

156
62

TRENDS IN CAD EDUCATION IN INTERIOR DESIGN PROGRAMS

by

Hye Mi Ko

Thesis submitted to the faculty
of Virginia Polytechnic Institute and State University
in partial fulfillment of the requirements for the degree

of

MASTER OF SCIENCE

in

Housing, Interior Design, and Resource Management

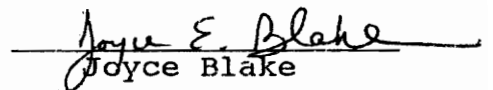
APPROVED:



Joan McLain-Kark, Chairperson



Nancy Canestaro



Joyce Blake

.2

LD
5655
V855
1990
K647
C.2

TRENDS IN CAD EDUCATION IN INTERIOR DESIGN PROGRAMS

by

HYE MI KO

Chairperson: Dr. Joan McLain-Kark

Housing, Interior Design and Resource Management

(ABSTRACT)

This research investigated Computer Aided Design (CAD) education in the interior design program focusing on educators' opinions about creativity aspects including computer application, teaching materials and teaching methods as well as other trends in CAD education. A questionnaire was sent to one hundred eighty-two members of the Interior Design Educators Council (IDEC).

A frequency distribution was used on 69 usable returned surveys to describe the sample characteristics and to determine the teaching materials and support. Means and T-tests were employed to examine if a significant difference of opinions toward CAD integration existed between designers based on creativity, teaching materials, and teaching approaches.

Findings indicate that educators are thinking positively regarding the creativity aspects of teaching CAD. There was no significant difference between IBM educators and Apple Macintosh educators in terms of

opinions concerning creativity and teaching approaches and also no significant difference in the educators who are using more flexible teaching approaches and the educators who are using more rigid teaching approaches in terms of creativity. Educators thought CAD courses are most helpful for students' future careers. Educators remarked that their college, department, and other faculties are generally very supportive. Overall the educators had fewer than 4 years of experience in teaching CAD. One or two CAD educators were teaching in each interior design program. IBM personal computer, AutoCAD software, instructor prepared tutorials were the most used teaching materials.

ACKNOWLEDGEMENTS

I would like to express my sincere thanks and gratitude to Dr. Joan McLain-Kark for her constant guidance and suggestions throughout the stages of the graduate program and this research. I would also like to thank Dr. Nancy Canestaro and Ms. Joyce Blake for their valuable suggestions. Special thanks are expressed to Chae Un Lim for his assistance in statistical analysis.

My deep appreciation goes to my husband Chan Uk Ko, for his support and encouragement that have enabled me to complete this thesis.

TABLE OF CONTENTS

	Page
ABSTRACT.....	ii
ACKNOWLEDGEMENT.....	iv
LIST OF FIGURES.....	vii
LIST OF TABLES.....	viii
Chapter One: Introduction.....	1
Purpose and Objectives.....	2
Need for the Study.....	3
Definition of Terms.....	4
Chapter Two: Related Literature Review.....	6
CAD Systems.....	6
Development of CAD.....	6
Hardware.....	7
Software.....	9
CAD Application in Interior Design Education.....	11
Courses.....	11
Staffing.....	13
Teaching Materials.....	14
Teaching Methods.....	16
Creativity and Cognitive Styles of Learning, Designing, and Computing.....	18
Creativity.....	18
Learning Styles.....	21
Designing Styles.....	22
Computing Styles.....	24
Learning and Creativity Application in CAD.....	26
Classes.....	26
Chapter Three: Conceptual Framework and Methodology....	28
Hypotheses.....	29
The Sample.....	30
Instrument/Data Collection.....	30
The Analysis of Data.....	32
Chapter Four: Results.....	33
Educators' Opinions about Benefits, Supports.....	34
Benefits of Teaching CAD.....	34
Supports for Teaching CAD.....	35

TABLE OF CONTENTS

(continued)

Creativity, Teaching Material, and Teaching Methods.38
Creativity on IBM vs. Apple Macintosh System.....38
Teaching Approach and Creativity.....40
Teaching Approach and IBM vs. Apple Mcintosh.....
Systems.....43
Computer Equipment and Teaching Material Usage...46
Teaching Experience and CAD Educators and.....
Creative Teaching.....48
Experience of Teaching CAD.....48
The Number of CAD Educators.....48
Creative Teaching Techniques.....51

Chapter Five: Summary.....53
Major Findings.....57
Implications.....59
Recommendations for Further Study.....60

REFERENCES.....62

APPENDIX A: Cover Letter to Interior Design Educators..65

APPENDIX B: Follow-up Cover Letter to
Interior Design Educators.....67

APPENDIX C: Questionnaire.....69

VITA.....73

LIST OF FIGURES

<u>Figure</u>		<u>Page</u>
1	The Characteristics of Cognitive Styles.....	23

LIST OF TABLES

<u>Table</u>		<u>Page</u>
1	Benefits of Teaching CAD in Interior Design Program.....	36
2	Support Received for CAD Program.....	37
3	Mean Scores on Creativity Based on IBM vs. Apple Macintosh System.....	39
4	Correlation Coefficient of Teaching Approaches and Creativity.....	42
5	Correlation Coefficient of Teaching Approaches and Creativity as Evaluated by Educators.....	42
6	Mean Scores on Teaching Approach Based on IBM vs. Apple Macintosh System.....	44
7	Mean Scores on Flexibility Evaluated by the Educators Based on IBM vs. Apple Macintosh System.....	45
8	Frequency Distribution of Teaching Materials.....	47
9	Frequency Distribution of Experience on Teaching CAD.....	49
10	Frequency Distribution of Number of CAD Educators in Interior Design Programs.....	50

CHAPTER I

INTRODUCTION

Computer-Aided Design (CAD) has become an important part of interior design education. Educators increasingly are realizing the influence of CAD on the interior design field and have introduced it to their students. There are many reasons for CAD integration into interior design education. First, for their future career preparation, students will need CAD skills which are demanded more than ever in design practice. For instance, between 1985 and 1988, CAD systems used by interior design organizations increased by 20.5% (Plant, 1988). Loebelson found that of the top 100 interior design firms, 95% are using CAD (Loebelson, 1990). Also most federal government projects must be done on the CAD system (Sherman, 1984).

Secondly, CAD systems can be a versatile tool for student projects. With the aid of CAD along with its massive memory, permanent storage, and its ability to plot out a design at great speed, students can examine different design alternatives they would not have attempted without a CAD system (Sherman, 1984).

Finally, educators can use CAD systems to teach how to design. They can teach with CAD drawings in color, wire

frame, furniture layout, elevation/section drawing, lighting design, and any other applications.

According to Hasell (1987), the computer is expected to be used for most interior design programs regardless of program length or type within five years. However very little research is done about how CAD is integrated into the existing interior design curriculum, and what educators think about CAD in the interior design field. Ettinger (1988) suggested that art educators look beyond the popular appeal of keyboard computer instruction and develop curriculum in a manner that supports a more comprehensive and critical study.

With the above basic needs, there is a question often asked among educators as to whether CAD inhibits a student's creative ideas. Since creativity is an important aspect in a design solution, the question of how CAD integration influences a student's creativity should be explored through research.

Purpose and Objectives

The purpose of this study is to examine educators' opinions about creativity and its relationship to teaching methods and teaching materials and to explore other aspects of CAD instruction. The study addresses the following

objectives:

(1) To explore educators' opinions about creativity and its relationship to teaching CAD, teaching materials (IBM system vs. Apple Macintosh system), and teaching methods (flexible approach vs. rigid approach).

(2) To determine the relationship between teaching methods (flexible approach vs. rigid approach) and teaching materials (IBM system vs. Apple Macintosh system).

(3) To find out, the benefits, support for teaching CAD, educators' teaching experience, the number of CAD educators in each program, and educators' creative teaching techniques.

Need for the Study

Interior design educators, the ones who will integrate CAD into their curricula as well as the ones who are presently teaching CAD in their curriculum, could find this information useful. Educators could also find additional teaching methods to strengthen their CAD classes from the results of this study.

Computer manufacturers and software companies may find this information helpful for improving their products thus increasing their market. In addition, interior designers who are using CAD in their practice also could use this information to teach new designers about CAD.

Definition of Terms

The following terms are used in this study:

(1) Binary - The base two number system that uses only zeros and ones.

(2) Bit - Taken from binary digit. It is a 0 or a 1 signal.

(3) Byte - A sequence of binary digits (bits) that the computer operates on as a single unit. It is eight bits and is the basis of comparison used in describing various systems and manufacturers. One byte is a character of memory. A megabyte would be one million characters of memory.

(4) CAD - The acronym for computer-aided design.

(5) CPU - The acronym for central processing unit. The microprocessor portion of the computer that accomplishes the logical processing of data. The CPU contains the arithmetic, logic, and control circuits and possibly the memory storage.

(6) Digitizer - A data input device resembling a drawing board, which will generate coordinates when touched with a puck, pen stylus, or a mouse.

