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The Introduction and Teaching of Drafting Through CAI to Students with Potential Vocational Talent

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THE INTRODUCTION AND TEACHING OF DRAFTING

THROUGH CAI TO STUDENTS WITH
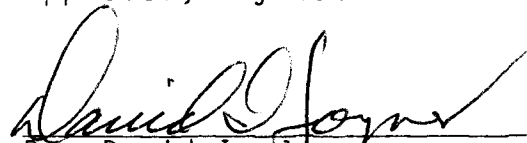
POTENTIAL VOCATIONAL TALENT

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A STUDY

PRESENTED TO

THE FACULTY OF THE SCHOOL OF EDUCATION

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IN PARTIAL FULFILLMENT

OF THE REQUIREMENTS FOR THE DEGREE

MASTER OF SCIENCE IN EDUCATION

———————————

BY

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This research paper was prepared under the direction of the instructor in Problems in Education VIAE 636. It is submitted to the Graduate Program Director for Vocational and Industrial Arts Education in partial fulfillment of the requirements for the Degree of Master of Science in Education.

Approved, May 1985

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CHAPTER I

INTRODUCTION

An entire society could be structured around a knowledge
structure, in which the old passed on knowledge and the young
simply received it. But the enormous speed of change in our
time, brought on by the cybernetic revolution, necessitates a
total change in the structure (Theobold, 1970, p. 163, MST
April 1981).

To ensure our nation's place as a leader in our ever-
changing technological world, we must educate people to think
and act from a technological perspective. By acquiring appropri-
ate technical mean, they will be able to extend their own po-
tential. The result of this form of education will be individuals
who can contribute and adapt to a dynamic technological society.
Consistent with the abilities, interests and needs of learners,
they will develop attitudes and abilities in the proper use of
tools, techniques, and resources of technical and industrial
systems. (Starkweather, May/June 1983, p. 8/9).

Eight year olds can figure out a computer-generated program
and act manually on the information with more apparent ease than
the adults. Those who are not involved in the transition to
computer literacy are going to face increasing difficulties. An
extraordinary opportunity exists, when students and teachers are
learning about computers together.

The high cost of computer graphics technology has pre-
viously prevented its widespread use. Now the cost is dropping
rapidly and interactive computer graphics is becoming available
to more and more people. Micro-computers installed in American
schools are proving their worth in the classroom. Children are
keenly interested in microcomputers while teachers are finding
more and more creative ways to use them.

A second - generation of computer hardware and software is
emerging in the market place, offering more value for the educa-
tional dollar. Classroom computers have now passed beyond the
novelty stage, but the real work of transforming them into
powerful and indispensable tools available to every teacher and
pupil is still ahead.

The computer-using educator's job has become increasingly
challenging as more hardware and software products have become
available and as ideas about how to use computers effectively
have proliferated.

The intellectual environments offered to children by today's
cultures are poor in opportunities to bring their thinking about
thinking into the open, to learn to talk about it and test their
ideas by externalizing them. Access to computers can dramati-
cally change this situation. Even the simplest computer graphics
work ("turtle geometry") can open new opportunities for sharp-
ening one's thinking. Programming the "turtle" requires step by
step analysis and directions to the computer. As children advance,
they can program the computer to make more complex decisions and
find themselves engaged in reflecting on more complex aspects of
their own thinking. (Papert, p.6).

Our educational system and our society have too much at stake. Our technological future demands that we make full use of our human resources - that we create a work force skilled enough to handle the highly technical jobs of the 'Eighties and 'Nineties. But in doing so, we can perform another great right; we can help narrow the gap in our society between the "haves" and "havenots." Technology has given us the key; all we have to do is use it. (Podemski, Husk, and Jones, 1983, p.22).

STATEMENT OF THE PROBLEM

The purpose of this study was to determine whether a CAI program in drafting could be designed and used to motivate underachieving vocationally talented students.

RESEARCH GOALS

The primary objective of this research was to clarify or to answer the problem the author has chosen, using the following objectives as a guideline:

1. To determine if selected elements of drafting could be adapted for computer-aided instruction (CAI).

2. To provide students with opportunities for developing thinking skills and creativity in an open-ended computer learning environment.

3. To assess the attitude of students towards CAI and to determine if changes in attitudes occurred as a result of CAI exploratory courses.

4. To develop student awareness and skills in high technology fields through an exploratory program in the areas of

drafting and graphics, grades 7 - 9.

