

Old Dominion University

ODU Digital Commons

OTS Master's Level Projects & Papers

STEM Education & Professional Studies

1991

A Study Comparing Basic Skills of Computer Assisted Drafting Students to Traditional Drafting Students

Mark D. Pavlak
Old Dominion University

Follow this and additional works at: https://digitalcommons.odu.edu/ots_masters_projects



Part of the [Education Commons](#)

Recommended Citation

Pavlak, Mark D., "A Study Comparing Basic Skills of Computer Assisted Drafting Students to Traditional Drafting Students" (1991). *OTS Master's Level Projects & Papers*. 405.
https://digitalcommons.odu.edu/ots_masters_projects/405

This Master's Project is brought to you for free and open access by the STEM Education & Professional Studies at ODU Digital Commons. It has been accepted for inclusion in OTS Master's Level Projects & Papers by an authorized administrator of ODU Digital Commons. For more information, please contact digitalcommons@odu.edu.

A STUDY COMPARING BASIC SKILLS OF COMPUTER-
ASSISTED DRAFTING STUDENTS TO TRADITIONAL
DRAFTING STUDENTS

A RESEARCH PAPER PRESENTED TO THE FACULTY OF
THE COLLEGE OF EDUCATION, OLD DOMINION UNIVERSITY

IN PARTIAL FULFILLMENT OF THE REQUIREMENTS FOR
THE MASTERS OF SCIENCE IN SECONDARY EDUCATION

BY
MARK D. PAVLAK, M.S.

AUGUST 1991

SIGNATURE PAGE

This research was prepared under the direction of Dr. John M. Ritz in OTED 636. It is submitted to the Graduate Program Director for Occupational and Technical Studies in partial fulfillment of the requirements for the Degree of Master of Science in Education.

Approved by: John M. Ritz Date 6-25-91
Dr. John M. Ritz
Advisor

Approved by: John J. DeRolf III Date 7/18/91
Dr. John J. DeRolf III
Graduate Program Director

ACKNOWLEDGEMENTS

My sincere gratitude goes to Dr. John Ritz for the direction and guidance he provided during my program of study. A very special thanks goes to my wife April, son Kyle, and daughter Jessica, for their love, encouragement and support, that helped me finish this paper and degree.

TABLE OF CONTENTS

	page
Signature Page	i
Acknowledgements	ii
Table of Contents	iii
Table of Figures	v
CHAPTERS	
I. INTRODUCTION	
A. Statement of the Problem	2
B. Hypotheses	2
C. Background and Significance	3
D. Limitations	6
E. Assumptions	7
F. Procedures	7
G. Definition of Terms.....	8
H. Overview of Chapter I	8
II. REVIEW OF LITERATURE	
A. Computer-Assisted Drafting	10
B. Summary	15
III. METHODS AND PROCEDURES	
A. Population	17
B. Instruments	18
C. Data Collection	18
D. Statistical Analysis	19

E. Summary	20
IV. FINDINGS	
A. Explanation of Tables	21
B. Summary	22
V. SUMMARY, CONCLUSIONS, AND RECOMMENDATIONS	
A. Summary	26
B. Conclusions	29
C. Recommendations	30
BIBLIOGRAPHY	31
APPENDICES	
Appendix A, Pre-test and Post-test	33
Appendix B, Four Drawing Assignments	38

TABLE OF FIGURES

TABLE	TITLE	PAGE
1	Comparison of Pre-test and Post-test	23
2	Comparison of the Four Drawing Assignments	24
3	Graphic Analysis of Four Drawing Assignments	25

CHAPTER I

INTRODUCTION

Drafting is a graphic language that is used universally by engineers, draftsmen, and other people involved in design to describe the shape and size of objects. It has developed through the centuries, and its fundamental principles are understood by trained persons in all civilized nations.

Drafters use specialized kinds of lines and symbols to communicate ideas through the use of drawings. These special lines and symbols are called standards and allow individuals to communicate world-wide.

Traditionally drawings had been done by drafters at drawing tables, using drawing equipment. But during the last several years the development of technological equipment has bolstered the productivity of the draftsman. With the advent of the computer age, drawings are now being done on computers.

Computer aided drafting (CAD) has become an important part of industry. It is one of many computer base technologies which are changing the way industry is working. Companies are replacing traditional equipment with computers and software. The result is an increase in both quality and amount of drawing and design work completed.

As with other technological innovations, equipment availability leads the CAD trained operators (Chin-Yin Yuen, 1990). Because of the lack of operators who have been trained for use of CAD, many firms are reluctant to invest in a CAD systems.

This indicates a definite challenge for education. To meet this challenge schools must now move quickly to incorporate CAD instruction into the curriculum. Traditional drafting programs must re-tool to meet this new demand. It is the opinion of most teachers that CAD needs to be integrated into the drafting curriculum or replace it (Chin-Yin Yuen, 1990).

STATEMENT OF PROBLEM

The problem of this study was to compare the basic drafting skills of traditional drafting students to CAD students in a one semester course at Maury High School in Norfolk, Virginia.

HYPOTHESES

The problem will be addressed through the following hypotheses.

H1: There is a significance difference in the performance of students enrolled in basic drafting who are taught CAD drafting instruction compared to those taught traditional drafting instruction in the quality of drawing.

H2: There will be a significance difference in the technical proficiency of the CAD group compared to the technical proficiency of the traditional group.

BACKGROUND AND SIGNIFICANCE

The 1980's are most noted for the development of the micro-computer. The micro-computer is more commonly known as a personal computer (PC). At the same time mini computers and mainframe-based CAD systems were being marketed in the '70's, personal computers were being developed. PC's were based on a new breed of miniature circuits, called micro-processors. Although larger computers continue to run graphic software, PC has revolutionized CAD. The low cost of PC CAD has brought interactive graphics to within reach of most industries and schools.

The benefits of a CAD system over traditional drafting stems from the use of computers. A computer is simply faster than a human in creating lines, circles, and complex objects.

It reduces drafting time by three or four times.

The difference between CAD systems over traditional drafting is the way information is processed. A traditional drafter adds to a drawing using pencil and paper. A CAD operator alters a drawing using an input device attached to a computer. With CAD the operator can work many times faster, with greater accuracy. The basic reason for the increase in speed is the removal of tedious work. For a traditional drafter every image is made by moving a pencil. In a CAD system, the tiresome task of drawing multiple objects are preformed automatically. Only end and center locations are given.

