchandising students could complete an assignment to support their study of the buying aspect of merchandising. Sales representatives for apparel manufacturers often offer several variations of the same garment to buyers. It is the buyer's responsibility to visualize different variations of these garments in order to make appropriate buying decisions. Students could use the program to view choices involved in selecting a line of clothing for a particular clientele or market.

Clothing selection students spend time evaluating various figure types in order to provide flattering clothing choices for individuals of all shapes and sizes. Students in clothing selection could use the DESIGNER'S SKETCHPAD to practice problem solving for particlar figure types. The different garment pieces in the library could be manipulated to create flattering garments for petite, tall and large size figure types. Using the computer to visualize these garment piece combinations allows the student to spend more time analyzing and evaluating the garment in terms of a particular figure type.

The previous two suggestions for use of the DESIGNER'S SKETCHPAD in the classroom deal directly with the visual communication that the computer provides. The program could also be used with more focus on the printout that accompanies the designing process. The picture of the garment and the questions could be utilized effectively in the areas of clothing construction and apparel production.

Clothing construction students could make use of the printout to compose guide sheets for the construction of garments generated by the DESIGNER'S SKETCHPAD. The garments could be broken down into units and described in terms of directions for construction. Apparel production students could use the program in a similar manner. They could evaluate garments generated by the computer in terms of cost for

production. For example, they would have to identify all of the construction involved in a garment and analyze the cost of producing that garment. Computer printouts could be used to prepare specification sheets for production. The BUYER program could also be used in this manner. However, students would be limited to costing the three blouses evaluated in the program.

The DESIGNER'S SKETCHPAD and Future Research

Throughout data collection and analysis for this research, several specific suggestions for future research became evident. Level of experience was defined as the number of courses completed in apparel design. This approach to defining level experience addressed formal education only. It was not appropriate for measuring the personal level of experience for the individual students. The students within each classroom representated a whole range of individual differences in ability and personal learning style. These differences were overlooked between the two classes. Observations in both classes suggest some students possess innate abilities to sketch and visualize garments, while others do not. Further research is needed on how personal level of experience affects computer experimentation.

Another observation relating to the personal qualities of students is the way in which different individuals learn. Some students readily accept the computer as an instructional tool

and are willing to use it as such. Yet others seemed hesitant or indifferent to using the computer. Further research might address the effect learning style has on experimentation with garment design variations. This research would help explain the successful use of computers by certain students and the unsuccessful use by others.

In this study attitude was measured to get feedback on the DESIGNER'S SKETCHPAD. The outcome of this measurement was not formally tested in respect to achievement. Future studies could take a more formal approach to attitude and its affect on achievement. Attitude could also be used to define learner characteristics of those with positive feelings regarding the computer program. If certain students possess highly positive attitudes, they can be studied as a group to identify common learner characteristics that may associate them with a particular learning style.

A final suggestion for further research using the DESIGNER'S SKETCHPAD would be to repeat the experiment with a larger sample group. For example, the study could be repeated in three or more apparel design classes in one semester or the study could be administered to the same course over a set of consecutive semesters. Having a sample triple the size of one in this study might provide other insights for further development of the program. The focus of this research has been

to make computer technology available to students in apparel design. Visual thinking and learning skills are of great importance to the student in apparel design. The development and testing of this computer program has not only exposed tudents to computer technology, but it has attempted to enhance their visual thinking and learning skills, as well. Further research can build upon the development and testing initiated in this study.

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BIBLIOGRAPHY

Arnheim, R. (1969). Visual Thinking. Los Angeles, CA: University of California Press, Ltd.

Ausburn, L. J. & Ausburn, F. B. (1978). Visual literacy: Background, theory, and practice. Programmed Learning and Educational Technology, 4, 291-297.

Brackelsberg, P. (1987). Bodice Editor. The Clearing House. Computer Science, Iowa State University, Ames.

Clark, R. E. (1985). Evidence for confounding in computer-based instruction studies: Analyzing the meta-analyses. Education and Communication Technology Journal, 33(4), 249-262.

Cohen, P. A., Ebeling, B. J., & Kulik, J. A. (1981). A meta-analysis of outcome studies of visual-based instruction. Education and Communication Technological Journal, 29(1), 26-36.

