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A Survey of Architects and Engineers in the State of Virginia to Determine if Traditional Drafting Skills Should Continue to be Taught in Virginia's High Schools

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A SURVEY OF ARCHITECTS AND ENGINEERS IN THE STATE OF VIRGINIA TO DETERMINE IF TRADITIONAL DRAFTING SKILLS SHOULD CONTINUE TO BE TAUGHT IN VIRGINIA'S HIGH SCHOOLS

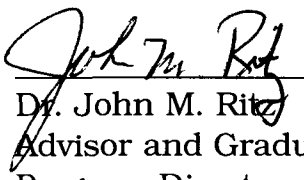
A Research Paper
Presented to
The Faculty of the School of Education
Old Dominion University

In Partial Fulfillment
of the Requirements for the Degree
Master of Science in Education

by
James M. Peters
March 1997

APPROVAL PAGE

This research paper was prepared by James M. Peters under the direction of Dr. John M. Ritz in OTED 636, Problems in Education. It was submitted to the Graduate Program Director as partial fulfillment of the requirements for the Degree of Master of Science in Education.

APPROVAL BY:  4-17-97

Dr. John M. Ritz
Advisor and Graduate
Program Director

Date

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CHAPTER I

INTRODUCTION

From the beginning of human history, drawing pictures has been an effective means of recording and communicating ideas. Drawing has changed drastically from those early scratchings on the walls of caves to the three dimensional modeling of today's technical drawings created on computer-aided design and drafting systems.

Technical drawings, also referred to as mechanical drawings, are produced freehand or with instruments. Freehand drawing produces a sketch on paper and is rendered with only pencil and eraser. These drawings are often used for preliminary design and are the accepted language of industry. Most finished mechanical or technical drawings, which are usually made to scale, require such precision instruments as T-squares, triangles, parallel bars, drafting machines, compasses, templates and irregular or French curves.

In many architectural and engineering firms these traditional drawing instruments are now being replaced by computers. The availability of computer-aided design and drafting (CADD or CAD) software, has made it possible for almost anyone with little or no traditional drawing skills to produce at least preliminary drawings themselves. Most architects and engineers working today began their careers with traditional board skills which prepared them for understanding and using today's CAD systems.

STATEMENT OF PROBLEM

The purpose of this study was to survey a random sample of architects and engineers in the State of Virginia to determine: first, if they were still using traditional drafting tools and skills on a regular basis themselves and secondly, to see if they felt it was desirable for high schools in the state of Virginia to continue to teach these skills as a prerequisite to teaching computer-aided drafting and design (CAD or CADD) in order to prepare students for future employment.

RESEARCH GOALS

The following questions guided this research design:

1. Determine the use of traditional and computer aided drafting tools and skills in architectural and engineering firms.
2. Determine whether architects and engineers feel that it is important to continue to teach traditional drafting skills in high school technology education classes.
3. Determine whether architects and engineers feel that it is important to teach CAD skills in high school technology education classes.
4. Determine what type(s) of CAD programs are currently in use in architectural and engineering firms.

BACKGROUND AND SIGNIFICANCE

Many high school drafting teachers, not only in the State of Virginia but across the nation, have pushed aside the drafting tables and put away the T-squares, triangles, pencils and paper to make room for computer desks and CAD workstations. There are educators and administrators who feel that traditional drafting tools and skills no longer have a place in the modern electronic school. Yet, in preliminary conversations with architects who use pencil and paper on a daily basis to quickly record and partially refine design ideas the researcher got the impression that traditional board skills were not only desirable, but prerequisite to an understanding of CAD applications.

"There are hundreds of thousands of drafting tables out there," said Robert Davison, director of operations for *Generic.* "However, the people using those drafting tables, particularly at smaller firms, are often faced with daunting hardware and training costs as they seek to computerize. Indeed, the cost per seat for professional CAD setups can range from several thousands of dollars for PC-based units to more than ten thousand dollars for workstation-based designs." (Puttré, 1991, p. 60)

As a technology teacher, it is important to know what skills are needed by the students taught to prepare them for future employment in the fields of architecture and engineering. Having input from a sampling of professionals working in these fields has helped to provide an understanding of what drafting and CAD skills are needed in these professions.

LIMITATIONS

This study was based on the following limitations:

1. The research was limited to a random sample population of architects and engineers in the State of Virginia.
2. The research was limited to surveys which were completed by professionals in these respective fields.