Computer-aided drafting not only permits quicker drafting, but also increases quality. Consistent line quality is hard to achieve with a pencil. Neatness is also improved with CAD. Since the drawing is held in computer memory, you cannot damage it. Another key to quality is the precision of a drawing. A CAD system can achieve accuracy of greater than one-thousandth of an inch.

Revisions of a drawing are common in most drafting environments. Modifying drawings is one of the most time consuming tasks of the drafter. A CAD system provides for quicker modifications. When revisions are needed, the drawing is loaded into the computer, the design is changed and the

drawing is then saved again.

More companies are realizing the advantages of CAD. The results of a Texas study on CAD revealed that 57 percent of the companies were using CAD at the present and another 58.2 percent of the companies that were not using CAD at the present, plan to do so in 3 to 5 years. In addition, 64.3 percent of the companies felt that CAD should be taught at the secondary level of education (Becker, 1985). However at what level should CAD be introduced? Can CAD be used to teach basic skills and replace traditional drafting and will it be as effective?

Some feel, the drafting curriculum of today must include preparation on both CAD and the basic fundamentals (Addison, 1988; Burns, 1986; Goetsch, 1986; Isbell & Lovedahl, 1988). Presently over 90 percent of drafting is still done manually, so manual skills are needed and likely will be in demand for some time (Burns, 1986). The amount of time devoted to manual drafting will decrease in coming years as the transition to CAD by industry becomes more complete.

The purpose this investigation was undertaken was the prospect of determining the effectiveness of teaching students basic drafting skills on CAD, as compared to the effectiveness of teaching the traditional drafting technic. The correlation between CAD effectiveness on quality, neatness, and timesaving

should allow the students to be as effective as traditional methods.

LIMITATIONS

This study was based on the following limitations:

1. The research was limited to a population of 28 students in the traditional drafting group and 14 students in the CAD group.
2. The research was limited to a pre-test and post-test of a final exam used in the basic drafting classes at Maury High School, Norfolk, Virginia.
3. The research was limited to grades at the end of the fall semester of the 1990-1991 school year for the traditional class and the spring semester of the 1990-1991 school year for the CAD class. Each class ran for a total of 90 class meetings.

ASSUMPTIONS

The study was based on the following assumptions:

1. Each student enrolled in both groups have had no previous drafting classes prior to enrolling in their respective class.
2. The students enrolled in the CAD class will perform basic drafting skills as well as those in the traditional group.
3. The test, given to measure performance levels, is a valid indicator of student achievement.

PROCEDURES

At the beginning of the 1990-1991 fall and spring semesters, each group was given the final exam for the Basic Drawing I class. This test was designed to evaluate the students proficiency in drafting. The test was repeated at the conclusion of the school year and the results were compared against each other. In addition the results of the CAD group

where compared to the results of the traditional group. This along with the comparison of similar drafting assignments throughout the semester allowed a comparison to be made between the basic skills of each group.

DEFINITION OF TERMS

Terms used in this study were defined as followed:

1. Computer-aided drafting (CAD) – the use of computers and graphic software to assist the drafter in preparing a drawing.
2. CAD software– contains commands which guide the drafter in creating drawings.
3. Traditional drafting– the use of drawing boards, pencils, scales, erasers, etc. in the creation of a drawing.

OVERVIEW OF CHAPTER I

In Chapter I of this study, the problem and hypotheses were identified. The problem stated was to determine the difference between students who learn basic drafting skills on the CAD

system to those who learn basic skills using the traditional drafting method at Maury High in Norfolk, Virginia. The background and significance for the study, its limitations, assumptions and the definition of terms have been stated. In addition, a brief description of the procedures involved in carrying out this research have been discussed.

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

CHAPTER II

REVIEW OF LITERATURE

This study was based on the rationale that a program must be future-orientated, student-centered, relevant to societal needs, and based on the study of the physical technologies. Many studies are cited that refer to the use of computers in education and the need for orienting the technology curriculum toward the new technology. Still many studies can be found comparing the effectiveness of CAD drawing to traditional methods. However this study compared the effectiveness of teaching CAD to teaching drafting with traditional drafting methods. Education should provide students with the skills and concepts needed to understand the complex systems of the future. Technology education must begin to read the writing on the wall in areas such as drafting. This chapter contains information about CAD and its development, along with a comparison to traditional drafting methods.

COMPUTER-ASSISTED DRAFTING

It can be persuasively argued that the computer graphic system appeared with the first digital computers.

Massachusetts Institute of Technology's (MIT) Whirlwind computer had a cathode ray tube (crt) graphic display. Another early use of computer graphics was the SAGE (Semi-Automatic Ground Environment) air defense command and control system of the mid-1950's. SAGE converted radar information into computer generated pictures. SAGE also introduced the light pen, which allowed the operator to select information by simply pointing at the appropriate target displayed on the screen.

A milestone in the development of computer graphics was the pioneering work of Dr. Ivan Sutherland, whose 1963 MIT doctoral thesis describing "SKETCHPAD" contained some of the seminal data-structure work laying the theoretical basis for computer graphic software (Sutherland, 1963).

Also around 1963, MIT's Steve Coons began developing surface-patch techniques, ideally suited for CAD. At about the same time, S.H. Carson put together a team at Lockheed in Georgia to investigate the use of computer graphics for numerical control (NC) part programming.

In the early to middle 1960's, "computer graphics" was by no means the universal terms for the technology. Devices were called electronic displays, computer-controlled displays, informational displays, evaluated displays, and CAD was often referred to as automated drafting (Bertoline, 1985).

Through the 1960's and the early 1970's, computer graphics

and CAD were considered by most to be expensive toys that could be justified only by government agencies (Teicholz, 1985).

In 1964, there were no more than 100 graphic terminals installed. That number grew to about 50,000 by 1977 and was in excess of 8.8 million by 1985. CAD use is now so wide spread that once familiar sights of drafts-persons and engineers hunched over boards in a drafting room is as much a memory as the slide rule (Procise, 1990). Drafting boards have been replaced by CAD stations, and rooms that once housed a number of drafting tables have given way to small cubicles.