Dedic, B. J & Hilliker, J. S. (1982). STAYWARM with clothing computer program. ACPTC Combined Proceedings. Reston, VA: The Association of College Professors of Textiles and Clothing.

Dence, M. (1980). Toward defining the role of CAI: A review. Educational Technology, 20(11), 50-54.

Everett, J. C. (1985). Computer applications for merchandise budgeting. ACPTC Combined Proceedings. Monument, CO: The Association of College Professors of Textiles and Clothing.

Gillingham, M. G. & Guthrie, J. T. (1987). Relationships between CBI and research on teaching. Contemporary Educational Psychology, 12, 189-199.

Hammond, M. F. (1985). Cognitive and visual elements of using a computer for instruction. In K. Duncan and D. Harris (eds.) Computers in Education (pp. 1013-1017). North Holland: Elsevier Science Publishers B.V.

Hoelscher, .̇. (1986). Computing and information: Steering student learning. Computers in the Schools, 3(1) 23-29.

Hollen, N. R. & Kundel, C. J. (1987). Patternmaking by the Flat Pattern Method (6th ed.). New York, New York: Macmillan Publishing Company.
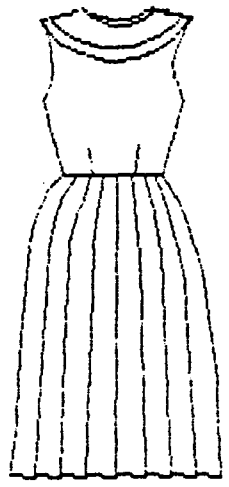
60

Hortin, J. A. (1980). <u>Visual Literacy and Visual Thinking.</u>
(Report No. IR 010 094). Manhattan, KS: Kansas State University
(ERIC Document Reproduction Service No. ED 214 522).

Kean, R. C. & Laughlin, J. (1981). <u>Computer-Assisted Programmed</u>
<u>Instruction in Textiles.</u> (Report No. IR 010 502). Lincoln, NE:
University of Nebraska (ERIC Document Reproduction Service
No. ED 223 241).

Kulik, J. A., Kulik, C-L., & Cohen, Peter A. (1980). Effectiveness
of computer based college teaching: A meta-analysis of findings.
<u>Review of Educational Research, 50</u>(4), 525-544.

Kulik, J. A. & Kulik, C-L. (1987). Review of recent literature on
computer-based instruction. <u>Contemporary Educational Psychology,</u>
<u>12</u>, 222-230.

Kunz, G. I. & Jezek, M. (1982). Hi-tech buying decisions: Fashion
merchandising. <u>ACPTC Combined Proceedings.</u> Reston, VA:
The Association of College Professors of Textiles and Clothing.

Jolly, L. D. (1984). Computer simulations for teaching retail
management concepts. <u>ACPTC Combined Proceedings.</u> Monument, CO:
The Association of College Professors of Textiles and Clothing.

Madgison, E. M. (1978). Issue overview: Trends in computer assisted
instruction. <u>Educational Technology, 18</u>(4), 5-8.

Manion, M. H. (1985). CAI modes of delivery and interaction: New
perspectives for expanding applications. <u>Educational Technology,</u>
<u>25</u>(1), 25-28.

Marshall, R., Hooper, E. J., & Slaybaugh, J. (1985). A computer
simulation to evaluate construction quality of ready-to-wear
garments. <u>Journal of Computer-Based Instruction, 12</u>(4),
101-103.

Marshall, R. & Slaybaugh, J. (1986). Student attitudes toward a
computer based simulation to assess construction quality of
ready-to-wear garments. <u>Clothing and Textiles Research Journal,</u>
<u>5</u>(1), 1-9.

Maurer, M. & Simonson, M. R. (1984). <u>Computer Opinion Survey</u>
(Version AZ)REV. Iowa State Research Foundation, Inc. Ames, IA

Mayhew, F. W. & Gardner, V. (1983). The Alterlab lesson: A simulation
package to teach principles of pattern alterations. <u>ACPTC National</u>
<u>Meeting Proceedings.</u> Reston, VA: The Association of College
Professors of Textiles and Clothing.

Roblyer, M. D. (1985). The greening of educational computing: A proposal for a more research based approach to computers in instruction. Educational Technology, 25(1), 40-44.

