A STUDY OF VOCATIONAL-TECHNICAL COMPUTER-AIDED DRAFTING PROGRAMS IN OKLAHOMA VOCATIONAL-TECHNICAL SCHOOLS DURING 1988-1989

By

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CHAPTER I

INTRODUCTION

Not so long ago the traditional drafting tools of the designer and engineer had been the drawing board, a wide range of drawing instruments, and a slide rule. In recent years the slide rule has been replaced by the electronic calculator. Conventional drafting equipment is now being replaced by another tool called the computer. The first demonstration of the computer as a design and drafting tool was given at Massachusetts Institute of Technology, in 1963, by Dr. Ivan Sutherland, with a system he developed called "Sketchpad". The system used a cathode ray tube and a light pen for graphic input to the computer. In 1964, International Business Machines (IBM) introduced the first commercial computer-aided drafting (CAD) system (Giesecke, 1986).

Many changes have taken place in CAD systems since the introduction of the first system. The changes in the CAD systems were due primarily to the advent of the microprocessor, more sophisticated software or programs, and new industrial applications. In most cases drafters and engineers could create, revise, and store drawings with relative ease, utilizing less space and less time at the

drawing board. Increases in productivity and cost effectiveness were two advantages constantly stressed by CAD advocates (Giesecke, 1986). According to Wallach (1988), for most engineering services, a company's profit depended heavily on the number of hours which its designers and drafters spent at the drawing board. With the aid of CAD, the designers and drafters were more productive and their companies more profitable. These profits were credited to the advances in computer graphics and programs which allowed workers to do more work in less time. These modern innovations have caused our vocational drafting programs to reevaluate their drafting equipment to stay abreast of industry's needs.

Statement of the Problem

When a vocational-technical program was to be evaluated, revised, or updated, comparisons to previous studies had to be made to determine the specific need. Since there was a lack of knowledge pertaining to the existing conditions and practices of Oklahoma's vocational-technical drafting programs, the intent of this research was to furnish new data on existing conditions and current practices of vocational-technical computer-aided drafting programs in Oklahoma.

Purpose of the Study

The purpose of this research study was to find out the present conditions and practices among the vocational-technical computer-aided drafting instructors in Oklahoma

vocational-technical schools during the school year 1988-1989. This would enable existing vocational-technical computer-aided drafting programs to be compared, identify new trends and patterns, and bring to light any weaknesses in the programs. Drafting instructors, advisory committees, and the state supervisors in charge of drafting would be able to utilize the study and improve the programs. In addition, the study would be beneficial as a guideline for the creation and development of new drafting programs.

Major Objectives

This study was undertaken to determine the present status of the vocational-technical computer-aided drafting programs in Oklahoma's vocational-technical schools. There were seven questions to be answered in the study:

1. What was the educational background of the vocational-technical drafting instructor?
2. How many years of industrial drafting experience did the instructor have?
3. What classroom facilities were available?
4. What methods of presentation were being used?
5. What was being taught in the computer-aided drafting class?
6. What was the average size of the vocational-technical computer-aided drafting class?
7. What were the vocational-technical drafting instructors beliefs regarding the phasing out of traditional manual drafting by CAD?

From the resulting data, it was possible to compare and evaluate existing vocational-technical computer-aided drafting programs. This, in turn, provided a basis for future improvement through the use of more effective program design methods.

Assumptions

1. It was assumed that all the respondents answered the survey questions as truthfully and honestly as possible.

2. The design of the research instrument would yield the data needed for the study.

Limitations of the Study

1. This study was limited to the state of Oklahoma.

2. This study was limited to practicing vocational-technical computer aided drafting instructors of full-time programs for the school year 1988-89.

Definition of Terms

It was necessary to have an accurate comprehension of the terms which were to be used in this study frequently. Below is a list of the terms and their definitions.

1. CAD - stands for Computer-Aided Drafting or Computer-Aided Design. Despite the slight difference in term, the meaning is the same - the use of computer technology to produce graphic information (IBM, 1987).

2. Hardware - (1) physical equipment used in data processing, as opposed to programs, procedures, rules, and

associated documentation. (2) contrasted with software (IBM, 1987).

3. Software - (1) computer programs, procedures, and rules concerned with the operation of a data processing system. (2) contrasted with hardware (IBM, 1987).

4. Program - (1) a series of actions designed to achieve a certain result. (2) a series of instructions telling the computer how to handle a problem or task (IBM, 1987).

5. Printer - an output device that writes output data from the system on paper or other media (IBM, 1987).

6. Plotter - an output device that prepares an inked drawing, based on information it receives from the computer (Wallach, 1988).

7. Hardcopy - the term used to describe permanent output from the computer system, such as a drawing or a printed page (Wallach, 1988).

Scope of the Study

1. The specific information requirement for this study as determined from the problem was an analysis of the vocational-technical computer aided drafting programs in the Oklahoma vocational-technical schools during the school year 1988-89.

2. The information, obtained by the normative survey method, was a previously prepared questionnaire which was mailed to all the vocational-technical computer-aided drafting instructors; the selections were taken from the

Oklahoma Vo-Tech Personnel Directory which listed the drafting instructors for the school year 1988-89. Because this was a relatively small number of instructors (n=21), the total population was used for this study.

3. The information was taken from the questionnaire and tabulated. It was then assembled in table format for visual scrutinization.

CHAPTER II

REVIEW OF LITERATURE

The literature related to this study was surveyed in five main categories, which were identification of the need, history of drafting, expansion of the drafting trade, applications, and research methodology.