(7) Hardware - Physical equipment that belongs to computer systems such as electronic, magnetic, and mechanical devices.

(8) Light Pen - An input pointing device, data may be

entered by clicking the end of the pen on the monitor screen.

(9) Memory - The components of the computer which stores data or instructions.

(10) Menu - The master menu listing available task: an auxiliary menu lists the options offered by a given task.

(11) Peripherals - Additional equipment working in conjunction with, but not as a part of the computer.

(12) RAM - the acronym for random access memory. Temporary memory: information that can be lost when power to the system is shut down.

(13) ROM - The acronym for read only memory. Permanent memory: information that is stored and read out.

(14) Software - The name given to programs that are input to the computer; operational sequences to run program.

(15) Work station - A computer that includes a monitor for display and which can manipulate data.

CHAPTER II

RELATED LITERATURE REVIEW

Three major areas were reviewed; CAD systems, CAD application in interior design education, and Creativity and Cognitive styles of Learning, Designing, and Computing styles in computer education.

CAD Systems

Development of CAD

The first computer graphics systems appeared with the first digital computers at Massachusetts Institute of Technology (MIT) in the middle 1950's. In 1963, Ivan Sutherland described Sketchpad, a computer graphic system in his dissertation (Teicholz, 1985). The first commercial Computer Aided Design program was developed by IBM in 1964. Since then, CAD has developed into a powerful human-machine interface tool in the military, aerospace, automotive, and electronics industries as well as in universities (Teicholz, 1985).

In architecture and interior design fields; however, CAD research has lagged due to limited budgets (Mitchell, 1977). The CAD market began to grow in 1969 when many new companies were formed (Teicholz, 1985). Between 1976 and

1980, the CAD industry grew at a 60 percent annual rate (Teicholz, 1985). During this time, the importance of CAD was clearly recognized in the architecture field. It is evident that CAD has appeared in university curricula, conferences and workshops (Mitchell, 1977). In 1978, computer hardware prices were reduced by 40 percent by IBM (Teicholz, 1985). From this point on, the computer became more cost effective in many fields including architecture and interior design. For example in 1989, \$22,000 to \$32,000 would cover the cost of: AutoCAD software (\$4,500), a 386-based PC (\$10,000-15,000), a high-resolution color monitor and graphics card (\$2,500-\$8,000) and a D-sized plotter (\$5,000) (Interior Design, August, 1989). The lower-cost of microcomputers in the 1980's finally brought CAD technology to the smaller companies and interior design educational programs (McLain-Kark, 1987).

Hardware

The components of CAD systems are input devices, the CPU (central processing unit), output devices, and the human user. The CPU performs the computing functions and is associated with the execution of instructions. Transfer of data and instructions between the human user and the CPU is accomplished by the input and output devices. Input devices are keyboard, tablet, joystick and card reader. Output devices are a monitor (CRT), printer, plotter, and

camera.

Computer Aided Design systems can be categorized into three major types: microcomputer systems, minicomputer systems, and mainframe systems, which are classified according to the size of the CPU (central processing unit). CAD microcomputers usually consist of a large capacity internal hard disk which stores the software, a floppy disk drive, and a monitor. The peripherals consist of a tablet or a mouse and a printer or a plotter. Microcomputer systems commonly consist of an 8-bit microprocessor which, together with read only memory (ROM) and random access memory (RAM), form the basic computer unit. The speed of the slower microcomputer can be increased by replacing the 8 bit CPU with a 16, or 32 bit CPU. The memory of the small microcomputer can be increased and a hard disk drive can be added as well to make the microcomputer more powerful. Therefore the microcomputer system can perform 80-90 percent of the capability of larger and much more expensive systems (McLain-Kark, 1991).

The major advantage of the microcomputer system is its low cost, making it available to both large and small organizations. In-house microcomputers in interior design organizations have significantly increased from 40.7% in 1985 to 52% in 1988 (Plant, 1988). From a survey of Interior Design Education Council members, Hasell (1987) found that the microcomputer is more popular than mainframe

systems, for both undergraduate and graduate programs. The trend indicates that the usage of the microcomputer system will continue to increase.

A minicomputer-based system can usually support from four to eight terminals or more. The CPU of a minicomputer system generally has a faster processing time than that of the microcomputer. The price of a minicomputer ranges from \$80,000 to \$1,000,000 or more.

The processing power of a mainframe system may range from 16-bit machine up to two million bytes of memory and costing \$100,000 to \$200,000 to 32-bit machine costing in excess of a million dollars (Ball, 1984). Mainframe systems can perform a wide variety of functions. All the early CAD work was accomplished on mainframes, usually at large governmental or university organizations (McLain-Kark, 1991). Mainframe and minicomputer terminals as well as output devices can be located far from the main computer and the output devices are then connected to computer by means of coaxial cables. In 1988 the most used microcomputer in ASID (American Society of Interior Designers) organizations was the IBM PC and IBM compatible systems and the next most often used computer was Mackintosh/Apple system (Plant, 1988).

Software

Software is the program or set of instructions that is

used in order for the hardware to function. The system is delivered to the user as a problem-solving device, capable of immediate application at the user's facility. The largest single CAD specific software application was AutoCAD in ASID organizations in 1988 (Plant, 1988). AutoCAD is the most popular microcomputer CAD software with over 360,000 workstations installed. This translates to over 50% of the CAD microcomputer market (McLain-Kark, 1991). Two important and productive features of AutoCAD make third-party applications possible; its open architecture and its built-in programming language, AutoLISP. 'Open architecture' refers to the form of the AutoCAD program itself, which can be modified by using AutoLISP. With AutoLISP, which is a programming language, third-party developers can create customized menus (AutoDesk, 1987).

Furniture manufacturers have developed interior design software and these software programs interface with the CAD software to make a standardized data base of templates which can later be inserted into any space plan. Herman Miller's software package for the CalComp System 25 is called Space Planning System Plus. It allows users to plan, specify, document, and manage Herman Miller systems products (Herman Miller, 1987). Also Herman Miller makes available symbol libraries of their furniture lines for AutoCAD.

CAP made by Computer Aided Planning Inc., is a software which also aids users in planning, specifying, drawing, ordering, and managing contract furniture. CAP's Electronic Catalog structure enables users to select furniture manufacturers' products and options (Computer Aided Planning Inc.). Haworth, a furniture company, also developed the CADvantage design support system. They have several software programs for technical applications in interior design and architecture: cost estimating, lighting calculations, acoustical calculations, and structural analysis (Plant, 1988). They have made the rapid production of a drawing possible. Therefore, by using the above software, the skilled interior designer should be able to spend more time being creative, making decisions, problem solving, and evaluating designs.

CAD Application in Interior Design Education

Courses

In education, computers were first used in graduate programs (Wingler, 1969) and later in undergraduate programs (Dumesnil, 1988). About 182 IDEC (Interior Design Educators Council) members who were members of the computer network of IDEC were surveyed and the results indicated that either they currently are using computers in teaching or show an interest in using computers in the future (IDEC,

1989). Lindsey (1988) found in her study that over half FIDER (Foundation for Interior Design Education Research) accredited university interior design programs offered a course only to teach the students the basic operation of the computer and to familiarize the students with the software. All programs offering this type of course also provide a course in which the student learns the use of a computer as a drafting tool. Lindsey also found that CAD was most frequently used to teach plan view drawing and next most frequently to teach elevation/section drawing. The least taught areas were lighting, plumbing, and HVAC (Heating, Ventilation, and Air-Conditioning) schematic design as well as three dimensional drafting types.

A computer seminar about the workings and potential of computers in interior design was introduced at the University of Northern Iowa (McLain-Kark, 1980). Hasell found in her study that most graduate and undergraduate programs do not require a programming language course for either mainframe or micro-computers. However, Mitchell (1977) suggested that students take a first level programming language course. According to him this is absolutely essential in learning computer-aided design. He also recommended that students know how to approach real problems creatively and critically, not how to enter predefined data to generate answers to predefined puzzles. Case and Rabun (1985) mentioned that students should take a

separate course on computer application programs before taking the professional practice course. Sherman (1984) reported that teaching CAD without hands-on experience could prove to be detrimental to learning. Also Wu & Willis (1978) reported that a full and accurate comprehension of a studied space is a prerequisite to the student's experience with computer graphics.

However, large amounts of instructional time using computer graphics presents a problem to CAD education in interior design program. Mitchell (1977) proposed replacing some of the traditional content of an architectural curriculum to integrate CAD application into architectural programs.

Staffing

Lindsey (1988) found in her study that the mean student/instructor ratio in CAD classes in FIDER accredited university interior design programs is 17.37 students per instructor (p.37). Finding a qualified staff to teach CAD has been a difficult task. There may be only a few interior designers available with sufficient CAD background.