The proliferation of CAD software for the PC is largely responsible for this transformation. CAD capabilities that carried a cost of \$300,000 per station five years ago are now available for the price of a fast PC and the software. The pricing is so competitive that many engineering firms have settled on PC-based CAD for their primary production systems.

One of the most difficult problems CAD instructors face involves ensuring that the training they provide will transfer to the world of work. One cannot look at the future of CAD without considering how education will be able to offer a program that is both current and meaningful to the student.

CAD is a tool used to enhance the design process. Human beings have always used tools to make life easier so that they

may become more productive. Certain tasks associated with drafting have always been tedious and time consuming, such as lettering, line consistency, and so on. Recently man has turned to the computer as a means of easing these tasks, and becoming more productive in many different applications of drafting. CAD is the latest tool used in drafting to make life easier and graphic representation more productive. CAD has the potential to change the very nature of drafting if it is fully utilized and if students are taught the power and flexibility of it (Bertoline, 1985).

CAD is a different way to draw in very exceptional ways. Manual drafting may be the easier way to draw initially, but the ease of changing and correcting CAD drawings eclipses manual erasing and redrawing work. Besides being faster and more sophisticated, CAD has revolutionized the design process by integrating drawing functions with design analysis and by joining text data with graphics to create intelligent drawings.

There are a number of functions you perform on CAD that you cannot perform manually. Manual drawing accuracy is based on visual accuracy, but CAD is based on the actual point and thus is more exact. Second, to change a drawing manually, you must erase and redraw, but with CAD, the computer will automatically redraw corrections for you. Third, CAD gives you

a tool to keep track of any item on the drawing (Kennedy, 1986).

Once the graphics are created you can manipulate the lines, change the dimensions, move part of the drawing to another location, erase part of the drawings without disturbing surrounding parts, change the size of elements, rotate and mirror entities, duplicate in other locations, on a segment of the drawing to be used elsewhere. You might even electronically move part of a drawing from one level to another.

In manual drafting, you learn certain fundamentals of drafting. How to use a pencil and scale, the importance of keeping a sharp pencil point, how to draw a straight line with a t-square, and how to letter and dimension. CAD drawings also require an understanding of the basics. In CAD your pencil is actually a cursor working on a cartesian coordinate system. The cursor is moved to the desired location and some input device (keyboard, mouse, or light pen) is struck to plant the point on the screen.

Pictures are displayed with incredible response. They can be made to grow, shrink, and rotate. Zooming may be used to select just those parts of a large picture one wishes to study or alter.

Computer-aided drafting software is used in almost every

drafting discipline. Mechanical drafters design products using multi-view drawings and modeling. After the product is designed, the geometric data can be used to direct machines during manufacturing (CAM). Architects use CAD systems during all stages of building design. Facilities design programs help the architect lay out space and rooms. Then plans, elevation, and section views are completed for building constructions. Architectural engineering and construction firms also use CAD for structural design and landscape architecture. Electronic engineers use CAD to design electronic products. The use of symbols helps the drafter easily add components to the drawing.

A computer-assisted drafting system is suitable for any person who has a reason to draw. The speed and ease of using computers will result in quicker drawing time and better quality design.

SUMMARY

After reviewing the related literature, one may perceive the tremendous potential and capabilities of CAD in education. In order to keep pace with the advantages in technology we must begin in the classroom. It is obvious that the trend in industry is to computer automation, such as computer-assisted

drafting and computer-assisted manufacturing. Now is the time to act to make sure the content which is taught in the high school curriculum is relevant to the industrial world around us. The introduction of CAD instruction is inevitable, the question however is it more effective to teach CAD rather than traditional methods to beginning students.

CHAPTER III

METHODS AND PROCEDURES

The problem of this study was to determine the effectiveness of teaching basic skills to a group of students using CAD instruction as compared to teaching traditional drafting methods to another group, at Maury High School in Norfolk, Virginia. The purpose of this chapter was to identify: 1) how the population was selected, 2) the instrument used to obtain data, 3) methods of data collection and 4) the treatment of the data.

POPULATION

The traditional drafting group was made up of 39 students during the 1990-1991 fall semester. The students ranged from grades 9-12. There were eight 9th graders, thirteen 10th graders, eleven 11th graders, and six 12th graders. Ten of the students withdrew or transferred from the programs leaving the total at twenty-eight. The CAD drafting program group was made up of twenty-one students during the spring semester of the 1990 - 1991 . The students ranged from grades 9 - 12. There were eight 9th graders, three 10th graders, four 11th graders,

and six 12th graders. Seven of the students transferred or dropped leaving the total at fourteen.

INSTRUMENT

At the beginning of the school year, the students were given the final exam from the Mechanical Drawing curriculum to measure their technical proficiency in drafting. The test was evaluated on a point value score and was repeated at the end of the semester. During the semester each group was given four assignments. The assignments were designed to identify the students understanding of basic concepts. The assignments were graded on a point value score to identify the quality of work. Appendix A contains the pre-test /post-test. Appendix B contains the assignments completed by all students.

DATA COLLECTION

Data collection for test results were collected and evaluated at the beginning and the end of each semester. The resulting means were recorded and compared to determine if differences existed. Data collection for assignments were collected and evaluated during the semester. The resulting means of each group were than compared to each other.

STATISTICAL ANALYSIS

At the beginning of the semester each group was given a pre-test to determine the amount of drafting that they had. The results of the pre-test were compared to each other using the t-test method of statistical analysis to determine if a significant difference existed between the two groups at the beginning of the study. At the end of the semester the two groups were given a post-test to determine their technical proficiency of drafting. Results of the final exam (post-test) were tabulated and given a point value score. The results of the two groups were then compared using the t-test method of statistical analysis to determine if a significance difference existed in the scores.

During the semester the students were given four identical drawing assignments. The traditional group was to do the assignments using traditional drafting methods to complete the assignments. The CAD group was to use a CAD system to complete the drawings. Drawings were evaluated per class by total mean scores. The t-test method of statistical analysis was used to determine if there was a significant difference in the performance of the two groups.

SUMMARY

This chapter has described the methods and procedures used to collect and analyze data. In Chapter IV the findings of the research will be presented, along with an analysis of the statistical data.

