

# A Study on the Impacts of Computer-Aided Design and Computer Technologies on Clothing and Textiles : Current Trends and Future Outlook\*

의류학에의 컴퓨터 디자인 및 컴퓨터 테크놀로지 응용실태와  
미래의 방향에 대한 연구\*

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## 〈 Abstract 〉

최근 컴퓨터 디자인(Computer-Aided Design)을 비롯한 컴퓨터의 응용은 의류패션과 직물 산업분야에 있어서 디자인 및 생산공정이 자동화되는 등 의류 디자인 및 제작에 중요한 역할을 하고 있다. 본 연구의 목적은 컴퓨터화 사회로의 이행에 따른 1) CAD를 포함한 컴퓨터 시스템의 의류학에의 응용실태, 2) 컴퓨터 응용에 대한 인식 및 미래의 방향, 3) 의류학내의 전반적인 문제점과 해결방안 등에 대하여 연구하고자 한다.

연구방법은 전국 의류학 관련 교육자(43개 4년제 대학의 교수) 110명을 대상으로 설문지법을 사용하였으며 회수된 58부(53% 회수율)를 SAS로 통계처리하여 Likert's method of summated ratings로 분석하였다.

연구결과에 따르면 CAD는 11%의 대학에서, 컴퓨터개론이 25%의 대학에서, Telecommunication, Spreadsheet, Database는 각각 4%의 대학에서 강의되고 있다. CAD는 주로 다른 과목에 포함되어 "몇주"(4%), "몇일"(4%) 정도 강의되고 있으며 컴퓨터개론은 다른 과목에 포함되어 "반학기"정도 강의되는 경우(14%)가 가장 많은 것으로 나타났다. 또한 37%의 대학에서 앞으로 5년내에 의류학에 컴퓨터 디자인 및 컴퓨터 시스템을 도

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입할 계획으로 있으며 특히, CAD에 대한 관심이 높았다. 64%의 대학이 의류학과 건물 내에 컴퓨터 시설이 갖추어져 있지 않아 모든 교수들이 컴퓨터교육을 위한 시설 재정이 필요하다고 하였다. 컴퓨터활용의 부족이 의류학 관련학과의 취약부분으로 인식됨에 따라 앞으로 CAD에 관한 연구 및 컴퓨터관련 수업의 개설, 시설 확충 등이 보완되어야 할 것으로 나타났다.

본 연구 결과는 한국내 의류관련학과의 CAD를 포함한 컴퓨터의 응용 실태와 성향을 실증적으로 조사분석함으로써 앞으로 나아갈 방향을 제시하고 미국과의 비교 분석을 통하여 컴퓨터의 의류학내 응용이 우리 실정에 맞게 정착되는 데 도움이 될 것으로 기대된다.

## I. INTRODUCTION

The issue is the impact of Computer-Aided Design and other computer technology on clothing and textiles, which became clear during the 1990s. The introduction of computer technology like CAD into clothing and textiles has been accompanied by 'sociological pressure' from the computerized society. There has been huge economic pressure behind the introduction of new computer technology into clothing and textiles because computer technology is now pervasive in all industries. This pressure has been expressed by the statements such as the 'needs of industry' and the 'growing demand for information technology skills'(Wellington, 1990).<sup>1)</sup>

Especially because of the vocational significance of computer technology, the economic pressure has been particularly strong in such areas as retailing and designing, both of which are parts of the clothing and textiles.

Driven by the need to keep up with this trends and to enhance the marketability of clothing and textiles graduates, computer-aided design and other computer technology are increasingly adopted in clothing and textiles within the U.S.A.<sup>2)34)</sup> In Korea, there are several studies focusing on the automation for basic patterns.<sup>5)6)7)8)9)</sup> However, less empirical research is done about, to what extent CAD and other computer technology are currently adopted into the Korean clothing and

textiles. Therefore, the purpose of the study was to describe and assess current trends and future outlook of CAD and other computer technology on Korean clothing and textiles, which arise especially because of our own circumstances as a developing country. The result of this study may be able to provide more substantial information concerning CAD and other computer technology for projecting the future directions to incorporate efficiently based upon our own environment in Korea.

