A COMPARISON OF COMPUTER ASSISTED INSTRUCTION AND LABORATORY INSTRUCTION IN TEACHING SPECIFIC PATTERN DEVELOPMENT CONCEPTS AND PRINCIPLES

by

Choi-Man Joyce Lai

A thesis
presented to the University of Manitoba
in partial fulfillment of the
requirements for the degree of
Master of Science
in

DEPARTMENT OF CLOTHING AND TEXTILES

Winnipeg, Manitoba

April, 1990

ISBN 0-315-63320-4

A COMPARISON OF COMPUTER ASSISTED INSTRUCTION AND LABORATORY INSTRUCTION IN TEACHING SPECIFIC PATTERN DEVELOPMENT CONCEPTS AND PRINCIPLES

BY

CHOI-MAN JOYCE LAI

A thesis submitted to the Faculty of Graduate Studies of the University of Manitoba in partial fulfillment of the requirements of the degree of

MASTER OF SCIENCE

To my parents, my brother and sisters, and Felix

ABSTRACT

Automation of the apparel industry becomes more evident with the increasing use of Computer-Aided Design (CAD) systems in the manufacturing sector. Adopting new technologies in the education of apparel design would equip students with the knowledge of CAD to meet the needs of the automated industry. Little research, however, was found to study the impact and potential of the use of CAD systems in apparel design education. The purpose of this study is to compare the effectiveness of Computer-Assisted Instruction (CAI) using a CAD system and that of a laboratory teaching method for pattern development.

An experiment was conducted to manipulate the explanatory variable of instruction mode and to determine any changes on student achievement after the delivery of study treatments. The study sample was composed of 26 female students enrolled in an introductory pattern development course. Subjects were randomly assigned into the experimental group, which received the CAI treatment, and the control group, which received the laboratory treatment. The explanatory variables of student experience in pattern development and clothing construction, and student computer experience were determined by their responses to an entry behavior test. Student past academic performance was measured by their grade point average in at least two of the three selected clothing and textiles core courses. A pretest and two posttests (practical and written) were administered to measure the response variable of student achievement.

Results of the statistical analyses demonstrated no statistically significant difference in the mean test scores between the CAI and the laboratory groups at the significance

level of 0.05. It was determined that student performance did not favor either of the teaching methods. However, students showed significant gain in learning pattern development on the achievement measures.

No interaction effect on student achievement was found between mode of instruction and student experience in pattern development and clothing construction. Findings also suggested that the interaction of instructional mode and past academic performance did not display significant effect on student achievement. Subjects in both groups performed equally well regardless of their experience and past academic performance levels. Within the CAI group, the differences in performance between students with high and low computer experience were insignificantly small.

ACKNOWLEDGEMENTS

The author wishes to express her appreciation to the individuals who contributed to the completion of this study. Millions of thanks go to my advisor, Professor Elizabeth Shannon and to Professor Cecilia Gonzales and Dr. Nancy Kingsbury for their guidance, support and encouragement in this endeavour.

Thanks are extended to the Department of Clothing and Textiles for the permission to utilize the computer and laboratory facilities during the conduct of the study. The author gratefully acknowledges the assistance of Mr. Robert Balshaw for his advice regarding the preparation of SAS programs and the interpretation of study results. Special thanks go to Mr. Lenny Leung for his assistance with the preparation of figures.

Special thanks are extended to all the students who participated in the study. Their support contributed not only to the completion of the study, but also valuable recommendations for future research in this area.

Finally, thanks and appreciation must be extended to my family members for their love and unfailing support throughout the entire research process. Recognition must also be given to my partner, Felix Choi, whose advice and encouragement contributed greatly to the completion of this thesis.

TABLE OF CONTENTS

Appendix page

LIST OF TABLES

LIST OF FIGURES

CHAPTER I

Introduction

Traditionally, computer technology has not been widely employed by the apparel industry due to the high cost of computerizing operations. Whereas worldwide about 1200 apparel companies use computer-aided grading and marking systems, a number of these companies that design their products on computer systems remains small (Kallal, 1984). However, the recent increased use of computer-aided design (CAD) systems in the apparel manufacturing industry reflects the industry's final adoption of computer technology in the product design area. As predicted by the participants in a 1983 American Apparel Manufacturers Association sponsored CAD/CAM seminar, the apparel industry will follow other industries by increasing the use of CAD in line development (Kallal, 1984).

The key to computer automation is an increase in efficiency and competitive nature of manufacturing operations. A study of American based apparel companies identified four key improvements resulting from computer automation:

1) Decrease in production lead time;
2) Increase in productivity 400% across the board;
3) Technologically speaking, computer automation was most suitable for companies with 201-500 employees;
4) All types of computer systems could be employed by companies in many different ways (Kosh, 1988, p.34).

Results of the above study revealed that in the apparel industry, manufacturing operations were the most automated while design/merchandising functions were least automated. However, a trend toward automation in design and merchandising is foreseeable. Specifically, "about one-third of the companies today are creating new product concepts on CAD systems, marketing via computer graphics and doing initial line adoption on computer system" (Kosh, 1988, p.36). Thus, more and more apparel companies are becoming aware of the benefits of adopting a highly technological design process supported by computer systems (Van De Bogart, 1988).

A quote from Bill Eaton, vice president and chief information officer at Levi -- "CAD systems are the wave of the future"-- best reveals the significant impact of CAD on the apparel industry (Van De Rogart, 1988). In order to remain competitive, similar advances in computer automation have been occurring in the Canadian apparel industry (Canadian Apparel and Manufacturing, 1987). Consequently, it is important for students of design to become aware of a CAD system as a viable tool in design and pattern development. Hands-on experience with a CAD system should be one of the focal points in a clothing and textiles department to equip students with technological knowledge necessary for successful performance in a highly automated apparel industry.

Very little literature can be found about the use of computer-aided design systems in the apparel industry. Lack of access to the system is the major reason hindering the evaluation of CAD as an effective teaching tool for apparel design. With the recent acquisition of AutoCAD[R] in the Department of Clothing and Textiles at the University of Manitoba, it became possible to teach students the potential of a CAD system. The purpose of this research is to design within

AutoCAD[R] a self-instructional tutorial program and to evaluate its effectiveness in teaching specific pattern development concepts and principles. It is the intention of this research to evaluate the effectiveness of AutoCAD[R] in the apparel design curriculum. Whereas clothing and textiles academicians are not the developers of this computer-aided design system, implications as to the effectiveness and value of this system as a teaching tool will be useful for future curriculum development.

Statement of the Problem

Despite the increasing adoption of computer-aided design systems into the apparel industry, not all the clothing and textiles academicians and students are exposed to the nature and the potential of these systems. No studies have been found in which the nature of CAD and its implications in the apparel design education have been examined. Clothing design students should be educated to have an easy transition to advanced technological jobs in the industry. It is this expertise of the apparel design students that will help to assure the automation of the apparel field in the future. Therefore, it is important to design and evaluate a tutorial computer program so students can learn basic design concepts through one of the CAD systems, in particular, AutoCAD®. Apart from the delivery of knowledge, this tutorial will expose students to the nature of a CAD system. The major problem of this investigation, hence, is to examine whether a computerized tutorial designed within AutoCAD® is effective in teaching students specific pattern development concepts and principles in comparison to the regular laboratory instruction.

Purpose of Study

This study involves designing a computer tutorial program within the AutoCAD^{R} system and evaluating the effectiveness of this tutorial in teaching specific pattern development concepts and principles.

Specific Objective

1) To design a tutorial computer program using AutoCAD^{R} to teach specific pattern development concepts and principles.

2) To design a set of instructions (a manual) supplementary to the tutorial program to acquaint students with the procedure of operating the computer and completing the program.

3) To determine the significant differences between the achievement levels of students taught with the use of a self-instructional computer program with a manual and students taught with the use of laboratory instruction.

Rationale

The 1980s have been marked by the significant role played by computer-aided design systems in the apparel industry. The continuous adoption of CAD into the apparel manufacturing sector is mainly the result of the powerful applications of the CAD systems in production. At the 1986 Bobbin Show, the industry was shown what CAD can do:

1) aid the stylist in creating renderings in full color,
2) aid the designer in developing patterns,
3) grade patterns with prescribed grade rules,
4) develop and plot accurate and cost effective markers,
5) direct a laser or multi-ply cutting system (Wilson, 1987).

With all these capabilities of CAD, it will only be a matter of time before product design is linked to pattern design and then to production in the apparel scene. Because of the growth of new technology in the apparel industry, dramatic shifts will occur in employment patterns (Shim, 1984). These changes in tomorrow's job market will affect the way clothing and textiles students are educated to meet the needs of advancing technology in the apparel industry.

Incorporating technological knowledge in clothing and textiles programs has been one of the major concerns of clothing and textiles educators. Of the seven opportunity areas identified at the Association of College Professors of Textiles and Clothing (ACPTC) Futures Seminar in April of 1983, one area was to develop and adopt new technologies in communication as well as in textiles and clothing. These seven areas were further collapsed into 14 ideas, with the area of conducting research in computer applications as one of the top five ideas (Stowe, 1984). Thus, the incorporation of CAD systems in the apparel design classroom is the focus of future curriculum planning. Heisey (1984) suggested that with the use of CAD, "students can learn basic concepts of flat pattern quickly without the time-consuming manipulation of physical materials, ... and they can be introduced to the potential of the computer in applications directly related to clothing" (p.12).

To assist students in developing a positive attitude toward the use of CAD, CAD systems should be developed and tested for their potential in university curricula. AutoCAD[R], a computer software package originally recommended for architecture, interior design, and engineering fields (Autodesk, Inc., 1987), is being applied to apparel design because of the advantage of accuracy in developing production sketches and garment specifications (Pickrell, 1989). Because AutoCAD[R] runs on personal computers, students are now able to experience many of the advantages of systems like Gerber and Lectra for about one-tenth of the cost (Miller & DeJonge, 1987). This enables students to view the computer as a tool for design in their future careers. This development of positive attitude towards CAD is important to offset designers' or pattern makers' traditional resistance to CAD systems in apparel (Miller & DeJonge, 1987). In a survey of 20 users of CAD/CAM systems by Philadelphia College of Textiles and Science, Wilson reported that the apparel industry has been slow to apply CAD as compared to CAM (Computer-Aided Manufacturing systems) because of a lack of knowledge as to how easy and effective CAD is when integrated in the design area (Wilson, 1987). Designers are said to resist the use of CAD due to the time factor, and this is where the university's role can be effective. Computer programs developed within CAD systems are valuable to teach students the basics of CAD technology and to prepare them to effectively use this technology in the apparel industry.

The recent acquisition of the AutoCAD^{R} system in the Department of Clothing & Textiles at the University of Manitoba marks the beginning stage of incorporating CAD in clothing design classes. However, so far, no program has been developed or tested to investigate the potential of this software system as a viable teaching device. In the early part of 1988, the researcher together with a fellow graduate student, developed a design library to highlight visual effects of height and width in dress design (Lai & Snell, 1988). Based on the findings of this study, AutoCAD^{R} was viewed as a powerful teaching tool for students interested in careers in the highly computer automated industry of today and tomorrow. Moreover, further experimentation was strongly recommended to explore the potential of this system. Thus, the main purpose of this thesis is to provide a starting point for developing a self-instructional program and examining its effectiveness in teaching apparel design (pattern development concepts and principles).

Traditionally, students learn and practise pattern development skills via lecture and laboratory instructions. In laboratories, students' understanding of pattern development concepts and principles is reflected through the manipulation of physical materials such as pattern pieces. In order to establish a criterion upon which the effectiveness of the computerized tutorial can be evaluated, a comparative study is desirable. That is , the effectiveness of computer assisted instruction and that of the laboratory teaching will be compared in terms of student achievement level.

Hypothesis

The following hypotheses stated in the null form were formulated from a consideration of the objectives of the study:

Hypothesis

There is no significant difference in student achievement between the use of Computer Assisted Instruction with AutoCAD^{R} and laboratory instruction in teaching specific pattern development concepts and principles.

Sub-hypotheses

1) There is no significant relationship between mode of instruction and student achievement.
2) There is no interaction effect on student achievement between mode of instruction and level of experience in pattern development and clothing construction.
3) There is no interaction effect on student achievement between mode of instruction and past academic performance in selected Clothing & Textiles courses.
4) There is no significant difference between high and low computer experience level in the achievement of students using the Computer Assisted Instruction.

Limitations

Delimitations of the Study

1. Subjects were those who were enrolled in an introductory pattern development course in the department of Clothing & Textiles.
2. The researcher was the only instructor present in the delivery of treatments instead of having a professor responsible for the instructions as in regular curricula.
3. The tutorial was designed as an individual instructional unit and was not meant to be integrated in the structure of the regular curricula for the sake of the study.

Limitations of the Study

1. The small sample size available for this experiment is a limiting factor.
2. The short duration of the treatment (less than one hour) is another limiting factor of the study. Since the experiment was not meant to be run throughout the entire academic term, student achievement was only measured at two points in time (i.e. pretest and posttest). Thus, the arrangement of the experiment did not allow the collection of attitudinal data to measure student achievement as a continuous phenomenon.
3. The history factor was not controlled for simultaneity of experimental and control sessions. Since both the CAI and laboratory sessions could not be run simultaneously by the same experimenter, an attempt was made to balance the

participation of both groups in terms of time of day, day of week, portion of semester. This factor was also due in part to different times of student availability for participating in the study.

4. The computer tutorial was designed to maximize the efficiency of the computer in teaching the subject matter. However, long computer response times or delays were inevitable if students had too many spelling mistakes or wrong phasing when feeding answers to the computer.

Definitions

Operational Definitions

For the purposes of this study, the following definitions apply:

Explanatory Variables

1. Mode of instruction. Mode of instruction was defined as teaching method used to instruct students specific pattern development concepts and principles. Two teaching methods were selected for the purposes of this study. With the use of laboratory instruction, students received verbal instruction from an instructor in the laboratory setting. With the use of computer assisted instruction, students received instruction from a tutorial program, designed within the AutoCAD^{R} system, in the computer terminal where an instructor was present to solve any operational problems students might have.

2. Student experience level of pattern development and clothing construction. Student experience referred to knowledge or skills in sewing, designing or developing patterns. It consisted of two levels:

i) high experience

ii) low experience

Student experience was measured by an entry behavior test that examined the number of years of experience students had in sewing, garment construction, and pattern design; and the number of garments and patterns completed. Students with at least three years of experience and have completed at least three garments and three patterns in the past were ranked as those with high experience.

3. Student past academic performance level in selected clothing & textiles courses. Student past academic performance referred to student competence attained in the area of clothing & textiles as reflected by their grades in at least two of the three introductory core courses in the Department of Clothing & Textiles. It consisted of two levels:

i) high

ii) low

Level of past academic performance was measured by students' grade point average in at least two of the following Clothing & Textiles courses:

64.101 Introduction to Apparel Design

64.102 Today's Textiles

64.222 Dynamics of the Fashion Industry

According to the letter grade system indicated on the University of Manitoba transcript, a student is classified as one with high academic performance if his/her grade falls between B and A+. Students with low academic performance are those whose grades falls between C+ and F.

4. Student computer experience level. Computer experience level referred to student knowledge of computers including mastery of basic computer operational routines and experience with educational microcomputer program (e.g. drill and practice, tutorial, or simulation). It consisted of two levels:

i) high

ii) low

Computer experience was measured by an entry behavior test that examined whether students had experience with educational microcomputer programs and had taken any computer science course or written a computer program. Students who had used educational microcomputer programs before, and had either taken at least one university course in computer science or had written a computer program were classified as those with high computer experience.

Response Variable

Student achievement. Student achievement was defined as student competency attained in the subject area including mastery of specific pattern development skill (flat collar pattern development) and concepts and principles of flat collar pattern development. It was measured by scores which represented the percentage of correct student responses on each of the following tests:

i) pretest;

ii) posttest I; and

iii) posttest II.

These three tests will be descripted in the Chapter of Methodology.

Definition of Terms

Computer Assisted Instruction (CAI)

CAI refers to specifically designed programs that contain instructional material to be presented to students, usually on the screen of a terminal or personal computer. Programs are designed to teach, reteach, and to review or to provide tutoring, drilling, and practice after a concept has been taught (Larsen, 1985; Williams, 1988).

Tutorial Computer Program

This is a computerized instructional approach that takes the responsibility for instruction and contains a 'human-computer dialogue'. This human-computer dialogue, which resembles interpersonal conversations between the user and the author of the computer tutorial, tries to manipulate the meaning-making process of the user (Bork, 1980; Streibel, 1986).

Laboratory Instruction

This is an umbrella term that can cover one or various combinations of activities that range from experiments, exercises, demonstrations, to project work or participation in research (The International Encyclopedia of Education, 4467). Because of the variety of approaches available to laboratory instruction, it is defined here in accordance with the intention of this research.

Laboratory instruction is a combination of the following activities: verbal introduction, demonstration, and hands-on experience; with the following goals:

(a) knowledge and comprehension (concepts and principles of pattern development); and

(b) manual skill (pattern development skill).

Since no prelab lecture was given, the level of teacher's verbal information in the laboratory of this study might be slightly higher than that in average laboratory sessions (35-50%) (The International Encyclopedia of Education, 4470). In this experiment, reception of knowledge was done via verbal introduction at the beginning of the laboratory session. After new concepts and principles are presented, the laboratory can provide concrete experience that gives meaning to the subject matter. Thus, meaningful learning rather than rote learning (memorization without understanding) can take place in the laboratory situation.

CHAPTER II

Literature Review

Student-Computer Interaction

Students are active participants in the process of learning in order to create knowledge within their own context of social construction (Greene, 1982; Streibel, 1986). Learning is an intentional act on the part of the learner. This process of meaning-making is highly dependent on the mode of instruction, that is, the way of representing meaning. Among the various approaches of knowledge creation, the most prominent ones include the traditional classroom teaching, laboratory demonstration, book or slide presentation, and computer-assisted instruction. Computer Assisted Instruction (CAI) is an educational tool designed to teach, reteach, review or provide tutoring or drill and practice after a concept has been taught (Williams, 1988). It is the quality of student-computer interaction that enhances the process of learning. This student-computer interaction refers to "communication that requires two or more interactants (one can be a programmed computer) that share an inter-dependency in a flexible relationship to achieve one or more goals" (Larsen, 1985, p.17).

Tutorial Computer Program

With a variety of software programs used in today's education, more students are provided the opportunity to learn by interacting with the computer. Among the major approaches to the use of computer to assist students in learning, the "tutorial" approach is the one that tries to manipulate the meaning-making process of the student through "human-computer dialogues" (Streibel, 1986). Tutorial computer programs are developed to teach students by using a "mixed-initiative dialogue" (Bork, 1980; Dennis, 1979). What does the term "dialogue" mean?

A dialogue refers to a conversation between a student and a teacher (or an author of a program), who tries to stimulate meaningful responses from the student, which will contribute to learning (Bork, 1980). Dialogues should resemble conversations. Through the medium of a computer program, the teacher (or author) asks the student questions that help the student learn the material (Bork, 1980; Larsen, 1985).

The following assumptions underlie the theory of human-computer interaction in tutorial courseware (both content and program strategy (Dennis, 1979)):

Quality control. In a computer tutorial, human-computer interaction is guided by the intentions of an author, instructional designer, and/or programmer. These intentions, or goals, are specified during the process of interaction to ensure desired performance of learners. Hence, as the circumstances of learning are arranged properly, educational goals in student learning can be ensured (Nunan, 1983; Streibel, 1986). For instance, instructions are given in a tutorial program for students to follow in order to acquire a particular skill.