CHAPTER IV

FINDINGS

The purpose of this study was to compare the basic skills of CAD drafting students to traditional drafting students in a one semester course at Maury High School in Norfolk, Virginia. The results of the data collected from test instruments are presented in this chapter. This data was used to determine if there was a significant difference in the performance and technical proficiency of students enrolled in the CAD drafting group compared to the traditional drafting group.

To collect the data a test was given to determine the amount of drafting experience each group had before enrolling in the program. The resulting means of each group were compared using a t-test method. For the pre-test the mean score of the CAD group was 9.2 compared to that of the traditional group which was 9.64. The t comparison was .14 indicating there was no significance difference in either group at the beginning of the study.

The same test was repeated at the end of the semester for each group. The resulting means were then compared using the t-test method to determine if there was a significant difference in the technical proficiency of the two groups. The

mean score for the CAD group was 90 compared to that of the traditional group which was 81.79. The t comparison was -1.88 indicating there was a significant difference at the .05 level. The results of these comparisons can be found in Table 1.

Each group was given four assignments which are found in Appendix B. Drawings were evaluated per class by the mean score. The t-test method was used to determine if there was a significant difference in the performance of the two groups. The results can be found in Table 2 along with a graphic analysis in Table 3. In each assignment the CAD group performed at a much higher level. The t comparison for each assignment showed there was a significant difference at the .05 level and the .01 level.

SUMMARY

In this Chapter results of the test administered to gather data were recorded and noted along with the results of assignments. Chapter V provides a summary of this study along with conclusions and recommendations that resulted from the interpretation of the collected data.

TABLE 1

A COMPARISON OF THE MEAN SCORES OF THE EXPERIMENTAL GROUP AND THE CONTROL GROUP ON PRE-TEST AND POST-TEST

	\bar{X}	\bar{X}
EXPERIMENTAL (CAD) N=14	9.2	90
CONTROL (TRADITIONAL) N=28	9.64	81.79
	PRE-TEST	POST-TEST
T-TEST	.14	-1.88

THE "t" COMPARISON SHOWED NO SIGNIFICANT DIFFERENCE IN THE TWO GROUPS FOR THE PRE-TEST. THIS WOULD INDICATE THAT THE TWO GROUPS ENTERED THE EXPERIMENT AT THE SAME LEVEL.

THE "t" COMPARISON SHOWED A SIGNIFICANT DIFFERENCE AT THE .05 LEVEL FOR THE POST-TEST. THIS WOULD INDICATE THE CAD GROUP HAD PERFORMED AT A MUCH HIGHER LEVEL THAN THE TRADITIONAL GROUP.

TABLE 2

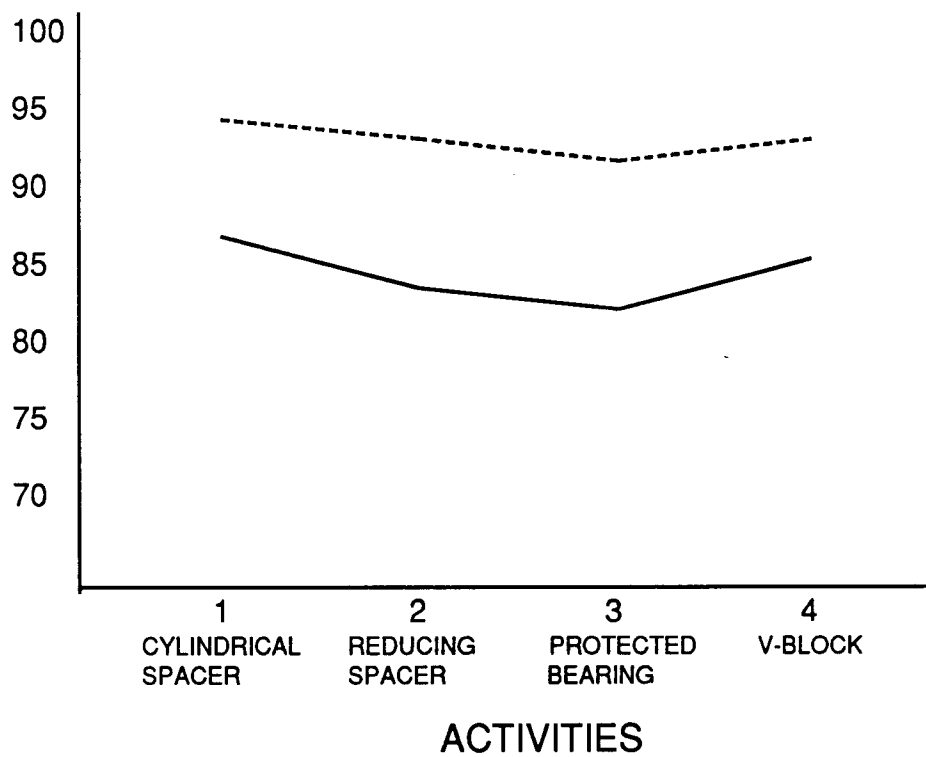
A COMPARISON OF THE MEAN SCORES OF THE EXPERIMENTAL GROUP AND THE CONTROL GROUP ON FOUR DRAWING ASSIGNMENTS

	\bar{x}	\bar{x}	\bar{x}	\bar{x}
EXPERIMENTAL (CAD) N=14	94.28	93.58	91.43	92.14
CONTROL (TRADITIONAL) N=28	86	83.93	82.68	85
	1 CYLINDRICAL SPACER	2 REDUCING SPACER	3 PROTECTIVE BEARING	4 V-BLOCK
T-TEST	-3.26	-4.68	-2.85	-3.09

THE "t" COMPARISON SHOWED A SIGNIFICANT DIFFERENCE AT THE .05 AND .01 LEVELS FOR EACH ACTIVITY.

TABLE 3

GRAPHIC ANALYSIS OF MEAN SCORES OF CAD GROUP AND
TRADITIONAL GROUP ON ASSIGNMENTS



CAD GROUP = -----

TRADITIONAL GROUP = _____

CHAPTER IV

SUMMARY, CONCLUSION, AND RECOMMENDATIONS

The problem of this study was to determine if there was a significant difference in the performance of students enrolled in basic drafting who are taught CAD drafting instruction compared to those taught traditional drafting. It was also part of the problem to determine if there was a significant difference in the technical proficiency of the CAD group compared to the technical proficiency of the traditional group.