Identification of the Need

According to the National Science Foundation as quoted by Burns (1986, p. 10), "computer-aided design may represent the greatest increase in productivity since electricity." It combined the skill and creativity of the architect, designer, drafter and engineer with the power of the computer. Few innovations have made an impact on manufacturing so great as that of computer-aided drafting. The process of designing a part that once might have taken weeks or even months to complete haD been reduced to days (Allen, 1987).

All of the technology that had developed over history, 75% of it had taken place over the last 25 years. It was estimated that by the year 2000, just over 10 years from now, technological development would at least double and possibly quadruple. Nowhere did this prediction seem more real than for those associated with CAD (Bertoline, 1985).

Computer-aided drafting was a current technology that could not be ignored or pushed a side. Statistics also indicated that by the year 2000 there would be 1,220,000 jobs created for CAD/CAM (computer-aided drafting and manufacturing) workers. This suggested that CAD should be taught in many school systems to aid industry in meeting those anticipated future needs by exposing students to computers (Becker, 1987).

Persons desiring to enter this field should first obtain a good, solid base in the fundamentals of drafting and design. As when using any advanced tool or equipment, an understanding of basic drafting concepts and the ability to use these skills was essential. Presently, over 90 percent of drafting was still done manually, so manual skills were needed and likely would be in demand for a long time to come (Burns, 1986).

History of Computer-Aided Drafting

Computer-aided drafting had been in use since the early 1960's. Early systems had to rely on large, mainframe computers that only major companies could afford. The aerospace and automobile industries began to develop their own software programs to assist in product development. Commercial CAD systems began to appear in about the year 1964 (Burns, 1986).

The more recent development of mini and microcomputers has made CAD systems available to many more users. The use of CAD hardware and software has experienced tremendous

growth since the early 1970's. The U.S. Office of Technology Assessment (OTA) states that "between 1973 and 1981, the CAD system market grew from under $25 million in annual sales to over $1 billion," a 40 times increase. The years ahead were expected to show even greater growth (Burns, 1986).

Expansion of Computer-Aided Drafting

Every school with a vocational-technical program recognizes the need to incorporate computer-aided drafting into their curriculum. What was a novelty just a year or two ago is now almost universally recognized as a job necessity. Schools were spending thousands of dollars on sophisticated computers and CAD workstations to give their students experience on state-of-the-art equipment, making their graduates often more in tune with the latest technology than their prospective employers (Anderson, 1986).

Drafters were increasingly using computer-aided drafting systems. Instead of sitting at drafting boards, drafters who used CAD systems sat at computer terminals and made drawings on a TV-like screen. The drawing could then either be made into a hardcopy (drawn) on the printer or plotter, or could be stored electronically in the computer's memory, or be placed on microfilm, or be used to guide (control) automatic industrial machinery. Some CAD drawings never end up on paper.

Traditionally, a drafter worked from an engineer's, architect's, or designer's rough sketches to produce drawings. The drafter used pens, pencils, ink, compasses,

templates, and other tools to do this work. In a CAD system the drafter took the rough sketches and created drawings on a computer screen with the aid of the keyboard, mouse, or other input device. By using the commands programmed into the computer, the drafter could produce finished drawings in less time than before, and the drawings were more consistent and of a higher quality than those drawn manually (Burns, 1986).

No one could have looked at the future of CAD without considering how education would be able to offer a program that was both current and meaningful to the student. In addition, for many people, CAD was such a new and advanced tool that few people had little or no practical experience or training on a computer-aided drafting system (Bertoline, 1985).

It was important that one think of CAD as a tool used to enhance the design process. Human beings have always tried to invent and use tools to make life easier so as to become more productive. Certain tasks that drafters performed had always been tedious and time consuming, such as lettering, line consistency, and so forth. Recently, people have turned to the computer as means of easing these tasks, thus becoming more productive in many different applications through the tool called CAD (Bertoline, 1985).

According to Fesolowich (1987, p. 32), "the acronym CAD includes the term 'drafting'." "One must be able to draft before turning to a high technology system that allows them to do so." "The computer does not 'draw' - operaters do."

Manual drafting will exist side by side with CAD systems

for many years. One reason was that drafters would be needed to correct minor mistakes on CAD drawings using manual drafting tools. This was done because it was not cost effective to re-enter the data base to correct a drawing every time a minor mistake was found.

Applications

The application for computer-aided drafting has a large range. According to Wallach (1988, p. 594), with a typical CAD system a drafter can:

1. Eliminate the time-consuming (and therefore costly) redrawing of such things as holes, fasteners, spokes, doors, and trees.
2. Rapidly and precisely letter text information on drawings, signs, and reports.
3. Store and instantly retrieve drawings and information with virtually no storage space, compared with the storage of drawings on paper.
4. Reproduce drawings to any selected scale.
5. Store often used shapes in a "library," so these shapes would be available for frequent use.
6. Edit drawings quickly and easily without redrawing everything on the page, as often had to be done when working with the traditional drafting equipment.
7. Erase or make the necessary changes on the computer monitor, before a hardcopy was made on the printer or plotter.

8. Make automatic calculations which would present almost any mathematical aspect of the drawing.
9. Rotate and/or reposition objects on the monitor before plotting.
10. Produce "mirror images," so the drafter only had to draw half of symmetrical objects.
11. Link drawings with data bases (stored information) and spreadsheet information (column listings), so the drafter could generate such items as parts lists and billing information for the objects to be drawn.