In architectural CAD programs at the University of California at Los Angeles, two staff members are team teaching a course. They have found that it is essential to introduce and illustrate all concepts by means of

transforming them to specific architectural examples (Mitchell, 1977). It means that one teacher whose major is architecture and the other teacher whose major is related to the CAD technology are necessary. This approach may not be necessary today.

Preskill (1988) commented about teachers' perceptions in teaching new technology. As we come to learn more and more about teacher's developmental needs, it becomes increasingly clear that the teachers may feel isolated and have little opportunity to share ideas and experiences with their colleagues. Interior design educators may also feel the same about teaching new computer technology. The support of CAD classes from department and other faculties, and the educators' teaching experience of CAD may encourage the educators to teach CAD. A CAD workshop for educators may foster integration by showing them how to best use these CAD systems by planning instruction for students. Also, conferences and related magazine articles all promote integration.

Teaching Materials

According to Lindsey's study (1988), the most widely used type of computer by FIDER accredited university interior design programs was the personal computer and the most used drafting software package was AutoCAD and next most used packages were MacDraw and VersaCAD (p. 44).

Unlike the IBM computer for AutoCAD, the Apple Macintosh computer for MacDraw does not need any command. The Apple system is less sequential because it has three main attributes. First, the input method is much more pleasing than the keyboard entry of the IBM system for AutoCAD. The movement of the Apple mouse is similar to the sweep of the artist's hand. Secondly, the use of pull-down menus, pattern and color palette windows with icons for the various tools, makes the Apple screen presentation and driving method less sequential than the command driven systems. Thirdly, the fast and simple manipulation of color, pattern and shape makes a variety of conventional applications to the user. AutoCAD also allows interactive creation and editing of drawings of any size, using a digitizer or mouse to point to menu items and move the drawing cursor around the screen, combined with keyboard commands, but it is still very sequential.

Lindsey also found that text and tutorials prepared by the instructor were used most often in the program. Inside AutoCAD was the most often used textbook among the commercially prepared texts and tutorials (p. 44). Susan Zavotka of Ohio University reported (IDEC, 1985) that testing orthographic views, and mental rotations, animated 16 mm films and videotapes with interactive software were very promising in teaching these skills in a shorter period of time. Mike Sherman (IDEC, 1987) at University of

Illinois at Urbana-Champaign used several types of equipment for three CAD courses: 19 Mackintosh-Plus personal computers, five printers, including a laser printer, a graphics plotter, a video camera for interfacing with the PCs, and a library of software. Many experienced PC trainers prefer a two to one ratio of students to computers (Seymour, 1985). Lindsey (1988) found that the mean student/work station ratio in CAD classes in FIDER accredited university interior design programs is 1.87 students per work station (p. 39).

Teaching Methods

In university interior design programs, the most widely used teaching method was the lecture/laboratory method (Lindsey, 1988). In interior design programs, the introduction of technology produces technophobia as in other fields. To minimize technophobia, Sherman (1984) emphasized the importance of hands-on experience. He found the anxiety level increased greatly for students who have little or no previous experience with the computers. The anxiety level is very low for the students who have had hands-on experience with computers. More experienced learners also find computers forgiving of errors, and "safe" when they experiment with unusual or potentially dangerous responses (Smith & Dunn, 1987). Hands-on experience may also help problem solving as well as

technophobia in learning a computer. The more similarities existing between the two situations, the more likely the transfer of problem-solving strategies between the two situations is possible (Krasnor & Mitterer, 1984).

Seymour (1985) recommended a self-paced approach produced especially for each hardware and software product in teaching computers. He reported that a self-paced approach allows students who are concerned about their progress to avoid embarrassment in a classroom. He also reported that self-paced teaching programs make individual motivation high to get the most out of these self directed, self-paced programs.

As reported in the literature, hands-on experience and flexible learning approach could increase students' motivation and decrease anxiety level. High motivation and low anxiety level might help students generate new, original creative ideas. This same approach might help in teaching CAD. This issue will be addressed further in creativity and cognitive styles of learning, designing, and computing styles section.

Creativity and Cognitive Styles of Learning, Designing,
and Computing

Creativity

Interior Design Career Guide (IDEC, 1988) identifies an interior designer as a person who identifies, researches and creatively solves problems pertaining to the function and quality of the interior environment. It is expected that the interior designer also approaches a problem creatively and analytically. Creativity is regarded as one of the most important characteristics which Interior Designers should possess (IDEC,1988).

Anderson (1960) reported that creativity represents the emergence of something original and unique. Taylor (1972) pointed out that creativity varies in depth and scope rather than type and suggested that there be no difference between scientific and artistic creativity. He also reported on the creative process based on the theory of Wallas in 1925. The first is the exposure stage which is the initial period the individual collects raw material about a problem. The second phase is the incubation stage, which is an unconscious reorganizing of information. This phase necessarily does not follow in an orderly progression, but frequently interacts and overlaps to a large extent. The third stage is the illumination stage in which a recognizable and meaningful experience occurs. The

final stage is the execution stage that involves additional skills in translating subjective notions into objective form. He commented that several studies, more directly concerned with flexibility of thought, indicate that creative people will perceive a configuration in more possible ways and more quickly than less creative people who tend to rigidly remain fixed on their first impression. In the training of creativity, he also emphasized the importance of understanding communication, not in the usual sense, but including the non-verbal forms as well as language and the importance of learning to see things in terms of structural of spatial relations and also insight into the dynamics of creativity.

Thus it is necessary to ask how CAD influences the creative process. Jones (1985) discussed several issues regarding creativity and the computer. First, in the case of the creative aspect of the imagination and skill, defined by Webster, much of the mechanical skill is delegated to the paint program, but the imaginative part of the task-deciding where and how to apply the effect remains. Next is future patterns. Even though professional graphics service support is increasingly apt to be provided for advanced office systems, designers judge creatively the entire presentation in regard to composition, color selection and coordination, as well as adherence to corporate design standards. The issues of

compatibility and turnaround time were originally barriers to coordination, but the compatibility situation is changing as tools for integrating graphics functions and turnaround delays are improved by more powerful, low-cost hard-copy devices that provide faster high-quality output. Finally, he emphasized that beyond the computerization of artists' tools, computers can serve as decision support systems for graphic designers.

As defined by Webster, creativity has two aspects; imagination and skill (Jones, 1985). When a designer can use CAD skillfully, he or she may have one creative aspect to a design problem and put more time and energy saved from skillfulness to imagination.

MacKinnon (1962, 1965) and his associates at the Institute for Personality Assessment and Research at Berkeley studied individuals judged to be highly creative, including eminent scientific writers, mathematicians, and architects. In the studies, subjects who were nominated as "highly creative" were compared with those of less creative distinction. The highly creative architect, for example, turned out to be self-confident, flexible, self-accepting, little concerned with the opinions of others and strongly motivated to achieve.

Furthermore, Cross (1985) reported that the cognitive styles of computers are mismatched with the cognitive styles which most designers strongly possess to foster

creativity. Cross (1985) reported that a designer is quite clearly learning while he is designing. Therefore creativity of designers is deeply related to the designers' learning. In part, the nature of designers' learning and creativity is addressed through the cognitive styles of learning, designing, and computing.

Learning Styles

Pask (1972) reported there are two different cognitive styles in teachers and learners: serialist versus holist. A serialist follows a logical, step by step approach and pursues a straight path to a goal. A holist does not follow a straight path and prefers to learn out of sequence and in a random way.

He found in his research that students learn better and show a greater ability to generalize ideas from the knowledge they have gained if their learning styles are matched to the teaching styles (serialist to serialist or holist to holist). Furthermore, the least successful matched students tended to perform better than even the most successful mismatched ones.

Other cognitive styles are convergent and divergent thinking. Convergent thinking is concerned with converging on a single correct answer to a problem and requires close-ended solutions, while divergent thinking is concerned with generating a wide range of answers and requires open-ended

solutions. Hudson found in his research that the convergent students learned best from the convergent teachers, while the divergent students learned best from the divergent teachers (Hudson, 1967).

Focused (rigid) thinking and flexible thinking are also cognitive styles of learning. Witkin (1969) reported that a focused thinking person solves a problem by dealing with field dependence, whereas a flexible thinking person solves a problem focusing on field independence, a thinking style of relatively context free. He found that a flexible thinking person performs better in generating a new idea which has creative characteristics.

Designing Styles

As addressed before, a designer is learning while designing. Cross (1985) indicates that people have different cognitive styles in designing as well as in learning; serialistic design strategy versus holistic design strategy, convergent design strategy versus divergent design strategy, and focused (rigid) design strategy versus flexible design strategy. In addition, matched and mismatched design strategies between teachers and students influence the design student's success (Cross, 1985).