This chapter is a summary of the problem researched, the background pertaining to the problem, the selection of the population, the test instrument, results, and the conclusions drawn from the study. Recommendations for further action follow the research study conclusions.

SUMMARY

Computer-aided drafting has become an important part of industry. It is one of the many computer-based technologies which are changing the way industry is working. The results is an increase in both quality and the number of drawings and

design work completed. This indicates a definite challenge for education, and to meet this challenge schools must now move quickly to incorporate CAD instruction into the curriculum. Traditional drafting programs must be re-tooled to meet this new demand.

The benefits of a CAD system over traditional drafting stems from the use of computers. A computer is simply faster than a human in creating lines, circles, and complex objects. It reduces drafting time by three or four times.

Some feel, the drafting curriculum of today must include preparation on both CAD and the basic fundamentals. The amount of time devoted to manual drafting will decrease in coming years as the transition to CAD by industry becomes more complete.

One of the most difficult problems CAD instructors face involves ensuring that the training they provide will transfer to the world of work. One cannot look at the future of CAD without considering how education will be able to offer a program that is both current and meaningful to the student.

One may envision the tremendous potential and capabilities of CAD in education. In order to keep pace with the advantages in technology we must begin in the classroom. It is obvious that the trend in industry is to computer automation, such as computer-assisted drafting and computer-

assisted manufacturing. Now is the time to act to make sure the content which is taught in the high school curriculum is relevant to the industrial world around us. The introduction of CAD instruction is inevitable, the question however is, is it more effective to teach CAD rather than traditional methods to beginning students.

The purpose of this study was to determine the effectiveness of teaching CAD instruction as compared to teaching traditional drafting methods to another group at Maury High School in Norfolk, Virginia. The CAD group consisted of 14 students during the spring semester of the 1990 - 1991 school year. The traditional group consisted of 28 students from two classes during the fall semester of the 1990 - 1991 school year.

To determine the students' technical proficiency in drafting, students were given the final exam in the Basic drafting curriculum and the resulting means were compared using the t-test method of statistical analysis. The same test was administered at the end of each semester and the resulting means were compared again. To determine the students quality of drawings each group was given four identical assignments. The mean of each group were compared to identify if a significant difference existed.

CONCLUSIONS

Based on the data presented in Chapter IV, it was determined that students enrolled in the CAD group at Maury High School showed a significant difference both in the technical proficiency and the quality of drawing over a one semester course. This would indicate that CAD would be more effective in teaching students basic skills than would traditional methods.

The t comparison of the pre-test means indicated no significant difference in the two groups at the beginning of the experiment. The t comparison of the post-test means showed a significant difference at the .05 level, which indicated the CAD group performed at a higher level.

The students were also given four identical assignments throughout the semester. The resulting means for each assignment were compared using the t-test method. The results showed a significant difference at the .05 and .01 levels for each of the four assignment. This would indicate that the CAD group was more effective in producing higher quality work.

RECOMMENDATIONS

Based on the findings of this research, the following recommendations were made:

1) CAD should be taught to the beginning level to students enrolled in drafting.

2) In-service should be provided on CAD equipment for all technology teachers.

3) The curriculum should be re-written to provide guidance to teachers teaching CAD drafting.

4) Further studies should be undertaken comparing different software to one another to determine which software is more effective for teaching basic CAD.

BIBLIOGRAPHY

- Addison, D.B, "The Changing Technical Drafting Curriculum." Industrial Education. 1988 77(6).
- Becker, K, "Incorporating CAD into the Curriculum." Industrial Education. 1986 74(4).
- Burnes, W.E., Computer- Aided Design (CAD) Industrial Education 75(6) 1986.
- Chi-Yin Yuen, S, Incorporating CAD instruction into the drafting curriculum 50(3) 1990.
- Duelm, B, Computer Aided Drafting: fundamentals and applications, The Goodheart-Wilcox Company, INC. NY, NY 1989.
- Goetch, D.L., The Changing Drafting Curriculum Design Graphics Worked 10(9) 1986.
- Isebell, C.H., Lovedahl, G.G. "Introducing CAD into traditional drafting program." Industrial

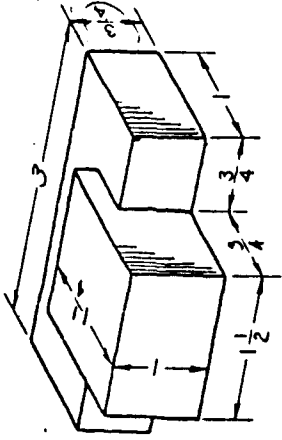
Education 77(8) 1988.

Kennedy, E. Lee, "CAD-Drawing Design, Data Management" 1986
New York.

Sutherland, I.E., "SKETCHPAD: A Man-Machine Graphic
Communication System," TR-296, MIT Lincoln
Laboratories, Lexington Mass., January 1963.

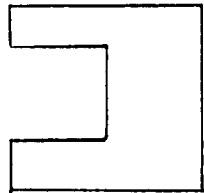
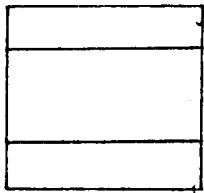
Teicholz, CAD/CAM handbook (1985)

APPENDIX A
PRE-TEST AND POST-TEST



Problem 5•16. Draw three views of the front base.