With a solid background in the principles of drafting, a person could make neat, accurate, and consistant drawings on a CAD system, in a fraction of the time it would have taken to draw them by traditionally applied drafting (TRAD) methods (Wallach, 1988).

The principal users of CAD were the automobile and aerospace industries, but almost every industry which was involved with drafting used CAD in one way or another. For instance the electronics industry used CAD in the design of printed circuit boards (PCB), and for integrated circuits. This greatly sped up the tedious process of drawing so many lines, many of which crossed other lines. CAD not only sped up the work it could also detect errors (Burns, 1986).

Architectural, construction, cartography (mapping), oil and gas, and engineering applications offered immense potential. Most authorities believed that we were just beginning to dream up the many uses for CAD in those areas (Burns, 1986).

Summary

The goal of Vocational and Technical Schools was to educate people for employment. With statistics showing that in the year 2000, technological development would at least double and possibly quadruple and over a million jobs would be created for CAD/CAM workers, the reason vocational and technical drafting programs must train their students on CAD systems was evident. CAD systems were being used in almost every industry that used traditional drafting with the automotive and the aerospace industries being the principal users.

Most of the literature reported that even though most industries used CAD systems there was still a need for people to know the traditional method of drafting. One reason was that drafters were needed to correct minor errors on CAD drawings with manual drafting tools, because of the expense of re-entering the data base. This suggests that the vocational-technical drafting programs still teach traditional manual drafting side-by-side with computer-aided drafting.

CHAPTER III

METHODOLOGY

The purpose of this research study was to survey the vocational-technical computer-aided drafting programs in Oklahoma's Vocational-Technical Schools. This study was conducted to determine the existing conditions and current practices of these programs. Chapter III outlines the methodology used in the study presenting the reader with the design of the research, the procedures for data collection, and the subsequent analysis of the data.

Design

The specific information requirement for this research study as determined from the problem was an analysis of the vocational-technical computer-aided drafting programs in the Oklahoma vocational-technical schools during the school year 1988-89. The data was obtained by using a mailed questionnaire (Appendix B) with a self-addressed stamped return envelope. The development of the instrument was based on input of professionals in computer-aided drafting, this researcher's own experience, and Garrett's research survey conducted in 1983-84 to evaluate and compare the industrial arts drafting programs in Oklahoma's public high schools (Garrett, 1984).

Procedures for Data Collection

Selection of the Subjects

The population was comprised of practicing instructors in the field of Computer-Aided Drafting. The population was limited to the drafting instructors of full-time programs in the area vocational-technical education schools of Oklahoma. A list of all 21 Vocational-Technical drafting instructors in Oklahoma was secured from the Oklahoma Vo-Tech Personnel Directory which listed the drafting instructors for the school year 1988-89. Because this was a relatively small number of instructors (n=21), the total population was used for this study.

Administration of the Questionnaire

The questionnaire was administered to all vocational-technical drafting instructors (n=21) in Oklahoma by a mailed survey/questionnaire with a self-addressed stamped return envelope in February 1989. A total of 18 questionnaires were received by the researcher, representing an 85.7 percent return rate.

Analysis of Data

The data received from the questionnaire was tabulated into seven major areas: (1) instructor's educational background; (2) industrial drafting experience; (3) computer-aided drafting room facilities; (4) methods of presentation;

(5) CAD subject areas taught; (6) size of CAD classes; and (7) computer-aided drafting vs. traditional manual drafting.

The questionnaire responses were listed as to the frequency of occurrence, followed by determining percentages for each response area. The results of the research study are presented in Chapter IV.

The questionnaire contained questions to determine the educational background (H.S., Assoc., B.S. or M.S.), and the industrial experience in drafting of the selected respondents. Because adequate facilities were a very important facet of the vocational-technical CAD program, the questionnaire also asked the respondents about these items: CAD system, graphics tablet, mouse, printer, plotter, electric erasers, T.V. & VCR, overhead projector, and drafting tables.

The questionnaire was used to obtain data from the respondents about the current methods of presentation being used. The methods were: lecture, demonstration, questioning and discussion, sound films, VCR presentations, transparencies, models, guest speakers, and field trips.

The mailed survey was to discover which subject areas were presented on a most frequent basis in the CAD classroom. The subject areas were: Architectural, Mechanical, Pressure Vessel, Civil, Pipe, Electronic, and Structural.

The questionnaire was used to determine the size of the computer-aided drafting classes and ascertain the number of instructors teaching drafting at each vocational-technical school. The questionnaire also provided the survey with data

from the participants as to whether they thought traditional manual drafting would be phased out completely by CAD in the future.

The questionnaire was mailed to the selected participants, and the results, in tabular form, are presented in Chapter IV.

CHAPTER IV

RESULTS

The purpose of this research study was to determine the present conditions and practices among the vocational-technical computer-aided drafting instructors in Oklahoma's vocational-technical schools during the school year 1988-1989. Chapter IV presents the results of this study.

Return Rates

The total population consisted of 21 computer-aided drafting instructors who taught full-time in a day program. In February of 1989, the survey questionnaire was prepared and mailed. Initially 15 instructors responded, providing a 71.4 percent response rate. Two weeks later a second appeal was made, which boosted the total to 18 respondents or a 85.7 percent total response rate.

Survey Data

The seven major areas in which the CAD instructors were asked to respond to were: (1) instructor's educational background; (2) industrial drafting experience; (3) CAD room facilities; (4) methods of presentation; (5) subject areas taught; (6) size of CAD classes; and (7) future of tradi-

tional manual drafting and CAD. The responses to the mailed, survey questionnaire were listed as to frequency of occurrence, and each area of response has been calculated in terms of percentages. Because of roundings-off, some of the tabulations in this chapter did not add up to exactly 100 percent.