## II. REVIEW OF LITERATURE

In the field of apparel industry, the rapid acceptance and use of the computer was no different than in many other businesses. New advances in technology are changing the way textiles and garments are designed and manufactured all over the world.<sup>10)</sup> Using computer technology, companies have the potential of increasing productivity by 400 percentages(Kosh, 1988).<sup>11)</sup> In 1980, AAMA(American Apparel Manufactures Association)<sup>12)</sup> found that 39% of the manufacturers were using or planning to use computers for pattern making. In 1985, Fraser<sup>13)</sup> found that 9.4% of the manufacturers computerized for design, and 20% of the companies using or predicting they would be using computer for design within five years. In 1988, Sheldon<sup>14)</sup> found that the most commonly utilized types of computerized equipment are those for grading(73%), marker making

(70.5%), pattern making(37%), and design/illustration (10%). The rate of use of computers by designers does appear to be accelerating faster than predicted three years ago by Fraser.<sup>13)</sup>

To stay abreast of these changes in apparel design and production which have been brought about by the use of computer technology, a growing number of college apparel design programs include computer-aided design instruction. In a course designed to teach pre-production design techniques using a computer-aided design system at Colorado State University, it was found that students greatly improved their ability to draw the fashion figure(Knoll, 1990).<sup>15)</sup> Therefore, clothing and textiles could assist in the transfer of technology from the computer industry to the apparel industry. Many clothing and textiles are currently integrating computer study and applications into university programs in merchandising and apparel design(Collier & Collier, 1990).<sup>16)</sup>

Knoll(1989)<sup>17)</sup> suggested that substantial growth in computer use in clothing and textiles college programs can be expected during the decade of the 1990s. While the clear trend today in computer software use in the word processing area, the near future likely will see increased faculty literacy via computer technology ; training in computer-aided design, telecommunications, data base, and spreadsheet. In terms of future applications, the most significant increases will be a rising percentage of students who leave college and enter the business world well-trained in computer technology for the 1990s. This is also the case in college-business liaisons and agreements to fund the appropriate computer technologies in textiles/clothing research.<sup>18)19)</sup>

According to Collier and Collier(1990),<sup>16)</sup> the capability of dedicated computer systems to facilitate design creation and alteration has been the prime consideration. According to Kosh(1989),<sup>20)</sup> the design job has the most varied requirements for computer

automation. Computer-aided design systems are providing designers with the means to make their information accessible to merchandising, marketing, finance, manufacturing, and management on real time basis. CAD systems today will best serve designers in these three ways : reducing time from concept to production, expending their artistic capabilities, and aiding them in presentations. Also, Belleau & Didier (1989),<sup>21)</sup> Sheldon(1988),<sup>14)</sup> Collier & Collier(1990),<sup>16)</sup> and Sheldon & Regan(1990)<sup>22)</sup> indicated such advantages of computerized technology that computer-aided design is one way to shorten response time between manufacturers and retailers, ultimately consumer demands. CAD system is not designed to automate the design process itself, but rather to free the designer from some of the time-consuming, repetitive tasks, leaving more time for greater design achievement. Any repeated element(pattern pieces, store fixture, or room layout) recalled for use in current or future drawings. Elements can be retrieved, duplicated, and modified quickly. Various characteristics can be tested in computer visualization without the expense of producing trial fabrics for all of the considered combinations.

Fraser(1985)<sup>13)</sup> concluded that CAD in Clothing and Textiles is a necessary tool for those dealing with computerization in apparel manufacturing. Designers, patternmakers, and production managers agreed that it is difficult to find people who are trained to use computers. Designers should be able to operate a computer-aided design system. Design students must feel comfortable in a high technology environment and be able to use computers as a tool to develop their creative ideas.