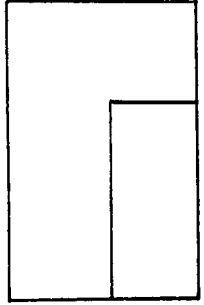
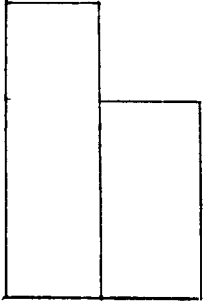
MULTI - VIEW



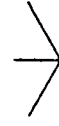
OBLIQUE



ISOMETRIC

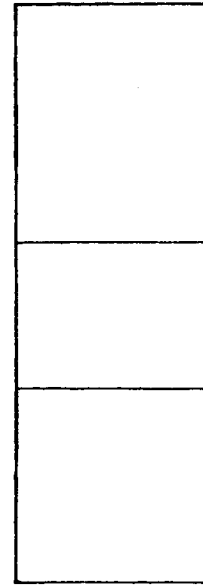
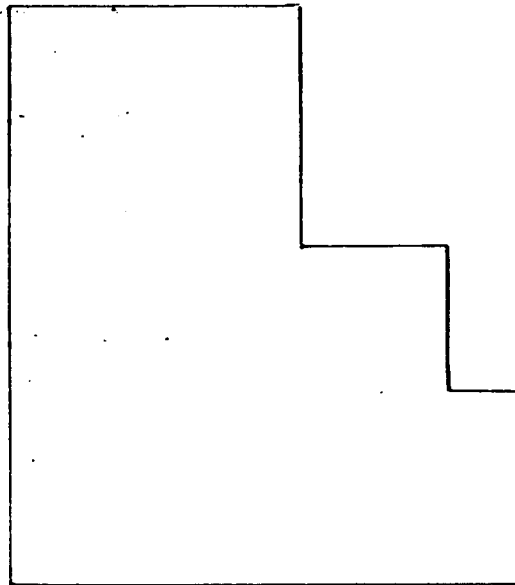
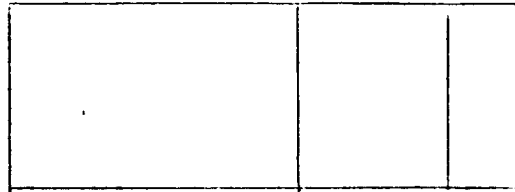


OBLIQUE



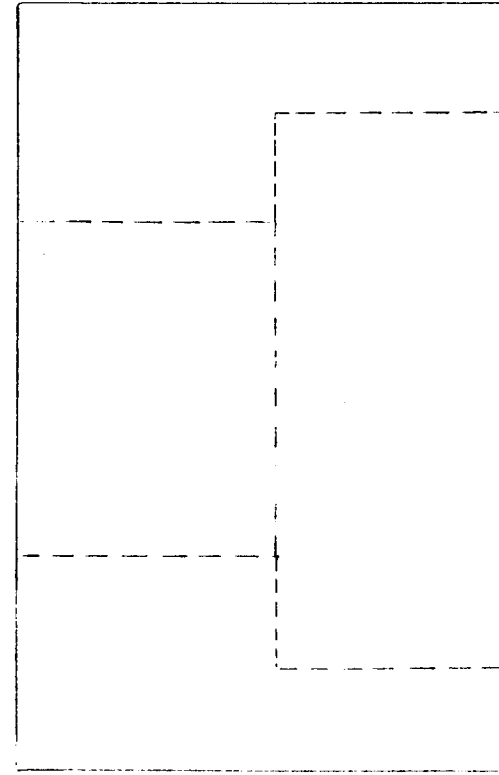
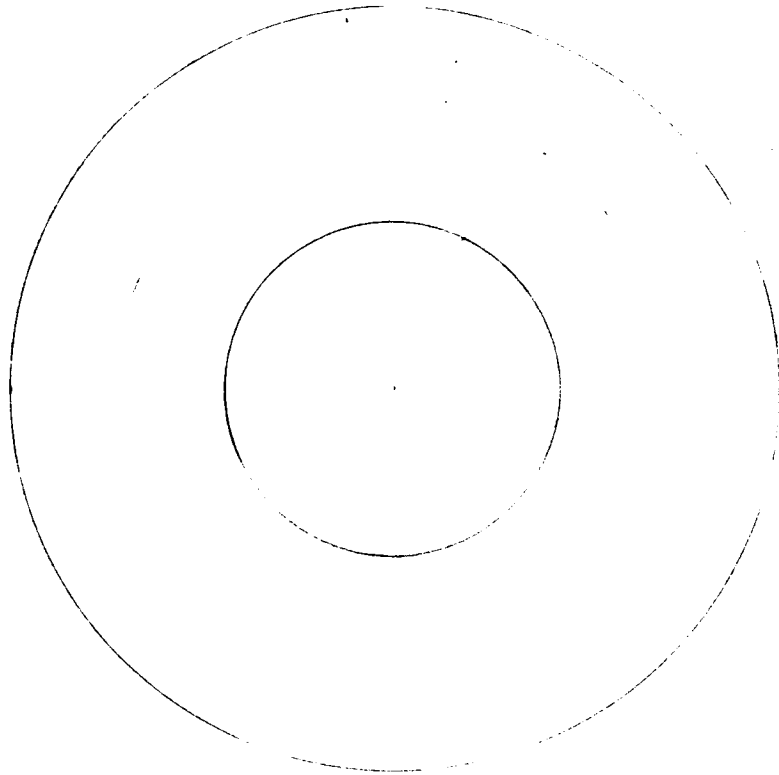
ISOMETRIC