On-line tests, such as embedded tests, have been the most powerful applications of human-computer dialogues in tutorial courseware. In comparing students' performances with those specified by an author of a program, on-line tests offer immediate feedback to the student. As the student is asked to participate by answering questions throughout the program, feedback is given to him/her to guarantee a behavioral outcome set up by the teacher or the author (Bork, 1980; Streibel, 1986) Here, on-line testing is carried out to assist the student in learning.

Means-ends rationality. As learning goals are pre-determined in the tutorial courseware, the sequencing of learning is consequent upon preplanning these goals. Means (or specific steps) are then designed to achieve the objectives of the interaction process (Apple, 1982; Nunan, 1983). Students have to adjust themselves to this computational environment within which they are expected to achieve objectives pre-set by the author(s). Students are treated as "data-based, rule-following, symbol-manipulating, information processors" (Streibel, 1986). Within this framework, the only control a student gets is a form of "pseudo-control", such as the control of rate and timing of responses. For example, students are allowed to pause during the conversation with the computer to absorb a particular area; or to review certain parts of the dialogue to reinforce the ideas presented (Bork, 1980). Thus, it is by the rule-following nature of the tutorial courseware that uniform educational goals can be reached.

Individualization. Little emphasis has been placed on individual student needs in traditional group-based instruction. Teachers typically present information to a number of students simultaneously. In a tutorial program, the human-computer interaction is highly responsive to individual learner needs on the basis of on-going learner responses. Input from the learner is received through his/her responses to on-line tests. Although each task or question presented to the student is the same, the student may process the information and respond to the computer differently (Bovy, 1981). The interaction between the computer and the learner is structured so as to carry out any corrective action in case the learner cannot achieve the expected outcome. As the learner has the option to control the pacing of the program, even a simple task of pressing a key to signal the computer to proceed enables the learner to adjust his/her own pace of meaning-making.

Visualization of Information. The human-computer dialogue becomes more stimulating with the good graphic capabilities of the computer. Not only can information be presented by the computer in the form of text, but also in the form of pictures or icons. As students may interpret information in different ways, different forms of presentation convey different impressions to the students. However, if the same informational content is displayed using two or more modes of communication, the chances of the same information conveyed to different learners will be greater (Bork, 1980). It is also important to realize that pictorial information, especially if well designed, has certain motivational impact on the student's learning process.

Consequences of Conducting a Computerized Tutorial Program

In view of the above assumptions, a computerized tutorial creates an environment within which human-computer interactions take place. Within the technological framework, the author of a tutorial program follows the logic of prediction and control to construct a set of rules and messages that permits a learner to reach the specified learning goal. As a learner follows these rules or messages in a form of dialogue, he or she can adjust his or her own pace of learning as well. Taking into consideration all these assumptions about "human-computer interactions", the consequences of conducting computer tutorial programs can be summarized in the following paragraph.

A learning outcome is guaranteed as students progress toward a pre-determined goal through the human-computer dialogue. Means of acquiring knowledge are set up to guide the learner towards the goal of knowledge creation (Streibel, 1986). The rate of learning and the number of correct responses are reflective of the success of the program in achieving the pre-specified learning objectives of the author of the program or the teacher. Hence, the set of temporal expectations of the learner's behaviour accelerates the learning process in computerized tutorials.

Past Research in the Use of Computer in Clothing & Textiles and Other Areas

The theoretical framework supported by Streibel(1986), Bork(1980), Larsen(1985), and others underlies the intention of this thesis to design and evaluate a computer (CAD) tutorial program in teaching specific pattern development concepts and principles. This review of research covers previous investigations of the effectiveness of computer assisted instruction conducted at the college level. Because the use of computer software in the clothing area is not extensive at present (Terry & Offerjost, 1984), evidence of past studies in other subject areas that support the research question were reviewed. Some of the studies reviewed gave predictions regarding the use of teaching tools not exactly identical to the "computer-tutorial approach" discussed earlier. Yet, it is based on the similarities between these instructional tools and the computer-tutorial approach that predictions may be made in light of the findings of these studies.

Effectiveness of CAI

The recent increase in the volume of research on computer use in education is indicative of the enthusiasm for computers. Many studies were conducted to compare computer-based college teaching with other conventional teaching methods. Consistent evidence was found to conclude that there were no learning benefits to be gained from employing any specific method of teaching. That is, computer assisted instruction was found as effective as the traditonal methods in delivering instructions. Jamison et al. (1974) reviewed almost a dozen small-scale studies of computer-based instruction in college classrooms. They came to a conservative conclusion that CAI, when used as a replacement, was about as effective as the traditional instruction. The only index of success of CAI in some studies was that it might result in savings of student time (Jamison et al., 1974; Skinner, 1988). Kulik, Kulik, and Cohen (1980) presented results of a meta-analysis of findings from 59 independent studies of computer-based college teaching. Results of this analysis suggested that CAI made small but significant contributions to student achievement. They also found that design features of experiment, control for historical effects, experimental setting and area of discipline did not have any bearing on the experimental outcomes. However, Clark (1985) argued that achievement gains found in the above studies were overestimated. Clark (1983, 1985) attributed achievement gains from CAI to the uncontrolled effects of instructional method, novelty, and the use of different teachers in both CAI and traditional approaches. For instance, both Clark (1985) and Kulik et al. (1980) noted that the positive effect for CAI or any media of learning disappeared when the same instructor designed and produced both treatments. Yet, the argument that the teacher's rivalry with a new technology might mask the true effect of CAI on student achievement was held. In examining other studies of media's influence on learning, Clark (1983) further concluded that the great majority of these comparison studies clearly indicated no significant difference between the CAI and the conventional instructional methods. In the area of basic clothing construction, two studies were carried out by Reich (1971) and Brandi (1978) to evaluate a self-instructional programmed course and a set of self-paced materials correspondingly. They both reached the conclusion that student achievement did not favor the use of these self-instructional programs, that is, all students performed equally well regardless of teaching mode.

In the past, a variety of studies has been conducted to evaluate the effectiveness of CAI in terms of student ratings. Research findings indicated that students at the university or college level demonstrated positive attitudes toward computerized learning (Cavin et al., 1981; Eisenberg, 1986; Jenkins & Dankert, 1981; Skinner, 1988). Some authors found that using computer-assisted instruction could improve students' attitudes toward this instructional method and/or the subject matter itself (Cavin et al., 1981; Mathis, 1970). Miller and Racine (1988) showed the positive effect of using the computer as a tool in apparel design in light of students' performance and attitude towards the use of computer. In particular, these researchers made use of the AutoCAD^R software to guide students through the entire clothing design and construction process. However, AutoCAD^R was not used here as a mode of instruction for teaching students design concepts. Although some designers fear that the computer will inhibit their creativity, these researchers found that the students in the experimental class favored the use of the computer as it simplified and enhanced the design process. Students also reported that they were impressed by the extreme accuracy and precision of the computer in pattern development (Miller & Racine, 1988). Similar findings regarding students' attitude towards the incorporation of computer in clothing area were reported by Woodson (1983), who explored the feasibility of producing basic patterns using a microcomputer with accessory equipment and software.

Evidence from the past research was found to support the generalization that there is no relationship between student achievement and method of teaching. Moreover, research also indicated that students rated the computer as a valuable and effective tool in learning. Not only is the effectiveness of an instructional method greatly dependent upon the courseware design (both content and program design), but the traits of the target group who receives the instruction are of equal importance. Student performance, hence, the success of computer-assisted instruction, may be related to students' entering content proficiency or experience, past academic performance, and computer experience.

Past Experience and Student Achevement

In their studies to examine the effectiveness of self-instructional materials in basic clothing construction, Reich (1971) and Brandi (1978) obtained different results regarding the relationship between student performance and experience of clothing construction. Brandi found significant differences between high and low experienced students on achievement measures, whereas Reich reported equal student performance regardless of experience level. High experienced students were described by Brandi as successful despite the teaching method. Reich added that this group of student took less time to complete the program. Low experienced students were described as more successful learners via the self-paced method, because they showed the largest gain in learning. This finding was not consistent with the general conclusion drawn by Judd, Bunderson, and Bessent (1970) in their study of the use of CAI in mathematics. Instead of showing a larger gain in learning, results of this study indicated that student control of progress through a CAI course was less successful in subjects with little familiarity with the course material.

Past Academic Performance and Student Achievement

Little research has been done to investigate how past academic performance may be related to student achievement. Lee's research hypothesized that students with low GPA's would learn more via the non-CAI treatment than via CAI. The results attained suggested that neither treatment favored students with low GPA's on the achievement measures (Lee, 1973). Significant effects for CAI were found in two studies where method and content were controlled (Hatfield, 1969; Lang, 1976). In each of these studies, CAI favored high ability students who profited from computer programming of mathermatics or physics principles. This greater learning for high ability students might be explained by the fact that the computer programming task allowed them to employ their skills more idiosyncratically. On the other hand, learning of low ability students was depressed because of the difficulty of mastering the computer, hence, fulfiling the learning task with the computer. However, Clark (1985) commented that greater learning shown by students with high ability in these studies might be due to the fact that they were challenged by the difficulty of the CAI learning task, but not by the medium of instruction, the computer.

Computer Experience and Student Achievement

Some literature indicated significant correlations between student achievement and computer experience level (Lee, 1973). In a study to compare the CAI with the traditional laboratory instruction in geology, Lee reported that students with previous computer experience had the largest gain in learning on achievement measures. Prior to taking CAI, students with previous computer experience demonstrated more favorable attitudes toward CAI than those with no previous computer experience. However, this difference disappeared after treatment. In the area of apparel design, Kallal and Fraser (1984) commented that a potential interaction problem might exist between computer technology and the creative human element. This problem lies in the designers' resistance to the use of the computer in the design area. On the other hand, some students express difficulty in working with the computer due to no or little previous computer experience and their inability to work independently. Together with the feeling of being expected to perform 'better' than those taking traditional instruction, these students may consequently be frustrated as they are unable to understand and perform the techniques properly (Larsen, 1985; Lictenwalner & Heisey, 1987).

Summary

Evidence from the past research conducted by Jamison et al. (1974), Clark (1983), and others was found to support the conclusion that student achievement did not favor any instructional methods. As for the relationship between student experience in the subject matter and their achievement, the data available from the past research did not seem to be consistent in inducing a general statement about how these two variables should be related. Some authors (Brandi, 1978; Judd, Bunderson, Bessent, 1970) found significant difference between high and low experienced students on achievement measures while others did not. Findings of prior studies also did not seem to support the conclusion that past academic performance was related to student achievement (Lee, 1973, Clark, 1985). Even though some authors (Hatfield, 1969; Lang, 1976) reported that CAI favored students with high ability, Clark (1985) argued that this result might be due partly to confounding factors other than CAI as a medium of instruction. Little literature was found to support significant correlation between student computer experience and performance. One relevant finding about the largest gain in learning achieved by students with previous computer experience was reported by Lee (1973) in the area of geology.

Based on these prior research findings, the following hypotheses were formulated for the study:

1. There is no significant relationship between mode of instruction and student achievement.
2. There is no interaction effect on student achievement between mode of instruction and level of experience in pattern development and clothing construction.
3. There is no interaction effect on student achievement between mode of instruction and past academic performance in selected Clothing and Textiles courses.
4. There is no significant difference between high and low computer experience level in the achievement of students using the Computer Assisted Instruction.

CHAPTER III

Methodology

Research Design

The experimental design selected for this study was to examine the use of a computerized tutorial in teaching specific pattern development concepts and principles. After designing a computer tutorial program within the AutoCAD^{R} system, an experiment was conducted to compare the effectiveness of this tutorial to that of the regular laboratory instruction. This experimental design was selected over other research designs as it allows direct observation of the changes in the dependent variable after the manipulation of the research treatment (Walizer & Weinir, 1978). The research was manipulated so that one experimental group received the CAI (computer assisted instruction) treatment and the other, the control group, received the non-CAI (laboratory) treatment. As well, time order was directly manipulated to observe changes in the variables over a period of time. The sample would be tested for any changes in the response variable when both groups were measured on their achievement level.

Figure 1 depicts the experimental design used for this study. The sample was randomly assigned into two groups: the experimental group and the control group. The pretest was administered as the first measure of the response variable, student achievement. This step was done in Time 1 in order to establish the student's level of knowledge in the subject matter. After the pretest, the research treatments were given out to the two experimental groups. In Time 3, both groups had to complete the posttest as a measure of their level of achievement after treatment. Here, the postest was composed of two parts, first, the practical pattern development test, which was already embedded in the instructional unit (posttest I), second, the written posttest (posttest II). The pretest and posttest II were paper-and-pencil tests and posttest I was constructed to measure transfer of knowledge. The scores obtained on the pretest and the posttests were compared to determine any relationships existing between the explanatory and response variables. See the section on Specific Procedures for details on how the study was conducted (p.39).

	<u>Time 1</u> --->	<u>Time 2</u> --->	<u>Time 3</u>
Experimental group	Pretest Y	CAI Treatmet	Posttest I Y
			Posttest II Y
Control group	Pretest Y	Non-CAI (Lab.)	Posttest I Y
		Treatment	Posttest II Y

<u>Figure 1</u>. Experimental design (Y = response variable)

Research Sample and Sample Selection

The research population to which the study pertained consisted of undergraduate students with clothing and textiles major, who planned to emphasize the apparel design and production area. As the contents of the instructional units covered basic pattern development concepts and principles, the treatments were designed for students who did not have any academic background in pattern development at the university level. This group was mainly composed of 73 female university sophomores and/or juniors for the 1989-1990 session.

A convenient sample of 35 students enrolled in Apparel Design: Pattern Development (64.219) was selected for this study. Apparel Design: Pattern Development is the first course in a sequence for clothing and textiles students who planned to focus on the apparel design area. Students enrolled in this course would not have academic backgrounds in pattern development at the university level. They had been introduced to concepts and principles of apparel design in 'Introduction to Apparel Design', a prerequisite course to 64.219, usually taken in their first year. Students enrolled in 64.219 are usually in their second or third year of the Clothing & Textiles program. As the resources for conducting this study were limited, a convenient sample restricted participants to students with Clothing & Textiles majors, who planned to focus on apparel design and production. Thus, the sample selected represented an appropriate research population. It was assumed that students enrolled in the course would be more interested in participating in the study, as the subject matter of the study treatment would be covered later in the course.

As the sampling frame was limited to the total student enrolment in 64.219, all 35 students were solicited to participate in order to maximize the sample size of the study. A presentation was made by the researcher in the first lecture of 64.219 to explain to students the purpose of the study, the importance of subject participation, and the study procedures. Twenty-nine students in the class volunteered to participate. The administration of the written entry behavior test and the pretest followed immediately after these 29 subjects gave written consent to their participation in the experiment. Blocking was used to randomly assign subjects into the two groups. This process involved assigning students to matched pairs based on student past academic performance in at least two of the three selected clothing and textiles courses, and then randomly assigning one member of each pair to the experimental group, the other to the control group. Thus, there was an attempt to assure initial equivalence of the experimental group and the control group.

The study final sample was composed of 26 female students enrolled in the course of Apparel Design: Pattern Development. The sample size was reduced from 29 to 26 due to the occurrence of two dropouts from the sample and the presence of an outlier, who completed only one of the three selected clothing and textiles courses. The reason for one student in the CAI group to drop out was incompetence to complete the computer tutorial, while the other student dropped out before treatment with unknown reason.

The 26 subjects measured in the study were equally divided into the experimental and the control group. As the experiment was not conducted in a regular class schedule, arrangements had to be made to conduct the experiment outside student class schedules. Subjects in the experimental group and the control group were further divided into groups of two to four based on the times that they were available for the experiment. A majority of the participants, 81%(21), selected the Clothing & Textiles major, and 19% (5) selected the Comprehensive program of the Faculty of Human Ecology. Among the Clothing & Textiles students, 67% (14) were sophomores, and 28% (6) were juniors, and the remaining 5% (1) were seniors. Eighty percent (4) of the comprehensive students were juniors and the remaining 20% (1) were seniors. See Figure 2. All the five comprehensive students happened to participate in the laboratory session by chance.

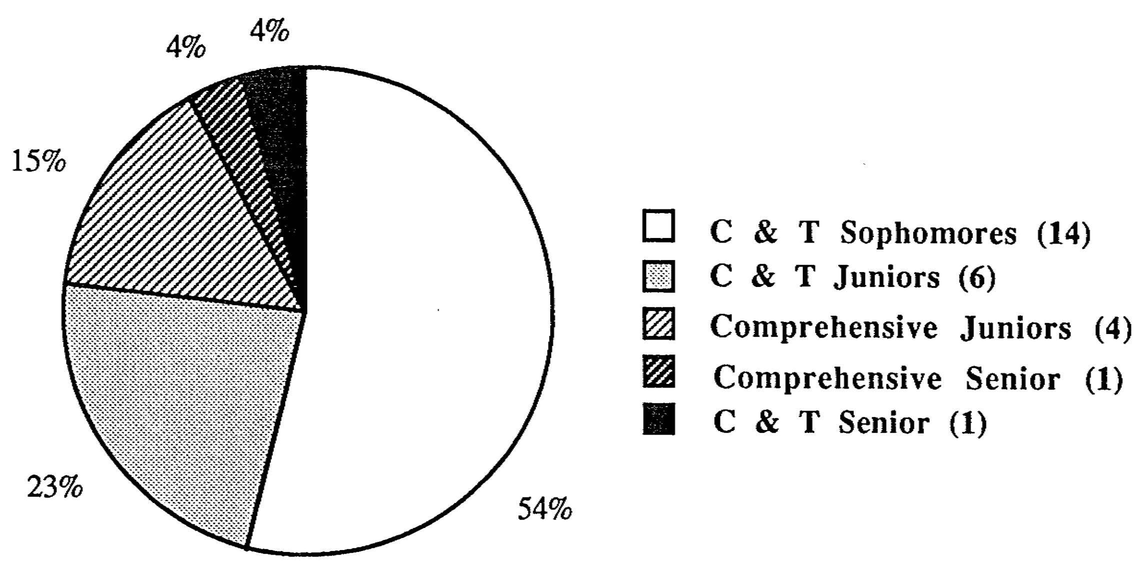


Figure 2. Subjects' major and year of program distribution.

Instrumentation

Treatment

A computer tutorial program was designed within the AutoCAD[R] system for the purposes of the study. The instructional materials covered in this program focused on the concepts and principles of pattern development of 'flat collars' (Appendix A). The subject matter was chosen because the amount of information covered was complete and sufficient to be implemented into a computer tutorial program of approximately an hour in length. The duration of the program was also dependent on individual learner's pace of learning. As stated earlier, no previous knowledge of pattern development was required in order to complete the program. It was this characteristic of the program that made it possible to be completed by beginners, who were assumed to have no background in the area of pattern development at the university level. Instructional analysis was undertaken carefully when developing the instructional materials and different tests. This will be discussed later in this section. A detailed description of the instructional design of the program is given in Appendix B. The computer tutorial consisted of 27 frames. The contents of the program included the following sections:

1. collar types,
2. collar styles,
3. how to develop flat collar patterns,
4. develop your own flat collar pattern.