Instructor's Background

Questions One and Two pertained to the instructor's educational background and the number of years of industrial drafting experience. Table I shows that all who teach computer-aided drafting in Oklahoma's vocational-technical schools had graduated from High School and 50 percent had Bachelor's Degrees; in addition, 44 percent had Master's Degrees.

Industrial Drafting Experience

Table II reveals that 61 percent of those surveyed had 5-14 years of industrial drafting experience. Twenty-two percent of the respondents had 15-24 years of industrial drafting experience, and and additional 17 percent have had industrial drafting experience, but it had been less than 1-4 years altogether.

Computer-Aided Drafting Room Facilities

When teaching vocational-technical computer-aided drafting, the facilities and equipment were very important criteria for incorporation of a successful program. The

TABLE I

OKLAHOMA'S VOCATIONAL-TECHNICAL DRAFTING INSTRUCTOR'S EDUCATIONAL BACKGROUN

Background	Frequency	Percent
High School Degree	1	6%
Associate's Degree	0	0%
Bachelor's Degree	9	50%
Master's Degree	8	44%

n=18

TABLE II

YEARS OF INDUSTRIAL DRAFTING EXPERIENCE FOR OKLAHOMA'S VOCATIONAL-TECHNICAL DRAFTING INSTRUCTORS

Years	Frequency	Percent
1-4	3	17%
5-9	7	39%
10-14	4	22%
15-19	3	17%
20-24	1	5%
25-30	0	0%

n=18

purpose of Question Three was to discover the current status of the equipment and facilities. Table III reveals that 100 percent of the respondents had CAD systems (monitor, keyboard, & CPU), color monitors, graphics tablets, a plotter, and drafting tables. Thirty-three percent of the respondents used a mouse on the CAD system, 22 percent used a digitizer pen, 39 percent used both, and 6 percent didn't use either one. Eighty-nine percent of the schools that responded had a printer and 72 percent had electric erasers.

Methods of Presentation

Question Eight in the survey was designed to determine what methodologies were utilized by the CAD instructors when teaching the students. Table IV represents the frequency of the various methods used and, in percentages, a comparison of each was presented relative to the total response. The main methods used were those of demonstration (100%), questioning & discussion (94.4%), and lectures (94.4%). Table IV also revealed that 77.7% of the CAD instructors used VCR presentations, transparencies, and field trips. Thirty-three percent of the CAD instructors also used some other method not listed.

Subject Areas Taught

The purpose of this section of the questionnaire was to determine which areas in CAD were most frequently taught to the students in the Oklahoma vocational-technical computer-aided drafting classes (Question Nine). Table V gives the

TABLE III

COMPUTER-AIDED DRAFTING ROOM FACILITIES
USED BY VOCATIONAL-TECHNICAL
SCHOOLS IN OKLAHOMA

Facilities	Frequency	Percentage
CAD System (monitor, keyboard, & CPU)	18	100%
Color monitor	18	100%
Digitizing or Graphics Tablet	18	100%
Mouse (only)	6	33%
Digitizer Pen or Stylus (only)	4	22%
Both Mouse & Digitizer Pen or Stylus	7	39%
Printer	16	89%
Plotter	18	100%
Electric erasers	13	72%
T.V. & VCR	15	83%
Overhead projector		
1. Permanent	16	89%
2. Part time	2	11%
3. Not Available	0	0
Drafting tables	18	100%

n=18

TABLE IV

METHODS OF PRESENTATION USED BY VOCATIONAL-TECHNICAL CAD INSTRUCTORS IN OKLAHOMA

Methods	Frequency	Of Total Percentage
Lecture	17	94.4%
Demonstration	18	100.0%
Questioning & Discussion	17	94.4%
Sound films	4	22.2%
VCR presentations	14	77.8%
Transparencies	14	77.8%
Models	9	50.0%
Guest speakers	9	50.0%
Field trips	14	77.8%
Other	6	33.3%

n=18

frequency of response and a percentage of the total areas taught. The highest percentage was Mechanical CAD (100%), followed by Architectural CAD (77.8%), and Pipe CAD (61.1%). In addition, it was revealed that Advanced Architectural CAD (5.6%), Electro-Mechanical CAD (5.6%), and System Configuration & Customization (5.6%) were the areas taught by the CAD instructors the least.

Type of CAD Hardware

The purpose of Question Four was to ascertain what CAD hardware was the most widely used by Oklahoma's vocational-technical computer-aided drafting programs. Table VI gives the frequency of response and a percentage of the total types of hardware. There were two types of hardware that received the highest percentage. These were: (1) IBM (55.6%), and IBM Compatible or Clone (50.0%). Table VI also revealed that not one of Oklahoma's vocational-technical CAD programs's used Apple hardware.

Type of CAD Software

The purpose of Question Five was to discover which CAD software was used the most by the vocational-technical CAD programs in Oklahoma's vo-tech schools. Table VII reveals that 100 percent of the respondents had the AutoCAD software. Twenty-eight percent of the school's had VersaCAD, and an additional 22 percent had CADKey software.