PICTORIAL SKETCHING



USING GOOD DIMENSIONING PRACTICES , SHOW ALL NESSARY DIMENSIONS

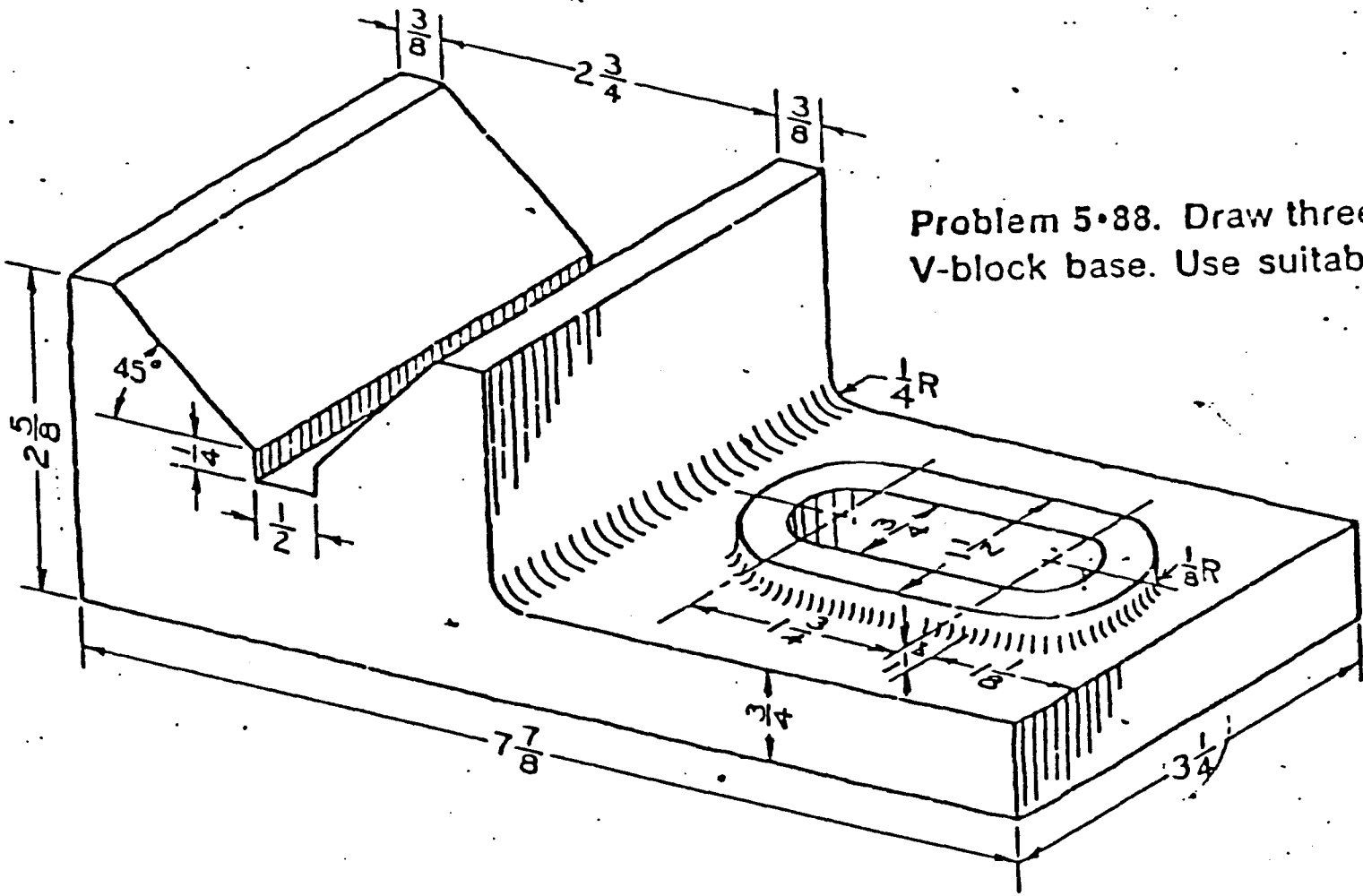
DIMENSIONING



PLACE A CUTTING PLANE LINE ON THE FRONT VIEW AND
SHOW THE RIGHT SIDE VIEW IN SECTION

FULL SECTION

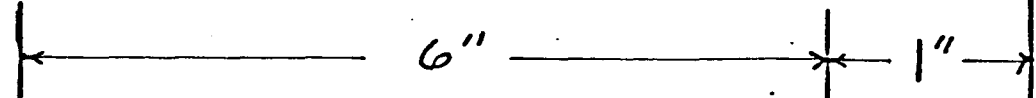
APPENDIX B
FOUR DRAWING ASSIGNMENTS



Problem 5•88. Draw three views of the V-block base. Use suitable-size sheet.

1"

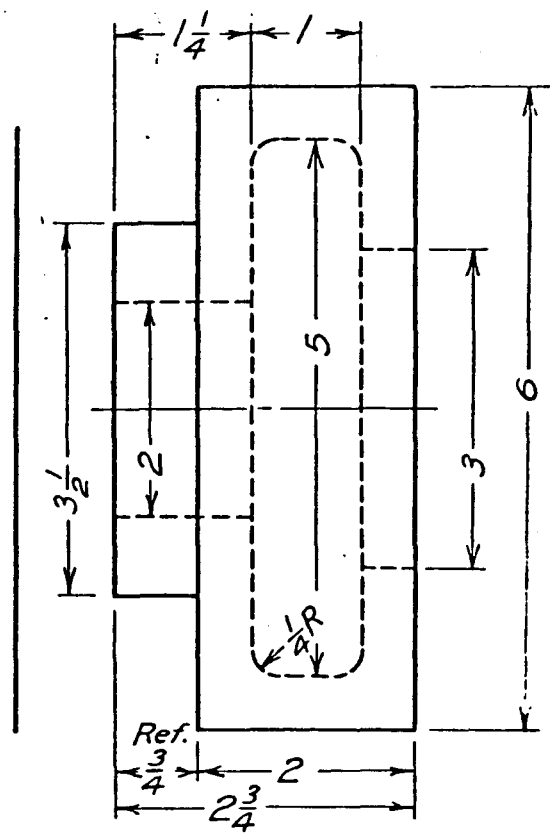
1/2"



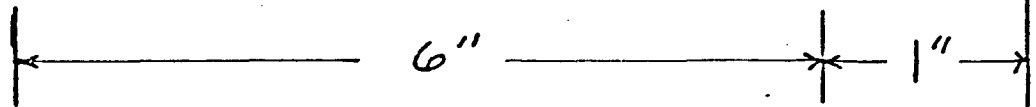
5/8"

MAURY HIGH SCHOOL	NAME OF DRAWING	PLATE
NORFOLK VA / YOUR NAME	SCALE	6
	DATE	

1/2"