ASSUMPTIONS

This study was based on the following assumptions:

1. Architects and engineers would accurately and honestly answer the questions of the survey and would return them to the researcher.
2. Each architect or engineer completing the survey knew what drawing skills were needed for an entry level employee in their particular firm.

PROCEDURES

Surveys containing questions relating the regular personal use of traditional drafting tools and skills were sent to a random sampling of 50 architects and engineers in the State of Virginia. Using the survey, they were also asked to express their feelings concerning traditional drafting skills and whether they felt these skills were important enough to continue to teach to high school students in the State of Virginia. The

results of these surveys were tabulated and the importance of continuing to teach traditional drafting skills in high schools was determined.

DEFINITIONS OF TERMS

Terms used in this study were defined as follows:

1. ***Traditional Drafting*** is the use of pencils, erasers, drawing boards, triangles, T-squares, parallel bars, drafting machines, compasses, templates, and irregular or French curves to produce architectural and engineering drawings.
2. ***CAD (CADD)*** is an acronym for computer-aided (assisted) design and drawing (drafting) - the use of computers and graphic based software to assist the drafter in preparing drawings.

OVERVIEW OF CHAPTER I

In Chapter I of this study, the problem and research goals were identified. The problem stated was to survey a random sampling of architects and engineers in the State of Virginia to determine whether traditional drafting skills should continue to be taught along with CAD skills in high schools to prepare students for future employment.

In the following chapters, the literature related to this study was reviewed, the methods and procedures used to collect and analyze the data were discussed in detail, and an analysis of the findings of the study, along with recommendations and conclusions were presented.

CHAPTER II

REVIEW OF LITERATURE

This study was based on the rationale that high school drafting programs must not only be computer based, but also need to have a foundation of traditional drafting skills. Other research has been done which compares the effectiveness of CAD to traditional drafting skills, however the researcher in this study believed that traditional drafting skills were needed as a prerequisite to an understanding of CAD and as an entry level skill for employment as a draftsperson in an architectural or engineering firm. Although this study confined its research to the fields of architecture and engineering, the researcher also believed that traditional drafting skills were also useful in the related fields of construction, commercial art, graphic arts, and the fine arts.

In this chapter the researcher cites articles from magazines, newspapers, and excerpts from textbooks on the subjects of traditional drafting and CAD.

Drawing to Communicate

Drawing is one of the oldest and most basic forms of visual communication. Early cave dwellers communicated by painting or drawing simple figures on the walls of caves. These drawings not only communicated with people of their time, but they were also a record for future generations as well. These simple drawings may have served the purposes of those cave dwellers but, as the world became more and more complex and as people began to construct and manufacture, the need for accurate and concise drawings increased. As a way to ensure uniform draw-

ing communication, technical drawing technology was developed, standardized, and refined. (Barden, pp. 42-43)

Mathematics and the Technical Design Process

The field of technical design began as a form of mathematics. Many of the early mathematicians used drawings in arithmetic, algebra, geometry, trigonometry, and calculus to solve problems. The Greeks even developed their theories of geometry by means of drawings.

From those early beginnings, the same mathematical drawing methods were applied to other fields. Architects, scientists, mechanics, artists, and craftsmen all understood the advantages of drawings.

We have all heard the expression, "A picture is worth a thousand words." Though trite, this expression is true because a picture can often explain an idea better than a lot of words. People in fields such as architecture, electronics, mapping and structural engineering often make use of sketches and drawings to communicate their ideas. (Sanders, pp.161-162)

Manual, Mechanical or Technical Drawing

Manual, mechanical, or technical drawing refers to drawings produced with traditional drafting instruments. However, some of these drawings are made freehand on paper using only pencil and eraser. Drafters make mechanical or technical drawings to show exactly how to construct or use machines, buildings, or other objects. (World Book Encyclopedia, Vol. 13, p. 358)

Manual Drafting: A Skill for the 21st Century?

Many teachers of secondary technology education programs and the technology education curriculum they use, engage students in manual drafting exercises. These instructors, when asked why they are teaching manual drafting respond, "It is a good way to teach them the basics." This answer leads naturally to the next question, "Just what are the basics in Engineering or Technical Graphics, commonly referred to as mechanical drawing or just plain drafting?" The term drafting arrived in this country with the manual arts movement in the late 19th century. And so the question, "Is manual drafting a skill that students will need to enter technical occupations in the 21st century?" remains unanswered.