TABLE V

COMPUTER-AIDED DRAFTING SUBJECT AREAS TAUGHT IN OKLAHOMA'S VOCATIONAL-TECHNICAL SCHOOLS

Subject Area	Frequency	Percent of Total
Architectural	14	77.8%
Mechanical	18	100.0%
Pressure Vessel	6	33.3%
Civil	9	50.0%
Pipe	11	61.1%
Electronic	5	27.8%
Structural	8	44.4%
Other		
Basic CAD	3	16.7%
Advanced Architectural CAD	1	5.6%
Electro-Mechanical CAD	1	5.6%
System Configuration & Customization	1	5.6%

n=18

TABLE VI

TYPE OF CAD HARDWARE USED IN OKLAHOMA'S VOCATIONAL-TECHNICAL DRAFTING PROGRAMS

Hardware	Frequency	Percent Of Total
IBM	10	55.6%
IBM Compatible or Clone	9	50.0%
APPLE	0	0%
Other		
Hewlett-Packard	1	5.6%
Terak	2	11.1%

n=18

TABLE VII

TYPE OF CAD SOFTWARE USED IN OKLAHOMA'S VOCATIONAL-TECHNICAL DRAFTING PROGRAMS

Software	Frequency	Percentage
AutoCAD	18	100%
VersaCAD	5	28%
P-CAD	0	0%
CADKey	4	22%
CADApple	0	0%
Other		
H-P Draft	1	6%
Bruning Draft	1	6%
Design Graphix	1	6%
Personal Designer (Prime)	1	6%
Computervision-PC Based	1	6%

n=18

Size of CAD Classes

Table VIII (Question Seven) reveals that 66 percent of the CAD classes had 1-19 students, while 28 percent of the CAD classes had 20-29 students, and 6 percent had 30-39 students.

Number of Instructors Per School

Table IX (Question Six) reveals that 89 percent of the vocational-technical schools in the State of Oklahoma had one computer-aided drafting instructor per school. Only one of the vo-tech schools that responded had more than one instructor. This school was located near a large city and had a larger school population.

Computer-Aided Drafting vs. Traditional Manual Drafting

Question Ten was designed to find out whether computer-aided drafting instructors thought traditional manual drafting would be phased out completely by CAD in the future. Table X reveals that 78 percent of the instructors implied CAD would not phase out traditional manual drafting in the future and 22 percent indicated that manual drafting would be phased out by CAD.

TABLE VIII

SIZE OF CAD CLASSES IN OKLAHOMA'S VOCATIONAL-TECHNICAL DRAFTING PROGRAMS

Average Number of Pupils per Program	Frequency	Percentage
1-9	6	33%
10-19	6	33%
20-29	5	28%
30-39	1	6%
40-49	0	0%

n=18

TABLE IX

NUMBER OF INSTRUCTORS PER SCHOOL TEACHING COMPUTER-AIDED DRAFTING IN OKLAHOMA'S VO-TECH SCHOOLS

Instructor Per School	Frequency	Percentage
1	16	89%
2	2	11%
3	0	0%
4	0	0%
Total	18	100%

n=18

TABLE X

VOCATIONAL-TECHNICAL DRAFTING INSTRUCTORS BELIEFS REGARDING THE PHASING OUT OF TRADITIONAL MANUAL DRAFTING BY CAD

Response	Frequency	Percentage
Yes	4	22%
No	14	78%
Total	18	100%

n=18

CHAPTER V

SUMMARY, CONCLUSIONS, AND RECOMMENDATIONS

The purpose of this research study was to find out the present conditions and practices among the vocational-technical computer-aided drafting instructors in Oklahoma vocational-technical schools during the school year 1988-1989. Since the population was relatively small (n=21), the total population was used for this study to obtain the necessary data. The respondents were selected from the Oklahoma Vo-Tech Personnel Directory which listed the drafting instructors for the school year 1988-1989. Each respondent was then mailed a survey questionnaire with a self-addressed, stamped return envelope. Each section of the questionnaire was then divided and translated so as to facilitate the answers to the major objectives as listed in Chapter I: (1) what was the educational background of the vocational-technical drafting instructor; (2) how many years of industrial drafting experience did the instructor possess; (3) what was being taught in the computer-aided drafting class; (4) what classroom facilities are available; (5) what methods of presentation were being used; (6) what was the average size of the vocational-technical computer-aided drafting class; and (7) did vocational-technical

drafting instructors believe traditional manual drafting would be phased out completely by CAD in the future.

All 21 instructors were selected as potential respondents for the mailed questionnaire. After the initial mailing and one follow-up mailing, 18 instructors returned questionnaires, making the return rate 85.7 percent.

The objective of this research study was to determine the present status of the vocational-technical computer-aided drafting programs in Oklahoma's vocational-technical schools. By mailing out the survey questionnaire to the respondents, it was possible to determine the educational background of the vocational-technical computer-aided drafting instructor, how many years of industrial drafting experience the computer-aided drafting instructor had, what CAD classroom facilities were available to the drafting instructor, what methods of presentation were being used, what the average size of the computer-aided drafting classes(es) was, and finally, the viewpoint of the computer-aided drafting instructors about whether traditional manual drafting would ever be phased out completely by CAD in the future.

Summary of the Findings

It was found that all but one of the drafting instructors had at least a Bachelor's degree and 44 percent had a Master's degree. The highest frequency for the "Years of Industrial Drafting Experience for Oklahoma's Vocational-Technical Drafting Instructors" was 5-9 years, the lowest frequency was 20-24 years.

It was found that the major CAD room facilities for a vocational-technical school were CAD systems (monitor, keyboard, & CPU); color monitors; graphics tablets; at least one other type of input device besides the keyboard, i.e. mouse, digitizer pen, or both; plotter; printer; a permanent overhead projector; drafting tables; T.V. & VCR; and electric erasers.