Simonson, M. R., Maurer, M., Montag-Torardi, M., & Whitaker, M. (1987). Development of a standardized test of computer literacy and a computer anxiety index. Journal of Educational Computing Research, 3(2), 231-247.

Splittgerber, F. L. (1979). Computer based instruction: A revolution in the making? Educational Technology, 19(1), 20-25.

Steinhaus, N. H. & Young, L. (1985). Computerized pattern drafting for the asymmetrical or unusually sized figure. ACPTC Combined Proceedings. Monument, CO: The Association of College Professors of Textiles and Clothing.

Woodson, E. M. (1983). Basic patterns via the micro computer. ACPTC Combined Proceedings. Monument, CO: The Association of College Professors of Textiles and Clothing.

Woodson, E. M. (1985). Development of a computerized device for body measuring. ACPTC Combined Proceedings, Monument, CO: The Association of College Professors of Textiles and Clothing.

APPENDIX

```
PPPP    FFFFF   III   L        EEEEE
P    P  F        I    L        E
P    P  F        I    L        E
PPPP    FFFF     I    L        EEEE
P       F        I    L        E
P       F        I    L        E
P       F       III   LLLLL    EEEEE    ::
```

```
 QQQ    FFFFF   III    L        EEEEE
Q   Q   F        I     L        F
Q   Q   F        I     L        E
Q   Q   FFFF     I     L        EEEE
Q  Q Q  F        I     L        E
Q   Q   F        I     L        E
 QQ Q   F       III    LLLLL    EEEEE    ::
```

13-JUL-1988   19:50:32.89   ANGIE

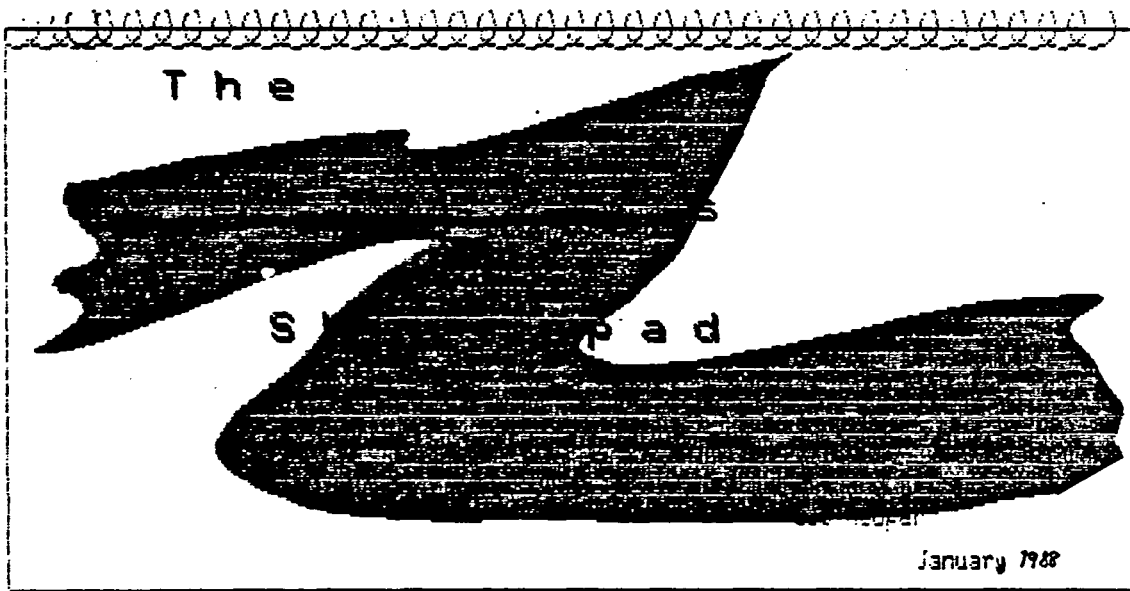Gen: Will the grainline of the pattern pieces be lengthwise. crosswise
Gen: How will the garment open (zipper. buttons. etc.)?
Gen: How will the back of the garment be designed?

Collar: How wide will the collar be?
Bodice: How much fullness will be added to the neckline?
Skirt: How long will the skirt be?

The Sketchpad

January 1988

Would you like an introduction to Sketchpad [Y/N]?

Welcome!

The Designer's Sketchpad is a tool created to assist you
in visualizing a design. The Sketchpad lets you create a
design by first, choosing a basic garment type and second,
choosing basic garment pieces from a library to complete the
design.