The Design Graphics Division of the American Society for Engineering Education (1996) adopted a model for engineering graphics which identifies three levels of drawing: Ideation, Communication and Documentation. *Ideation* drawing is freehand, very informal, and needs to communicate only with the designer. It is a way of "visual brainstorming" to seek possible solutions to problems. The purpose of these drawings is to explore many ideas in rapid succession and the use of traditional manual drafting tends to be too cumbersome. (Raudebaugh, 1996)

Communication drawing covers a variety of drawings including perspectives, renderings, technical illustration, etc. The purpose of these drawings is to further develop promising ideas and to communicate them to other interested individuals. These drawings are more complex

and usually involve color, shading and perspective which represent the finished product in a realistic manner. Traditional manual drafting is of some value in the development of communication drawings.

Documentation drawing, also known as working drawings, shop drawings, engineering, or manufacturing drawings, are governed by a strict set of standards. They are usually produced through the use of the orthographic projection system of descriptive geometry. It is the type of drawing on which most of our schools, from middle schools through the universities, focus. Often these programs focus on manual drafting and CAD, but they pay little attention, or ignore altogether, the other forms of drawings associated with the design process. (Raudebaugh, 1996)

Computer-Aided Design and Drafting

The use of computers and computer technology has greatly enhanced people's ability to express graphic images. In the field of design and drafting, the computer has become an important tool.

For thousands of years, the visible expression of thought or idea was a hard image. A hard image might have been as simple as a sketch or as complex as the set of architectural drawings for a 50-story building. Hard images are fixed. If changes are needed they can be time consuming and difficult to make.

Computers offer the drafter the ability to create soft images. A soft image is one that can be electronically manipulated and displayed. Soft images are in the computer system as groups of independent reference

points that can be modified. The image created by the operator is flexible because a change made to one point can create a sequence of related changes in other reference points.

Output devices for CAD computers are used by the computer system to display processed information in soft and hard form. Devices used for soft output are called monitors or display terminals. Plotters and various types of computer printers are used for hard output. (Barden, pp. 84-86)

Some CAD programs allow things to be designed and tested on personal computers long before they exist. Manufactures of everything from toys to airplanes can design and test products before they are ever built. Using these sophisticated CAD programs can shave years off of the development and manufacturing of new products. (Kurshan, 1993)

Traditional Architects Worry About New Technologies

The final section of this chapter is a paraphrase which summarizes part of a newspaper article which appeared in the Monday, April 29, 1996 edition of the Wall Street Journal.

"Architects Fret as Computers Supplant Pencils"

Traditionalists are worried that the ease of producing computer-aided drawings can mislead young architects about what is essential to good design and an understanding of spatial relations. Many young architects now spend far more time glued to computer monitors than hunched over drawing boards. This trend worries some leading architects, who believe that pencil and paper are integral to architectural

design.

"I think it's a problem," says New York architect and historian Robert A. M. Stern, who teaches at Columbia University. "The real issue is, does [computer-assisted design] take students away from the basics? I would say yes." He adds, "Working out plans, elevations and perspective sketches on pieces of paper gets the architect into the fundamentals of the craft."

Some traditional architects feel that it is a generational problem. Many of them love to draw and feel that drawing is the soul of what an architect does. Still, they understand that it is an architect's job to illustrate design concepts in a way that is understandable to clients and builders. Whether that is done with a pencil or a computer may really be irrelevant.

Architects first began using computer-assisted design software more than 10 years ago to prepare production drawings, eliminating many hours of tedious drafting work. Computers have become so integrated into the design process that the question is no longer whether to use them, but when it is still necessary to rely on old-fashioned drawing.

More firms are now using computer graphics in design competitions and client presentations. As software has become more sophisticated, architects have begun turning to computers earlier in the design process. Many architects now use computer animation software to produce simulations that allow clients to "walk through" or "fly over" pro-

posed buildings. A new animated CAD technology is being developed at the Massachusetts Institute of Technology's architectural school which will let clients see how light shines into buildings at different times of the day.