According to the findings, the main method of presentation in the vocational-technical CAD classes was the "Demonstration" method, which was used by all the drafting instructors surveyed. "Lecture" and "Questioning & Discussion" methods were close seconds, each being used by 17 of the 18 instructors. Other significant methods used were; "VCR Presentations", "Transparencies", and "Field Trips". It was also found that sound films were the least used by vocational-technical CAD instructors as a method of presentation.

It was found that all the vocational-technical CAD instructors taught Mechanical CAD and 14 out of 18 instructors taught Architectural CAD. The subject areas that were taught the least by the vocational-technical CAD instructors was, Advanced Architectural CAD, Electro-Mechanical CAD, and System Configuration & Customization.

According to the findings IBM and IBM compatible or clone hardware was used the most by Oklahoma's vocational-technical computer-aided drafting programs. It was also found that Apple hardware was not used by any of the vocational-technical drafting programs in Oklahoma.

It was found that 100 percent of the schools surveyed had the AutoCAD program. The second most utilized CAD software was VersaCAD, but it was only used by 28 percent of the schools surveyed.

As indicated by the findings 66 percent of the schools had 1-19 CAD students enrolled per program. Twenty-eight percent had 20-29 students enrolled and an additional six percent had 30-39 students enrolled.

It was found that 89 percent of the vocational-technical schools in the state of Oklahoma had just one instructor. Only one of the vo-tech schools that responded had more than one instructor.

It was found that 78 percent of the CAD instructors surveyed indicated that traditional manual drafting would not be phased out completely by CAD in the future. The other 22 percent of the CAD instructors implied that CAD would completely take over traditional manual drafting in the future.

Conclusions

From the resulting data, it was possible to compare, contrast and assess the existing vocational-technical computer-aided drafting programs in the Oklahoma vocational-technical schools. After having tabulated and analyzed the information assembled from the participants in the survey, there were some observations that could be articulated as follows:

1. Because all but one of the vocational-technical

drafting instructors had at least a Bachelor's degree and 44 percent had a Master's degree, it could be concluded that a person desiring to be equal with the norm of instructors in vocational-technical drafting programs in Oklahoma should possess a Bachelor's degree in college.

2. Because 83 percent of the vocational-technical drafting instructors had five or more years of industrial drafting experience, it could be concluded that a person desiring to have as many years of industrial drafting experience as the average vocational-technical drafting instructor should possess at least 5 years of industrial drafting experience.

3. Because the main methods of presentation in the vocational-technical computer-aided drafting classes were the Demonstration, Lecture, Questioning & Discussion, VCR presentations, Transparencies, and Field Trips, it could be concluded that a person teaching CAD needs to incorporate as many of these methods of presentation as possible to assist them in clarifying and teaching the material.

4. Because IBM and IBM compatible or clone was the most widely utilized hardware by Oklahoma's vocational-technical computer-aided drafting programs, and that Apple hardware wasn't used at all, it could be concluded that a vocational-technical school planning to implement a new CAD program and desires to be equal with the norm of the other CAD programs in Oklahoma should possess IBM or IBM compatible or clone hardware.

5. Because 100 percent of the vocational-technical

computer-aided drafting programs used the AutoCAD software program, it could be concluded that any person desiring to teach CAD in one of Oklahoma's vocational-technical schools needs to know how to utilize the AutoCAD program.

6. Based on the finding that 66 percent of the vocational-technical schools had 1-19 CAD students enrolled per program, twenty-eight percent had 20-29 students enrolled, and an additional six percent of the programs had 30-39 students enrolled, it could be concluded that most vocational-technical CAD programs did not have more than 20 students per program unless the school was located in or near one of the large metropolitan areas in Oklahoma.

7. Because 89 percent of the vocational-technical schools had only one computer-aided drafting instructor, it could be concluded that one instructor was sufficient unless the enrollment in the CAD program exceeded 30 students.

8. Based on the findings and from the review of literature that 78 percent of the vocational-technical CAD instructors surveyed indicated that traditional manual drafting would not be phased out completely by CAD in the future, it could be concluded that the majority of Oklahoma's vocational-technical drafting instructors believe that traditional manual drafting should be taught along with computer-aided drafting.

Recommendations

Based on the findings of this study, the writer has suggested the following recommendations:

1. With the field of computer-aided drafting changing so rapidly, a vo-tech school offering this program must by willing to stay abreast of these technological changes;

2. A vocational-technical school planning to implement a new CAD program require the following equipment: CAD systems (monitor, keyboard, & CPU); color monitors; graphics tablets; at least one other type of input device besides the keyboard, i.e. mouse, digitizer pen, or both; plotter; printer; a permanent overhead projector; drafting tables; TV & VCR; and electric erasers. The quantity of each piece of equipment should be determined by the projected enrollment in each new drafting program.

3. There should be seminars and/or workshops conducted for vocational-technical computer-aided drafting instructors with the purpose of keeping the instructors updated on the latest discoveries in the computer-aided drafting area; in addition, these seminars and/or workshops could provide information as to the management aspects of equipment, maintenance and facilities.

4. A person desiring to teach vocational-technical drafting in one of Oklahoma's vocational technical schools have a Bachelor's degree and at least five years of industrial drafting experience.

5. Vocational-technical drafting instructors should continue to teach traditional manual drafting along with computer-aided drafting.