Therefore, educators must now update facilities to keep up with the accelerated computerization of the apparel industry. It is also imperative that they now plan to prevent a future technology gap between education and the apparel industry(Sheldon, 1988).<sup>14)</sup>

The definitions of terms used in this research are

as follows :

- Computer Literacy : computer literacy is defined as the ability to use the computer as a tool to accomplish work using the appropriate software application for the specific task.
- Computer Aided Design(CAD) : a computer graphics software systems which allows the user to draw and modify or edit the drawing using a mouse device or an electronic drawing surface. CAD is used in many aspects of garment design and production from the product development phase through the entire production phase.
- Telecommunications : communication that is possible between computers via a modem and telephone lines. It is possible to access information in data libraries for research purposes through this technology. It is also possible to send and receive text materials via telecommunications.
- Spreadsheet : a software program which allows the user to work with numerical information which must be arranged in columns and rows. This information can be manipulated using formulas which the user creates.
- Data base : a software program which allows the user to organize lists of information into logical groups.

### III. METHODOLOGY AND PROCEDURES

#### 1. Research Questions

The research questions addressed in this study are as follows :

- 1) At the present time, to what extent is CAD and other computer technology incorporated into clothing and textiles?
- 2) What are some future trends in computer use in the study of clothing and textiles?

- 3) What are the unresolved problems, and how can these problems likely be overcome?

#### 2. Description of the Population

The population included educators at four-year Korean institutions which offered undergraduate degree programs in clothing and textiles nation wide. The 110 random sample of college faculty teaching in clothing and textiles from forty-three institutions was chosen from the professional organization membership directory, Journal of the Korean Society of Clothing and Textiles.

#### 3. Administration of Instrument

Since this research is descriptive in nature, a survey research method was employed in collecting data for this study. The items selected for inclusion in the questionnaire were structured to answer the research questions and were initially determined through a review of the literature in computers, and clothing and textiles.

110 questionnaires were sent to college faculty teaching in clothing and textiles. Each participant received a cover letter, survey instrument, and self-addressed stamped envelope. A cover letter accompanying each questionnaire briefly explained the nature of the study, the importance of responding, and assuring the respondents of confidentiality. Regular postage stamps were used in response to research reported by Borg and Gall<sup>29)</sup> that stated the use of hand-stamped envelope has been found to yield more returns than using postal-permit envelopes(1983). The mailing took place in December 1991 and January 1992. All questionnaires were given an identification code number by institution for purposes of follow-up. One week later, follow-up letter was mailed to faculty members. The timing of the follow-up was based on

research by Dillman.<sup>24)</sup>

As the questionnaires were returned, the coded numbers were entered into the data base. The 58 completed surveys from 28 institutions were processed and analyzed using SAS/STAT and Likert's method of summated ratings.<sup>25)</sup>

#### IV. RESULTS

##### 1. At the present time, to what extent is CAD and other computer technology incorporated into clothing and textiles?

Information on student use of computer technology was collected about what computer related courses were offered in clothing and textiles and whether or not computer hardware and software was available to them in the same building in which they took their clothing and textiles courses.

In response to computer related course offerings in clothing and textiles, one quarter of institutions offered electronic data processing in their undergraduate programs as liberal art, or elective, or required course. Eleven percent of institutions offered computer-aided design as elective, or/and sequential course. Only 4 percent of the institutions offered telecommunication, spread sheet, and data base respectively as a liberal art.

Topics that were most frequently combined into one course were electronic data processing(32percent of the schools), data base(11percent of the schools), computer-aided design(7percent), computer-aided manufacturing(7percent), telecommunication(4percent), and spreadsheet(4percent).

Electronic data processing : 14percent of the schools covered electronic data processing through half course. 11 percent of the schools covered this topic through several weeks, and 7percent of the schools covered this topic through several days. But a 50percent of the institutions indicated that there was no lecture of this

topic in their program.

Data base : Each 4percent of the institutions were taught this topic through a half course, or several weeks, or several days. But 75 percent of the institutions indicated that there was no lecture on this topic in their program.