5. To tap the potential of underachieving gifted/talented students who may have capabilities in reasoning and spatial performances.

BACKGROUND AND SIGNIFICANCE

It is anticipated that the project will

A. provide a model for CAI in drafting,

B. contribute to the school's high technology program,

C. provide guidance/information to other schools, and

D. help to build a link between school programs and the workplace.

As no authors describing such a study as this could be found, many studies are cited that refer to the use of computers in education and the need for orienting the industrial arts curriculum toward the new technologies.

This study is based on the rationale that a program must be future-oriented, student-centered, relevant to societal needs, and based on the study of the physical technologies.

Typically, professionals who teach drafting for any length of time come to sense the need for three-dimensional models to aid their students in visualizing objects. Although teacher-made models can serve well for some needs, they have several drawbacks, including the following:

1. many model shapes are not easily changed,

2. students are deprived of model-building experience, and

3. there is limited availability of models for student handling. (Berghauser, 1981)

Computers can help by being able to project three dimensional views and, by virtue of its software, to rotate, reduce, enlarge, and color these objects. Industrial Arts is in serious trouble if the profession does not bring the programs into focus with the current state-of-the-art technology.

Education should provide students with the skills and concepts needed to understand the complex systems of the future. Industrial Arts education must begin to read the "writing on the wall" in training areas such as drafting. Should students continue to be trained in the traditional mode of drafting when the future holds that practice as obsolete? Or will the profession move toward computerized drafting using the CRT (cathode ray tube) technology widely employed in industry today?

Educators can teach the theory and fundamentals of the skill area. However, placing a student into an industrial setting (on an unpaid internship) where, through a shadowing process, he or she learns the basics of CRT drafting firsthand, begins to experience the feeling for the job and the work world, and identifies potential career choices, provides an opportunity not possible in the classroom. Industrial sites look favorably on such a venture to create a positive public image and to develop potential employees (Vascera and DiMeo, 1982).

This paper describes a project designed to provide an innovative computer-based learning environment for vocationally talented students in grades 7-9. The students learned LOGO, a computer language for intermediate school students, and engaged in a variety of computer programming activities designed to enhance basic skills and to develop problem solving abilities.

The project was also designed to provide basic training and support for teachers of underachieving vocationally talented students, and to develop a set of curriculum materials and a teacher methodology which will allow these methods to be successfully implemented in other schools.

The fascination or intense interest associated with learning to program a computer leads to an increase in motivation for most students. The LOGO learning environment operates most effectively when students are allowed to decide the content and pace of the activities they undertake. This control of their own learning appears to improve their self-confidence. Programming in an interactive computer graphics situation lends itself to an emphasis on process rather than product, in that the typical tasks are structured to enable direct feedback on the intermediate steps during the solving of the problem. A discrepancy between what is intended and what actually happens is thus more readily available to both teacher and learner than is usually the case, and such an error or "bug" becomes a source of insight into the problem solving process. (Weir and Watt, 1983, p. 215)

Typical beginning LOGO tasks in Turtle Geometry mobilize and help to cultivate skills in spatial reasoning often not otherwise utilized in the conventional curriculum and this fact can be an advantage to those with strengths in this area. In the process of exploring problems in Turtle Geometry, students gain concrete mathematical experience which provides a foundation for more abstract mathematical subjects such as algebra, geometry, and trigonometry. In addition, they develop skills in reading, spell-

ing, and typing in the process of inputting their programs and in deciphering the computer messages; the availability of a text-editor enhances this experience and provides motivation and a practical tool, allowing some students to make dramatic progress in creative expression. (Weir and Watt, 1983)

The development of spatial reasoning and linguistic ability do not necessarily go hand in hand. For example, subjects weak in linguistic skills can have relatively unimpaired or even highly developed spatial intelligence. Since spatial orientation is rarely used in the usual school subjects, children whose strengths lie in this area often go unrewarded. LOGO has the virtue of developing such spatial skills, allowing their owners to shine among their peers and to turn such skills to an academic (mathematical) purpose. (Weir and Watt, 1983)

One of the great advantages of having micro-computers in the classroom is the opportunity they afford to assist the student whose abilities lie outside the norm. Too often teachers are forced to aim lessons at the "mediocre middle," while students toward either end of the scale tend to suffer. Bright students quickly become bored; slow learners soon fall behind and either drop out or become "problems." The computer enables the teacher to provide meaningful remedial work or new challenges through supplementary assignments, as well as to reach handicapped or special students on an individual basis. Although the computer is not intended to replace the teacher, it does offer a valuable extra hand in appropriate situations. (Weir and Watt, 1983)

Achievement outcomes are important in determining the effect-

iveness of CAI. Research studies demonstrate students learn more using a computer than students engaged in traditional instruction materials alone. Kulik (1982) completed an analysis of fifty-one separate research studies on students in secondary schools, defined as sixth grade and above. The fifty-one studies show that students who received CAI scored better on objective tests than students who received traditional instruction only. CAI improved retention as well as the speed at which students learn a given amount of material.