6. The findings and conclusions of this study should be distributed to vocational-technical drafting instructors,

state supervisors of drafting, advisory committees and any others who play a part in the planning of new CAD programs or the updating of old CAD programs in Oklahoma's vocational-technical schools.

Recommendations for Further Study

1. Parallel studies should be conducted using a similar questionnaire as used in this study to survey the chief drafters and/or drafting supervisors in industry involved with CAD. This recommendation was in agreement with another computer-based study recommmendation administered by Kimbrell (1987);

2. Another study should be undertaken to determine the reasons why students enroll in vocational-technical drafting programs.

3. A study should be conducted to study the efforts of vocational-technical schools' efforts to recruit new students into the drafting programs.

4. Studies should be conducted in other vocational-technical areas using a similar questionnaire.

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APPENDIXES

APPENDIX A

COVER LETTER

OSU

Oklahoma State University

SCHOOL OF OCCUPATIONAL AND ADULT EDUCATION
COLLEGE OF EDUCATION

STILLWATER, OKLAHOMA 74078-0406
CLASSROOM BUILDING 406
(405) 624-6275

February 3, 1989

Mr. Arthur Lock
Indian Meridian AVTS
1312 S. Sangre Road
Stillwater, OK 74074

Dear Mr. Lock:

Because of the rapid change in the Drafting Profession since the introduction of CAD and new software, a study to determine what CAD room facilities, programs, and methods of teaching are the most widely used in the vocational-technical computer-aided drafting programs in Oklahoma's vocational-technical schools is desperately needed. I have chosen to research this problem for my Master's degree thesis at Oklahoma State University. The purpose of this research is to develop a survey of the vo-tech CAD programs so that the programs can be compared, identify new trends and patterns, and bring to light any weaknesses in the programs. This is done so CAD instructors, advisory committees, and supervisors of CAD can use the study to improve the CAD programs. In addition, the study will be beneficial as a guideline for the creation and development of new programs.

In this regard, I would appreciate your completing the enclosed questionnaire. Completing the questionnaire will require only about ten minutes of your time. Please return the completed questionnaire in the enclosed self-addressed, stamped envelope by Friday, February 17, 1989.

The information obtained by this project will be of interest and help to all of us. I will, of course, furnish you with a copy of the results as soon as they are available. Thank you for your time and cooperation.

Sincerely,

Dwight R. Hughes
Research Assistant

Ray E. Sanders
Assistant Professor
Thesis Adviser

DRH/RES/kp
Enclosure

CENTENNIAL
1890 • 1990

Celebrating the Past . . . Preparing for the Future

APPENDIX B

DATA COLLECTION INSTRUMENT

A STUDY OF VOCATIONAL-TECHNICAL COMPUTER-AIDED DRAFTING PROGRAMS IN OKLAHOMA VOCATIONAL-TECHNICAL SCHOOLS DURING 1988-1989

Dwight R. Hughes
Research Assistant

Ray E. Sanders
Asst. Professor

Department of Occupational & Adult Education
Oklahoma State University
Spring 1989

Directions: Please respond with your answer to each of the following questions.

(Please Print or Type)

Name: _____

School: _____

1. Degrees held: H.S.____ ASSOC.____ B.S.____ M.S.____

   Other_____

2. How many years of industrial drafting experience do you have?_____

3. Do you have the following Computer-Aided Drafting (CAD) room facilities in your school?

   a. CAD system (monitor, keyboard & CPU)Yes____No____Number_____

   b. Color Monitor.....Yes____No____Number_____

   c. Digitizing or Graphics Tablet.....Yes____No____Number_____

   d. Mouse.....Yes____No____Number_____

   e. Digitizer pen or Stylus.....Yes____No____Number_____

   f. Printer.....Yes____No____Number_____

   g. Plotter.....Yes____No____Number_____

   h. Electric erasers.....Yes____No____Number_____

   i. T.V. & VCR.....Yes____No____Number_____

j. Overhead Projector.....Permanent _____
Part time _____
Not Available_____

k. Drafting tables.....Yes____No____Number_____

l. Other_____

_____

4. What type of CAD Hardware does your drafting program use?
(Check all that apply)

IBM____ IBM compatible or Clone____ APPLE____

Other (please specify)_____

5. What type of CAD Software does your drafting program use?
(Check all that apply)

AutoCAD____ VersaCAD____ P-CAD____ CADKEY____ CADAPPLE____

Other_____

6. What is the number of CAD Instructors in your school?_____

7. What is the average number of CAD students in your program?_____

8. Do you use the following methods of presentation in your CAD class?

		Percentage of Time
a. Lecture	Yes____No____	_____
b. Demonstration	Yes____No____	_____
c. Questioning & Discussion	Yes____No____	_____
d. Sound films	Yes____No____	_____
e. VCR presentations	Yes____No____	_____
f. Transparencies	Yes____No____	_____

g. Models.....Yes____No____ _____

h. Guest Speakers.....Yes____No____ _____

i. Field Trips.....Yes____No____ _____

j. Other.....Yes____No____ _____

_____

9. What different areas of CAD do you teach? (Check all that apply)

Architectural____ Mechanical____ Pressure Vessel____

Civil____ Pipe____ Electronic____ Structural____

Other_____

_____

10. In one paragraph, please give your view on the following question.

* Do you think traditional manual drafting will be phased out completely by CAD in the future?

Yes_____ No_____ Why or Why not?

Thank you for participating in this study!

Please return the completed questionnaire in the enclosed self-addressed stamped envelope by Friday, February 17, 1989.