The Sketchpad's main menu will direct you through the design
process. The SELECT option allows you to choose from four basic
garment types to begin your designing. EDIT takes you into the
library of garment pieces that are used to complete the basic
garment type.

The SAVE option stores your design in a directory on the computer.
This directory can later be accessed using the RETRIEVE option.
RETRIEVE allows you to review and/or modify a design that has
previously been saved. PRINT produces a hardcopy of your design.
The Sketchpad creates only the front of a garment, you are
responsible for designing the back.

Press (RETURN) to continue.

Special Keys

The (↑)(↓) keys are used to make a selection from a menu. When
the arrow is opposite the desired option, press (RETURN) to select
the option.

The (PF2) key has been programmed to give helpful suggestions
should you need assistance. When you see the message (PF2) Help
in the lower right-hand corner of the screen, press (PF2) to see
these suggestions.

The (PF4) key is an exit key. To exit a menu, press (PF4) to
return to the previous menu. Continue to press (PF4) to
exit the program.

Press (RETURN) to continue.

DESIGNER'S SKETCHPAD EVALUATION
PILOT TEST
FALL 1987

USER INFORMATION
_____

Major: Sex: Classification:
    __AD   __H.Ec.   __M   __F   __Fresh.   __Soph.
    __FM   __Non-H.Ec.   __Junior   __Senior
            __TC/RS   __Grad.   __Other

Check the Textiles and Clothing courses you have completed:

__Flat Pattern   __Clothing Constr.(121)   __Draping
__Fashion Design   __Clothing Constr.(221)   __Clothing Selection
__Adv. Design(525)

Have you ever used a computer?

TECHNICAL
_____

1. Were you able to get on the system easily?

2. Was the program easy to operate?

3. Was the screen display functional/easy to understand?

General Comments:

CONTENT
_____

1. Were the aims or objectives of the program made clear in the introduction?

2. Were the instructions clear?

3. Were the garment pieces recognizable?

4. Were there enough choices of each garment piece?

General Comments:

STUDENT

1. How many designs did you create?

2. Which procedure for designing did you use?
   ____*create many garments   ____*create a garment   *other
   ____*save all garments   ____*review the garment
   ____*review each garment   ____ *save the garment   ____

3. Did you know how to proceed through the program?

General Comments:

POST

1. What suggestions do you have for the program?

2. What applications do you see for this program in your TC classes?

3. Is it appropriate to use the computer for this topic?

General Comments:

Textiles and Clothing Student:

As a part of my Master's thesis research, I have developed a computer program for use in teaching apparel design. The program, entitled "Designer's Sketchpad", is a tool created to assist you in visualizing a garment design. I would like your assistance in testing this computer program.

Your professor has agreed to give you additional credit for participation in this research, however, if you choose not to participate your class grade will not be affected.' I am interested primarily in how the computer program works and thus I need you to complete the attached design activity and surveys. Your name will not be associated with your design work or your responses to the surveys.

Thank you.

Angie O'Riley   U

305 MacKay

294-3264

DEMOGRAPHIC INFORMATION

MAJOR:

___AD   ___FM   ___TS   ___TC/RS   ___Other

CLASSIFICATION:

___SR.   ___JR.   ___SOPH.   ___FRESH.   ___Other

SEX:

___M   ___F

Have you ever worked on a computer before?   ___yes   ___no

How many times have you worked on a computer as part of a class activity?

___0   ___1-5   ___6-10   ___11 or more

How often do you use a computer?

___never   ___daily   ___weekly   ___bi-monthly   ___monthly

Check the classes you have completed from the list below:

_____TC225 Apparel Design Systems: Flat Pattern

_____TC245 Apparel Analysis and Selection

_____TC278 Fashion Illustration I

_____TC279 Fashion Illustration II

_____TC325 Appare. Design Systems: Draping

_____TC345 Fashion Design

_____TC525 Advanced Apparel Design Systems

SPRING 1988

ASSIGNMENT I _____

You. are the head designer for a major dress manufacturer. You have been asked to create a line of dresses for the coming season. Using the paper and materials provided, select a standard garment type and create variations on that garment to present to your managers. From the group of designs you create, your managers will select the dresses to be produced for the coming season. Return all of your designs and your working papers in the folder provided.