Computer-aided design : Each 7percent of the institutions were taught this topic as a component in a course through several weeks, or several days. But a 50 percent of the institutions indicated that there was no lecture on this topic in their program.

Telecommunication : Only 4percent of the institutions were taught this topic as a component in a course through several weeks. A 79percent of the institutions indicated that there was no lecture on this topic in their program.

Spreadsheet : Only 4percent of the institutions taught this topic as a component in a course through several weeks. A 79percent of the institutions indicated that there was no lecture on this topic in their program.

On the other hand, Knoll<sup>15)17)</sup> reported that in 44percent of American clothing and textiles students were required to take any course work in spreadsheet for one semester, or two semesters, or as component of one semester course. In 38percent of students were required to take data base course work for one-semester, or as part of a one-semester computer literacy course. Also, in less than 20percent of students required to take any course work in computer-aided design for one semester or two semesters or three semesters, or as a component of one semester. And in 6percent of students were required to take some course work involving telecommunication.

In regard to the changes that have been seen in the use of computers in clothing and textiles in the last five years, the most reported change was the increase in faculty attaining computer literacy as indicated by 23percent of the respondents. The second option most

Table 1. Topics and Amount of Course Time Devoted to Each Topic

Topics	None %	Several days %	Several weeks %	Half course %	NR %	Total %
Electronic data processing	50.0	7.1	10.7	14.3	17.9	100.0
Data base	75.0	3.6	3.6	3.6	14.3	100.0
CAD/CAM	49.8	7.2	7.2	-	35.8	100.0
Telecommunication	78.6	-	3.6	-	17.9	100.0
Spreadsheet	78.6	-	3.6	-	17.9	100.0

There are rounding errors in 100%.

frequently chosen was just getting started with the implementation of computers into their programs. But 12percent of the educators indicated no use of computer. However, over 70percent of the educators observed incorporating computer technology in their clothing and textiles in some ways, such as faculty attaining computer literacy, using computer in class assignment, adding computer lab in department, and requiring computer literacy course.

In regard to the availability of computer facility, computer hardware and software was not available to students in the same building in which they took their clothing and textiles course, among 64 percent of institutions. This result shows lack of facilities in Korean clothing and textiles program.

## 2. What are some future trends in CAD and other computer use in the study of clothing and textiles?

When asked to predict changes related to computer use in clothing and textiles, the most frequent choice was increased faculty use of computers. Under half of the educators reported inclusion of computer studies into clothing and textiles, that is, offering computer-aided design, required computer literacy of all clothing and textiles students, spreadsheet, data base, and telecommunications. Also, more lab facilities will be needed, and more university support is predicted. Only 0.4percent cited that no progress would be made in the incorporation of computer technology into clothing

Table 2. Observed Changes in the Use of Computer

Observed change	Frequency	Percentage
Faculty attained computer literacy	30	22.6
Just getting started	23	17.3
Increase in computer use	20	15.0
Computer used in class assignment	19	14.3
No use of computer	16	12.0
Computers first used within the last 5years	14	10.5
Computer lab added in department	7	5.3
Computer literacy course required	3	2.3
No response	1	0.8
Total	133	100.1*

\* This figure differs from 100% because of rounding error

Table 3. Expected Changes in the Use of Computer in the Next Years

Expected change	Frequency	Percentage
Increased faculty use of computers	44	19.1
Offering courses about CAD/CAM	72	31.2
More lab facilities will be needed	37	16.0
More university support	24	10.4
Computer literacy course required	16	6.9
Costume collection computerized	15	6.5
Increased use of spreadsheet and data base	11	4.8
Increased use of telecommunications	10	4.3
No use expected	1	0.4
No response	1	0.4
Total	231	100.0

and textiles. Therefore, there would be an expanded use of CAD and other computer technology in the study of clothing and textiles.

In response to the need for re-tooling or professional development education in computer skills, every educator felt there were urgent needs to re-tool or educate computer technology in information ages.