APPENDIX C

FOLLOW-UP LETTER

OSU

Oklahoma State University

SCHOOL OF OCCUPATIONAL AND ADULT EDUCATION
COLLEGE OF EDUCATION

STILLWATER, OKLAHOMA 74078-0406
CLASSROOM BUILDING 406
(405) 624-6275

February 17, 1989

Mr. Mark Saunders
Indian Capital AVTS
Rt. #6, Box 206
Muskogee, OK 74401

Dear Mr. Saunders:

A week ago, we sent you a questionnaire seeking information about your CAD program. The purpose of this research is to develop a survey of the vo-tech CAD programs so that the programs can be compared, identify new trends and patterns, and bring to light any weaknesses in the program.

If you have completed and mailed back this questionnaire, please disregard this letter. However, in the event the questionnaire never reached you, we would appreciate your help. Please take a few moments to complete the enclosed duplicate questionnaire and return it to OSU.

To keep within time constraints we ask that you please return the questionnaire as soon as possible. Your help in providing this valuable information is greatly appreciated.

Sincerely,

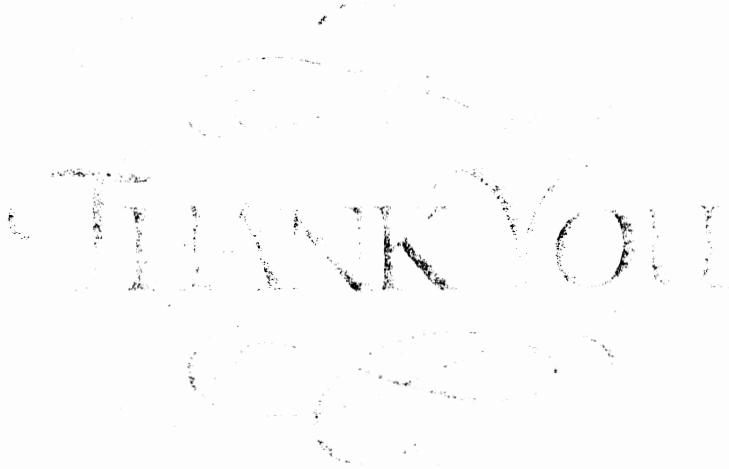
Dwight R. Hughes
Research Assistant

Ray E. Sanders
Assistant Professor
Thesis Advisor

kp

APPENDIX D

THANK YOU CARD



Dear Mr. Danny Cowart,

Thank you so much for your participation in the computer-aided drafting program survey for my Masters Thesis at Oklahoma State University. Your time and cooperation was greatly appreciated.

Thank you again,

Dwight R. Hughes

Dwight R. Hughes
Research Assistant
Oklahoma State Univ.

APPENDIX E

VOCATIONAL-TECHNICAL DRAFTING

INSTRUCTORS SURVEYED

VOCATIONAL-TECHNICAL DRAFTING INSTRUCTORS SURVEYED BY MAIL

INSTRUCTOR	SCHOOL
Mr. Henry Bailey	Tulsa County AVTS
Mr. Edward Conn, Jr.	Gordon Copper AVTS
Mr. Danny Cowart	Tri-County AVTS
Mr. Ronald Davis	Mid-America AVTS
Mr. Ralph Hinman	Great Plains AVTS
Mr. Dwayne Janzen	O.T. Autry AVTS
Mr. Jon P. Jones	Mid-Del AVTS
Ms. Linda Lancaster	Francis Tuttle AVTS
Mr. Arthur Lock	Indian Meridian AVTS
Mr. Robert McClain	Canadian Valley AVTS
Mr. Vance McNeal	Pontotoc County AVTS
Mr. Gerald Patterson	Francis Tuttle AVTS
Mr. Bryan Ralph	Southern Oklahoma AVTS
Mr. Bill Reed	Canadian Valley AVTS
Ms. Becky Rose	Red River AVTS
Mr. Mark Saunders	Indian Capital AVTS
Mr. Norman Smithson	Central AVTS
Mr. Steve Strong	Foster Estes AVTS
Mr. Thomas Trimble	Tulsa County AVTS
Mr. Edward Welch	Kiamichi AVTS
Mr. Bruce Yancey	Moore-Norman AVTS

VITA

Dwight Ray Hughes

Candidate for the Degree of

Master of Science

Thesis: A STUDY OF VOCATIONAL-TECHNICAL COMPUTER-AIDED DRAFTING PROGRAMS IN OKLAHOMA VOCATIONAL-TECHNICAL SCHOOLS DURING 1988-1989

Major Field: Trade and Industrial Education

Biographical:

Personal Data: Born in Alva, Oklahoma, November 22, 1963, the son of Boyd and Nelwyn Hughes. Married to LaNae Ames August 16, 1986.

Education: Graduated from Freedom High School, Freedom, Oklahoma, in May, 1982; attended Northwestern Oklahoma State University in Alva, Oklahoma, 3 years; received Bachelor of Science degree in Technical Education from Oklahoma State University in July, 1987; completed requirements for the Master of Science degree at Oklahoma State University in May, 1989.

Professional Experience: Evening Drafting Instructor at Indian Meridian Vocational-Technical School, Stillwater, Oklahoma, from January 1989 to present; Graduate Research Assistant, Occupational and Adult Education Department, Oklahoma State University, Stillwater, Oklahoma, from August 1987 to present.

Professional Organizations: Phi Kappa Phi Honor Society, Iota Lambda Sigma Vocational-Technical Fraternity, Graduate Student Council, Activities Funding Allocations Committee (AFAC) Board.