ASSIGNMENT II _____

You are the head designer for a major dress manufacturer. You have been asked to create a line of dresses for the coming season. Using Designer's Sketchpad, select a standard garment type and create variations to present to your managers. From the group of designs you create, your managers will select the dresses to be produced for the coming season.

Submit a hardcopy of each of the designs you wish the managers to consider for production. There will be a folder provided for the hardcopies of your designs.
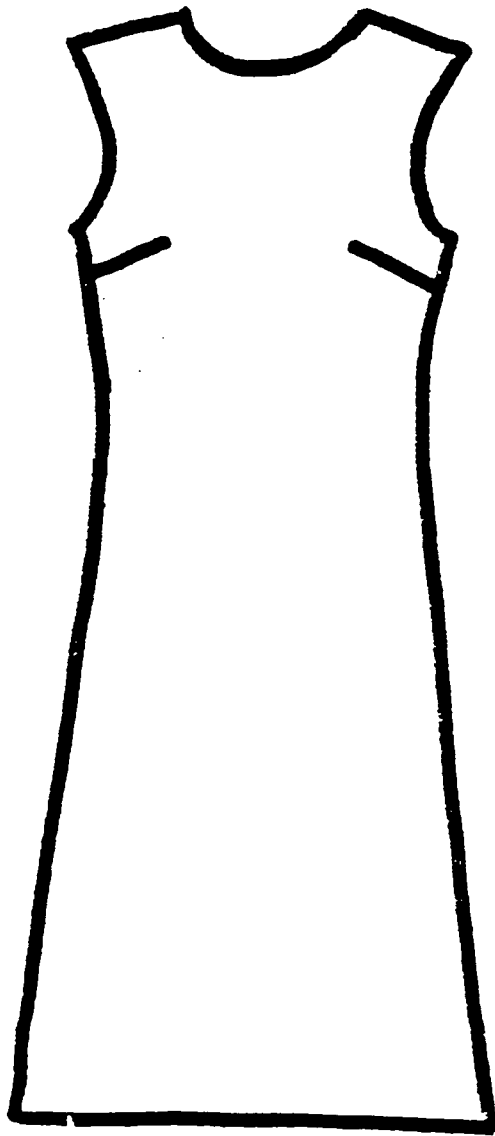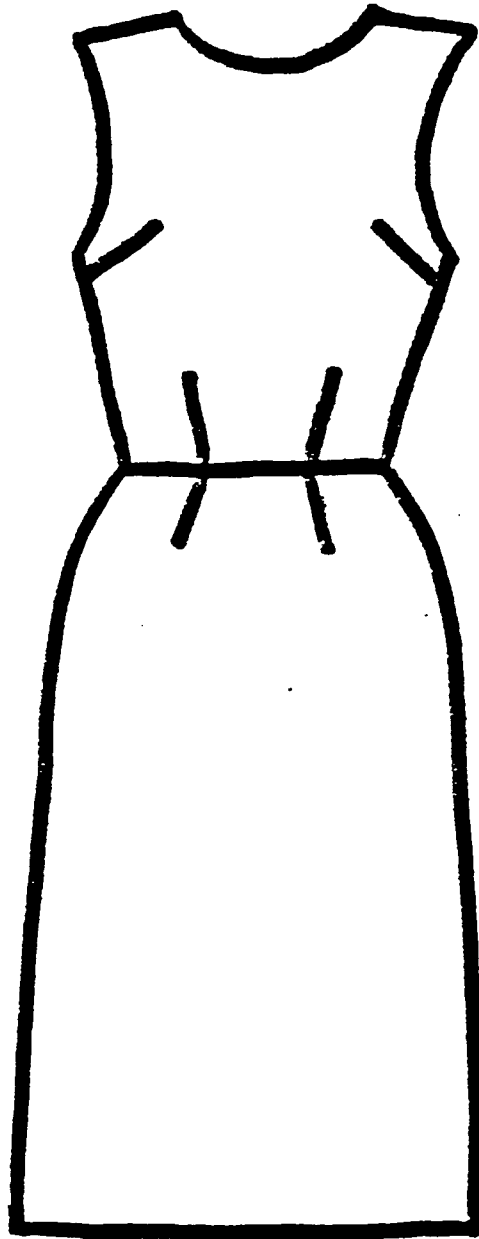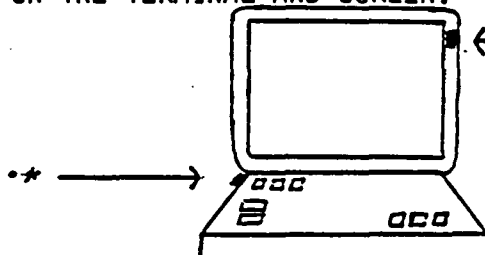
VAX LOG ON PROCEDURE FOR . . .