In response to "which areas would you like to learn?", 76percent of the participants stated that they would like to learn CAD/CAM. Word processing was chosen by 10percent, and telecommunications was chosen by 7percent. Data base was chosen by 6percent, and spreadsheet was chosen by 1percent.

Table 4. Areas Preferred to Learn

Areas	Frequency	Percentage
CAD/CAM	78	75.7
Word processing	10	9.7
Telecommunication	7	6.8
Data base	6	5.8

computer technology are you interested in sharing information about?", 37percent of the participants selected program ideas for the inclusion of the computer into clothing and textiles. This result was relevantly the same with the Knoll study.<sup>15(17)</sup> The second option most frequently chosen was a way to fund computer technology(28percent). Professional computer-aided instruction development program was the third choice of 21percent of the participants. Information about computer hardware and software was the last choice for 12percent of the participants.

When asked to predict the highest growth area in computer technology, 44percent of the faculty selected fashion design(CAD). This response consistently supports that educators regarded fashion design field as the most important program and perceived important available employment outlet for graduates in Korea. Thirty-four percent of the faculty selected clothing construction/apparel production. Fashion merchandising was the third choice with 15percent. The

Table 5. Interested Area

Interested Areas	Frequency	Percentage
Computer inclusion into clothing and textiles	25	36.8
Ways to fund computer technology	19	27.9
Programs for computer-aided instruction	14	20.6
Information about hardware and software	8	11.8
No response	2	2.9
Total	68	100.0

(1982)<sup>26)</sup> indicated that the highest percentage of Korean clothing and textiles graduates was employed either as secondary teachers or as designers in the clothing and textiles industries. This study indicated that employment status has been changed during 10 years, that is, fashion design and retailing in the clothing and textiles industry were respectively the first and second common employment areas, while secondary teaching in school was the lowest ranked employment area. Therefore, this result implied needs for closer connection between clothing and textiles schools and industries.

Table 6. Growth Area in Computer Technology

Response	Frequency	Percentage
Fashion design	36	43.9
Clothing construction/production	28	34.2
Fashion merchandising	12	14.6
Textiles	5	6.1
No response	1	1.2
Total	82	100.0

When educators were asked whether or not there was a plan to implement computer technology in clothing and textiles, 64 percent of the respondents stated that there was a five-year plan to implement computer technology at their institution.

In the future, the biggest projected trends with regard to computer technology were the increased

Table 7. Perceived Rank of Employment Areas for Clothing and Textiles Graduates

Employment Area	Weighted Score
Fashion design	140
Retailing	99
Apparel production	46
Fashion coordination	14
Fashion illustration	10
University teaching	8
Textile testing and development	7
Product promotion and advertising	4
Secondary teaching	1

faculty use of computers and offering computer-aided design. Needs for more computer lab facilities were the third most mentioned trend. More university support was predicted. All clothing and textiles students were expected to attain computer literacy. Spreadsheet and data base and telecommunications were predicted to increase in use.

Only 0.4 percent cited that no progress would be made in the incorporation of computer technology into clothing and textiles. Therefore, there would be an expanded use of computer technology in the study of clothing and textiles.



**Table 8. Perception of Strengths and Weaknesses of Clothing and Textiles**

Perceived strength & weaknesses	Mean	SD	very week 1	2	neutral 3	4	very strong 5	NR	Total (n) (%)
Professional image in this field	4.5	0.7	-	-	7	16	35	-	58
			-	-	12.1	27.6	60.3	-	100.0
Visibility of clothing and textiles	4.3	0.8	-	1	10	15	32	-	58
			-	1.7	17.2	25.9	55.2	-	100.0
Opportunity for creative expression	4.0	1.0	-	5	11	21	20	1	58
			-	8.6	19.0	36.2	34.5	1.7	100.0
Career opportunities for graduates	3.9	1.0	1	4	13	19	21	-	58
			1.7	6.9	22.4	32.8	36.2	-	100.0
Field experience	2.4	1.2	17	12	17	6	4	2	58
			29.3	20.7	29.3	10.3	6.9	3.4	100.0
Incorporating computer technology	2.2	1.2	23	11	13	9	2	-	58
			39.7	19.0	22.4	15.5	3.4	-	100.0