Even though little feedback was given, three short tests were embedded in the computer program to help students practise knowledge gained at intervals. These short tests differed from the pretest and the posttests as they were not used as achievement measures in comparing the effectiveness of the two teaching methods. Each participant in the computer session received the computer tutorial program and a manual, which covered instructions on how to operate the terminal and the program (Appendix C).

The subject content of the laboratory session was identical to that of the computer program. Transparencies were used as visual aids to supplement the laboratory instructions. Each participant in the laboratory session received verbal instructions on the subject matter, supplemented by visual aids; a demonstration of flat collar pattern development; and a paper-and-pencil test that was composed of the three tests embedded in the computer tutorial (Appendix J). This test was administered between the completion of instruction and the first posttest to help participants practise or review the knowledge gained. Both treatments, the computer and the laboratory instructional units, were completed by each subject in a single session, which lasted from 30 minutes to over one hour. Each subject was required to receive the treatment at a time when she was available. Except for the delivery of instructions in the laboratory group, no time limit was given to complete each instructional unit so that the subjects could adjust their own rate of learning.

Moderator Variables

Student experience in pattern development and clothing construction and computer experience of participants in the experimental group were determined through the use of an entry behavior test constructed by the researcher (Appendix D). This test, reviewed by two experts in the clothing and textiles area, consisted of two parts, one measuring student experience in sewing, designing or developing patterns, and the other measuring student experience in the use of computers. Subjects were classified as high or low experienced in these two perspectives based on their responses to this test. The measurements of these two variables were described in the section of "Operational Definitions". Student past academic performance was measured by students' grade point average in selected clothing and textiles courses. This grade point average served as a measure of student competence attained in the area of clothing and textiles. According to the letter grade system indicated on the University of Manitoba transcript, subjects scoring between B and A+ were classified as those with high academic performance. Subjects scoring between C+ and F were classified as those with low academic performance.

Testing Instrument

Student achievement attained before and after completing the instructional programs on flat collar pattern development was measured by means of two paper-and-pencil tests. These two short-answer tests were developed by the researcher; and the formats of the tests varied slightly to control any correlation between them. The pretest was one page long. It was administered before treatment to measure students' prior knowledge of the subject matter (Appendix E). The posttest (referred as posttest II in this study) was one and a half pages long. It exceeded the pretest by two more questions, again, to control any correlation between this test and the pretest (Appendix F). Both tests were designed to measure student level of learning of the concepts and principles of pattern development of flat collar. The score range for the pretest was 0 to 10, and 0 to 15 for the posttest II. Scores on the posttest II were transferred to the base of 10 for data analyses. The difference of scores obtained by students on these two tests indicated gain in student learning after treatment.

To ascertain that student content proficiency was caused by the experimental variables being tested, the subjects were asked in both the pretest and the posttest II whether they had read any specific information on the subject matter before and during the administration of the experiment. Prior to the experiment, one student, who was randomly assigned to the laboratory session, had read specific information on the subject matter during the past year. Whereas two students, who participated in the computer sessions, read about the subject matter from other sources when the experiment was in process. However, it was found that the performance of these three students did not deviate from the mean scores obtained by the study sample on the achievement measures.

Along with the written posttest II, subjects were given a chance to express their attitude toward the instructional media by completing an evaluation form (Appendix G). This evaluation form was adapted from the testing instrument used in Skinner's (1988) study of attitudes of college students toward computer assisted instruction. It should be noted that student attitude toward the media of learning that they experienced was not one of the objectives of this study. Even though their response to mode of learning would not have direct bearing on the study itself, the information obtained might be valuable for future implications of using either of the teaching techniques for apparel design.

Another test, posttest I, was administered to both the experimental and the control groups immediately after the subjects received the treatment. Subjects in both groups were asked to perform an intellectual problem-solving skill in the media of learning to which they were assigned. The task involved developing a pattern for a flat collar style selected by each participant (see Appendix A). Supplies such as rulers, brown paper and french curves were provided to subjects in the laboratory sessions; whereas subjects in the experimental group followed instructions given in the manual in completing the test. Posttest I was a practical test used to measure the applied aspect of student achievement with respect to the subject matter. A total of 5 marks was alloted to the practical test I. Again, scores obtained on this test were converted to the base of 10 for data analyses. No time limit was given to complete any of these measures.

Specific Procedures

Students enrolled in the course Apparel Design: Pattern Development were solicited to participate in the study on September 6, 1989, the first lecture of the course. During this first meeting with the students, the researcher distributed a cover letter to each potential participant explaining the purposes and procedures of the study, and the importance of subjects' participation (Appendix H). Subjects were also guaranteed complete anonymity and that test scores obtained in the experiment would not affect any grades of the courses they were enrolled in. As well, subjects who were going to participate in the laboratory group would be given the chance to take the computer tutorial after the experiment was completed. A summary of the research findings would be provided to each participant as requested.

Students who chose to participate in the study signed a consent form (Appendix H), which was followed immediately by the administration of the entry behavior test and the pretest. Subjects completed these two tests in about 10 to 15 minutes. Participants then submitted copies of their time tables which identified the times that they would be available for the experiment. Student responses to the entry behavior test were used to place students at either high or low level of past experience in clothing construction and pattern development, and experience in the use of computers. With reference to their past academic performance in at least two of the three selected clothing and textiles courses, subjects were randomly assigned into the experimental (CAI) and the control (laboratory) groups through blocking.

Subject assignment was completed during the first week of the experiment. Students were reminded in class on September 11 and followed up by phone calls about the groups and times to which they were assigned. The timetable for the experiment was posted in the department. Since the study was not conducted in class, arrangements had to be made with subjects to receive treatments in groups. The 26 subjects were randomly assigned into the experimental and the control groups, each of which were further divided into five small groups. Each sub-group had two to four subjects. The subjects were divided into these sub-groups at the times that they were available for participating in the experiment. Those who were chosen to participate in the computer sessions were distributed the manuals supplementary to the tutorial in advance; and they were requested to read the manuals thoroughly before coming to the sessions.

In the second and third weeks, the experimental group received the computer tutorial and the control group received the laboratory instructions. The computer groups completed the treatment in an average of 30 minutes at the computer terminal in the Department of Clothing & Textiles. Whereas the laboratory groups received their treatment in either one of the laboratories available in the department. The laboratory instructions were completed by the researcher in an average of 18 minutes. The principal investigator of the study was the only person present during the delivery of the treatments. Each subject was required to complete the instructional unit at the time of her participation. The researcher demonstrated the mouse to the subjects in the computer sessions in approximately 9 minutes prior to completing the tutorial. An effort was made for subjects in the experimental and the control groups to participate at similar times of the day.

The practical pattern development test, posttest I, was administered immediately after subjects in each group completed the instructional programs. Subjects in the computer sessions required an average of 25 minutes to complete posttest I. While students in the laboratory sessions completed the same test in an average of 14.5 minutes.

The administration of the written posttest, posttest II, was in process during the fourth week of the experiment. Subjects were required to complete the written posttest plus an instructional evaluation form exactly one week after the completion of the experimental treatments. Subjects in the computer sessions completed this test in an average of 11.6 minutes, while those in the laboratory sessions required an average of 10.7 minutes. The names of the subjects remained anonymous throughout the study, as coded numbers were used on all the tests completed by the subjects. The whole process of the experiment, starting from subject recruitment to the last administration of posttest II and the instructional evaluation form, was completed in four weeks.

Pilot Study

A preliminary study was conducted in summer, 1989 to determine the feasibility of proposed research procedures and the appropriateness of measurement instruments and the computer tutorial. Due to the limited enrolment in the summer session, only six students participated in this preliminary study. Three of the subjects were second and fourth year Clothing & Textiles majors, and the other three were graduate students. The administration of the entry behavior test and the pretest preceded the completion of the tutorial. It took the subjects an average of 8 minutes to complete these two tests. Students then followed the instructions given in the manual to complete both the tutorial and the practical posttest embedded within the tutorial in an average of 52 minutes. Students were then allowed to take home the written posttest II and the instructional evaluation form and return these to the researcher the following day. Students were requested to time themselves when completing the test and the evaluation form, which took them an average of 7.5 minutes. With 10 as the maximum score, the means of pre-test, posttest I, and posttest II scores were 3.3, 9.6, 8.1 respectively. Suggestions were given to improve the measurement instruments, the computer tutorial, and the manual.

Data Analysis

All analysis was conducted using the Statistical Analysis System (SAS). Descriptive statistics were used to summarize the characteristics of the data. The explanatory variables were instructional mode, student experience in pattern development and clothing construction, student past academic performance, and student computer experience; and the response variable was student performance. The frequency distribution of the response variable was examined, along with the appropriate indices of its central tendency and its variability. For example, mean, median, and standard deviation were examined for the response variable. To examine the assumption of normality within each group formed by the explanatory variables, the frequency distribution of each response variable was checked to see if it was approximately normal in shape. Exploratory data analyses such as stem-and-leaf plots, normal probability plots, and box plots were examined for testing for normality. In addition to these plots, the test statistic was examined for the residuals of the explanatory variables with respect to the pretest and postest scores.

The primary purpose of this study was to determine differences in student achievement between the use of CAI and laboratory instruction in teaching specific pattern development concepts and principles. T-tests were performed to compare the means of student test scores (response variable) to determine any real difference between the means for the CAI and laboratory groups. Two-sample t-tests were used to determine if there was significant difference between the posttest results for both experimental groups. Paired-comparisons t-tests were performed to test whether there was a significant difference (1) between the means of pretest and posttest (i.e. gain in learning) for each group of student; and (2) between the means of the two posttests for each group of students. Two-sample t-tests and paired-comparisons t-tests were also performed to test hypothesis four, whether there was a significant difference in test scores between students with high and low computer experience in the CAI group.

Hypotheses two stated that there was no interaction effect on student achievement between mode of instruction and student experience in pattern development and clothing construction. Hypothesis three stated that there was no interaction effect on student achievement between mode of instruction and student past academic performance. A 2x2 analysis of covariance (ANACOVA) with a single covariate (pretest) was performed for both hypothesis two and three. Analysis of covariance has the advantage of increasing the treatment effect estimate as using the pretest as a covariate provides an adjustment for initial difference between the groups (Campbell & Cook, 1979). That is, if the CAI and laboratory groups turned out not equivalent on pretest results, analysis of covariance would be desirable to adjust for this non-equivalence. The analysis of covariance performed for hypothesis two had mode of instruction and student experience in pattern development and clothing construction as the explanatory variables, pretest as covariate, and posttest scores as the response variable. Similarly, for hypothesis three, student past academic performance was analyzed using ANACOVA for its interaction effect with mode of instruction. Each of the above explanatory variables was nominal with only two levels, and the posttest scores, the response variable, were ratio.

As the pretest scores were treated as a covariate in analyses of covariance, the effect of 'pretest' as a single independent variable on the response variable, posttest scores, was examined. Regression analysis was conducted to determine the effect of pretest when it was examined alone. However, it should be noted that since both the experimental and the control groups received the pretest, its influence on student achievement on the posttest would be equal for both groups.

CHAPTER IV

Results and Discussion

Results

Descriptive Statistics

The mean and standard deviation of the pretest and posttest scores were calculated for the entire sample, for the experimental and the control groups, and for other aggregates in the study. A total of 10 marks was alloted to each of the pre- and posttests administered in the experiment. For the entire sample, the mean

Table 1

Means, Medians and Standard Deviations of Pre- and Posttest Scores for the Entire Sample

Test	Mean	Median	Standard deviation
Pretest	0.70	0.00	1.10
Posttest I	8.40	8.00	1.00
Posttest II	5.60	5.48	1.80

Note. Maximum score = 10.

n = 26.

pretest score was 0.70 with a standard deviation of 1.10. The mean posttest I (practical test) score was 8.4 with a standard deviation of 1.00; and the mean and standard deviation of posttest II (written test) scores were 5.6 and 1.80, respectively. [See Table 1 for means and standard deviations of the pre- and posttest scores.]

At pretesting, the mean test score for the laboratory (control) group was 1.15, with a standard deviation of 1.30. The CAI (experimental) group had a mean pretest score of 0.23, and a standard deviation of 0.48. Both the experimental and the control groups performed equally well on the posttest measures. The mean posttest I score for the laboratory group was 8.35 with a standard deviation of 1.11; and 8.38 for the CAI group with a standard deviation of 1.00. For posttest II, the

Table 2

Means, Medians and Standard Deviations of Pre- and Posttest Scores for CAI and Laboratory Groups

Test	Group *	Mean	Median	Standard deviation
Pretest				
	Lab.	1.15	1.00	1.30
	CAI	0.23	0.00	0.48
Posttest I				
	Lab.	8.35	8.00	1.11
	CAI	8.38	8.50	1.00
Posttest II				
	Lab.	5.56	5.67	2.19
	CAI	5.56	5.33	1.79

Note. Maximum score = 10.

* n = 13 for each group.

mean score for the laboratory group was 5.56 with a standard deviation of 2.19; and the CAI group obtained the same mean score, 5.56, with a standard deviation of 1.79 on posttest II (see Table 2).

In hypotheses two, instructional mode was examined for its interaction effect with student experience in pattern development and clothing construction. Descriptive statistics were used to summarize the means and standard deviations of aggregates of students with respect to student experience (see Table 3). At pretesting, students with low experience in pattern development and clothing construction (n=20) had a mean of 0.55 and a standard deviation of 0.99; those with high experience (n=6) had a mean of 1.17 and a standard deviation of 1.29. For posttest I, the mean score for students with low experience was 8.30, with a standard deviation of 1.06; whereas the mean score for those with high experience was 8.58, with a standard deviation of 1.02. For posttest II, the mean and standard deviation for those with low experience were 5.43 and 1.90, respectively; and 6.00 and 1.70, respectively for those with high experience.

In hypothesis three, instructional mode was examined for its interaction effect with student past academic performance. Students with low past academic performance in selected clothing and textiles courses (n=15) had a pretest mean score of 0.60, and a standard deviation of 1.04. Students with high past academic performance (n=11) had a pretest mean score of 0.82 and a standard deviation of 1.15. For posttest I scores, the mean for those with low academic performance was 8.20 with a standard deviation of 1.24, and 8.60 for those with high academic performance with a standard deviation of 0.66. For posttest II scores, 5.16 and 1.72 were the mean and standard deviation for those with low academic performance

Table 3

Means, Medians and Standard Deviations of Pre- and Posttest Scores for Groups with Low and High Experience in Pattern Development and Clothing Construction

Test	Group	n	Mean	Median	Standard deviation
Pretest					
	Low exp.	20	0.55	0.00	0.99
	High exp.	6	1.17	0.75	1.29
Posttest I					
	Low exp.	20	8.30	8.00	1.06
	High exp.	6	8.58	8.75	1.02
Posttest II					
	Low exp.	20	5.43	5.50	1.90
	High exp.	6	6.00	5.67	1.70

Note. Maximum score = 10.

respectively; and 6.12 and 1.92 for those with high academic performance respectively. The means and standard deviations are recorded in Table 4.

In hypothesis four, students in the CAI group were aggregated into 2 levels of computer experience to determine whether there was a significant difference in student achievement between these two groups. As indicated in Table 5, students with low computer experience (n=11) had a mean of 0.69 at pretesting, and a standard deviation of 1.09. While students with high computer experience (n=2) had a pretest mean score of 0.70 and a standard deviation of 1.10. The mean posttest I score for those with low computer experience was 8.26, with a standard deviation of 1.07; and 8.80 for those with high computer experience, with a

Table 4

Means, Medians and Standard Deviations of Pre- and Posttest Scores for Groups with Low and High Past Academic Performance in Selected Clothing and Textiles Courses

Test	Group	n	Mean	Median	Standard deviation
Pretest					
	Low GPA	15	0.60	0.00	1.04
	High GPA	11	0.82	0.00	1.15
Posttest I					
	Low GPA	15	8.20	8.00	1.24
	High GPA	11	8.60	8.50	0.66
Posttest II					
	Low GPA	15	5.16	5.00	1.72
	High GPA	11	6.12	6.33	1.92

Note. Maximum score = 10.

standard deviation of 0.84. For posttest II scores, students with low computer experience had a mean of 5.29 and a standard deviation of 1.78; while students with high computer experience had a mean of 6.73 and a standard deviation of 1.73.

Table 5

Means, Medians, and Standard Deviations of Pre- and Posttest Scores for Groups with Low and High Computer Experience

Test	Group	n	Mean	Median	Standard deviation
Pretest					
	Low exp.	11	0.69	0.00	1.09
	High exp.	2	0.70	0.00	1.10
Posttest I					
	Low exp.	11	8.26	8.00	1.07
	High exp.	2	8.80	9.00	0.84
Posttest II					
	Low exp.	11	5.29	5.33	1.78
	High exp.	2	6.73	6.83	1.73

Note. Maximum score = 10.

Before testing the hypotheses, exploratory data analyses were used to test for normality of the response variable within each group formed by the explanatory variables. The normality of the response variable would suggest that a random sample was drawn with a normal distribution for the study. Information obtained from the stem-and-leaf plots, normal probability plots and box plots suggested that the response variable within each group formed by the explanatory variables was normally distributed. A statistical test for normality was performed to calculate a test statistic ('W' in Table 6) to compare the shape of the sample distribution for the residuals of the explanatory variables with respect to the pre- and posttest scores with the shape of a normal distribution. Table 6 showed the W (0<W<1) values for testing normality. Values of W that are too small indicate that the data were not a sample from a normal distribution. The W values for the residuals of instructional mode, instructional mode x experience in pattern development and clothing construction, instructional mode x student past academic performance, and computer experience were found to be close to 1 (e.g. 0.98). These values suggests that the data came from a sample with normal distribution.

Table 6

W-Values of Normality Tests for Residuals of Explanatory Variables with Respect to Pre- and Posttest Scores

	W Value					
	Pretest	(p<w)	Posttest I	(p<w)	Posttest II	(p<w)
Instructional mode	0.88	(<0.01)	0.92	(0.06)	0.98	(0.84)
Instructional mode x exp. in pattern development	0.91	(0.04)	0.93	(0.08)	0.97	(0.71)
Instructional mode x past academic performance	0.93	(0.09)	0.93	(0.11)	0.96	(0.47)
Computer experience	0.71	(<0.01)	0.94	(0.23)	0.97	(0.67)

Test of Hypothesis

The primary purpose of this study was to determine whether there is no significant difference in student achievement between the use of CAI with AutoCAD^R and laboratory instruction in teaching specific pattern development concepts and principles. The significant level of 0.05 was chosen for data analysis of the study. Before testing the hypotheses, regression analysis was conducted to examine the effect of pretesting on the achievement measures. That is, pretesting might alter the posttest scores by providing the opportunity for practice. The F values of 0.37 (p=0.55) and 0.13 (p=0.72) assessed at the 0.05 significance level revealed no statistically significant relationship between pretesting and posttest I, and pretesting and posttest II respectively. Yet, it should be noted that even though a difference was found, the effect of pretesting would be the same on the CAI and the laboratory groups as both groups received the pretest.