Lawson compared the problem-solving strategies between postgraduate architecture students and postgraduate science

Cognitive styles	Characteristics
Serialist	pursues logical small steps, a straight path
Holist	pursues out of sequence, different view point

Convergent	concerned with a single correct answer requires closed-ended answers to a question
Divergent	concerned with a wide range of answers requires open-ended answers to a question

Focused (rigid)	deals with field dependence
Flexible	focuses on field independence, context free

Figure 1. Characteristics of cognitive styles

students. He found that scientists tend to solve problems by step-by-step logical strategies, while architects tried to understand problems by seeking solutions directly through experiments. Bayazit (1987) compared and analyzed the design projects done by architectural students according to the learning styles of the students, and found that convergent and serialist students had great difficulty in the final project and even had difficult relationships with the instructors.

Dohr (1982) developed two courses using the linear and exploratory program development approaches. A linear approach is similar to the serialist, convergent or focused design styles. The exploratory approach is similar to the holist, divergent and flexible styles. She found that the subjects in the exploratory method were more creative and expanded more ideas on their final project while those in the linear method were more technical. She recommended that the exploratory approach be used to generate more creativity in courses. Burkhart (1960) reported divergent thinking offers students a appealing and exciting way of learning and in this context the value of creativity is apparent.

Computing Styles

Cross (1985) explained two different computing styles through a split-brain theory. The left hemisphere of a

human brain dominates in verbal, analytical modes of thought and controls serialist, convergent, linear ways of thinking. The cognitive style of a computer may be restricted to the functions of the left brain.

On the other hand, the right hemisphere dominates in nonverbal, synthetic modes of thought and controls holistic, divergent and flexible ways of thinking. A person who loses the right hemisphere function of the brain can not recognize an object in a human sense (Cross, 1985). Edwards (1979) applied split-brain theory to teaching drawing and found that the right brain dominates in creativity. Therefore, there is a mismatch between the cognitive abilities of a computer and the people whose creative abilities are restricted to the right hemisphere function (Cross, 1985).

Bayzit (1987) supported cognitive styles between the designer and the computer by mentioning that the designer relies on intuitive design logic rather than a stylized computer logic. He also indicated that the computer's main functions include: (1) serving as an extension to the memory of the designer, (2) enhancing the analytical and logical power of the designer, and (3) relieving the designer from routine tasks. He also described the functions of the designer as: (1) controlling the design process in information distribution, (2) applying creativity, ingenuity, and experience, and (3) organizing

the design information.

Learning and Creativity Application in CAD Classes

According to the cognitive theories reviewed, the mismatched cognitive styles between the teachers and students, between the designers and computers may inhibit creativity. Educators have asked whether computers inhibit an interior designer's creativity. For this problem, Dumesnil (1988) reported that, "Ideally teachers need to provide a flexible learning experience so that students can adjust their pace to their individual background, ability and the amount of time available."

Cross (1985) also recommended the development of more solution-focused CAD systems which may enhance design student's learning and designing process. McLain-Kark and Rawls (1988) reported that a creative approach may be possible when complete symbolic menus for computers are developed. The symbolic menu may relate more to the right brain, which is nonverbal and controls holistic, divergent, and flexible thinking. As addressed in the teaching materials section earlier, the Apple Macintosh computer (with MacDraw and MacDraft) makes as much use of icon of symbolic menus as possible and is less sequential, while IBM (AutoCAD) system has more word-oriented menus and is very sequential (McLain-Kark & Rawls, 1988).

Cross (1982) emphasized the implications of cognitive

styles by indicating that teachers can at least make some effort to provide a range of learning experiences for their students in order to increase the chances of a match being made. Students should be helped to know and to understand their own preferred cognitive styles. He also reported in his paper that knowing, understanding, and developing a student's own preferred learning/designing style means that the learning/designing process can become more efficient and effective. Shull (1986) also suggested that teachers recognize the cognitive process of their students for more successful results in learning.

CHAPTER III

CONCEPTUAL FRAMEWORK AND METHODOLOGY

The review of literature indicated that creativity may be fostered from a flexible cognitive style in which a person solves problems with an open-ended and symbolic process rather than a step by step, rigid cognitive style. The research also revealed that the flexible approach will foster more creative ideas in the learning and designing process, suggesting that flexible teachers can motivate their students' creativity. The Apple Macintosh computer (with MacDraw and MacDraft) uses more symbol-oriented menus and less sequential while the IBM (AutoCAD) system uses more word-oriented menus and is very sequential. This suggests that the Apple Macintosh computer system may be a more flexible system than the IBM computer system.

Therefore, the educators who are using the Apple system may have more positive opinions in regards to the creative aspects of teaching CAD than the educators who are using the IBM system. Also the educators who are using the Apple system may use a more flexible approach to teaching than the educators who are using the IBM system.

In this study, educators' opinions about creativity aspects of teaching CAD in interior design program was analyzed by examining teachers' teaching materials,

methods, and then determining the relationship between creativity and teaching approach, creativity and teaching materials, and teaching approach and teaching materials. In addition, information about the benefits of teaching CAD, the support of the program, the educator's experience, the number of CAD educators and the educator's creative CAD teaching techniques were obtained.

Hypotheses

The following hypotheses were formulated regarding educators' opinions about teaching CAD.

(1) Educators who are using Apple Macintosh system will have more positive opinions about creativity aspects in teaching CAD than educators who are using IBM system.

(2) Educators who are using a flexible teaching approach will have more positive opinions about creativity aspects in teaching CAD than educators who are using a rigid approach.

(3) Apple Macintosh system educators will use a more flexible teaching approach than IBM educators.

The Sample

The sample of the survey consisted of 182 IDEC (Interior Design Educators Council) members (out of approximately 400 IDEC members) who indicated the use of or interest in the use of computers in their curricula on the 1989 IDEC Computer Newsletter survey. The sample was composed of interior design educators, who were familiar with the computer hardware and CAD software. The data in regard to the department and faculty support and the number of CAD educators was tabulated by the number of schools, not the number of people in the sample. For example, if two or more respondents from the same university answered the questionnaire, the mean score of the answers from those respondents was analyzed.

Instrument/Data Collection

The questionnaire was designed to obtain three types of information (see Appendix C)

(1) Educators' opinions about benefits and support of CAD.

(2) Creativity and educators' teaching approach (flexible, rigid approach), and teaching materials (hardware, software, tutorials).

(3) Educators' general information including

experience of teaching CAD, number of CAD educators, and their creative teaching techniques.

Question 1 asked the respondents the usages of CAD in their interior design programs to collect the data from the educators using CAD. Question 2 asked the respondents to rank the importance of benefits of teaching CAD. Question 3 consisted of six items using Likert scale which were scaled from strongly disagree (coded as 1) to strongly agree (coded as 6) to obtain educators' opinions on creativity of teaching CAD. Question 10 asked the support of college, department, and other interior design faculty in the seven item coded scales.

The items of question 7, which also used Likert scales were alternately ordered by two rigid teaching approaches and two flexible teaching approaches. The teaching materials which educators used including hardware, software, and tutorial were asked in questions 4, 5, and 9.

The general information on teaching experience, and the number of faculty teaching CAD was collected in questions 6 and 11. Question 12 asked for comments of creative teaching techniques. The overall questionnaire format was constructed by following Dillmans's Total Design Method (1978).

The questionnaire (Appendix C) was pretested on February 19, 1990 with six educators who are teaching in the department of Housing, Interior Design and Resource

Management at Virginia Polytechnic Institute and State University to identify any ambiguous questions or any difficulties the respondents might encounter in completing the questionnaire. The revised questionnaire was mailed on February 26, 1990, to the 182 participants. A self addressed stamped envelope and a cover letter (Appendix A) on department letterhead was sent with the questionnaire.

The questionnaires were coded for identification and follow-up letters and follow up questionnaires were sent to those who failed to return the questionnaire within three weeks.

The Analysis of Data

The data from the questionnaire were coded for computerized statistical analysis. For Hypotheses One and Three, the statistical means for each variable were calculated and the difference between sample means was tested with two sample T-tests with alpha set at .05. The correlation coefficient was used to test for Hypothesis Two regarding the relationship between the two variables, flexibility and creativity. Also, the data on the benefits of teaching CAD, teaching experience, number of educators teaching CAD, and teaching materials were analyzed through descriptive statistics including means, frequencies, and percentages.

CHAPTER IV

RESULTS

This chapter contains the findings and discussion relevant to this study. First, educators' opinions about benefits and support of teaching CAD were obtained. In the second section, the relationship between creativity and teaching materials (IBM vs. Apple system), the relationship between creativity and teaching methods (flexible, vs. rigid), and the relationship between teaching materials and teaching methods were compared. The final section contains information about experiences of those teaching CAD, the number of CAD educators, and educators' creative teaching techniques in teaching CAD.

There were 98 (54%) respondents who returned the survey, 69 respondents answered the questions and the other 29 were the educators who did not use the CAD at the time but most of them indicated that they wanted to use the CAD in 1990-91 semesters or have shown interests in using CAD in their interior design program in the near future. Since not all questions were answered by all respondents, the results were reported and tabulated in either actual numbers or percentages of the total number answering the particular question.