There are rounding errors in 100%

### 3. What are the unresolved problems, and how can these problems likely be overcome?

#### 1) Perceived Strengths and Weaknesses of Clothing and Textiles

Items in this section were scaled from (1) very weak to (5) very strong, with the mid-point (3) representing a neutral response. Mean values and standard deviations were also examined to determine the perceived strengths and weaknesses of respondents' programs of clothing and textiles. Sixty percent of the respondents rated professional image as a very strong characteristic. Whereas only 17 percent of the respondents rated field experience as a strong characteristic, and only 19 percent rated incorporating computer technology as a strong characteristic. Incorporating computer technology and Field experience were generally perceived as weakness of clothing and textiles.

#### 2) Perceived Suggestions for Improving Clothing and Textiles Program

Items in this section were scaled from (1) not needed to (5) very needed, with the mid-point (3) representing a neutral response. For improving the clothing and textiles program, first of all, 70 percent of educators suggested providing better equipment like computer facilities ( $M=4.7$ ,  $SD=0.5$ ), Offering computer studies ( $M=4.3$ ,  $SD=0.9$ ) and Offering internship for field experience ( $M=4.2$ ,  $SD=0.9$ ).

## V. CONCLUSIONS AND IMPLICATIONS

The results of this study indicated that educators are not availing themselves of the full potential of computer technology to participate in the information age, but there was an enthusiastic interest in CAD and computer studies related to clothing and textiles. Further, educators were most interested in computer

Table 9. Perceived Suggestions for Improving the Clothing and Textiles Program

Perceived suggestions for C & T program improvement	Mean	SD	not needed		neutral		very needed 5	NR	Total (n) (%)
			1	2	3	4			
Better equipment for computer facilities	4.7	0.5	-	-	1	14	41	2	58
			-	-	1.7	24.1	70.7	3.4	100.0
Offering computer studies	4.3	0.9	2	-	6	18	31	1	58
			3.4	-	10.3	31.0	53.4	1.7	100.0
Offering internship for field experience	4.2	0.9	1	1	10	17	29	-	58
			1.7	1.7	17.2	29.3	50.0	-	100.0

There are rounding errors in 100%

inclusion into clothing and textiles and ways to fund computer technology.

Although the data showed evidence of some changes that have occurred in the incorporation of computer technology into clothing and textiles, only few institutions have required computer courses for students. Unless more computer course work is required, there will be a technology gap between what graduates learned and how they perform in job-related work.

In regard to future trends based upon our own environments in Korea, increased faculty use of computers, offering computer studies such as CAD /CAM, spreadsheet, data base, telecommunications, and increased requirements for computer literacy were projected by the educators. They also projected that there would be more support from their university for lab facilities.

The respondents described their opinions regarding incorporating of CAD and other computer technology into Korean clothing and textiles.

Overall, the general outlook for clothing and textiles was optimistic ; however, educators generally agreed that many issues will affect clothing and textiles programs in the future. For improving clothing and textiles, educators provided the following directions with ample challenge for the future.

From the results and conclusions of this study, the following recommendations were suggested :

- Faculty and student internship in the industry should be considered as a way to increase awareness of the wide uses and applications of CAD and other computer technologies in real work place.
- Closer college-industry liaisons are needed to solve the funding problem, in one hand, for incorporating CAD and other computer technologies into the clothing and textiles field and, in the other hand, to utilize suggestions from researchers, CAD venders and apparel manufacturers interactively.
- Clothing and textiles colleagues, including CAD pratitioners in real work place, need to establish a cooperative communication forum through computer networks to share information about CAD systems with each other as well as to facilitate library and research database.

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