Hypothesis 1. The first hypothesis of the study is to determine whether there was no significant relationship between mode of instruction and student achievement. The means of the test scores were compared at the significance level of 0.05 for testing this hypothesis. That is, were the means of the test scores obtained by the CAI group equal to those of the laboratory group. The T values represented in Table 7 showed no statistically significant difference in the means of the posttest scores between the CAI and the laboratory groups. For posttest I, the T values was 0.09 (p=0.93) with a degree of freedom of 24. For posttest II, 0.00 was the T value (p=1.00) with a degree of freedom of 24. At pretesting, however, the T value of -2.40 at the 0.05 significance level (DF=15.3, p=0.03) showed significant difference between the two groups. The initial difference between the groups also justified the use of the pretest as a covariate in analyses of covariance for testing the other hypotheses in the study. After the implementation of the treatments, no significant difference was found between the two groups in the posttest scores. In order to examine student gain in learning after the treatment, a difference score (represented by 'gain' in Table 7) was calculated by subtracting each subject's pretest score from the posttest II score. The mean gain score for the CAI group was +5.33 whereas the mean gain score for the laboratory group was +4.41. The T value of 1.15 (DF=18.5, p=0.26) in Table 7 demonstrated no significant difference found between the mean gain scores of the CAI and the laboratory groups.

Table 7

T-Test Results for Difference in Mean Pre- and Posttest Scores between CAI and Laboratory Groups

Test Scores	DF	T	Prob>|T|
Pretest	15.3	-2.40	0.03 *
Posttest I	24	0.09	0.93
Posttest II	24	-0.00	1.00
Gain (Posttest II-Pretest)	18.5	1.15	0.26

* significant at 5% level of significance

Despite the fact that the mean gain score obtained by the CAI group was not significantly different from that obtained by the laboratory group, the positive gain scores indicated an increase from pretest to posttest for each group. The student gain in learning was further examined by calculating the T values for the difference between the pretest scores and posttest II scores. In Table 8, the T value calculated at the significance level of 0.05 for the entire sample (n=26) was 12.09 (p=0.0001), 13.94 (p=0.0001, n=13) for the CAI group, and 6.27 (p=0.0001, n=13) for the laboratory group. All these T values represented significant difference found between the pretest and the posttest II scores, hence, gain in learning for the entire group, and each of the CAI and the laboratory group. As well, to examine how the student performance on the written posttest II might differ from that on the practical posttest I administered immediately after treatment, their posttest I and posttest II scores were compared using the T test. In Table 9, the T values of -7.09 (n=26, p=0.0001), -6.82 (n=13, p=0.001), and -4.02 (n=13, p=0.0017) represented significant difference assessed at the 0.05 significance level for the entire sample, the CAI and the laboratory groups, respectively. That is, student performance on the two posttest measures differed significantly. Figure 3 represented in bar graph form all the mean test scores obtained by the two groups (see Appendix I for all pre- and posttest scores for the entire sample).

Table 8

Paired-Comparisons T-Test Results for Mean Difference Between Pretest Scores and Posttest II Scores for the Entire Sample, CAI Group, and Laboratory Group

Group	n	T	Prob> T *
Entire sample	26	12.09	0.0001
CAI	13	13.94	0.0001
Laboratory	13	6.27	0.0001

* significant at 5% level of significance

Table 9

Paired-Comparisons T-Test Results for Mean Difference Between Posttest I Scores and Posttest II Scores for the Entire Sample, CAI Group, and Laboratory

Group	n	T	Prob> T *
Entire sample	26	-7.09	0.0001
CAI	13	-6.82	0.001
Laboratory	13	-4.02	0.0017

* significant at 5% level of significance

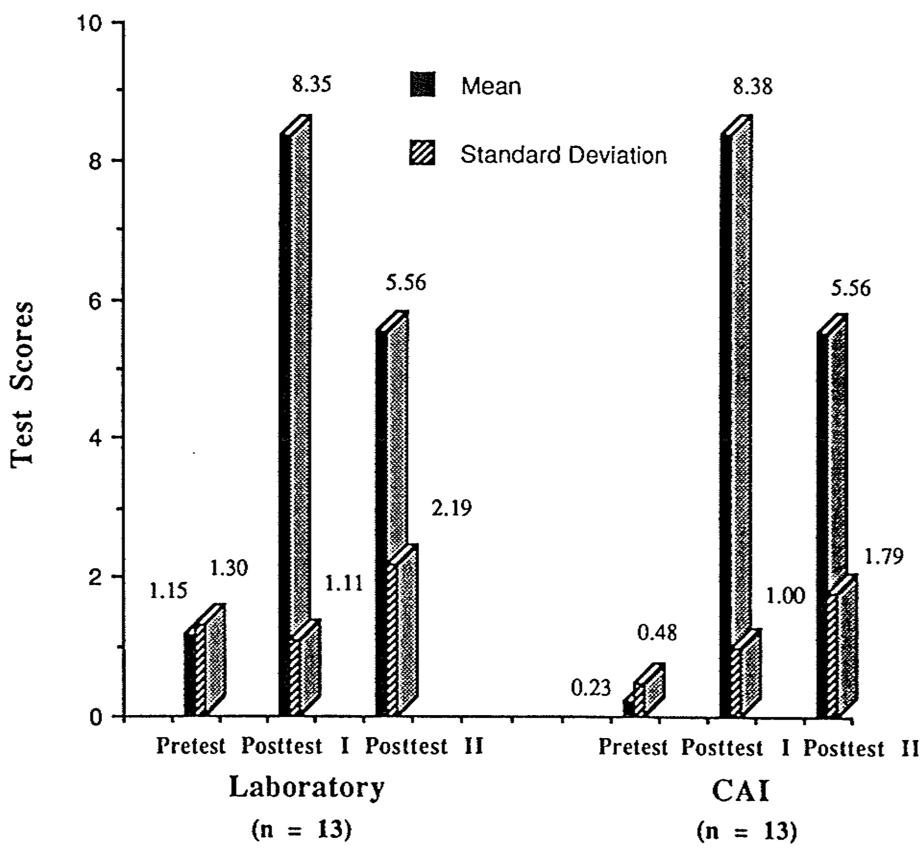


Figure 3. Mean pre- and posttest scores of the laboratory and the CAI groups. (maximum score = 10)

Hypothesis 2. Hypothesis two stated that there is no interaction effect on student achievement between mode of instruction and level of experience in pattern development and clothing construction. Two-way analysis of covariance (ANACOVA) were performed with instructional mode and student experience as the explanatory responses, the posttest scores as the response variable, and the pretest scores as the covariate. The results of the ANACOVA did not show significant difference for posttest I scores. Instructional mode (F=0.15, p=0.71), experience (F=0.21, p=0.66), their interaction (F=0.08, p=0.78), the covariate (F=0.34, p=0.57) and the crossed effect of pretesting, instructional mode and experience (F=0.06, p=0.81) yielded insignificant F values at the significance level of 0.05 (Table 10). The same analysis was performed on posttest II scores. None of the

Table 10

Two-Way Analysis of Covariance of Interaction Effect of Instructional Mode and Experience on Student Posttest I Scores, with Pretest as Covariate

Source	DF	Type I Sum of Squares	F	Prob > F
Pretest	1	0.41	0.34	0.57
Instructional mode	1	0.18	0.15	0.71
Exp. in pattern dev. & clothing construction	1	0.25	0.21	0.66
Instructional mode x Experience	1	0.10	0.08	0.78
Pretest x Instructional mode	1	2.74	2.24	0.15
Pretest x Experience	1	1.08	0.88	0.36
Pretest x Instructional mode x Experience	1	0.07	0.06	0.81

explanatory variables and the covariate was found statistically significant at the 0.05 significance level. Table 11 represents the F values for instructional mode (F=0.03, p=0.87), experience (F=0.31, p=0.58), their interaction (F=0.12, p=0.73), the covariate (F=0.11, p=0.74), and the crossed effect of pretesting, instructional mode and experience (F=0.23, 0=0.63). Thus, there is insufficient evidence to reject hypothesis two. The results of ANACOVA indicated that there was no significant difference between the achievement of students with low experience in pattern development and clothing construction and the achievement of those with high experience. Nor was there significant interaction effect found on student achievement between mode of instruction and experience in pattern development and

Table 11

Two-Way Analysis of Covariance of Interaction Effect of Instructional Mode and Experience on Student Posttest II Scores, with Pretest as Covariate

Source	DF	Type I Sum of Squares	F	Prob > F
Pretest	1	0.45	0.11	0.74
Instructional mode	1	0.11	0.03	0.87
Exp. in pattern dev. & clothing construction	1	1.25	0.31	0.58
Instructional mode x Experience	1	0.49	0.12	0.73
Pretest x Instructional mode	1	3.60	0.90	0.35
Pretest x Experience	1	5.54	1.39	0.25
Pretest x Instructional mode x Experience	1	0.93	0.23	0.63

n = 26.

clothing construction. That is, when the subjects were separated according to their level of experience, the two teaching methods were about the same in terms of student achievement. Figure 4 represents in bar graph form the mean test scores of students separated by their experience level in each of the experimental and control groups. This figure depicts little difference among the aggregates when the interaction between instructional method and student experience was taken into account.

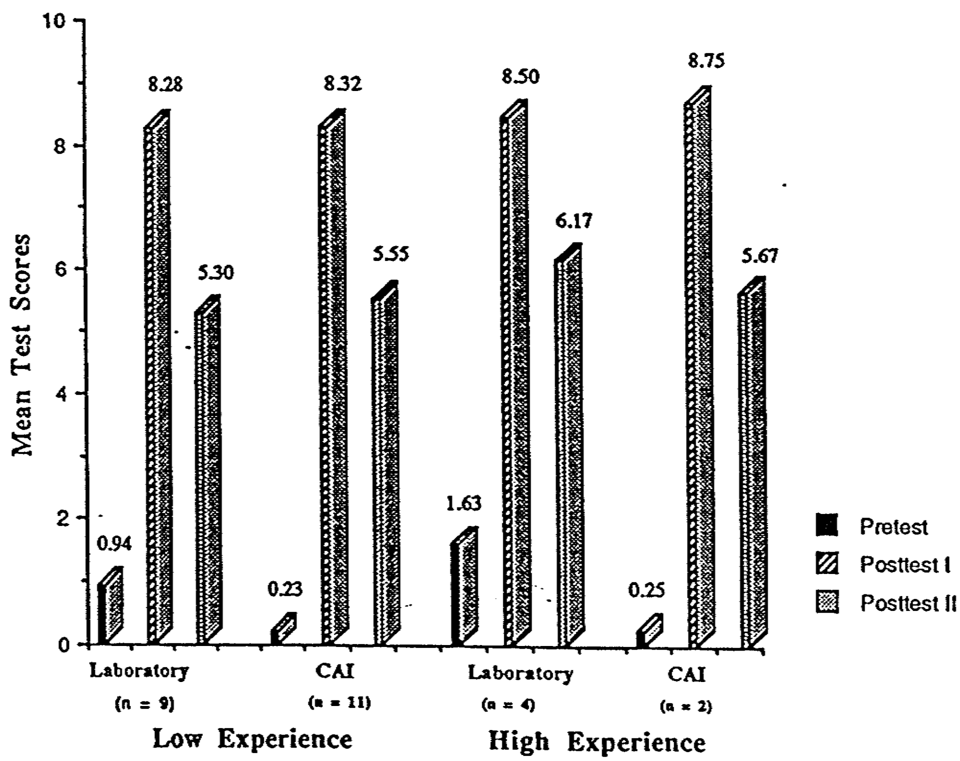


Figure 4. Mean pre- and posttest scores of students separated according to level of experience in pattern development and clothing construction in CAI and laboratory groups.

Hypothesis 3. To test the hypothesis that there is no interaction effect on student achievement between mode of instruction and past academic performance in selected clothing and textiles courses, two-way analysis of covariance was performed with the pretest as a covariate. The difference between posttest I scores for students with high or low academic performance was statistically insignificant ($F=0.71$, $p=0.41$). The other explanatory variable, instructional mode ($F=0.14$, $p=0.71$), the covariate, pretest ($F=0.33$, $p=0.57$), and the interaction of instructional mode and academic performance ($F=0.14$, $p=0.71$) were all found statistically insignificant with regards to their effect on posttest I scores. Despite the adjustment of initial group difference with the use of the pretest as a covariate, no significant

Table 12

Two-Way Analysis of Covariance of Interaction Effect of Instructional Mode and Past Academic Performance on Student Posttest I Scores, with Pretest as Covariate

Source	DF	Type I Sum of Squares	F	Prob > F
Pretest	1	0.41	0.33	0.57
Instructional mode	1	0.18	0.14	0.71
Academic Performance	1	0.88	0.71	0.41
Instructional mode x Academic performance	1	0.17	0.14	0.71
Pretest x Instructional mode	1	2.15	1.72	0.21
Pretest x Academic perf.	1	0.47	0.38	0.55
Pretest x Instructional mode x Academic perf.	1	0.00	0.00	0.97

n = 26.

difference was found for the crossed effect of the two explanatory variables and the covariate (F=0.00, p=0.97) (see Table 12).

Similar results were found for posttest II scores (Table 13). Little difference in posttest II scores was found between students with high and low past academic performance (F=1.42, p=0.25). The covariate (F=0.11, p=0.74), instructional mode (F=0.03, p=0.87), the interaction between mode of instruction and academic performance (F=0.17, p=0.69), the crossed effect of pretest, instructional mode and academic performance (F=0.01, p=0.92) all proved insignificant at the significance level of 0.05. All the F-values assessed for posttest I and II scores revealed that the interaction of mode of instruction and past academic performance did not

Table 13

Two-Way Analysis of Covariance of Interaction Effect of Instructional Mode and Past Academic Performance on Student Posttest II Scores, with Pretest as Covariate

Source	DF	Type I Sum of Squares	F	Prob > F
Pretest	1	0.45	0.11	0.74
Instructional mode	1	0.11	0.03	0.87
Academic performance	1	5.71	1.42	0.25
Instructional mode x Academic performance	1	0.67	0.17	0.69
Pretest x Instructional mode	1	4.89	1.22	0.28
Pretest x Academic perf.	1	0.03	0.01	0.93
Pretest x Instruction mode x academic perf.	1	0.04	0.01	0.92

n =26.

display significant effect on student achievement, thus, there is insufficient evidence to reject this hypothesis at the significance level of 0.05. Figure 5 represents in bar graph form the mean pre- and posttest scores for students aggregated according to their level of academic performance in each of the experimental and control groups. This figure depicts very slight difference in scores between students with high academic performance and those with comparatively low academic performance.

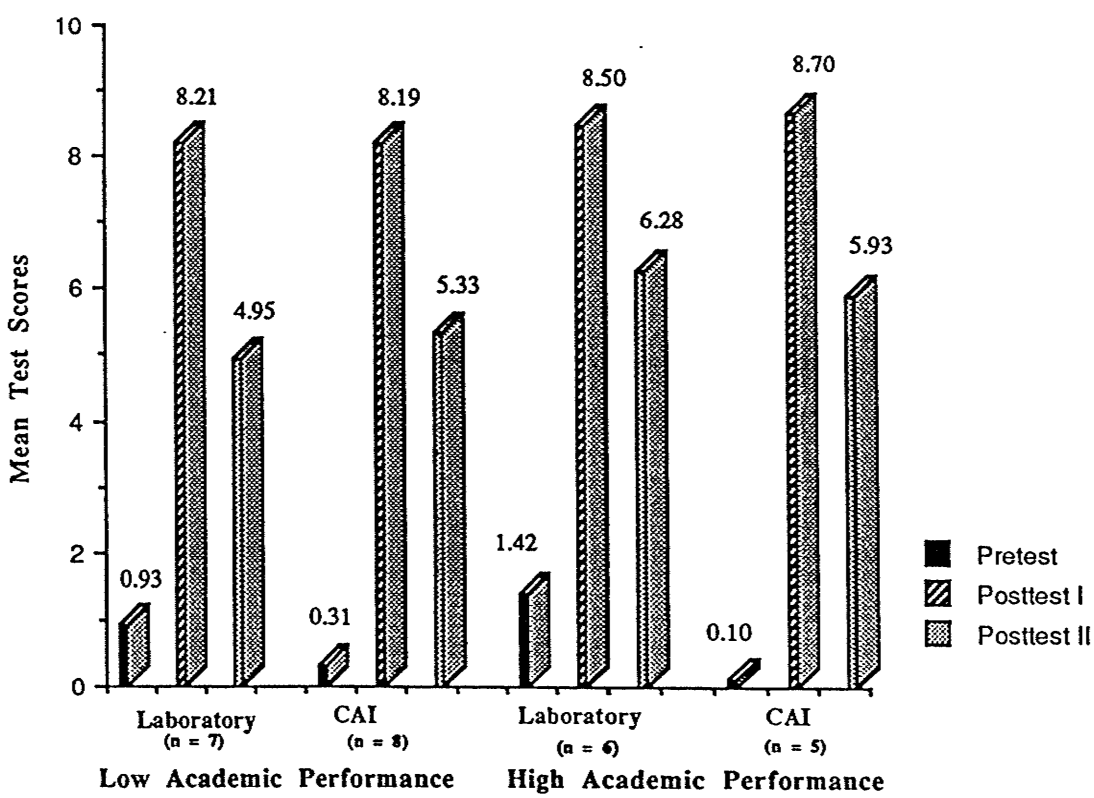


Figure 5. Mean pre- and posttest scores of students separated according to past academic performance in selected clothing and textiles courses in CAI and laboratory groups.

Hypothesis 4. To test whether there is no significant difference between high and low computer experience level in the achievement of students using the Computer Assisted Instruction, T test was performed for students participating in the CAI group. The means of the pretest, posttest I, posttest II, and gain (posttest II - pretest) scores were compared for any differences between students with high computer experience and students with low computer experience. Variances for the two groups with high and low computer experience were equal for the pretest ($p>F'=0.85$), posttest I ($p>F'=0.68$), posttest II ($p>F'=1.00$) and gain scores ($p>F'=0.91$). At pretesting, the T value of -0.02 ($DF=24$, $p=0.99$) assessed at the 0.05 significance level revealed no significant difference between students with low computer experience and those with high computer experience. Nor was there any difference imposed by computer experience between the mean scores for posttest I ($T=-1.05$, $DF=24$, $p=0.31$) and posttest II ($T=-1.64$, $DF=24$, $p=0.11$). As well, student gain in learning (posttest II - pretest) was calculated to test if students with high computer experience might have performed better than those with low computer experience. The T value of -1.44 ($DF=24$, $p=0.16$) suggested no significant difference in student gain in learning. The above T test results were recorded in Table 14. As stated in the hypothesis, results of the T test suggested that there was no significant difference between high and low computer experience level in the achievement of students using CAI.

Paired-comparisons T tests were performed to compare each subject's pretest score with her posttest II score for gain in learning. For the group with low computer experience ($n=11$), the T value of 12.29 ($p=0.0001$) assessed at the 0.05 significance level revealed significant difference in student gain in learning (Table

Table 14

T-Test Results for the Difference in Mean Pre- and Posttest Scores between Students with Low [n=11] and High [n=2] Computer Experience

Source	DF	T	Prob > T
Pretest	24	-0.02	0.99
Posttest I	24	-1.05	0.31
Posttest II	24	-1.64	0.11
Gain (Posttest II - Pretest)	24	-1.44	0.16

15). For the group with high computer experience (n=2), however, insignificant difference (T=6.00, p=0.11) was obtained even though the mean gain score (posttest II - pretest) for this group (6.03) was higher than that of those with low computer experience (4.60). The insignificant difference in gain in learning for those with high computer experience was attributable to the small size of this group (n=2), as the paired-comparisons T test became less sensitive to declare any significant difference between student scores. Similar paired T test results were found for the difference between student posttest I and posttest II scores. In Table 16, the T value of -6.44 (p=0.0001) revealed significant difference between the two posttest scores for students with low computer experience. While performance of students with high computer experience on posttest I did not differ significantly from that on posttest II (T=-1.67, p=0.34), even though their mean of difference between the two posttests (posttest I - posttest II) (2.07) was close to that of those with low computer experience (2.97). Figure 6 represents in bar graph form all the mean test scores obtained by the students with high and low computer experience.