Although some computer images tend to have a "hard-edged" look, the computer offers powerful advantages for rendering a building's proportions precisely. In the earliest stage of the design process, when a building first takes shape in the mind of a design architect, the computer has yet to play a central role. Many architects insist that the computer will never replace the sketchbook or cocktail napkin as the place for designers to muse about building shapes. "Drawing by hand is much freer than plotting something on the computer," explains Sheila Kennedy of Boston's Kennedy & Violich, an associate professor at Harvard's Graduate School of Design. "Sketching is a quick way to take a look at a design idea and determine whether something is amiss," she adds.

Design architects who work up three-dimensional building models in clay can now scan their models into a computer, where the images can be rotated, tinkered with and viewed from all angles. Additional gadgetry exists to produce three-dimensional models from computer plottings. The computer makes it possible to depict forms that would be difficult to convert into production drawings - "forms that seemingly merge and morph into one another," says Ms. Kennedy.

Even some of those who are strong supporters of this powerful

technology see a downside. Educators know that students can manipulate the software and get incredible 3-D images, but many of them don't understand the systems which make up a building. Many educators of architects feel that loose, creative sketching needs to be stressed.

"Nevertheless, many graduates may find their computer skills valued even more than their drawing. Having a graduate who can make a computer sing with the latest software catches our attention," says Harold Adams, chairman of Baltimore's RTKL Associates. "Having a good hand is important, but it's not as high on our priority list as it was five to six years ago." (Pacelle, 1996, p. B1)

Summary

After reviewing the literature, it is evident that most, if not all, people involved in the fields of architectural and engineering graphic communication feel that skills in freehand drawing and sketching are essential. Although traditional drafting skills have been very much in demand in these professions in the past, it is also evident that the computer and its rapidly improving CAD software are quickly overtaking the need for any traditional drafting skills to be taught in our schools. It would be ridiculous to assume that anyone using traditional drafting methods could prepare, correct and reproduce the drawings needed to construct or manufacture buildings or products with the speed and ease of those skilled in the use CAD.

CHAPTER III

METHODS AND PROCEDURES

Introduction

The purpose of this study was to survey a random sample of architects and engineers in the state of Virginia to determine: first, if they were still using traditional drafting tools and skills on a regular basis themselves and secondly, to see if they felt it was desirable for high schools in the State of Virginia to continue to teach these skills as a prerequisite to teaching computer-aided drafting and design (CAD or CADD) in order to prepare students for future employment. Within this chapter will be sections describing the population, instrumentation, data collection, statistical analysis, and summary.

Population

The population was obtained from a link on the Internet. Typing **www.aia.org** provided the path to the homepage of The American Institute of Architects. Subjects in this study consisted of a random sample of architects and engineers from the 474 firms in the State of Virginia. The sampling of 50 subjects was selected by choosing an architect or an engineer from every ninth firm on this list.

Instrumentation

The procedure used to collect the data included a survey developed by the researcher composed of six closed form questions and one ques-

tion with a possible single choice answer and a fill-in-the-blank choice (See Appendix A). The survey was sent with a cover letter explaining why the data was needed and the importance of their responses (See Appendix B). The closed form questions were used in order to expedite the use of the architect's and engineer's time, as well as the time required to tabulate and analyze the data. Using this closed form of questioning improved the reliability and consistency of the data. A three choice scale was used to measure attitudes about each of the first six questions of the survey with possible responses of Yes, Undecided, or No. A choice for the seventh question asked for a response of the type of computer software program being used by the those answering the survey. AutoCAD was the first of three possible choices. The second choice was a fill-in-the-blank and the last choice was the response, none.

Data Collection

The data was collected from questionnaires which were mailed in August1996 to a random sample of architects and engineers in the State of Virginia.

Statistical Analysis

The completed and returned questionnaires were hand scored by the researcher and the data was recorded as percentiles in the tables in Chapter IV.

Summary

Chapter III described the population being studied, the instrument used to collect the data, the data collection procedure and the methods used to analyze which will be presented in Chapter IV.

CHAPTER IV

FINDINGS

The purpose of this study was to survey a random sample of architects and engineers in the State of Virginia to determine: first, if they were still using traditional drafting tools and skills on a regular basis themselves and secondly, to see if they felt it was desirable for high schools in the state of Virginia to continue to teach these skills as a prerequisite to teaching computer-aided drafting and design (CAD or CADD) in order to prepare students for future employment. To provide answers to the research goals, a cover letter and survey were sent to a random sampling of 50 architects and engineers in the State of Virginia. Following is the list of questions and tables showing the responses from 30 architects and engineers, the 60% who returned their surveys.