DESIGNER'S SKETCHPAD

WARNING: Do NOT press the break key at any time. It may take
you out of the program and you will have to start over. If you
hit a key by mistake and can't get back in, turn off the machine,
wait 2 minutes and start over.

Use of this class userID is governed by
the Computation Center Code of Ethics.

1) TURN ON THE TERMINAL AND SCREEN.

UserID: XPL27   Password: QABYAM

*** Change Your Password Often ***
37722/36

•* to turn on the terminal, there is a toggle switch located
on the back of the left hand side.

••* to turn on the screen, press the yellow button located in
the upper right hand corner of the screen.

2) DIAL INTO THE VAX SYSTEM.

    * when you see a blinking square in the upper left hand
corner of the screen press: CONTROL A , CONTROL A
(the control key is located in the middle of the left hand side
of the keyboard)

    * the computer will read: DIAL:

    * you type: LB/VAX (in caps)

    * if you have made the connection, the computer will read:
xxx Iowa State University Vax xxx

    * if you see DISCONNECT, you need to try again.

3) ENTER YOUR USER ID AND PASSWORD.

>   * the computer will read: USERNAME:
>   PASSWORD:

>   * type the information in from your user card.

The computer will not accept a 0 letter for 0 number and vice
versa. Your password will not appear when you type it in. This
is to protect your account.

4) ESTABLISH YOUR STUDENT ACCOUNT.

>   * the computer will read: Welcome to Vax . . .
>   Initial Student Log In . . .

>   * you will provide your name and other identification for
establishment of the computer account.

>   * after you have finished entering the information, the
computer will read: one moment please . . .

5) MAKE YOUR ASSIGNMENT CHOICE.

>   * next the Student Menu will appear:

>>> Assignments
    Browse
    Mail
    Exit   Press <return> with the red arrow at assignments

>   * then the Assignment List will appear:

>>> Designer's Sketchpad   is the only assignment listed, so
                            press <return> to begin the program.

                    LOG OFF   PROCEDURES

The pf4 key in the upper right hand corner will get you out of
the program. Press pf4 at each menu.

When you see a $, type LO (log off) to exit the system.

Turn off the terminal and screen when you are finished.

SURVEY A

Using the provided scale, rate each of the following statements.