Table 15

Paired-Comparisons T-Test Results for Mean Difference Between Pretest and Posttest II Scores for CAI Group and Groups with Low and High Computer Experience

Group	n	T	Prob > T
CAI	13	13.94	0.0001 *
Low computer experience	11	12.29	0.0001 *
High computer experience	2	6.00	0.11

* significant at 5% level of significance

Table 16

Paired-Comparisons T-Test Results for Mean Difference Between Posttest I and Posttest II Scores for CAI Group and Groups with Low and High Computer Experience

Group	n	T	Prob > T
CAI	13	-6.82	0.001 *
Low computer experience	11	-6.44	0.0001 *
High computer experience	2	-1.67	0.34

* significant at 5% level of significance

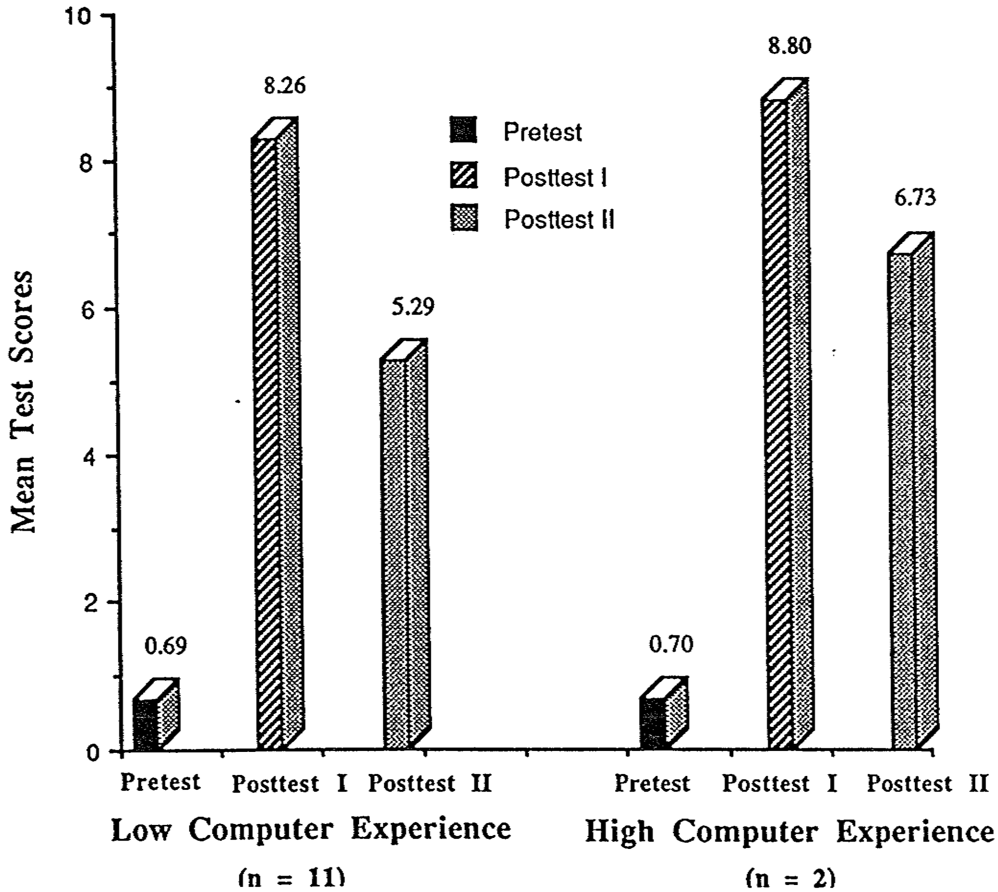


Figure 6. Mean pre- and posttest scores of students separated according to level of computer experience in CAI group.

Response to Mode of Learning

Student response to the mode of learning that they experienced in the study was recorded because the data might be valuable for future implications. It should be noted that the information reported in this section had no bearing on the study itself. Moreover, student response was only applicable to the teaching technique to which they were assigned in the study.

Student attitude toward CAI and laboratory instruction was measured by their responses to the items on the instructional evaluation form. In a form of Likert scale, students circled one of five responses for each of the four items, ranging from strongly disagree (1) through undecided / uncertain (3) to strongly agree (5). One student in the CAI group did not complete the evaluation form, therefore, student attitude toward CAI was reflected from a group of 12 students instead of 13. For the CAI group, 75 % (9) agreed that computer tutorial was an appropriate instructional technique for the subject matter, 16.67% (2) strongly agreed with the same statement, and the remaining 8.33% (1) was uncertain. For the laboratory group, 69.23% (9) agreed that the laboratory was an appropriate instructional technique for the subject, whereas 23.07% (3) strongly agreed and the remaining 7.7% (1) was undecided about this statement. The second item stated that the computer tutorial (or laboratory) was a valuable learning tool. All the students that received CAI expressed agreement with this statement, as 41.67% (5) agreed and 58.33% (7) strongly agreed with the statement. For the laboratory group, agreement was also expressed as 69.23% (9) agreed and 30.77% (4) strongly agreed with the statement. In the next item, students were asked if they preferred computer tutorials (or laboratories) to other instructional procedures. Half of the students (6) in the CAI group was uncertain about this statement. While the other half of the group was equally divided into three groups, with one group (2 or 16.67%) disagreed with the statement and the other two agreed (2) or strongly agreed with the statement. For the laboratory group, 53.85% (7) was undecided whether they preferred laboratories to other instructional procedures, whereas 15.38% (2) disagreed with the statement. The remaining 23.07% (3) and 7.7% (1) either agreed or strongly preferred laboratories to other instructional procedures respectively. The last statement on the evaluation form asked if more courses should be taught using computer tutorials (or laboratories) in the Clothing & Textiles department. More than half (58.33%) (6) of the CAI group agreed with the above statement, while 25% (3) strongly agreed, and 16.67% (2) disagreed with the statement. For the laboratory group, 53.85% (7) agreed that more courses should be taught using laboratories in the Clothing & Textiles department. The remaining 30.77% (4) and 15.38% (2) were unsure and in disagreement with the statement respectively. The overall student attitude toward both the CAI or laboratory approaches of instruction was positive, as the majority of the students expressed agreement / strong agreement with the statements on the evaluation form. Statement three, however, was an exception as the majority of the students in either group was uncertain if they preferred the instructional media that they received to other teaching procedures. Finally, for those who participated in the laboratory group, student interest in using the computer was indicated by their agreement and strong agreement (61.54%) to try a computer tutorial on the subject matter. Table 17 presents the means and standard deviations of the student ratings of the computer tutorial or the laboratory instructional methods.

Table 17

Means and Standard Deviations of Responses (in Form of Likert Scale) to Four Items of Instructional Evaluation Form

	CAI *		Lab. **	
Items	Mean	SD	Mean	SD
1.The computer tutorial (lab.) is an appropriate instructional technique for the subject matter.	4.08	0.52	4.15	0.56
2.The computer tutorial (lab.) is a valuable learning tool.	4.58	0.52	4.31	0.48
3.I prefer computer tutorial (lab.) to other instructional procedures.	3.33	0.99	3.23	0.83
4.More courses should be taught using computer tutorials (lab.) in the C & T department.	3.58	1.00	3.38	0.77

Note. 1 = strongly disagree. 5 = strongly agree

* n = 12

**n = 13

Discussion

The findings of this experiment support the conclusion that neither teaching method was more attractive in terms of student achievement. That is, the CAI approach is as effective as the traditional laboratory approach in teaching specific pattern development concepts and principles. This result supports early findings of Brandi (1978), Clark (1985), Jamison, et al. (1974), Reich (1971) and other researchers that student performance did not favor any specific teaching approach. This conclusion may be due in part to the fact that the experiment was controlled for instructor effects. As the same instructor (researcher) produced both treatments, differences in student achievement became insignificant or less pronounced statistically. Because other aspects of the treatments such as the subject matter and sequence of instruction being identical, it seems unlikely that having the media of instruction different would cause substantial differences in student performance. On the other hand, consideration has to be given to the fact that the short time period of the treatments (less than one hour) could have limited possible differences in results.

With computer assisted instruction, subjects took more time (12 minutes more) to complete the unit than their counterparts in the laboratory setting. As well, more time was required by the CAI group to complete the practical posttest I (10.5 minutes more). This difference in time of completion may be attributable to extra time needed to adjust to the AutoCAD^{R} system and the mouse, and occasional long computer response times especially when students made too many spelling mistakes. This finding fails to support the earlier conclusions made by Jamison et al. (1974)

and Skinner (1988) that CAI might result in savings of student time. Perhaps integrating CAI in the regular structure of a course would allow students more time to adjust themselves to the system and reduce the amount of time in completing the tutorial.

At pretesting, the significant difference found between the scores of both groups indicated initial group inequality despite random assignment of subjects in the CAI and laboratory groups. With a small sample size of 26, randomization did not assure the initial equivalence of experimental groups, which is more likely to happen for larger numbers of random assignments. This initial group difference disappeared after the treatments were delivered. The results also indicated student gain in learning for both groups, as their performance improved from the pretest to the written posttest. As well, it appears that students in both groups were able to apply their knowledge gained to a problem solving situation, as indicated by their significantly different scores on the practical posttest I. These findings of student improvement suggested that the CAI treatment is a reflection of the theoretical framework supported by Bork (1980), Larsen (1985), and Streibel (1986) and others. Through computer assisted instruction, a learning outcome was guaranteed because means of acquiring knowledge were set up to guide students toward the goals of the tutorial.

Student performance on the practical test I differed significantly from that on the written posttest II for both groups. Students seem to acquire good mastery of the pattern development skill through either media of teaching, whereas their scores on the written posttest were relatively low. Their relatively low performance on the written test, as opposed to the practical test, may be partly due to a decrease in retention of learning after a certain period of time (one week). It is possible that if the written posttest II was administered immediately after students received the treatments, some differences in student posttest II scores might be noted.

The differences between the achievement of students with or without previous experience in pattern development and clothing construction were insignificantly small. Results also failed to support the conclusion about the interaction effect between instructional mode and experience in pattern development and clothing construction on student performance. Thus, these findings are similar to those reported by Reich (1971) about equal student performance regardless of experience level. Students of both levels of experience did not seem to benefit in particular from any one of the teaching methods. As the subject matter of the study covered basic pattern development concepts and principles at an introductory level, it seems unlikely that having had some experience in pattern development and sewing would cause relatively high performance on the tests. The instructions were designed to teach the basics of the subject matter. For easy comprehension, the instructions did not assume previous knowledge of the subject matter based on past experience.

The findings of the study were similar to those of Lee (1973) in that neither the CAI nor the laboratory treatment favored students with high or low past academic performance. Slight but insignificant differences in student performance were shown for students with high and low academic performance in both groups. It is unlikely that students with high ability would learn more via CAI as reported by Hatfield (1969) and Lang (1976). Again, the duration of the treatments might be too short to show any significant differences in the achievement measures. As well, the content of the instructions was well controlled in both groups that past academic performance would not have an effect on student performance in either group. Thus, the results of the study supported the hypothesis that moderated by their level of past academic performance, instructional mode did not have an effect on student achievement.

With the computer assisted instruction, the differences in performance between students with high or low computer experience were very small. It appears that computer experience is not a factor in determining the performance of the subjects. This finding fails to support Lee's (1973) conclusion that the largest gain in learning is achieved by students with previous computer experience. Since the computer tutorial was designed to be user-friendly, interactive, and non-threatening, it seems that students were able to learn the materials via CAI readily. With only two students with high computer experience, the rest of the CAI group appeared to adjust well to using the computer. Except for some spelling mistakes that increased the computer response times and possibly some frustration as well, students were able to learn at their own pace and complete the tutorial on their own. In fact, based on the student responses to the instructional evaluation form, the majority of the CAI group found that the computer tutorial is an appropriate instructional technique for the subject matter and it is a valuable learning tool. These positive attitudes towards the use of the computer might have eased the learning process. Thus, because of the user-friendly nature of the tutorial, a student's previous computer experience might not have any bearing on his/her performance. To determine differences in student performance as a result of previous computer experience in future studies, it would be more appropriate to include specific type of previous computer experience such as the use of specific CAD systems in designing patterns or apparel design.

Another conclusion that can be drawn about student attitudes toward the instructional techniques is that students generally had positive attitudes toward both teaching techniques. The majority of the students in either group agreed that the instructional technique they experienced was appropriate for the subject matter and was a valuable learning tool. This result supports earlier findings of Cavin et al. (1981), Miller and Racine (1988), and others that college students demonstrated positive attitudes toward computerized learning. It is likely that while the students in laboratories were familiar and comfortable with the traditional laboratory setting for the subject matter, those in the computer group were also impressed by the novelty and interactive nature of the computer as an instructional media. Perhaps future studies can include an attitude measure at pretesting to find out any attitude change after manipulating the treatments. On the other hand, students who participated in laboratories were given a chance to take the computer tutorial at the end of the experiment as a means to find out how their performance and/or attitude toward computers might differ from their counterparts in the CAI group. However, none of the students was interested in taking the tutorial. Perhaps students' further participation in the study was in conflict with their term and examination schedules. It is possible that direct contact by telephone instead of posting a sign-up sheet would have increased the response rate.

CHAPTER V

Conclusions

Summary

In the past decade, increasing attention had been drawn to the use of Computer-Aided Design (CAD) systems in speeding up the design and production functions of the garment manufacturing business. Adopting new technologies in the education of apparel design would be an asset to prepare students for an easy transition to the automation of the industry in the near future. The purpose of this study was to design a computer tutorial program within AutoCAD^{R}, a computer-aided design system, and to evaluate the effectiveness of this tutorial in teaching specific pattern development concepts and principles. Limited amounts of research were found that related to the impact and implications of adopting CAD systems in apparel design education. A comparative study was chosen to evaluate the effectiveness of computer assisted instruction, with the use of a CAD system, against that of the traditional laboratory teaching method.

The theoretical framework that underlies the intention of the study focused primarily on the impact of human-computer interactions initiated through computer assisted instruction (CAI). Through the human-computer dialogue, learning is guaranteed as students progress toward the objectives pre-determined by the author of the computer program. However, consistent evidence from past research was found to suggest that student achievement did not favor the use of CAI or any specific method of teaching. Thus, learning benefits gained from either employing CAI or the traditional laboratory teaching media were similar.

The major hypothesis of the study stated that there was no significant difference in student achievement between the use of Computer Assisted Instruction (CAI) with AutoCAD^R and laboratory instruction in teaching specific pattern development concepts and principles. In other hypotheses, student performance was examined for its relationship with student entering content proficiency or experience, past academic performance, and computer experience. An experiment was conducted to determine any changes on student achievement level after receiving the treatments of the study. The research sample was composed of 26 female students enrolled in an introductory pattern development course in the Clothing & Textiles department. The experimental group received the CAI treatment while the control group received the laboratory treatment. The performance of both groups was measured on the pretest and the posttests. All the data collected were coded with the use of the Statistical Analysis System (SAS). Descriptive statistics were used to summarize the characteristics of the data. Two-sample and paired-comparisons T tests were performed for hypotheses one and four. A 2x2 analysis of covariance (ANACOVA) with a single covariate (pretest) was selected for statistical analyses of data for each of hypotheses two and three.

Results of the T test demonstrated no statistically significant difference in the mean test scores between the CAI and the laboratory groups. That is, insufficient evidence was found to reject the hypothesis that there was no significant relationship between mode of instruction and student achievement. The findings indicated that either approach was successful in producing student gain in learning, as student performance on the posttest measures was significantly higher than that at pretesting. Moreover, significant difference was found between student performance on the practical posttest I and that on the written posttest II.

The findings of ANACOVA failed to reject the hypothesis about no interaction effect on student achievement between mode of instruction and student experience in pattern development and clothing construction. None of the above explanatory variables, the covariate (pretest), and their interactions was found statistically significant. That is, neither approach was more attractive when the students were separated according to their level of experience. For hypothesis three, all the F values assessed by ANACOVA for the posttest scores revealed the interaction of instructional mode and past academic performance did not display significant effect on student achievement. Thus, the findings failed to reject hypothesis three. For the last hypothesis, results of the T test, again, suggested no significant difference between high and low computer experience level in the achievement of subjects using CAI. That is, when aggregated according to the level of computer experience, these two groups of students who participated in the CAI group performed equally well in statistical terms.

Implications for Practice

Computer Assisted Instruction can be a viable teaching tool if used correctly by the instructor. As both the CAI and the laboratory approaches were found to be effective in teaching pattern development, instructors should not hesitate in adopting CAI in instruction. As an alternative to using the computer for the full duration of a course, instructors could consider using the computer in a session of a course to supplement students' learning of certain topics of pattern development or apparel design. Computer tutorials like the one used in this study would assist instructors on certain topics in a course while providing students a chance to have hands-on experience with the computer and to interact with other students during the learning process. With the aid of appropriate teaching manuals, the computer could be programmed to take over the role of teaching certain topic areas. Instructors are then free to tackle problems that student might encounter in learning the subject or to spend more time on other aspects of the course. Thus, instruction could become more efficient with the appropriate use of the computer in teaching. Computer Assisted Instruction could also improve uniformity of instruction, which is essential for beginning courses and for multi-teacher courses in which the effectiveness of instruction varies heavily with different instructors.

Depending on the area of discipline and objectives of a course, a computer tutorial of this kind might be expanded to replace regular course materials for the full duration of a course. In such a case, a textbook would be helpful to supplement the computerized instruction a student has to follow during the course.

Yet, with these implications of CAI, instructors should avoid basing their decisions of computer usage or purchases on the achievement gains of students. As CAI was not found to be superior to other teaching techniques for this subject, instructors should determine the use of computer by considering factors such as courseware, student learning time with the use of CAI, student gains in terms of computer literacy or cost efficiency of employing different instructional methods. More attention should be given to matching the teaching technique with the needs of the students and studying various attributes of the technique in achieving learning gains.

Recommendations for Further Research

It is recommended that future research should investigate attributes of teaching media that contribute to student learning. As no significant differences in student achievement were found between the two instructional techniques used in the study, researchers should focus their research to studying the attributes of the individual instructional technique and how these attributes can be strengthened to improve learning. With the recent integration of the computer in the apparel design curricula, more attention should be given to study the characteristics of CAI and their effect on the learning process and/or student knowledge of the CAD systems. Whether further media comparison research between CAI and other teaching medium is recommended, it should be understood that the success of the research is contingent upon the area of discipline to be studied. It would also be of interest to investigate factors that determine the use of computers in education. Factors such as cost efficiency, frequency of student use, courseware (content and program strategy), student learning time and student benefits in computer literacy can also be elaborated in future studies.

Upon investigating different attributes of CAI that would contribute to learning, future research could focus on integrating a computer tutorial in the regular course activities and utilizing the regular examinations for achievement measures. If the experiment could be run through the full duration of the course, attitudinal data may be collected at multiple points in time to determine the temporal relation of student achievement to the explanatory variables. Another point of interest would be to use the computer as a routine element for instruction by covering more topics in a regular course of pattern development. Here, further research may be conducted to find out whether student performance or interest in the course would diminish as the computer becomes a routine element of the course structure.