Although personal correspondence was not requested by the researcher, several respondents either wrote comments on the survey forms or took the time to comment by writing letters to more fully respond to the questions asked. These personal notes and letters showed that professionals in these fields are concerned about what is taught in our high schools.

PRESENTATION OF DATA

The tables which follow provide numerical and a percentage comparisons of the architects' and engineers' responses for each specific question of the survey. Each table cites a paraphrase of the questions presented in the survey.

Table 1

Do architects and/or engineers in the State of Virginia still use traditional drafting tools and equipment on a regular basis?

Percent	Number	Response
60	18	Yes
3	1	Undecided
37	11	No

Tables 1 showed that 60% of the architects and engineers still used traditional drafting tools and equipment on a regular basis, while 37% indicated that they were not.

Table 2

Do architects and/or engineers use CAD on a regular basis?

Percent	Number	Response
77	23	Yes
6	2	Undecided
17	5	No

Tables 2 showed that 77% of the architects and engineers reported to be using CAD, while 17% responded that that did not use CAD regularly.

Table 3

Would architects and/or engineers expect entry level drafting personnel to possess basic skills in the use of traditional drafting tools and equipment?

Percent	Number	Response
60	18	Yes
3	1	Undecided
37	11	No

Table 4

Do architects and/or engineers feel it is important for high schools to continue to teach traditional drafting skills as part of technology education?

Percent	Number	Response
77	23	Yes
13	4	Undecided
10	3	No

Table 3 showed that 60% of those surveyed did feel that it was important for entry level personnel to possess traditional drafting skills, but Table 4 showed that a larger percentage of those surveyed (77%) felt it was important for traditional drafting skills to continue to be taught to Virginia's high school technology education students.

Table 5

Do architects and/or engineers feel that it is important for high school students to be taught CAD?

Percent	Number	Response
100	30	Yes
0	0	Undecided
0	0	No

Even though 17% (See Table 2) of those responding to the survey were not using CAD on a regular basis themselves, and 10% were not using any kind of CAD program (See Table 7), Table 5 clearly showed that everyone responding (100%) felt it was important to teach CAD to high school students.

Table 6

Do architects and/or engineers feel that a student who had learned to use CAD well, but did not possess traditional drafting skills, would do well at an entry level position?

Percent	Number	Response
56	17	Yes
13	4	Undecided
30	9	No

Although Table 6 showed that just more than half (56%) of the respondents felt that having CAD skills alone would provide students with the skills necessary for entry level positions, Table 4 showed that a full 77% of the respondents still felt that traditional drafting skills should continue to be taught.

Table 7

Which CAD software programs do architects and/or engineers currently use?

Percent	Number	Response
63	19	AutoCAD
27	8	Other
10	3	None

Of those firms not using *AutoCAD*; three used *Microstation*, two used *DataCAD*, two used *MiniCAD*, and one used *Blueprint.* The greatest number of architects and/or engineers surveyed were using AutoCAD as their primary CAD software.

Excerpts From Personal Letters

Because the above tables reflect only the responses given to the specific questions of the survey, the researcher felt that it was important as well to include excerpts from the letters and notes written by a few of those surveyed. Following are their open ended responses.

Open Ended Responses

Architect, W. L. Almquist said, "I believe it is essential that students possess both mechanical drafting skills and are proficient with CAD technology as well. The ability to sketch an isometric or perspective from a given plan is invaluable in the design phase of any project. The essential ability is to translate one's three dimensional thoughts into a two dimensional medium. While CAD technology will continue to grow and expand our capabilities, the competent architect must employ a variety of graphic talents."

"There will be an increasing demand for entry level positions requiring CAD competency, as several of our clients already require our services to be performed in this manner. While this office and other small offices still render services utilizing basic drafting skills, the larger firms will require an applicant to be proficient in computer technology." (personal communication, August 23, 1996)

Architect, A. E. Sadler wrote, "Your questions are thought provoking. I have been an architect or architectural draftsman for forty years. During the first thirty years of my career all design and drawing was accomplished by traditional drafting tools. Approximately ten years ago, we purchased our first CAD station. At the time I was apprehensive and skeptical about the future of CAD. My doubts were unfounded. At the present time, our firm has twelve drafting stations. Our stations are CAD equipped. All of our drawings are produced by CAD. We no longer use traditional drafting tools. Some firms are still drafting with tradi-

tional tools, at least for a portion of their work. But I believe that in the near future it will be impossible for architectural firms to be competitive without CAD.