1 = strongly disagree

2 = disagree

3 = disagree somewhat

4 = neutral

5 = agree somewhat

6 = agree

7 = agree strongly

1. The program helped me complete the assigned activity.

2. I had trouble understanding how to proceed through the program.

3. I saved time using the program.

4. The garment pieces in the library were not recognizable.

5. The program offered plenty of selections in the library.

6. I did not enjoy using the progam.

7. I was able to print my finished garment design easily.

8. The program should not be used in apparel design classes.

9. I was able to log on to the computer easily.

10. Computers should not be used in apparel design.

11. I feel more comfortable using computers since I have used the program.

12. Using the program was a waste of time.

13. The program increased my understanding of design principles.

14. Apparel design students should not be required to use the program.

15. The program made me more aware of garment design variations.

16. The program did not stimulate my creativity when designing garments.

17. If I were to do another assignment, I would choose to use the program.

18. The introduction to the program was difficult to understand.

19. Having used the program will help me when I get a job.

20. I felt limited when I was designing with the program.

21. I enjoy designing garments.

22. It was easier to sketch by hand than to use the program.

COMPUTER OPINION SURVEY
(VERSION AZ) REV
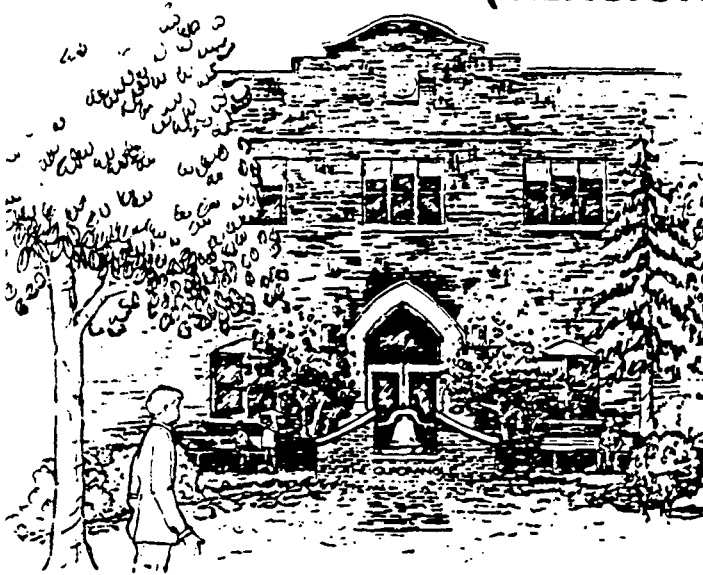
by
Matthew Maurer, M.S.
Michael R. Simonson, Ph.D.
Instructional Resources Center
LAGOMARCINO HALL
College of Education
Iowa State University
Ames, Iowa
(515) 294-6840

Directions: •Use black lead pencil only.

•Do *not* use ink or ballpoint pens.

•Make heavy black marks that fill the circle completely.

•Erase cleanly any answer you wish to change.

•Make no stray marks on the answer sheet.

Name: Last, First, and middle initial - (Fill in the circles, too.)

Sex: Male or Female

Grade: Your grade in school (Example: Senior in High School = 12)

Birth Date: Month, Day, Year (fill in circles)

Special Codes:

K. Have you ever taken a course in computer literacy and/or computer programming?

1 = no
0 = yes

L. If your reponse to question K was yes, how many semesters of total course work in computer literacy have you had?

0 = less than a full semester
1 = one semester
2 = two semesters
3 = three semesters
4 = four semesters
5 = five semesters
6 = six semesters
7 = seven semesters
8 = eight semesters
9 = nine semesters

TURN TO THE BACK OF THIS PAGE AND CONTINUE.

COMPUTER OPINION SURVEY

Instructions: Please indicate how you feel about the following statements. Use the scale below to indicate your feelings. Mark the appropriate circle on the answer sheet.

1 = Strongly agree
2 = Agree
3 = Slightly agree

4 = Slightly disagree
5 = Disagree
6 = Strongly Disagree

1. Having a computer available to me would improve my productivity.   1 2 3 4 5 6

2. If I had to use a computer for some reason, it would probably
save me some time and work.   1 2 3 4 5 6

3. If I use a computer, I could get a better picture of the facts and figures.   1 2 3 4 5 6

4. Having a computer available would improve my general satisfaction.   1 2 3 4 5 6

5. Having to use a computer could make my life less enjoyable.   1 2 3 4 5 6

6. Having a computer available to me could make things easier for me.   1 2 3 4 5 6

7. I feel very negative about computers in general.   1 2 3 4 5 6

8. Having a computer available to me could make things more fun for me.   1 2 3 4 5 6

9. If I had a computer at my disposal, I would try to get rid of it.   1 2 3 4 5 6

10. I look forward to a time when computers are more widely used.   1 2 3 4 5 6

11. I doubt if I would ever use computers very much.   1 2 3 4 5 6

12. I avoid using computers whenever I can.   1 2 3 4 5 6

13. I enjoy using computers.   1 2 3 4 5 6

14. I feel that there are too many computers around now.   1 2 3 4 5 6

15. Computers are probably going to be an important part of my life.   1 2 3 4 5 6

16. A computer could make learning fun.   1 2 3 4 5 6

17. If I were to use a computer, I could get a lot of satisfaction from it.   1 2 3 4 5 6

18. If I had to use a computer, it would probably be more trouble than it was worth.   1 2 3 4 5 6

19. I am usually uncomfortable when I have to use computers.   1 2 3 4 5 6

20. I sometimes get nervous just thinking about computers.   1 2 3 4 5 6

21. I will probably never learn to use a computer.   1 2 3 4 5 6

22. Computers are too complicated to be of much use to me.   1 2 3 4 5 6

23. If I had to use a computer all the time, I would probably be very unhappy.   1 2 3 4 5 6

·24. I sometimes feel intimidated when I have to use a computer.   1 2 3 4 5 6

25. I sometimes feel that computers are smarter than I am.   1 2 3 4 5 6

26. I can think of many ways that I could use a computer.   1 2 3 4 5 6

80

1.) Title of project (please type): _____ Development and Testing of a Computer

Simulation in Apparel Design.