An increase in sample size is also recommended to increase the power of statistical analyses for the study. Instead of having students in a pattern development course participate in the study, the sample might be increased to include all clothing and textiles sophomores and juniors. As subjects are not drawn from those enrolled in a particular course, this sampling procedure would eliminate subjects who are not Clothing and Textiles majors such as the Comprehensive students who participated in this study. Thus, those Clothing and Textiles students who might not major in apparel design could also be studied.

BIBLIOGRAPHY

Apple, M. W. (1982). Education and power. London: Routeledge & Kegan Paul.

Autodesk, Inc. (1987). AutoCAD reference manual. (Publication TD 106-009). Sausalito, California: Author.

Bork, A. (1980b). Preparing Student-computer dialogs: Advice to teachers. In R. Taylor (Ed.), The computer in the school: Tutor, tool, and tutee (pp. 15-52). New York: Teachers College press.

Brandi, B. D. (1978). Development and evaluation of a set of self-paced instructional materials for selected fundemental construction skills. U.S.A.: The Florida State University.

Bovy, R. C. (1981). Successful instructional methods: A cognitive information processing approach. Educational Communication and Technology Journal, 29(4), 203-217.

Campbell D. T., & Cook T. D. (1979). Quasi-experimentation design and analysis for field settings. Boston: Houghtton Miffin Co.

Campbell, D. T., & Stanley, J. C. (1966). Experimental and quasi-experimental designs for research. Chicago: Rand McNally College Publishing Company.

Cavin, C. S., Cavin, E. D., & Lagowski J. J. (1981). The effect of computer-assisted instruction on the attitudes of college students toward computers and chemistry. Journal of Research in Science Teaching, 18(4), 329-333.

Cavin, C. S., Cavin, E. D., & Lagowski, J. J. (1979). The use of computer-assisted instruction to provide optional assistance to students. Educational Technology, 19(6), 42-45.

Clark, R. E. (1983). Reconsidering research on learning from media. Review of Educational Research, 53(4), 445-459.

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

Cohen. J. (1977). Statistical power analysis for the behavioral sciences. New York: Academic Press.

Dennis, J. R. (1979b). Tutorial instruction on a computer. Series on Educational Applications of Computers. Vol. 6e. Urbana, IL.: College of Education, University of Illinois.

Dick, W., & Carey, L. (1985). The systematic design of instruction. England: Scott, Foreman and Company.

Dreyfus, H. H. (1979). What computers can't do. (2nd Ed.). New York: Harper & Row.

Eisenberg, Y. (1986). The effects of computer-based instruction on college students' interest and achievement. Educational Technology, 26(4), 40-43.

Ellinger, R. S., & Frankland, P. (1976). Computer-assisted and lecture instruction: A comparative experiment. The Journal of Geography, 75, 109-120.

Gardner, H. (1983). Frames of mind: The theory of multiple intelligences. New York: Basic Books.

Greene, M. (1982b, October). The University of the Public. Lecture given at the Pennsylvania State University, University Park, P.A..

Hatfield, L. L. (1969). Computer assisted mathematics: An investigation of the computer used as a tool to learn mathematics. Unpublished doctoral dissertation, University of Minnesota, Minneapolis.

Heisey, F. (1984). The future of apparel production and construction. Journal of Home Economics, 76, 8-13.

Jamison, D., Suppes, P., & Wells, S. (1974). The effectiveness of alternative instructional media: A survey. Review of Educational Research, 44, 1-61.

Jenkins, T. M., & Dankert, E. J. (1981). Results of a three-month PLATO trial in terms of utilization and student attitudes. Educational Technology, 21, 44-47.

Judd, W. A., Bunderson, C. V., & Bessent, E. W. (1970). An investigation of the effects of learner control in computer-assisted instruction prerequisite mathematics. (Tech. Rep. No. 5). Austin: University of Texas, Computer Assisted Instruction Laboratory.

Kallal, M. J., & Fraser, A. (1984). Computer-aided apparel design as an integral component of apparel design programs: Justification and implementation. ACPTC Proceedings: Combined Central, Eastern, and Western Regional Meetings, 113.

Kinsner, W., Pear J. J. (1988). Computer-aided personalized system of instruction for the vitual classroom. Canadian Journal of Educational Communication, 17(1), 21-36.

Kosh, K. (1988, February). No miss with MIS. Bobbin, 34-43.

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

Lai, C. M. J., & Snell, S. A. (1988). Computer-aided design: The development of a design library to highlight visual effects of height and width in dress design.

Unpublished manuscript, University of Manitoba, Winnipeg.

Lang, C. R. (1976). Computer graphic simulations in high school physics. Unpublished doctoral dissertation, Kansas State University, Kansas.

Larsen, R. E. (1985). What communication theories can teach the designer of computer-based training. Educational Technology, 25(7), 16-19.

Lee, A. L. M. (1973). A comparison of computer-assisted instruction and laboratory instruction in a undergraduate geology course. Dissertation Abstracts International, 34, 2273A.

Lichtenwalner, M., & Heisey, F.(1987). Learner characteristics of students in a self-instructional course of basic clothing construction. ACPTC Proceedings: Combined Central, Eastern, and Western Regional Meetings, 47.

Mathis, A., Smith, T., & Hansen, D. (1970). College Students' attitudes toward computer-assisted instruction. Journal of Educational Psychology, 61, 46-51.

Miller, P. B., & DeJonge, J. (1987, February). University explodes computer aided design by microcomputer. Bobbin, 127-128.

Miller, P. B., & Racine, A. (1988, September). Less means more in CAD. Bobbin, 30(1), 222-226.

Nunan, T. (1983). Countering educational design. New York:Nichols Publishing.

O'shea, T., & Self, T. (1983). Learning and teaching with computers. Englewood Cliffs, NJ: Prentice-Hall.

Pickrell, J. (1989, February). Pattern maker using CAD for theatrical costume design. CADalyst, 30-33.

Reich, N. A. (1971). Development and evaluation of a self-instructional programmed course in basic clothing con-struction at the college level. U.S.A.:

The Pennsylvania State University.

Scientific laboratory instruction.(1985). The International Encyclopedia of Education. Great Britain: A. Wheaton & Co. Ltd..

Shim, S. Y. (1984). The future of retailing: Implications for textiles and clothing curriculum. Clothing and Textiles Research Journal, 2(2), 6-7.

Skinner, M. E. (1988). Attitudes of college students toward computer-assisted instruction: An essentrial variable for successful implementation. Educational Technology, 28(2), 7-15.

Staff. (1987, Septemter/October). Automation is the salvation of family business. Canadian Apparel Manufacturer, 4-6.

Stowe, B. S. (1984). Textiles and clothing - Our future: where from here? ACPTC Proceedings - Combined Central, Eastern, and Western Regional Meetings, 92-95.

Streibel, M. J. (1986). A critical analysis of the use of computers in education. Educational Communication and Technology, 34 (3), 137-61.

Terry, L. M., & Offerjost, J. L. (1984). Micro-computer-assisted instruction on color concepts for apparel. ACPTC Proceedings- Combined Central, Eastern, and Western Regional Meetings.

Tuckman, B. W. (1972). Conducting educational research. U.S.A.:Harcourt Brace Jovanovich, Inc.

Van De Bogart, W. (1988, February). Designing for the times. Bobbin, 58-64.

Walizer, M. h. & Weiner P. L. (1978). Research methods and analysis searching for relationships. U.S.A.: Harper & Row, Publishers, Inc.

Williams, H. D. (1988, October). Topics in Curriculum: Mathematics and Natural

Science. Lecture given at the University of Manitoba, Winnipeg.

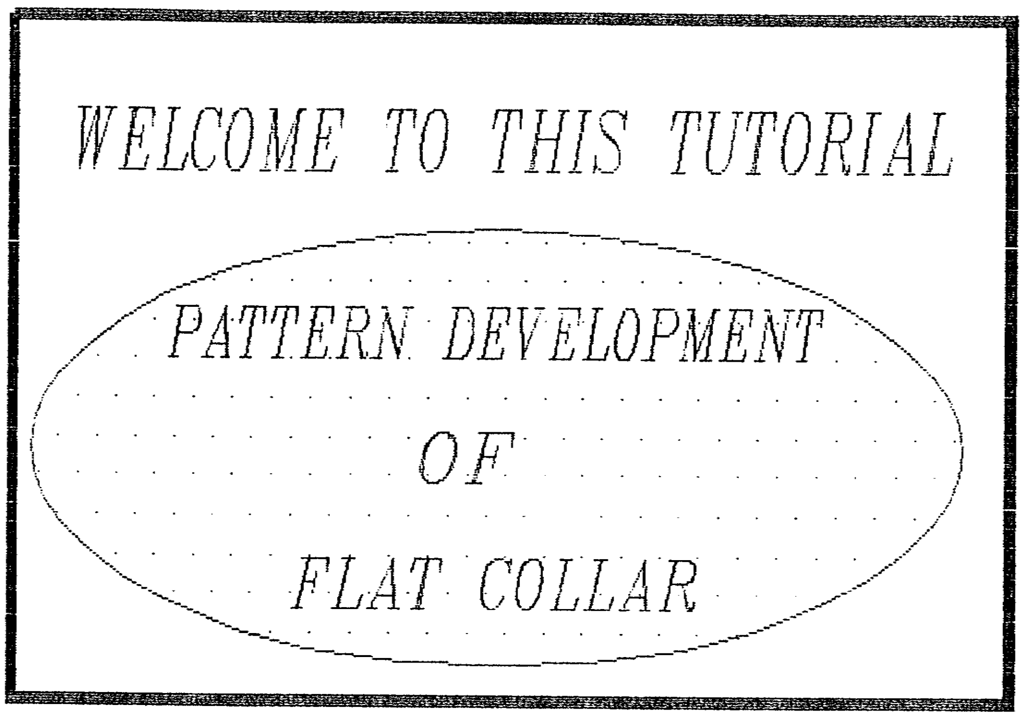
Wilson, D. (1987, June). PCT & S gives quick responses to CAD. Bobbin, 171-173.

Woodson, E. M. (1983). Basic patterns via the micro computer. ACPTC Proceedings: Combined Central, Eastern, and Western Regional Meetings, 80.

Appendix A

Computer Tutorial Program

Frame 1



Frame 2

OBJECTIVE

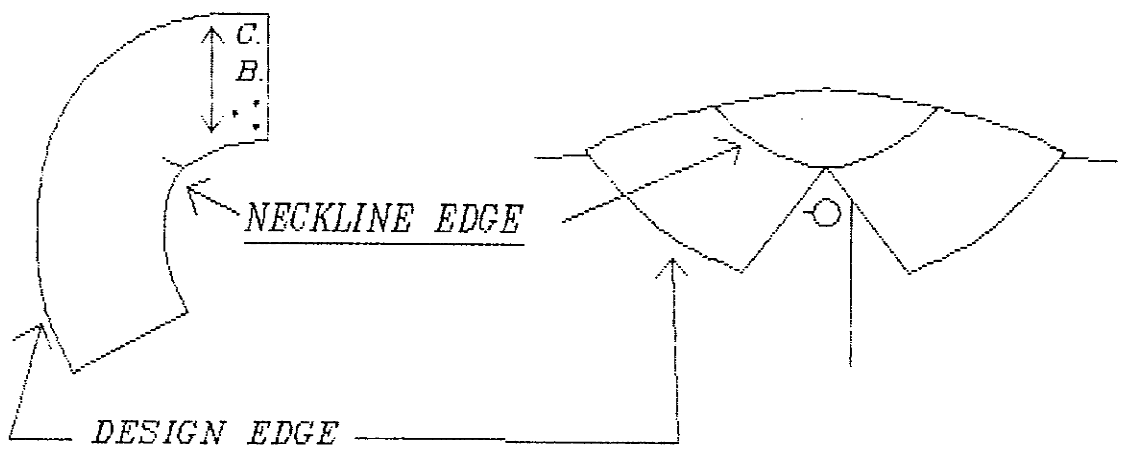
After you complete this tutorial, you will be able to:

1. *identify collar types,*
2. *identify collar styles,*
3. *learn how to develop flat collar patterns,*
4. *develop your own flat collar pattern.*

You are ready to accomplish this tutorial.
Press Y to continue.

Frame 3

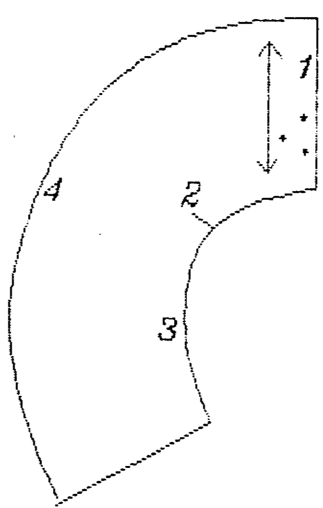
These terms are referred to during the tutorial. It is important for you to know:



C.B.	Center Back
↕	Grainline
—	Crossmark at shoulder
∴	Place on fold of fabric

Frame 4

Match the numbers shown on the flat collar pattern with the terms given.



______ Neckline edge

______ Center back

______ design edge

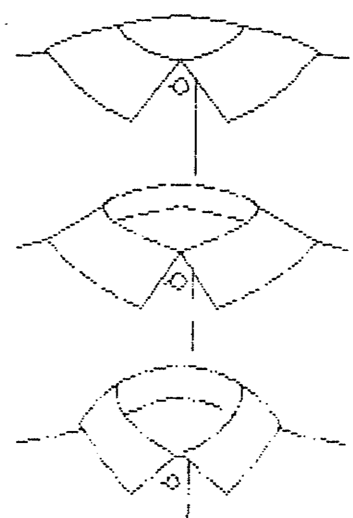
______ Shoulder crossmark

Frame 5

SECTION 1 COLLAR TYPES

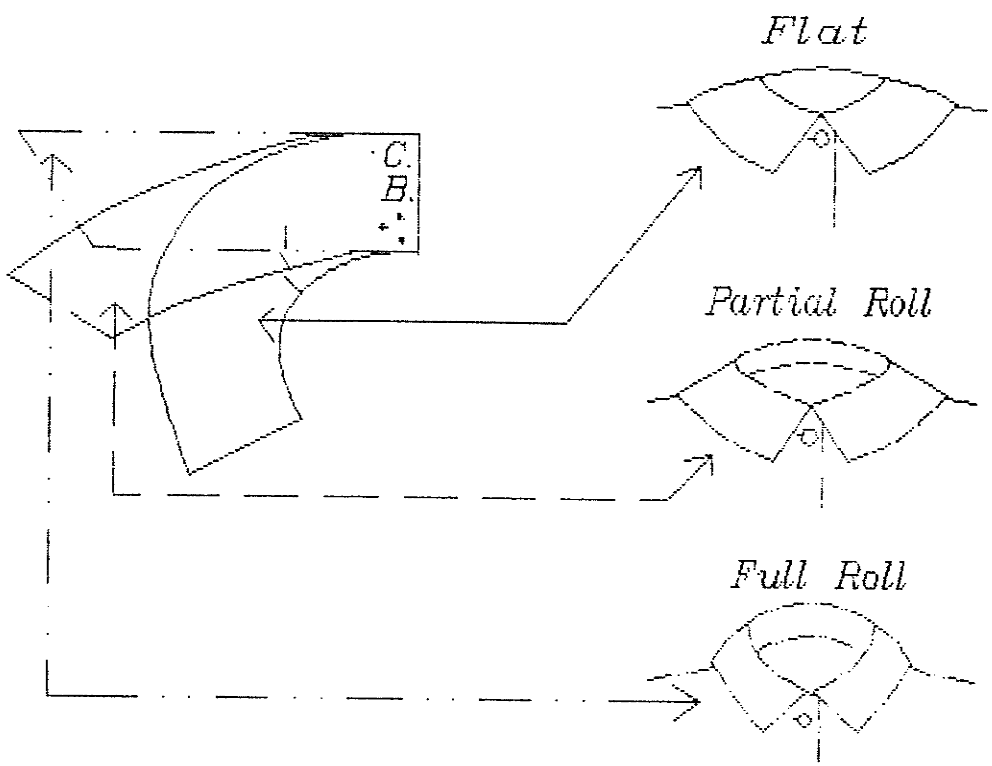
The three basic collar types are:

1. *Flat*
2. *Partial Roll*
3. *Full Roll*



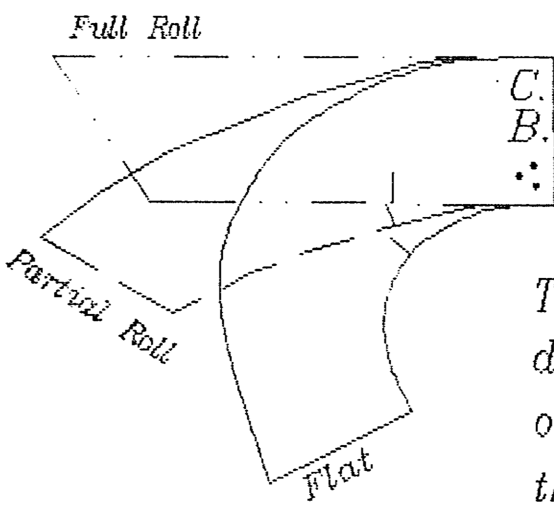
Type refers to collar classification according to the SHAPE of the NECKLINE EDGE.

Frame 6



These are the patterns of the 3 collar types.

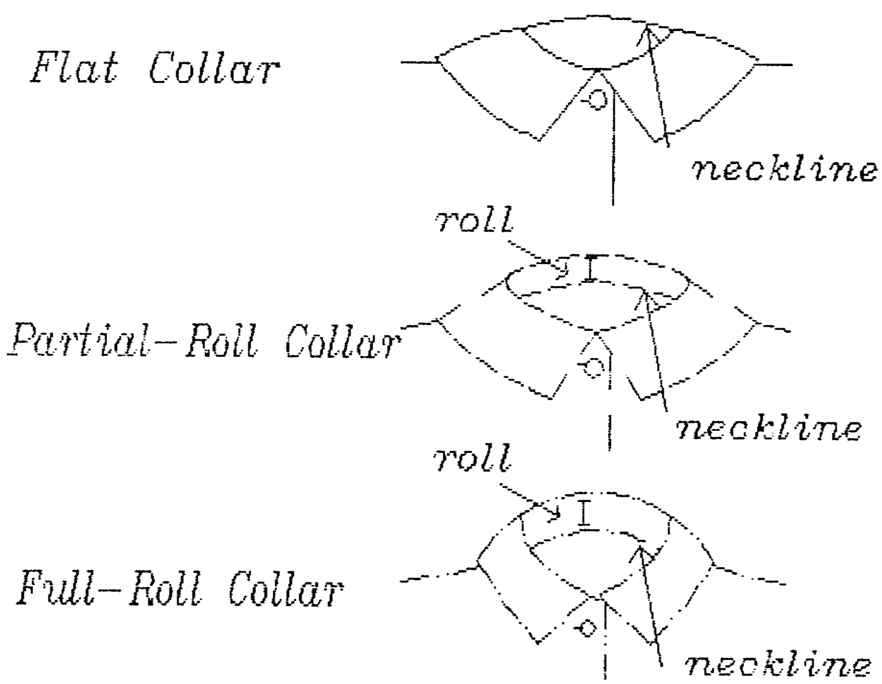
Frame 7



The SHAPE of the NECKLINE EDGE determines the amount of ROLL of the collar. The diagram shows the relationship between the NECK-LINE shapes of the 3 collar types when they are the same width and are matched at center back.