The advantages of CAD over manual drafting are as follows:

a. In time, we built up a library of details which can be reused in a number of different projects. Often the details need some revisions, but that still requires less time than entirely new drawings. The library of details is especially useful if the firm specializes in a particular type of building. For example, our firm has designed over 35 schools. Many of our details can be reused on different schools.

b. It is much easier and quicker to revise/change drawings with CAD. When producing working drawings, many changes are inevitable. Making revisions/changes is simply a fact: that is the way drawings are produced.

c. We can draw the floor plans and then send disks to our consultant engineers. (Floor plans are required by several disciplines when producing a set of working drawings: architectural, plumbing, mechanical, electrical and interior design). When we send disks of the floor plans to consultant engineers, they do not have to draw the plans themselves. Also, errors are prevented because all floor plans will be exactly alike.

d. We can prepare a drawing at one scale, then change it to another scale. This is especially useful in floor plans because we typi-

cally draw the overall plans to 1/8 inch scale, but will blow up sectioned areas (toilets, kitchens,etc.) to a larger scale.

e. CAD drawings should be more accurate and have less errors or discrepancies than manually prepared drawings. CAD produced drawings are always drawn to scale; manually prepared drawings may be out of scale."

Although all of our working drawings are prepared by CAD, most of the early design work (when the design is still in a very fluid state) is still done by manual drawing or sketching. However, I have observed that even our designers are using their computers more during the design effort.

It is a little hard for me to admit this, but if we were considering a person for employment, their ability or inability to draft using traditional drafting tools would not be an issue, but their familiarity with CAD would be a plus." (personal communication, August 9, 1996)

An anonymous note on one survey stated, "I am a one man consulting firm specializing in historic presentation work. I do not have CAD, but continue to use traditional methods of preparing concept designs and sketches. My feeling is that traditional drafting, sketching, graphics, etc. should still be taught - maybe even a course on sketching on dinner napkins (by hand - no CAD)!" (personal communication, August 1996)

Architect, Michael Taylor wrote, "We have found that entry level employees who possess the basics of sheet and project layout, line-

weights, and strong sketching skills have a greater understanding of all aspects of this profession. Computer aided drafting programs are an important part of the production of the contract documents, mostly for repetitive features copied and mirrored. The basics come into play early in the design process, well before the computers are even powered up.

We hope that through it all educators don't make the mistake of concentrating on the "future" and "power of the computer" while forgetting that true design comes from within... with a solid understanding of the basics." (personal communication, August 13, 1996)

In the letters and notes which accompanied several of the surveys, the use of freehand drawing and sketching (even on dinner napkins) was stressed more than traditional drafting skills.

Summary

In Chapter IV, the researcher presented and explained the data received from the sample of architects and engineers who responded to the survey. The researcher also included excerpts from personal letters and notes received from several of those responding to the survey.

CHAPTER V

SUMMARY, CONCLUSIONS, AND RECOMMENDATIONS

SUMMARY

The purpose of this study was to determine if architects and engineers in the State of Virginia were still using traditional drafting skills and to measure, by their responses to a survey, if they felt that traditional drafting skills should continue to be taught in Virginia's public high schools. The Review of Literature in Chapter II not only gave a short history of the evolution of drafting technology, but also showed that the problem of this study was an area of concern for professional architects and engineers as well.

In Chapter III the methods and procedures used in this research study were explained and the population was described. To provide answers to the research objectives, a survey (See Appendix A) and a cover letter (See Appendix B) were sent to a random sample of 50 architects and engineers in the State of Virginia.

The data obtained from those responding to the survey was organized and tabulated to provide the statistical findings of this study in Chapter IV. The data was organized into tables, followed by narrative explanations to show what percentages of Yes, Undecided, and No responses were obtained for each of the questions on the survey. This data provided the basis for the conclusions and recommendations reported in this chapter.

CONCLUSIONS

The research goals from Chapter I provided the framework for the conclusions which follow:

1. *Determine the use of traditional and computer aided drafting tools and skills in architectural and engineering firms.*

   At the time the research was conducted 60% of those responding to the survey were still using traditional drafting methods and skills on a regular basis, while 77% said they were using CAD on a regular basis.