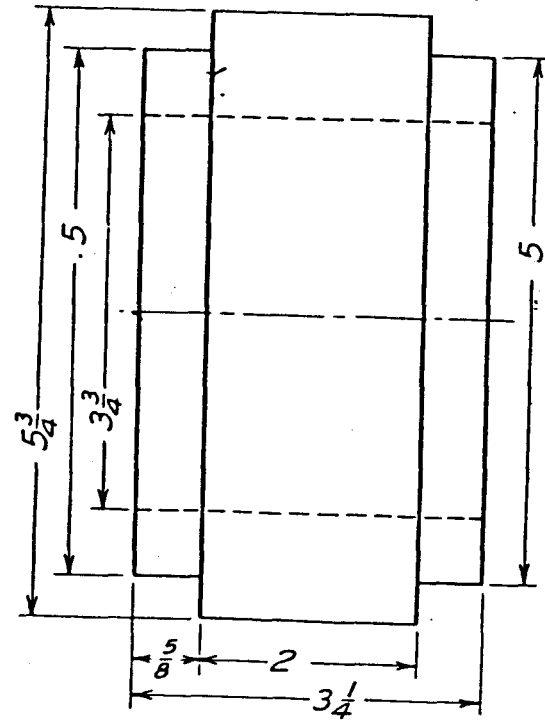
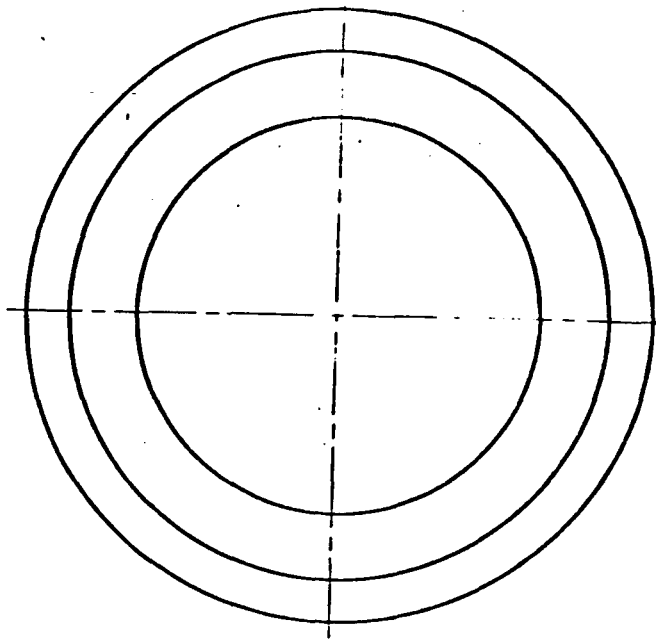


Problem 10-35. Make a drawing of the reducing spacer showing a full section

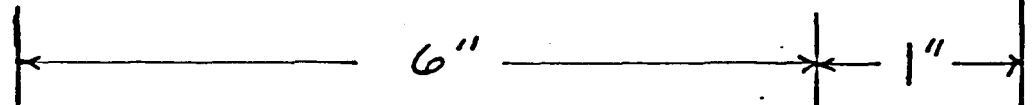


MAURY HIGH SCHOOL NORFOLK VA / YOUR NAME	NAME OF DRAWING	PLATE
	SCALE	DATE

1/2



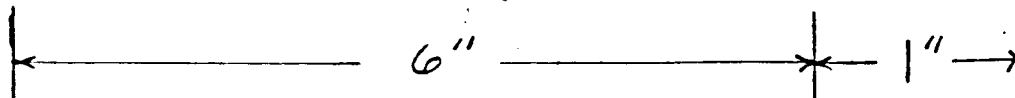
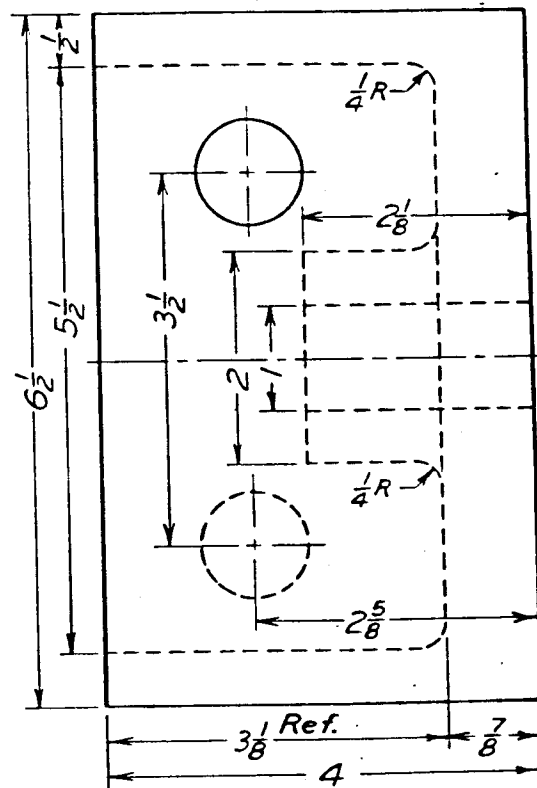
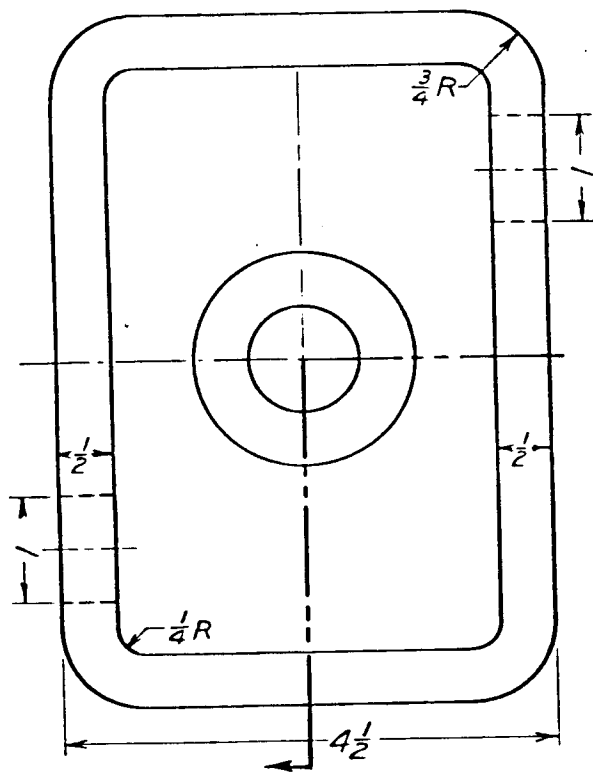
Problem 10-34. Make a drawing of the cylindrical spacer showing a full section.



$\frac{1}{2}$ " ← →	MAURY FITCH SCHOOL	NAME OF DRAWING	PLATE
	NORFOLK VA / YOUR NAME	SCALE	DATE

↑
 $\frac{1}{2}$

Problem 10-40. Make a two-view drawing of the protected bearing showing the right-hand view as a half section.



← 0/15 →	MAURY HIGH SCHOOL	NAME OF DRAWING	PLATE
	NORFOLK VA	SCALE	DATE