Frame 8

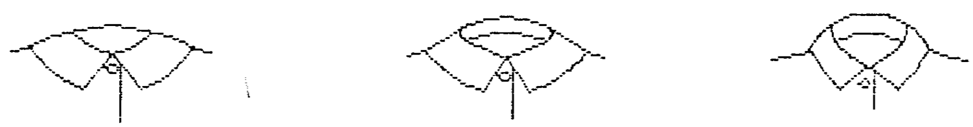
RULE:
The straighter the neckline shape of the collar, the greater the amount of roll.



Frame 9

Please complete the following questions:

1. *Name the following collar types.*



a. ______ *b.* ______ *c.* ______

2. *Which collar type has the straightest neckline edge?* ______

3. *Which collar type has the least amount of roll?* ______

4. *What determines the amount of roll of a collar?* ______

Frame 10

CONGRATULATIONS! You have completed Section 1!

Please proceed to Section 2.

Frame 11

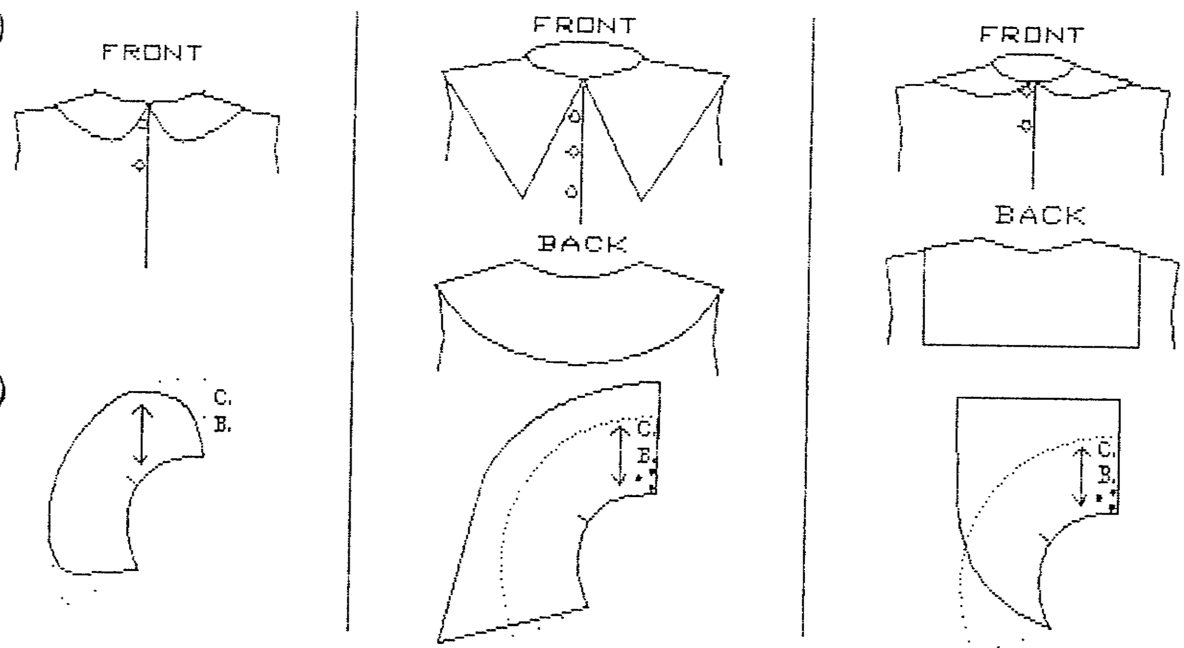
SECTION 2 -- COLLAR STYLES

Collar style relates to the shape of the design edge.

Examples of some collar styles made from the basic flat collar (A) and their respective patterns (B) are shown as follows:

Frame 12

(A)



(B)

Dotted lines in (B) indicate the original flat collar pattern.

NOTE: The neckline edge of the pattern is the same, but the shape of the design edge is changed.

Frame 13

Please complete the following sentence:

Collar style relates to ________________

____.

Frame 14

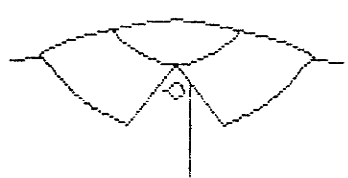
CONGRATULATIONS! You have completed Section 2!

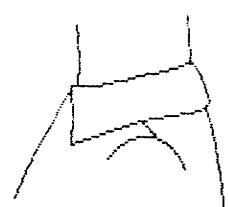
Please proceed to Section 3.

<u>Frame 15</u>

<u>SECTION 3</u> -- <u>HOW TO MAKE THE FLAT COLLAR PATTERN</u>

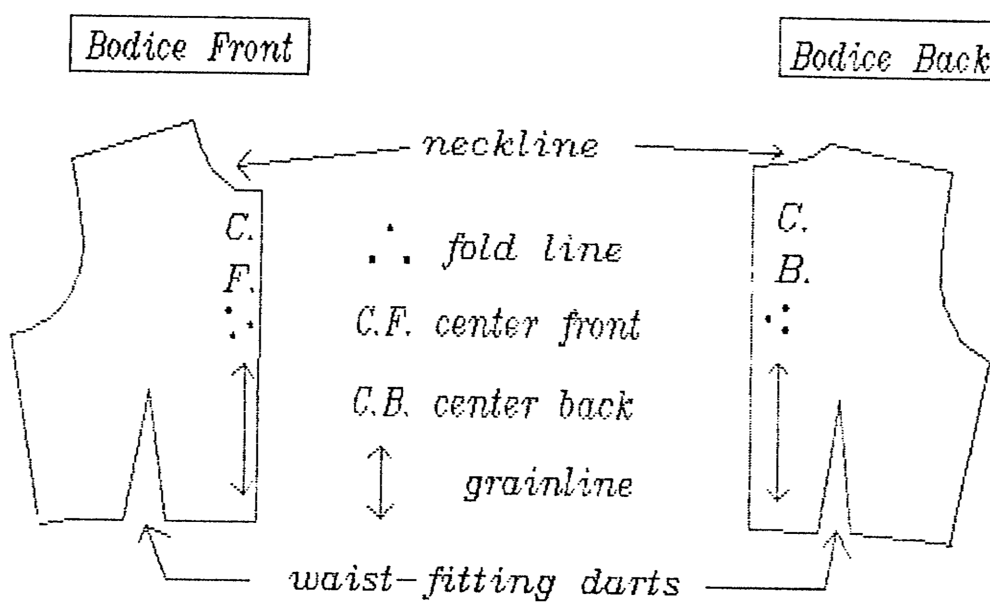
The <u>flat collar</u> almost duplicates the neckline area of the bodice pattern. It has <u>very little or no roll</u>.





Frame 16

The basic bodice front and back patterns are used to develop the Flat Collar pattern.



Frame 17

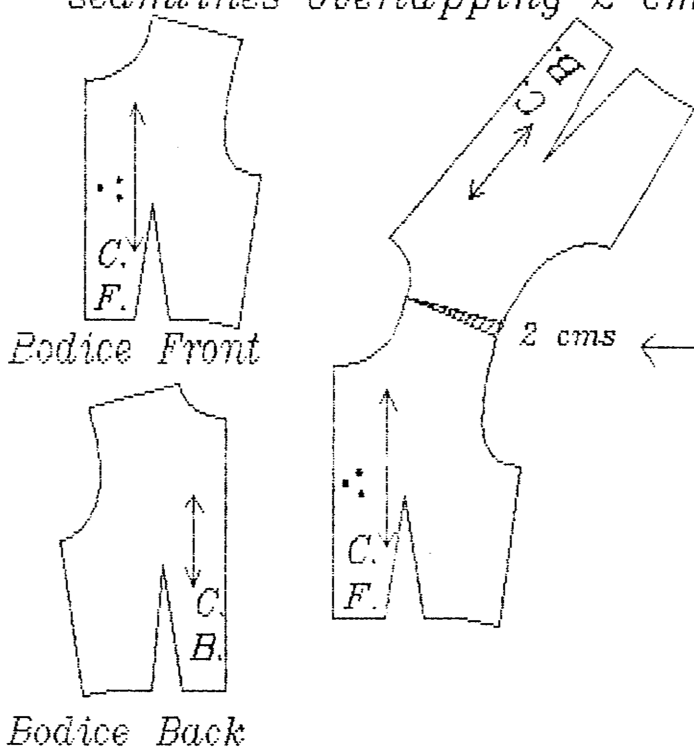
Here are the steps to follow in developing patterns for the Flat Collar.

*****

Please read the steps carefully.

Frame 18

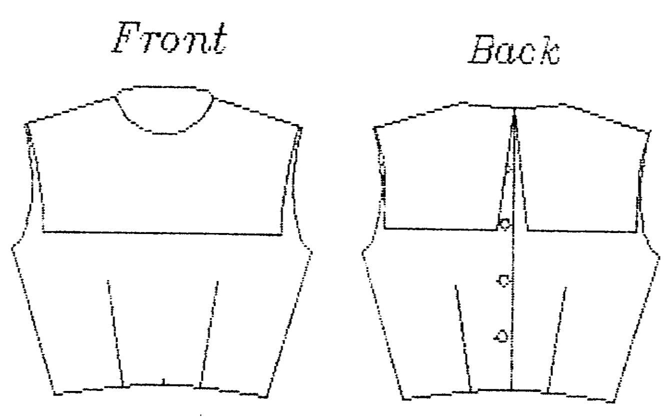
1. *Join bodice front and back patterns meeting at neckline point (as shown) with shoulder seamlines overlapping 2 cms at armhole.*



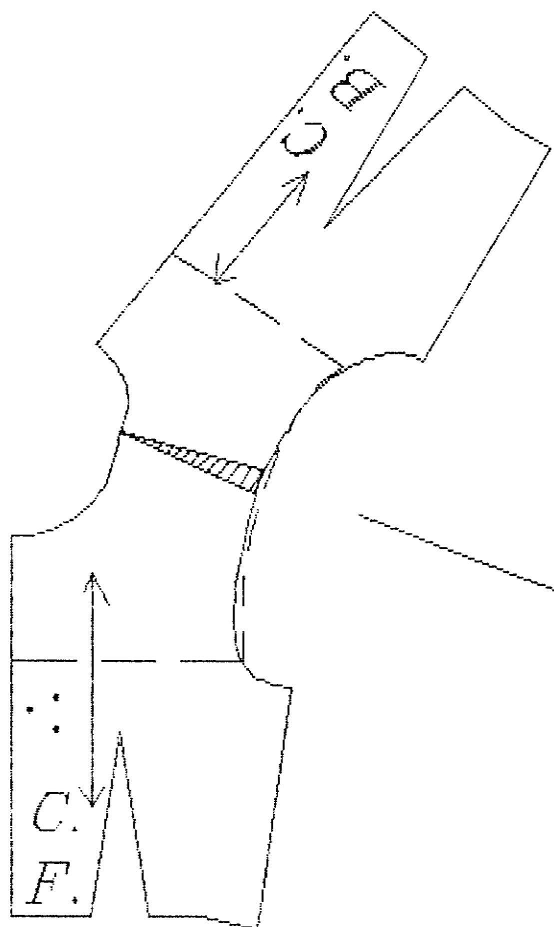
Overlapping shoulder seamlines 2 cms at armhole straightens collar neckline curve. This creates a very slight roll to give a smooth fit.

Frame 19

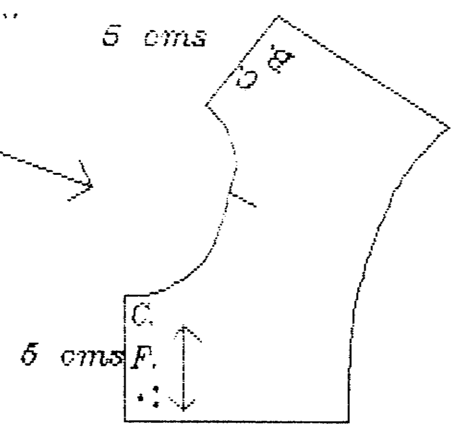
2. Observe the design edge of the collar that is being developed.



Frame 20

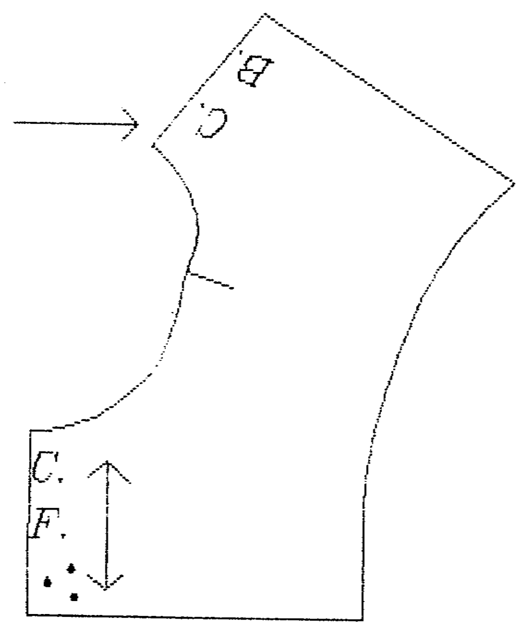


3. *Trace neckline from center front to center back.*
4. *Draw design edge of collar as shown (measure 5 cms down from C.F. & C.B. in this example).*
5. *Crossmark at shoulder.*
6. *Place C.F. on fold.*
7. *Establish grainline parallel to C.F..*



Frame 21

This is the pattern for the collar design shown in step 2.



Seam allowance (S.A) is required to complete the pattern. (However, adding S.A. will not be introduced here.)

Frame 22

CONGRATULATIONS ! You have completed Section 3!

Now comes the most fulfilling part of this tutorial!!

Frame 23

* * * * * * * * * * * * * * * * * * *

Prior to developing your own pattern, you are encouraged to review some of the previous frames.

* * * * * * * * * * * * * * * * * * *

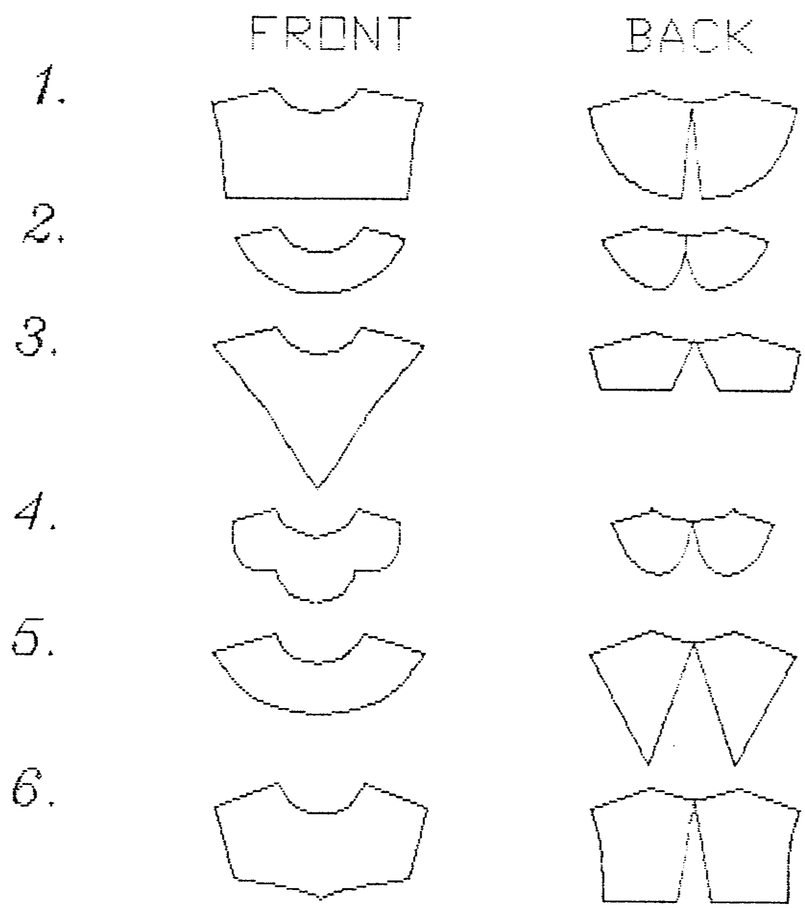
Frame 24

SECTION 4 -- MAKE YOUR OWN PATTERN

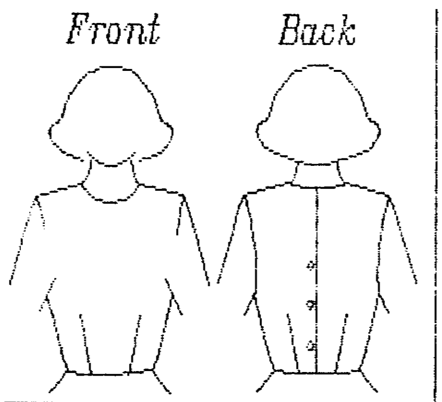
Please select one collar style that you would like to work on from the following icons:

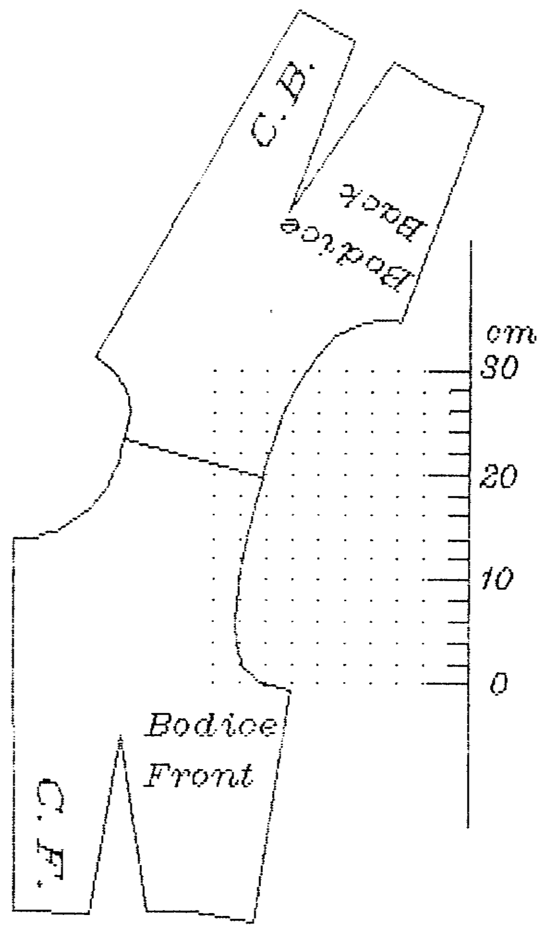
(Pick the number of the collar design you like.)

Frame 25



Frame 26





Use the bodice front & back patterns to develop a pattern for the collar style you select.

Submit a printout copy of this page to your lab tutor.

Frame 27

CONGRATULATIONS!

Now, you have:

a) a basic knowledge of the concepts and principles for the development of the flat collar pattern,

b) the skill to develop the flat collar pattern.

THANK YOU FOR YOUR PARTICIPATION !!

Appendix B

Instructional Design of Study Tutorial

A. Instructional Goal of the Tutorial or Laboratory

To acquire a basic knowledge of specific pattern development concepts and principles; and given a bodice front and a bodice back pattern, students in both groups will develop correctly a pattern for a specific style of flat collar.