Educators' Opinions about Benefits, and Supports

Each respondent was requested to check from a list the benefits and supports for teaching CAD. Six statements of the benefit were ranked and seven coded scales were remarked for support by respondents.

Benefits of Teaching CAD

The mean scores of the responses to the statements were obtained and the mean scores made up the rank ordering. This is because the data are interval and rank ordering is used to define how much each statement benefitted students.

The most important benefit of teaching CAD was a marketable skill for students' future careers with a mean score of 1.642.(see Table 1). Educators might have already noticed that of the top 100 interior design firms, 95% are using CAD (Loebelson, 1990).

The second benefit was the usefulness of CAD as a design aid in students' design processes with a mean score of 2.185. This may be the educator's approving of the usefulness of CAD which has the massive memory, permanent storage, and so on.

The third benefit concerned CAD as a teaching aid. This may indicate that not that many educators use CAD as a teaching aid.

The clean, better quality of students' portfolios was the fourth benefit which the educators chose. This means that educators regarded the design and teaching aid of CAD as more important than the feature that CAD produces good quality drawings for portfolios.

The fifth benefit was giving an edge to department's national standing in interior design. The last benefit was the time saving of CAD, which is faster than conventional drafting.

Support for teaching CAD

The data revealed that CAD educators were very much supported by their colleges, departments, and other faculties. The mean score of the support that educators received from their colleges was 5.24 out of 7 (see Table 2). It is above the mid point, 3.5. The mean score of the support that educators received from their departments was 5.75 and the mean score from the other faculties was 5.19. Overall, CAD educators are supported by their colleges, departments and the other faculties.

Table 1

Benefits of Teaching CAD in Interior Design
Programs

Ranking Order	Statements	Respondents Mean
1	CAD gives a marketable skill to students for future career.	1.642
2	CAD is useful as a design aid in students' design process.	2.185
3	CAD is used as a teaching aid.	3.855
4	CAD produces clean, better quality drafted drawings for a student's portfolio.	3.938
5	CAD program gives an edge in department's national standing	4.456
6	CAD is faster than conventional drafting, so student can do more projects	4.600

Table 2

Support Received for CAD Program

Sources of support	Mean
College	5.24
Department	5.75
Other faculty (Interior Design)	5.19
Total	5.4

* where 1 = not supportive and 7 = very supportive.

Creativity, Teaching Materials, and Teaching Methods

The three hypotheses stated that there would be a relationship between creativity and teaching materials, between creativity and teaching methods, and between teaching materials and teaching methods. Therefore, means of the responses to statements were obtained to test the three hypotheses and frequencies were obtained for teaching materials.

Creativity on IBM vs. Apple Macintosh Systems

Hypothesis One stated that educators who are using Macintosh systems will have more positive opinions about creativity aspects in teaching CAD than educators who are using IBM systems. This was not supported by the results. The average mean on all creative statements obtained was 4.19 for the educators who were using only IBM systems and 4.11 for the educators who were using only Apple Macintosh systems (see Table 3). It was found that there was no significant difference between IBM educators and Macintosh educators in terms of creativity ($t = -.07$, $p = .4715$).

However, three respondents commented that Macarchitron's 3-D Modeling seems to enhance creativity after students are comfortable with the program. Also the total mean score of the creativity statements was 4.09 out of total 6, which is higher than the neutral point, 3. It

Table 3 Mean Scores on Creativity Statements Based on IBM vs. Apple Macintosh Computer Systems

<u>Statements**</u>	<u>Mean</u>			
	<u>IBM</u>	<u>Apple</u>	<u>t</u>	<u>p</u>
A. Students have more difficulty being creative using CAD rather than standard drafting techniques.	3.72	4.17	-0.91	0.2115
B. CAD help students to develop new and original ideas.	3.97	4.17	-0.46	0.3225
C. Students can not think of creative ideas because they are spending time to figure out how to use CAD.	3.69	4.08	-0.69	0.248
D. The students who are proficient with CAD can be more creative using CAD.	5.44	4.75	2.48	0.0085
E. Students' spontaneous imagination to generate a unique idea is restricted by the technical function of CAD.	3.59	3.83	-43	0.336
F. Students come up with more ideas using CAD because the speed of CAD allows them to do more creative space planning.	4.13	3.67	0.85	0.199
TOTAL MEAN FOR ALL STATEMENTS	24.53 (4.19)	24.67 (4.11)	-0.07	0.4715

* N=32 for the educators who use only IBM computers and N=12 for the educators who use Apple Macintosh computers.

** Responses were coded where 1=strongly disagree, 2=disagree, 3=tend to disagree, 4=neutral, 5=tend to agree, 6=agree, 7=strongly agree. Where the statements were negatively stated (A,C, and E), they were coded in reverse order.

represents that in general, educators have positive opinions about creativity. Among six creativity statements, the mean score of 5.13 means that educators strongly agreed with Statement D that the students who are proficient with CAD can be more creative using CAD. It supported the fact, reviewed in the Chapter 2, that one of the aspects of the creative process was skill and the other was imagination. Thus a skillful person can spend more time on imagination and creativity because less time is spent on operating the computer.

Teaching Approach and Creativity

Hypothesis Two stated that educators who are using flexible teaching approaches will have more positive opinions about creativity aspects in teaching CAD than educators who are using the rigid approach. It was found that there was a low negative relationship between the teaching approaches flexibility and creativity ($r = -.3372$, $p = .003$) (see Table 4). When the value of r is between $-.30$ ($.30$) to $-.50$ ($.50$), it is interpreted that there are low positive (negative) correlations between two variables. On Question 8, educators evaluated their own flexibility. The correlation between educators' flexibility and creativity was not significant ($r = -0.0115$, $p = 0.464$).

The total mean score of the educators' teaching

approach (flexibility) was 3.35, which is below the neutral point of 3.5. It was found that in general the educators' teaching approach was more rigid than flexible. However, the mean score of the educators teaching approaches, self-evaluated was 6.587, over the neutral point of 5 (see Table 5). The educators evaluated that their teaching approach was more flexible than rigid.

Table 4

Correlation Coefficient of Teaching Approaches and Creativity

Teaching Approach (Flexibility) Mean	Creativity Mean	r	p
3.35	4.15	-.3372	.003

Table 5

Correlation Coefficient of Teaching Approaches and Creativity as Evaluated by Educators

Teaching Approach (Flexibility) Mean	Creativity Mean	r	p
6.587	4.15	-.0115	.464

Teaching Approach Using IBM vs. Apple Macintosh Systems

Hypothesis Three stated that educators who are using the Apple system would use a more flexible teaching approach than educators who are using the IBM system. This was not supported by the results. The mean for all responses to the teaching approach (flexibility) of those educators who were only using IBM systems was 13.61 (see Table 6). A mean of 14 for all responses to the teaching approach (flexibility) was found among educators who were using only Apple systems. No significant difference between these two groups was found ($t = -.24, p = .4065$).

However, the mean to the statement 4 of those educators who were only using IBM was 5.40 and the mean for the statement 4 of those educators who were using Apple Macintosh system was 3.83. According to the T-test ($t = 2.78, p = 0.004$), there was a significant difference between IBM and Apple Macintosh educators. Therefore from statement 4, the educators who are using Apple Macintosh system were using a more flexible teaching approach than the educators who are using IBM system.

On Question 8, the educators evaluated how rigid or flexible their CAD teaching approach was. Between the flexibility characterized by the educators who used IBM systems and by the educators who used Apple systems, there was no significant difference found ($t = .43, p = .3345$) at the .05 level (see Table 7).

Table 6 Mean Scores on Teaching Approach Statements Based on IBM vs. Apple Macintosh Computer Systems

<u>Statements</u> **	<u>Mean</u>		<u>t</u>	<u>p</u>
	<u>IBM</u>	<u>Apple</u>		
1. I prefer to use a step-by-step tutorial to introduce CAD.	2.65	3.92	-1.98	0.027
2. Students with CAD problems should solve the problem on their own.	2.41	3.00	-1.06	0.148
3. I organize teaching materials very logically, and teach every point clearly before moving on to next point.	3.48	3.25	0.36	0.359
4. I prefer to give students a little instruction, then give a project for them to explore ideas from different perspective.	5.40	3.83	2.78	0.004
TOTAL MEAN FOR ALL STATEMENTS	13.61 (3.4)	14.00 (3.65)	-0.24	0.4065

* N=32 for the educators who use only IBM computers and N=12 for the educators who use Apple Macintosh computers.

** Responses were coded for flexible statements. 1=strongly disagree, 2=disagree, 3=tend to disagree, 4=neutral, 5=tend to agree, 6=agree, 7=strongly agree. The rigid statements (1,3) were coded in reverse order.

Table 7

Mean Scores on Flexibility Evaluated by the Educators on IBM vs. Apple Macintosh Computer Systems.

		Mean		
	IBM	Apple	t	p
The educator's				
Flexibility	6.90	6.58	.43	.3345

* Responses were coded for flexibility. 1= very rigid to 10=very flexible.