2. *Determine whether architects and engineers feel that it is important to continue to teach traditional drafting skills in high school technology education classes.*

   Of those responding to the survey 77% felt that it was important to continue to teach traditional drafting methods and skills to high school students in the State of Virginia.

3. *Determine whether architects and engineers feel that it is important to teach CAD skills in high school technology education classes.*

   Even though 17% of those responding to the survey were not using CAD on a regular basis themselves, every respondent (100%) felt that it was important to teach CAD to high school students.

4. *Determine what type(s) of CAD programs are currently in use in architectural and engineering firms.*

AutoCAD was the software program used by 63% of the architects and engineers responding, but because 10% of those responding were not using any CAD software, the AutoCAD usage translates to 70% of all CAD users responding.

RECOMMENDATIONS

Although freehand drawing and sketching are an introductory part of many traditional drafting courses, the researcher discovered, both from the literature reviewed and from correspondence received, that freehand drawing and sketching were the most important skills, if not the only skills, which need to be taught in preparation for CAD training.

It is therefore recommended that freehand drawing and sketching be taught as the major components of traditional drafting courses in the high schools of the State of Virginia. Because of the fact that 100% of the respondents to the survey agreed that teaching CAD was important, it is also vital that high school technology classrooms have sufficient computer hardware and software available for all students enrolled in drafting courses.

Since, at the time this research was done, more than two-thirds of the professionals who were using a CAD program were using AutoCAD as their software program of choice, it is recommended that AutoCAD be taught in every drafting class possible. Instructors should also remain aware of new CAD programs introduced.

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APPENDIXES

Appendix A - Drafting Skills Survey

Appendix B - Cover letter

APPENDIX A

Drafting Skills Survey

Purpose: A survey of architects and engineers in Virginia to determine their use of traditional drafting skills and their desire to see these skills taught in Virginia's high schools as a prerequisite to learning computer aided design and drafting.

Directions: Please check the box which most closely represents your use of traditional drafting skills and CAD and your desire to see these taught in our Virginia high schools.

1. Do you and the other architects and/or engineers in your firm use traditional drafting tools and equipment on a regular basis?

Yes	Undecided	No
❒	❒	❒

2. Do you and the other architects and/or engineers in your firm use CAD on a regular basis?

Yes	Undecided	No
❒	❒	❒

3. Would your firm expect entry level drafting personnel to possess basic skills in the use of traditional drafting tools and equipment?

Yes	Undecided	No
❒	❒	❒

4. Do you feel it is important for high schools to continue to teach traditional drafting skills as part of technology education?

Yes	Undecided	No
❒	❒	❒

5. Do you feel that it is important for high school students to be taught CAD?

Yes	Undecided	No
❒	❒	❒

6. Do you feel that a student who had learned to use CAD well, but did not possess traditional drafting skills, would do well at an entry level position in your firm?

Yes	Undecided	No
❒	❒	❒

7. Which type of CAD software program does your firm currently use?

AutoCAD	Other	None
❒	❒ _____	❒

Thank you for your continued support of education.

APPENDIX B

James M. Peters
145 Sir Oliver Road
Norfolk, Virginia 23505

August 8, 1996

[Architectural Firm]
[Street Address]
[City, State and Zip Code]

Attn: [Architect's or Engineer's Name]

Dear :

Are high school students today acquiring the knowledge and skills they will need to allow them to compete in our new global economy?

As a technology teacher, employed in a Virginia high school, it is important to me that the answer to this question be a resounding, "Yes!"

One area of technology education which is rapidly changing is that of technical or mechanical drawing. In many classrooms computers are rapidly replacing traditional drafting equipment. Pencil and paper have been replaced by computer screens and keyboards. Many would say that it is no longer important for students to learn to do hand lettering, multi-view projections and isometrics using traditional drafting methods because all of these activities can be replicated by computers.

As an architect or engineer, you are one of the professionals who may be hiring these students in the future and it is important for those of us in the field of education to know what skills you will be seeking from our graduates.

Will you please take a few minutes to read and respond to the short survey enclosed and return it in the self addressed, stamped envelope. Your response to this study is very important to me and could make a significant difference in what technology education students will be taught and what they will bring to you.

Thank you.

Sincerely,

James M. Peters, Teacher
Maury High School
Norfolk Public Schools

jmp/
enclosures