2.) I agree to provide the proper surveillance of this project to insure that the rights and welfare of the human subjects are properly protected. Additions to or changes in procedures affecting the subjects after the project has been approved will be submitted to the committee for review.

_____Angela L. O'Riley_____   3-10-88
Typed Named of Principal Investigator   Date   Signature of Principal Investigator

_____305 MacKay   ISU_____   _____294-3264_____
         Campus Address   Campus Telephone

3.) Signatures of others (if any)   Date   Relationship to Principal Investigator

_____   _____   _____

_____   _____   _____

4.) ATTACH an additional page(s) (A) describing your proposed research and (B) the subjects to be used, (C) indicating any risks or discomforts to the subjects, and (D) covering any topics checked below. CHECK all boxes applicable.

☐ Medical clearance necessary before subjects can participate

☐ Samples (blood, tissue, etc.) from subjects

☐ Administration of substances (foods, drugs, etc.) to subjects

☐ Physical exercise or conditioning for subjects

☐ Deception of subjects

☐ Subjects under 14 years of age and(or) ☐ Subjects 14-17 years of age

☐ Subjects in institutions

☐ Research must be approved by another institution or agency

RECEIVED MAR 11 '88 GRADUATE COLLEGE ISU

5.) ATTACH an example of the material to be used to obtain informed consent and CHECK which type will be used.

☐ Signed informed consent will be obtained.

☒ Modified informed consent will be obtained.

6.) Anticipated date on which subjects will be first contacted:

Month	Day	Year
3	24	88

Anticipated date for last contact with subjects:

Month	Day	Year
4	1	88

7.) If Applicable: Anticipated date on which audio or visual tapes will be erased and(or) identifiers will be removed from completed survey instruments:

Month Day Year

8.) _____ _____ ~~~Chairperson   Date   Department or Administrative Unit

_____3/8/88_____   Textiles and Clothing Department

9.) Decision of the University Committee on the Use of Human Subjects in Research:

☒ Project Approved   ☐ Project not approved   ☐ No action required

George G. Karas   3/29/88
Name of Committee Chairperson   Date   Signature of Committee Chairperson

Data set for dependent variables by student ID: [a]

ID N=23	LO	Ctime	Ctrial	Cdesign	COS	Dtime	Dtrial	Ddesign
TC 225---	----	-------	--------	---------	-----	-------	--------	---------
220	03	78	69	06	60	38	27	09
221	02	52	31	06	113	36	22	09
222	03	51	30	05	62	38	36	13
223	06	165	41	10	76	43	26	10
225	04	53	28	03	51	36	24	06
226	02	26	36	03	81	25	89	27
227	02	53	24	05	52	36	24	10
228	02	80	78	10	62	35	57	16
229	04	52	64	05	68	45	18	06
230	03	52	15	08	47	25	72	24
231	01	05	04	01	64	35	18	07
232	04	47	25	05	95	36	26	10
233	01	49	20	03	82	41	13	06
TC324x---	----	-------	--------	---------	-----	-------	--------	---------
330	02	74	56	06	63	48	23	10
331	02	23	07	03	53	43	29	10
334	02	54	24	10	63	48	29	10
335	01	17	05	02	37	32	20	06
336	01	34	24	05	62	44	26	10
337	01	47	33	05	51	37	30	10
340	04	64	81	04	67	51	25	10
341	04	63	59	03	74	49	37	13
343	02	75	93	03	78	43	25	10
344	02	42	28	07	62	46	39	17

[a] LO = Number of logins.
Ctime = Time in minutes spent on the computer assign.
Ctrial = Number of experimentations on the computer assign.
Cdesign = Number of printed designs on the computer assign.
COS = Computer Opinion Survey score.
Dtime = Time in minutes spent on the drawn assign.
Dtrial = Number of experimentations on the drawn assign.
Ddesign = Number of finished designs on the drawn assign.