All responses to the teaching approach of the educators who participated in the survey agreed with the statement four, which is a flexible teaching approach, "I prefer to give students a little instruction, then give a project for them to explore ideas from different perspectives." The mean of this question for all responses was 4.86, above the neutral point of 3.5.

Computer Equipment and Teaching Material Usage

The data on personal computer equipment, software packages, and the teaching material usage were analyzed. Thirty-four (49.3%) out of 69 educators indicated that they were using IBM computers (see Table 8). Twenty-one (30.4%) educators were using both IBM and Apple Macintosh systems. The number of educators who were using only Apple Macintosh systems was 12 (17.4%).

Of all the software packages, AutoCAD (52/75.4%) was the most often used software with the second most used being Macdraft (16/23.2%), and Macpaint the third most often used software package. Fifty-six (81%) out of 69 educators were using instructor prepared tutorial materials. AutoCAD Reference Manual, the second most used tutorial, was used by 29 educators (42%), and Inside AutoCAD, the third most used tutorial, was used by 21 educators (30.4%).

Table 8 Frequency Distribution of Teaching Materials

<u>Teaching Materials</u>	<u>Frequency</u>	<u>Percentage</u>
<u>Computer Type</u>		
1. IBM or IBM compatible systems	34	49.3
2. Macintosh/Apple systems	12	17.4
3. Others	2	2.8
4. Both IBM and Macintosh/Apple	21	30.9
Total	69	100.0
<u>Software Packages</u>		
1. AutoCAD	52	75.4
2. AutoShade	12	17.4
3. MacDraft	16	23.2
4. MacPaint	14	20.3
5. MacWrite	7	10.1
6. VersaCAD	10	14.5
7. Others: (MacArchitrion MacDraw Superpaint Mac3D CADKey Others)	28	40.6
<u>Teaching materials (tutorials)</u>		
1. Instructor prepared material	56	81.2
2. Inside AutoCAD	21	30.4
3. AutoCAD reference manual	29	42.0
4. Applying AutoCAD	10	14.5
5. Mastering AutoCAD	8	11.6
6. MacDraw user manual	9	13.0
7. MacArtist 3D user manual	1	1.4
8. Others	20	29.0

Since educators could check more than one category, the accumulated respondents' number (Software;139, Tutorials; 154) exceed the actual number of respondents (69).

Teaching Experience, CAD Educators, and Creative Teaching

Frequencies and percentages were obtained for the educators' teaching experience and for the number of educators teaching CAD. Frequency also was obtained for the educators' creative teaching techniques.

Experience of Teaching CAD

The number of educators who have less than one year teaching experience are 23 (33.8%) including six educators who have no experience (see, Table 9). The number of educators who have less than four year experience was 59 (85%) out of the total number of respondents, 68. Educators in general have limited teaching experience with CAD. Educators agreed with the fact that the skillful user in CAD can be more creative designing. The educators' opinions about creativity on using CAD may change after the educators gain more CAD teaching experience.

The Number of CAD Educators

The majority of the interior design departments have one to two CAD educators (see Table 10). Twenty eight (40.6 %) of the interior design departments have one CAD educator and seventeen (25.8%) interior design departments have two CAD educators.

Table 9

Frequency Distribution of Experience Teaching CAD

Period of teaching experience (semester)	Respondents Frequency	Percentage
no experience	6	8.8
1	7	10.3
2	10	14.7
3	7	10.3
4	6	8.8
5	3	4.4
6	9	13.2
7	3	4.4
8	8	11.8
9	1	1.5
10	3	4.4
12	2	2.9
15	1	1.5
16	1	1.5
30	1	1.5
no answer	1	
Total	68	100.0

Table 10

Frequency Distribution of Number of CAD Educators in
Interior Design Programs

Number of Educators	Respondents	
	Frequency	Percentage
0	3	4.5
1	28	42.4
2	17	25.8
3	11	16.7
4	3	4.5
5	1	1.5
6	3	4.5
doubled program	3	
Total	69	100.0

Creative Teaching Techniques

The respondents described their creative teaching opinions on Question 12. Five respondents answered that students were creative in pattern-development with CAD in for example carpet design, door facade, and textile design. Three respondents described that CAD helps students study space illusions and perspective principles and color interactions. Three respondents commented that MacArchitrion's 3-D modeling seems to enhance creativity after students are comfortable with the program and also have indicated that Mac project software actually helps teach project management. Therefore, even though Hypothesis One was rejected, educators who are using the Apple system have more positive opinions about creativity aspects of teaching CAD than educators who are using the IBM system. A few educators noticed that the software for Apple Macintosh systems enhance students creativity. Four respondents indicated that their own AutoCAD tutorials or the AutoCAD tutorials developed by other educators with accompanying drawing files help teaching CAD creatively.

The following comments were also made:

(1) Students who are creative in their ideas can develop them equally well and also feel less limited by the software.

(2) Skillful users can concentrate on creativity in designing with CAD.

(3) A programming class is a prerequisite for CAD use.

(4) Demonstration and self-related instruction allow students to develop a creative approach.

(5) It is necessary to give very clear instruction and then give students freedom to explore designing on CAD.

(6) Architectural CAD application is needed.

(7) Other interior design faculty, who do not teach CAD, find it difficult to accept CAD generated drawings, because they do not feel qualified to grade them.

CHAPTER V

SUMMARY

Computer aided design has been increasingly used in the interior design area since the early 1980's. Likewise, educators have been incorporating CAD in their programs over the last several years. This study investigated how the CAD classes are integrated into the current interior design program focusing on educators' opinions concerning creativity using CAD.

This research examined interior design educators' opinions about benefits and support of CAD and the relationship among creativity, teaching methods, teaching materials, and also general information about experience, number of CAD educators, and creative teaching techniques.

A questionnaire was sent to 182 members of IDEC (Interior Design Educators Council). A total of 69 responses were used in this analysis. Frequency distributions were used to describe the sample information and teaching materials for CAD. Means of responses to educators' opinions were tested with the T-test and correlation analysis to examine if a relationship existed among creativity, teaching approach, and teaching materials.

Educators ranked the strongest benefit of teaching CAD

was that it gives students a marketable skill for their future careers. Perhaps educators have recognized the need for CAD skills for students' future careers since CAD has been so prevalent in interior design companies. The second highest ranked benefit was the usefulness of CAD as a design aid in students' design process. This was ranked above the benefit of using CAD as a teaching aid. Interestingly, the feature of CAD to produce clear, better quality drawings for student's portfolio was rated fourth. Also less important (fifth) was the benefit of CAD giving a program an edge in national standing. Lastly, the speed of CAD so that students could do more projects was ranked sixth. This finding may differ from the field where productivity is highly rated. It may be because students may not get enough hours of CAD use in classes to be productive with it.

CAD educators believed that their departments, colleges, and other faculties are supportive of CAD program with departments being most supportive, followed by colleagues, and finally other interior design faculty. While this finding indicates that CAD support is good, it may suggest that CAD instructors will need to educate their colleges about CAD to receive more support from them.

The first hypothesis stated that educators who are using Macintosh systems will have more positive opinions about creativity aspects in teaching CAD than educators who

are using IBM system. This was rejected. It was found that there was no significant difference between IBM educators and Macintosh educators in terms of creativity opinions. This finding may be due to the small sample size. There were only 12 Apple Macintosh users, so differences would be difficult to detect. However educators have positive opinions about creativity of using CAD in interior design programs.

Most educators agreed that the students who are proficient with CAD can be more creative using CAD. Thus, according to the educators, as students' skills with CAD increase, their creative use of CAD ought to increase also.

Hypothesis Two stated that educators who are using flexible teaching approach will have more positive opinions about creativity aspects in teaching CAD than educators who are using rigid approach. It was found that there was no significant relationship between teaching approach and creativity. The mean score of the flexibility obtained by scores on teaching approach statements revealed that educators' teaching approach was more rigid than flexible. On the other hand, when asked in regard to flexibility, educators reported that they were flexible rather than rigid. Educators may have known that flexible teaching approach foster creativity and may try the flexible teaching approach however, they may find that CAD requires a more rigid or sequential approach. The other reason may

be the measure on flexible/rigid approach was not adequate.

Hypothesis Three stated that educators who are using the Apple system will use more flexible teaching approaches than educators who are using the IBM system. This was not also supported by the results. However all respondents, whether they use IBM or Apple systems, agreed with the statement "I prefer to give students a little instruction, then give a project for them to explore ideas from different perspectives," which is a flexible teaching approach.

General information about teaching materials, teaching experience, and the number of CAD educators were obtained. The most used computer in interior design education programs in this study was IBM with about half. The educators who were using only Apple Macintosh systems was 17.4% while the educators who were using both IBM and Apple Macintosh systems was 30%. According to Hildebrand's survey of computer users in IDEC (Hildebrand, 1984), Macintosh Apple computers were used more than IBM in education, 18 (Apple) versus 9 (IBM). However, educators are now using more IBM or using both IBM and Macintosh systems. Educators may have become more skilled so can use both CAD systems or they want students to have the capability of both systems for students' future careers.