B. Instructional Analysis

The first step in instructional analysis of a goal is to classify the goal statement according to the kind of learning that will occur (Dick & Carey, 1985). The goal involved in this design was hierarchical since it was an intellectual problem-solving skill. In order to learn how to perform problem-solving skill, the learner must first know the rules that are to be applied in the problem-solving situation. To learn the relationship among "things", the subordinate skills required for any given rule are typically the concepts that are used in the rules. Finally, the learner must be able to discriminate whether a particular example is relevant to the concept. The second step involves identifying and sequencing the major steps required to perform the goal. Figure B-1 outlines the major steps and sequence for reaching this instructional goal.

Instructional Goal

Given a bodice front and a bodice back pattern, develop correctly patterns for a specific style of flat collar.

Step 1
Select a Flat Collar style

Step 2
Rotate bodice back so B.F.&B.B. are overlapped at shoulder seam

Step 3
Draw neckline & design edge of collar

Step4
Label pattern

Principle 1
Know why overlapping patterns at shoulder seam is important

Principle 3
State relationship between neckline edge shape & amount of roll

Principle 4
Shape of design edge and neckline edge of flat collar

Term 3
Identify labels on collar pattern (also on B.F.,B.B. as in Term 1)

Principle 2
must use bodice front & back patterns for flat collar pattern development

Concept 3
Define flat collar

Term 1
Recognise/Identify terms that appear on B.F.&B.B. patterns

Concept 1
Define collar types

Concept 2
Define collar styles

Term 2
Identify neckline edge, design edge of collar

Figure B-1. Hierarchical analysis of a problem-solving goal

The hierarchical approach asks the question: "what does the student already need to know so that, with a minimal amount of instruction, the task can be learned?" (Dick & Carey, 1985, p.48). Figure B-1 demonstrates the intellectual skills subordinate to steps 2, 3, and 4 in the psychomotor skill of correctly developing patterns for the flat collar. There were no other relevant skills that the learner must master before continuing the instruction.

C. Performance / Bahavioral Objectives (Table B-1)

A performance objective is a detailed description of what a student will be able to do when they complete a unit of instruction. There are two types of performance objectives:

a)subordinate objectives - that pave the way to the achievement of the terminal objective;

b)terminal objective - refers to the instructional goal converted into an objective.

The terminal objective in this instructional design was:

"Given a bodice front and a bodice back <u>on the terminal</u> <u>(or in a laboratory situation)</u>, develop a pattern for a style of flat collar you (the student) select. Overlapping at the shoulder seam must be done; the shape of the neckline edge and design edge must be identical to the illustration; and the pattern developed must be labeled correctly.

D.Criterion-Referenced Test Items

Criterion reference test is composed of items that directly measure the behavior described in a given set of behavioral objectives. In this instructional design, three tests - pretest, embedded test, and posttest - were used to measure the objectives taught in the instructional program. The pretest measured those skills that were going to be taught to determine how much prior knowledge students had of what was to be taught. The embedded tests helped students practise knowledge gained, perhaps with no feedback, as they were tested after instruction on an objective and prior to the posttest. The posttest will also assessed all the objectives. The purpose of the posttest was to help the designer identify the areas of instruction that were not working. In this study, the formats of the pretest and the posttest varied slightly. To control any correlation between the two tests, the test items in the two tests were slightly different and one more question was given in the posttest (Table B-1).

The pretest given before instructions are presented will address four objectives (3.21 - 3.41 in Table B-1):

i) define collar type;
ii) define collar style;
iii) define flat collar;
iv) state the relationship between neckline edge shape and amount of roll of collar.

The two posttests, the practical pattern development test and the written posttest, covered eight objectives (2.3 - 4.1 in Table B-1). The practical test was administered mainly to cover the terminal objective.

Table B-1. Terminal and Performance Objectives

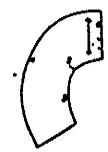
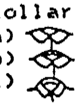
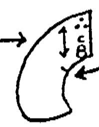
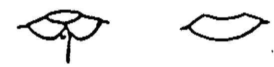
Subskill	Performance Objective	Test Item	
		Embedded Test	Pretest / Posttest
2.1 Recognise terms that appear on B.F. & B.B.	Able to recognise terms that appear on bodice front & back patterns		
2.2 Know to use bodice front & back patterns for flat collar pattern development	Are aware of using bodice front & back patterns for flat collar pattern development		
2.3 Know why overlapping patterns at shoulder seam is important	Given a question asking why overlapping must be done, students' answer should include: overlapping shortens the design edge, cause small amount of roll for the turn at the neckline.		2.3 State the reason for overlapping shoulder seamlines of Bodice front & back at the armscye when developing patterns for the flat collar
3.1 Identify neckline edge & design edge of collar	Given a flat collar pattern, students are asked to label it correctly.	3.1 Match the numbers shown on the flat collar pattern -->	 __ Design edge __ Neckline edge __ Center back __ Shoulder crossmark
3.2.1 Define collar types	Identify 3 collar types correctly and define 'collar type' in your own words. Definition must include collar classification according to the shape of neckline edge.	3.2.1 Name the following collar types: a) b) c) 	3.2.1 a)Define 'Collar Type' b)What are the basic collar types? (cont'd 3.4.1)
3.2.2 Define collar styles	In your own words, define 'collar style', the definition must include the 'shape of the design edge'.	3.2.2 Complete the following sentence: Collar style relates to ______________.	3.2.2 Define 'Collar Style'
3.3 Define flat collar	In your own words, write a definition of flat collar, which should include: lies flat on the bodice / little or no roll or stand; and almost a duplicate of neckline area of the bodice.		3.3 Define 'Flat Collar' (cont'd 3.4.2)

Table B-1 (cont'd)

3.4.1 State relationship between neckline edge shape & amount of roll of collar	(Embedded) Given 3 questions asking about the shape of neckline edge & amount of collar roll, the students' responses for each question should be: i) full-roll, ii) flat, iii) shape of neckline edge. (Pre-/Posttest) Given a question asking students to describe each collar type with respect to the neckline edge & amount of roll, answers should include: full-roll - straightest neckline and greatest roll; partial - medium curve (concave), medium roll ; flat - deepest curve, least roll.	3.4.1 i) Which collar type pattern has the straightest neckline edge? ii) Which collar type has the least amount of roll? iii) What determines the amount or roll of a collar?	3.4.1 Describe each collar type in terms of: - the shape of neckline edge; - the amount of roll.
3.4.2 Know the shape of design edge & neckline edge of flat collar pattern	Given a peter pan collar, draw a flat collar pattern, which should be fully & correctly labeled, with all indication of both the neckline & design edge location. 		3.4.2 In the space below, draw and label a basic peter pan collar pattern. Indicate also the neckline edge and the shape of collar. front back 
4.1 Identify labels on collar pattern	Students are able to label a collar pattern. (This objective can be achieved by test item in 3.4.2.)		

Instructional Goal	Terminal Objective	Test Item (Posttest)
The correct development of patterns for a specific style of flat collar	Given a bodice front & back, develop a pattern for a style of flat collar. Overlapping at the shoulder seam must be done; the shape of the neckline & design edges must be correct; and the pattern developed must be labeled correctly.	Use the bodice front & bodice back patterns provided to develop a pattern for the collar style you select

Tutorial Manual

PATTERN DEVELOPMENT OF FLAT COLLAR

Key to the Instructions:
UPPER CASE & underlined means type in.
lower case & underlined means hit the middle button on the mouse
and pick from the pull-down tool menu.
/ means hit the return or enter key.
Mouse - As you move a mouse around the tabletop, crosshairs
track its movement on the screen.
Hit the left button on the mouse to select the point
at which the crosshairs are positioned.
Hit the right button on the mouse to return.

Starting the Program

To start a new drawing, type in the followings:
1 /
A: (type in your last name) /

Once inside the drawing file, type in the following commands:

(LOAD "SLIDE") /

SLIDE /

(Type in your first name) /

Section 1 - Section 3

Instructions to complete the first three sections of the tutorial will appear at the prompt line. All you need to do from this point on is follow the prompt line.

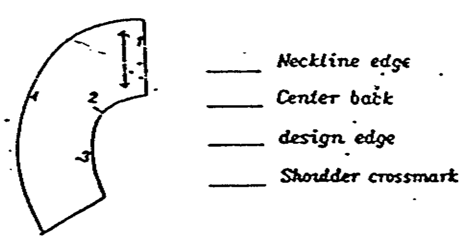
For example, after viewing a slide, you are asked to:

Type in <Y> when ready to continue to next slide: Y /

(here, type in Y and hit the return key.)

*Note that questions will be asked in the tutorial to check if you understand the material as you proceed. Read the directions that appear at the prompt line before entering your answers. An example is given below:

Match the numbers shown on the flat collar pattern with the terms given.



Enter number for neckline edge: (type in a number)

Key to the Instructions:
UPPER CASE & underlined means type in.
lower case & underlined means hit the middle button on the mouse and pick from the pull-down tool menu.
/ means hit the return or enter key.
Mouse - Hit the left button on the mouse to select the point at which the crosshairs are positioned.
Hit the right button on the mouse to return.

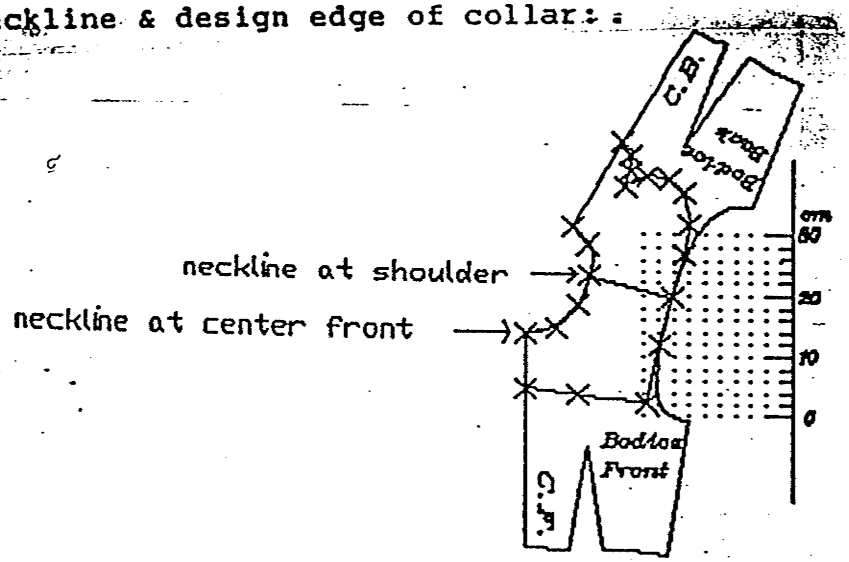
Section 4 - Make Your Own Pattern

You are provided with the bodice front and back patterns on the last slide of Section 4, use the commands given below to develop a pattern for the flat collar style you select.

Overlapping shoulder seam:
At the command prompt, type
ROTATE / (select object) pick bodice back / (base point) pick endpoint (from the pull-down menu), pick neckline at shoulder, (rotation angle) -8 /

(By rotating Bodice Back at -8 , shoulder seamlines are overlapped by 2 cms at armhole.)

Tracing neckline & design edge of collar:



LINE / pick endpoint, pick neckline at Center Front (as your starting point), ... /

(...... - starting from the neckline point at C.F., use LINE to trace front and back collar, i.e. trace around neckline in small segments (especially when you are working on curves), the design edge of the selected collar style, and hit the return key when finished.)

REDRAW /

Crossmarking at shoulder:
LINE / pick neckline at shoulder, pick to right of the last point (to form a crossmark) /

Labelling pattern:
MOVE / Window (to include the entire collar pattern) / (first corner) pick left of collar design edge at C.F., (other corner) pick right of back armscye / (base point) pick neckline at shoulder, (drag the mouse across to left of bodice back until you have enough space for displaying the pattern) pick a point to left of bodice back

Label the pattern correctly by inserting the labels given below. Repeat the INSERT command for each label:

INSERT / (type in label [or block] name as given below) / (insertion point) pick the appropriate point on the pattern / / /

		label [or block] names
1.	c f	centrefr
2.	↕	grline
3.	∴	fold

Submitting a printout copy:
SAVE / /

PRPLOT / DISPLAY / / /

THANK YOU FOR YOU PARTICIPATION!!!

Appendix D

Entry Behavior Test

Name: ________
Year: ________
Major: ________
Sex: ______
Tel.# ________

Please complete the following questions:

Part I

1. Do you have any sewing experience? Yes ____ No ____

2. If yes, how long have you been sewing? _______________

3. Have you ever made any garments? Yes ____ No ____

   If yes, how many? ____ Specify garment type: ______________

4. Have you ever tried to design a pattern? Yes ____ No ____

   If yes, how many patterns? ________________

5. Have you ever tried to alter commercial patterns? Yes __ No __

   If yes, how many commercial patterns? _____________

5. How would you rank yourself in terms of your pattern design skills?
   High level ______ Low level ______

Part II

1. Have you ever used the computer for:
   (check as many uses in your experience)
   ____ (a) word processing
   ____ (b) communication (sending messages around)
   ____ (c) computer games
   ____ (d) spread sheets
   ____ (e) educational microcomputer program (e.g. drill & practice, tutorial, or simulation, etc.)

2. Have you ever taken any course in computer science?
   Yes ____ No ____
   course name: __________________
   high school level ________ university level ________

3. Have you ever written a computer program? Yes ____ No ____

4. How would you rank yourself in terms of your computer experience level?
   High level ______ Low level ______

Pretest

TEST I

Complete the following questions:

1. What does the term "Collar Type" mean?

2. What are the basic collar types?

3. Describe each collar type in terms of
   (a) the shape of neckline edge;
   (b) the amount of roll of collar.

4. What does the term "Collar Style" mean?

5. Define "Flat Collar".

6. Have you read any specific information on designing collars during the past year? Yes ____ No ____

Appendix F

Posttest II

TEST II

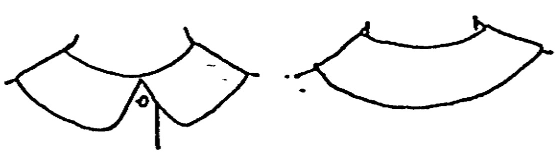
Complete the following questions. Submit this test to your lab. instructor when finished.

1. What are the basic collar types?

2. Describe each collar type in terms of
   (a) the shape of neckline edge;
   (b) the amount of roll.

3. Distinguish between Collar Type and Collar Style.

4. In the space below, draw and label a basic peter pan collar pattern. Indicate both the neckline edge and the design edge.
   Front Back



5. State the reason for overlapping shoulder seamlines of bodice front and bodice back at the armscye when developing patterns for the flat collar.

7. Apart from what you learned in this study, have you read any specific information on designing collars during the month of September? Yes __________ No __________

8. Define 'flat collar'.

Instructional Evaluation Form

Instructional unit completed: Computer Tutorial ________
Laboratory ________

Circle the appropriate number(s) to indicate your agreement or disagreement with each statement.

1 -- Strongly Disagree
2 -- Disagree
3 -- Undecided
4 -- Agree
5 -- Strongly Agree

Computer Tutorial

1. The computer tutorial is an appropriate instructional technique for the subject matter.

   1 2 3 4 5

2. The computer tutorial is a valuable learning tool.

   1 2 3 4 5

3. I prefer computer tutorials to other instructional procedures.

   1 2 3 4 5

4. More courses should be taught using computer tutorials in the C & T department.

   1 2 3 4 5

Laboratory

1. The laboratory is an appropriate instructional technique for the subject matter.

   1 2 3 4 5

2. The laboratory is a valuable learning tool.

   1 2 3 4 5

3. I prefer laboratories to other instructional procedures.

   1 2 3 4 5

4. More course should be taught using laboratories in the C & T department.

   1 2 3 4 5

5. I would like to try a computer tutorial on this subject.

   1 2 3 4 5

Other Comments: ____

____

Note. Adapted from Skinner M. E. (1988). Attitudes of College Students Toward Computer-Assisted Instruction: An Essential Variable for Successful Implementation. Educational Technology, 28 (2), 7-15.

Appendix H

Cover Letter and Consent Form

September 6

Dear Student,

The purpose of this research is to determine the effectiveness of a computer tutorial program designed to develop patterns. This study consists of three written tests. These are the entry behavior test to assess your experience in pattern design and the use of computers, a pretest and a posttest to assess the effectiveness of either the laboratory or the CAI (computer-assisted instruction) methods of pattern design.

Participants will be equally divided into two groups. The first group will be the CAI group, receiving computer-assisted instruction; the second group will be the laboratory group, receiving instruction in a laboratory setting. However, those in the second group will be given the chance to take the computer tutorial after the experiment is completed.

Any participant can withdraw from the experiment at any time. Your name will remain anonymous. The test scores you will obtain in this study will not affect the final grade of any courses you are taking.

I would like to ask your cooperation to participate in this study to determine the effectiveness of a computer tutorial program.

Thank you for your attention.

Sincerely,

Joyce Lai
Graduate Student
Department of Clothing & Textiles

Please complete and return the following Consent Form before you leave

CONSENT FORM

I,________________________, hereby agree to participate in this study and to be assigned to one of the experimental groups.

	Yes	No
Do you want a copy of the study results?	_____	_____

Appendix I

Pre- and Posttest Scores of the Study Sample

# of students	Pretest*	Posttest**	Posttest II***
	Laboratory		
1	0.00	4.00	13.15
2	2.50	5.00	10.25
3	0.00	5.00	10.25
4	0.00	4.00	8.50
5	1.00	3.50	7.00
6	2.00	5.00	2.50
7	0.00	4.00	7.50
8	1.00	4.00	12.50
9	2.00	4.00	11.00
10	3.00	4.50	6.50
11	0.00	4.00	3.00
12	0.00	3.25	6.50
13	3.50	4.00	9.75
	CAI		
14	0.00	4.00	9.50
15	0.00	4.50	10.00
16	0.00	5.00	11.75
17	1.00	4.50	12.00
18	0.00	4.75	5.00
19	0.00	3.75	8.00
20	1.50	3.25	8.75
21	0.00	4.50	7.50
22	0.00	4.50	8.00
23	0.50	4.25	9.50
24	0.00	4.00	7.50
25	0.00	3.50	5.50
26	0.00	4.00	5.50

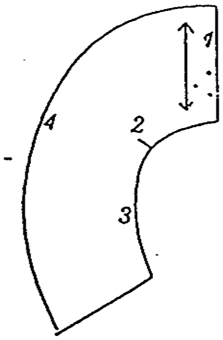
* maximum score = 10
** maximum score = 5
*** maximum score = 15

Appendix J

Embedded Test for Laboratory Session

Complete the following questions:

1. Match the numbers shown on the flat collar pattern with the terms given.



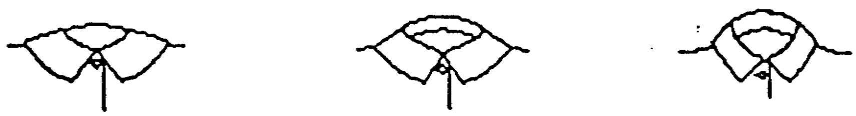
_____ Neckline edge

_____ Center back

_____ Design edge

_____ Shoulder crossmark

2. Name the following collar types.



a. ____________ b. ____________ c. ____________

3. Which collar type has the straightest neckline edge

4. Which collar type has the least amount of roll

5. What determines the amount of roll of a collar

6. Complete the following sentence:

Collar style relates to ______________________________

____.