Most educators were using instructor prepared materials followed by the book Inside AutoCAD. This

finding coincides with Lindsey's research (1988) which also found in the survey of FIDER (Foundation for Interior Design Education Research) programs that instructor prepared materials was the most used tutorial followed by Inside AutoCAD.

Most educators had less than two years experience of teaching CAD. Most interior design program have one or two CAD educators. Since 29 educators said that they were not using CAD and most of them will use CAD in the near future, the number of CAD educators will probably increase.

The educators commented on several creative teaching techniques such as that CAD can be creatively used in pattern development and help students learn space illusions, perspective principles, and color interactions. Educators also commented that creative students or skillful users can develop their ideas with CAD equally as well as they do in conventional designing, and recommended a prerequisite programming class, demonstrations, self-related instruction, structural instructions, and architectural CAD application software as creative teaching techniques.

Major Findings

(1) Overall, the educators indicated the benefits of teaching CAD in the following order: 1. Marketable skill

for students' future career, 2. Design aid in students' design process, 3. Teaching aid, 4. Better quality of students' portfolios, 5. Department's national standing, 6. Time saving on projects.

(2) CAD educators receive support from other faculty, their departments, and their colleges.

(3) IBM educators and Apple Macintosh educators did not have different opinions in terms of creativity. They have positive opinions about creativity of using CAD.

(4) The educators who were using flexible teaching approach and the educators who were using rigid teaching approach did not have different opinions in terms of creativity.

(5) The educators who were using Apple Macintosh system and the educators who were using IBM system did not use different teaching approaches. Overall, educators indicated that they were using flexible teaching approach, however, according to the mean score obtained by the Likert scaled teaching statements, the educators' teaching approach was more rigid than flexible.

(6) The IBM personal computer was the most often used hardware, AutoCAD was the most used software, the instructor prepared materials were the most used teaching materials in CAD programs.

(7) The majority (85%) of the educators have less than 4 years of experience in teaching CAD.

(8) The majority (66%) of the interior design departments have one or two CAD educators.

(9) Educators commented that CAD can be used creatively in pattern-development and help students learn space illusion, perspective principles and color interaction and also commented that creative students or skillful CAD user can use CAD creatively. Therefore, they recommended a prerequisite programming classes, demonstration with self-related instructions, and clear structural instructions, and architectural CAD implications for teaching CAD creatively.

Implications

This study revealed that educators have had positive opinions on creative aspects in integrating CAD classes in their interior design programs. The trend of integrating CAD courses in interior design programs is expected to continue in interior design programs.

The educators felt that their teaching styles were flexible in approach; however, from the analysis of the survey, it was found that the teaching approach was more rigid. It is necessary for educators to consider and develop more flexible teaching methods for CAD courses.

It is suggested that the educators who are teaching CAD as well as the educators who are not teaching CAD

attend meetings or conferences frequently to exchange teaching methods, materials for teaching CAD, and publication of papers. It is also recommended that a short course on CAD be available at interior design educators' conferences so that educators who do not teach CAD be kept updated on this new technology. This is because it was found from the comments on the surveys, that the interior design faculties who do not teach CAD, find it difficult to accept CAD generated drawings because they do not feel qualified to grade them. Furthermore, it was found that many CAD educators use their own teaching materials or manuals, therefore, it would be desirable that teaching materials such as a standard textbook be developed for interior design programs so that new CAD educators would feel more comfortable in starting a new CAD class.

Recommendations for Further Study

These recommendations for further research are as follows:

(1) The number of Macintosh users (12 out of 69) was not high enough to test Hypotheses One and Two, compared to the number of IBM users (34). Larger numbers of respondents are recommended.

(2) Additional questions on a comparison of whether IBM or Apple Macintosh could foster creativity could be

added into the instrument. This would help in investigating whether the computer equipment influence the creativity aspects of using CAD.

(3) A comparison study on a same project but one group using the IBM system and the other group using the Apple Macintosh system is recommended.

(4) More developed test types of questions, which could divide different cognitive styles and teaching approaches are recommended.

It was found that educators are positively integrating CAD in interior design programs. There were very limited papers found about CAD especially in interior design during this study. Teaching CAD is important but also research and publication would further develop CAD courses in interior design education as well as interior design practice.

REFERENCE

- Anderson, H. H. (1960). The nature of creativity. Studies in Art Education, 1(2), 11-17
- Auto desk, INC. (1987). News of the instructional applications of AUTOCAD. Sausalito, CA.
- Ball, A. K. (1984). A interactive microcomputer instructional program to teach basic computer-aided design. Unpublished doctoral dissertation, Virginia Polytechnic Institute & State University.
- Bayazit, N. (1987). Theoretical basis of computer-aided design education and research laboratory. Design Studies, 8(3), 138-149.
- Burkhart, R. C. (1960). The interrelationship of separate criteria for creativity in art student teaching to four personality factors. Studies in Art Education, 2(1), 86-106.
- Computer Aided Planning, Inc. (1985). CAP. Grand Rapids, MI.
- Computer Aided Planning, Inc.(1985). What is CAP. Grand Rapids, Mi.
- Cross, N. (1982). The relevance of cognitive styles in design education. Design Methods and Theories, 17(1), 37-50.
- Cross, N. (1985). Style of learning, designing and computing. Design Studies, 6(3), 157-162.
- Dumesnil, C. D. (1988). Preliminary evaluation Computer Aided Instruction in historic interior. Journal of Interior Design Education and Research, 14(2), 45-50.
- Dohr, J. (1982). Creativeness: A criterion for selecting a program development approach. Journal of Interior Design Education and Research, 8 24-28.
- Edward, B. (1979). Drawing on the right side of the brain. Los Angeles, CA: J. P. Tarcher.
- Ettinger, L. F. (1988). Art education and computing: Building a perspective. Studies in Art Education, 30(1), 53-62.

- Hasell, D. (1987). Enrichment in interior design education and practice with computers. Presented at Poster Session IDEC Conference, University of Saskatchewan, Saskatoon, Saskatchewan, CANADA S7N 0W0
- Herman Miller, Inc.(1987). CAD packages. Zeeland, MI.
- Hildebrand, P. (1984). Survey of IDEC computer users. Unpublished manuscript, University of Missouri, Columbia, Missouri.
- IDEC, (1988). Interior Design Career Guide. Interior Design Educator Council, Inc, Irvine CA.
- IDEC Computer Network Newsletter, (1987, Spring).
- IDEC Computer Network Newsletter, (1986, Fall).
- Jones, G. E. ed. (1985, April). Can creativity be automated? Computer Graphics World. 8, 73-74,77.
- Kransner, L. R., Mitter, J. O. (1984). LOGO and the development of general problem-solving skills. The Alberta Journal of Educational Research, 30 133-144.
- Lesgold (1984). Computer resources for learning. Peabody Journal of Education, (2) 159-167.
- Lindsey, P. F. (1988). Computer Aided Design teaching methods, materials, and equipment used by FIDER accredited schools of interior design. Unpublished master's thesis, East Carolina University, Greenville, NC.
- Loebelson, A. (1990, January). Interior Design Giants of 1990, Interior Design, 115-119.
- MacKinnon, D. W. (1962). The nature and nurture creative talent. American Psychologist, 17, 454-459.
- Mitchell, W. J. (1977 July). Teaching Computer Aided Architectural Design at UCLA. Proceedings at the Computer Aided Design Education International Conference. University of California Los Angeles.
- McLain, J. (1980). A method for incorporating computer graphics in interior design education. Unpublished manuscript. University of Northern Iowa, Cedar Falls.
- McLain-Kark, J. (1991). The Designer's AutoCAD Tutor. New York, NY: Van Nostrand Reinhold.

- McLain-Kark, J., Rawls, S. (1988). CAD education in Interior Design Computers and the creative process. Journal of Interior Education and Research.
- Plant, J. C. (1988). Computer utilization in interior design : A comparative study of attitudes, application, and equipment usage in 1985 and 1988. Unpublished master's thesis, Virginia Polytechnic Institute and State University, Blacksburg, VA.
- Preskill H. (1988, March). Teachers and computers: A staff development challenge. Educational Technology, pp. 24-26
- Pask, G., Scott, B.(1972). Learning strategies and individual competence. Int. J. Man-March Stud. 4(3), 217-253.
- Sherman, M. P. (1984). Computer Aided Design :From manual to plotter. Journal of interior design educators and research, 10 (2), 13-17.
- Seymour, J. (1985, February). How to choose a PC-training program. Today's Office, pp.39-42.
- Shuell, T. J. (1986). Cognitive conceptions of learning. Review of Educational Research, 56(4), 411-436
- Taylor, I. A. (1972). The psychology of the Creative personality. Creativity:An examination of creativity process, Paul Smith, Libraries Press, New York, 51-81.
- Teicholz, E. (1985). CAD/CAM Handbook. McGraw Hill, New York, Chapter 2, 4-7
- Wu,K. K., & Willis, V. J. (1978). Alternative Techniques for visual communication in interior design education. Journal of Interior Design Education and Research, 37-44
- Wingler, H. (1969). The Bauhaus: Weimer, Dessau, Berlin, Chicago. M.I.T. Press. Cambridge, MA.
- Witken, H. A. (1969). Some implications of research on cognitive style for problems of education in Gottesgen, M B and Gottesgen, G B (eds) Professional School Psychology, 3, Grime and straton, New York.

APPENDIX A:
COVER LETTER TO INTERIOR DESIGN EDUCATORS



VIRGINIA POLYTECHNIC INSTITUTE AND STATE UNIVERSITY

Blacksburg, Virginia 24061-0424

DEPARTMENT OF HOUSING, INTERIOR DESIGN AND RESOURCE MANAGEMENT DEPT. (703) 231-6163
OFFICE (703) 231- 7415

Date: February 26, 1990

Dear IDEC Member

Educators have recognized the increased use of CAD (Computer Aided Design) systems in the interior design field and have introduced it to their students. Educators' opinions about students' creativity and its relationship to the teaching methods, teaching materials, and teaching experience are the focus of this study. We are also interested in your opinions about the benefits of teaching CAD, the support you receive, as well as any suggestions on creative way of teaching.

You have been chosen as part of a sample of CAD educators, asked to give your opinions on these matters. If you do not teach CAD, please pass this survey on to the instructor who does.

Individual respondents and universities will not be identified in the research findings and will be kept confidential. Please return the completed survey in the self-addressed, stamped envelope by March 12, 1990.

Thank you for your assistance. The return address is:

Hye Mi Ko
9003 Glacier Rd.
Woodbury, MN 55125

Sincerely

A handwritten signature in cursive that reads "Hye Mi Ko".

Hye Mi Ko
Graduate Student

A handwritten signature in cursive that reads "Joan McLain-Kark".

Joan McLain-Kark, Ph.D.
Associate Professor

APPENDIX B:

FOLLOW-UP COVER LETTER TO INTERIOR DESIGN EDUCATORS



COLLEGE OF HUMAN RESOURCES

VIRGINIA POLYTECHNIC INSTITUTE AND STATE UNIVERSITY

Blacksburg, Virginia 24061-0424

DEPARTMENT OF HOUSING, INTERIOR DESIGN AND RESOURCE MANAGEMENT DEPT. (703) 231-6163
OFFICE (703) 231-7415

Date: March 12, 1990

Dear IDEC Member:

Two weeks ago a questionnaire was sent to you seeking your opinion regarding creativity aspect and teaching CAD in interior design curricula. If you have completed the questionnaire, I offer my sincere thanks. In the event that your questionnaire was misplaced, a replacement is enclosed. Please take a few minutes to fill out the questionnaire completed and return it in the self addressed envelope. I am writing to you again because of the significance each questionnaire has to the usefulness of completing my thesis.

Feel free to write any comments you wish. Your responses will be kept confidential. I appreciate your effort and valuable time. I look forward to hearing from you soon.

Sincerely

Handwritten signature of Hye Mi Ko in cursive.

Hye Mi Ko
Graduate Student

APPENDIX C:
QUESTIONNAIRE

QUESTIONNAIRE ON CAD INSTRUCTION
PLEASE RETURN BY MARCH 12, 1990

1. Are you using CAD in your interior design program?

YES

NO (If No, Stop here and please send the survey back in the enclosed envelope. Thank you)

2. Which benefit is more important in interior design education? (put number in ranking order from 1=most important, to 6=least important)

CAD GIVES A MARKETABLE SKILL TO STUDENTS FOR FUTURE CAREER.

CAD IS USEFUL AS A DESIGN AID IN STUDENTS' DESIGN PROCESS.

CAD IS USED AS A TEACHING AID.

CAD PROGRAM GIVES AN EDGE IN DEPARTMENT'S NATIONAL STANDING.

CAD PRODUCES CLEAN, BETTER QUALITY DRAFTED DRAWINGS FOR A STUDENT'S PORTFOLIO.

CAD IS FASTER THAN CONVENTIONAL DRAFTING, SO STUDENT CAN DO MORE PROJECTS.

3. Please circle the appropriate number to indicate how strongly you agree or disagree with the following statements regarding CAD instruction.

	1	2	3	4	5	6
	strongly disagree					strongly agree
A. STUDENTS HAVE MORE DIFFICULTY BEING CREATIVE USING CAD RATHER THAN STANDARD/DRAFTING TECHNIQUES ...	1	2	3	4	5	6
B. CAD HELP STUDENTS TO DEVELOP NEW AND ORIGINAL IDEAS.....	1	2	3	4	5	6
C. STUDENTS CAN NOT THINK OF CREATIVE IDEAS BECAUSE THEY ARE SPENDING TIME TO FIGURE OUT HOW TO USE CAD.....	1	2	3	4	5	6
D. THE STUDENTS WHO ARE PROFICIENT WITH CAD CAN BE MORE CREATIVE USING CAD...	1	2	3	4	5	6
E. STUDENTS' SPONTANEOUS IMAGINATION TO GENERATE A UNIQUE IDEA IS RESTRICTED BY THE TECHNICAL FUNCTION OF CAD	1	2	3	4	5	6
F. STUDENTS COME UP WITH MORE IDEAS USING CAD BECAUSE THE SPEED OF CAD ALLOWS						

THEM TO DO MORE CREATIVE SPACE

PLANNING.....1 2 3 4 5 6

4. Which computer systems are you using to teach CAD.
(circle all that apply)

- 1. IBM or IBM COMPATIBLE SYSTEMS
- 2. MACINTOSH/APPLE SYSTEMS
- 3. OTHERS:PLEASE LIST_____

5. What type of software packages are you using?
(circle all that apply)

- 1. AUTOCAD
- 2. AUTOSHADE
- 3. MACDRAFT
- 4. MACPAINT
- 5. MACWRITE
- 6. VERSA CAD
- 7. OTHERS_____

6. How many terms have you taught CAD ?

_____ (QUARTERS, SEMESTERS)

7. Please circle the appropriate number to indicate how strongly you agree or disagree with the following statements regarding your CAD teaching approach.

1	2	3	4	5	6
strongly disagree				strongly agree	

1. I PREFER TO USE A STEP-BY-STEP TUTORIAL TO INTRODUCE CAD..... 1 2 3 4 5 6 7

2. STUDENTS WITH CAD PROBLEMS SHOULD SOLVE THE PROBLEM ON THEIR OWN .1 2 3 4 5 6 7

3. I ORGANIZE TEACHING MATERIALS VERY LOGICALLY, AND TEACH EVERY POINT CLEAR BEFORE MOVING ON TO NEXT POINT.....1 2 3 4 5 6 7

4. I PREFER TO GIVE STUDENTS A LITTLE INSTRUCTION, THEN GIVE A PROJECT FOR THEM TO EXPLORE IDEAS FROM DIFFERENT PERSPECTIVE.....
.....1 2 3 4 5 6 7

5. OTHER

8. On the scale of 1 to 10, how would you characterize how rigid or flexible your CAD teaching approach is ?

Very Rigid		Very Flexible							
1	2	3	4	5	6	7	8	9	10

9. The teaching materials which you use are
(circle all that apply):

1. INSTRUCTOR PREPARED MATERIAL
2. INSIDE AUTOCAD
3. AUTOCAD REFERENCE MANUAL
4. APPLYING AUTOCAD
5. MASTERING AUTOCAD
6. MACDRAW USER MANUAL
7. MACARTIST 3D USER MANUAL
8. OTHER, PLEASE LIST

10. Please circle the appropriate number to indicate the level of support you believe you receive from the college/department and other faculty.

1	2	3	4	5	6	7
Not Supportive			Very Supportive			

COLLEGE.....	1	2	3	4	5	6	7
DEPARTMENT.....	1	2	3	4	5	6	7
OTHER FACULTY.....	1	2	3	4	5	6	7

(INTERIOR DESIGN)

11. How many teachers in your program are using CAD in their classes?
_____ Number

12. What ways have you found to be creative in teaching CAD?
Please describe one creative technique (teaching material/approach) for teaching CAD.

Other Comments:

VITA

Hye Mi Ko was born on June 5, 1960 in Seoul, Korea. In February 1983, she received a Bachelor of Arts degree in English Literature from Dong-Duck Women's University, Seoul, Korea. Hye Mi began her graduate study in September 1986 and in September 1990 received a Master of Science degree from Virginia Polytechnic Institute and State University in the department of Housing, Interior Design and Resource Management.

During her graduate studies, Hye Mi served as a graduate assistant in the department of Housing, Interior Design and Resource Management. Her major responsibilities included assistance in upgrading, expanding and maintaining the Interior Design Resource Room.

Hye Mi Ko