Braun (1980) asserts that the affective outcomes are more important than the achievement effects. In the area of affective/ motivational outcomes of CAI, the news is almost all good. At the college, high school, and elementary school levels, students have good things to say about learning from computers. Students consistently report that they enjoy the ability to move at their own pace, as well as the lack of embarrassment about mistakes.

Molnar and Forbes (1982) are among the many who have express-ed fear that we are not preparing our children for the information society in which they will live.(Braun,Molnar and Forbes in Bracey,'82)

The growing demand for people with extensive technical train-ing in information technology is well documented. Already, the U.S. is experiencing shortages of engineers and teachers with a math/science background.(Bracey, 1982)The use of computer tech,-nology in diverse fields such as history, composition, and business is becoming imperative.

Computer-augmented problem solving and computer-aided memory can reduce the difficulty and complexity of problems in all dis-ciplines and are likely to be a catalyst for major curriculum

revision efforts in education. It is anticipated that several educational trends will emerge in the future. Intelligent devices will tutor and advise students and provide small but powerful computation facilities. There will be a greater emphasis on problem-solving, algorithms, graphics, dynamics, and data processing at all levels of education. (Molnar, 1983)

This project is a beginning effort in providing students with the technological base needed in the society of the future.

THE GIFTED AND TALENTED

Intellect and achievement are far from perfectly correlated. To identify the internal and external factors that help or hinder the fruition of exceptional talent and to measure the extent of their influences are surely among the major problems of the time. (Terman, 1981)

The gifted child is often shortchanged in a system that sees the learner as a passive receiver of knowledge. The gifted child's superior learning ability allows him to score well on most standard achievement tests, making it appear as though he is doing well when, in fact, he is failing to develop more than a fraction of his potential. (Nelson and Cleland, 1981)

Even among youth of high-ability potential, aspects of personality arising from unfortunate experience may combine to hamper present performance, leading to underachievement or emotional instability. In the case of these gifted children, remediation should be undertaken as an initial phase of differential education in order subsequently to allow fuller operation of the natural potential. (Ward, 1981)

A major step in encouraging creativity in the classroom is the support of activities which increase the student's self-confidence and persistence. What is needed is a reshaping of the traditional classroom so that materials and facilities are arranged in ways that make it convenient for students to move from task to task, rather than in ways that make it easy and convenient for teachers to exercise complete and unyielding control. (Goodale, 1981)

Reinforcement and feedback are powerful influences in shaping behavior, and if creative effort is to be encouraged then the teacher should be alert to see that every effort in the direction of creativity, curiosity, independence, and self-reliance is rewarded. (Goodale, 1981). The teacher must provide alternate learning strategies, feedback rather than judgement, and a classroom climate which promotes self-esteem and offers safety for creative and cognitive risk-taking.

A major move to increase creative production by increasing the learner's feelings of self-worth and self-esteem has recently been outlined by Randolph and Howe (1966) in Self-Enhancing Education. It calls for a change in the teacher from an authority figure to a "helping person," a change in the class-room environment from competition to mutual support, and a change in the learner's self-concept that leads him from fearing failure to contributing what he can. (Goodale, 1981)

Instruction in creative thinking and problem solving has long been characterized by group or total class activities. Only in individualized, carefully planned, participatory activities are students able to exercise their own creative and problem solving abilities. High quality instructional materials always involve a small amount of exposition, directions, or didactic instruction and a large amount of carefully planned practice and reinforcement activity. (Feldhussen and Treffinger,1981)

Giftedness consists of an interaction among three basic clusters of human traits - these clusters being above average general

abilities, high levels of task commitment, and high levels of creativity. Gifted and talented children are those possessing or capable of developing this composite set of traits and applying them to any potentially valuable area of human performance. Children who manifest or are capable of developing an interaction among the three clusters require a wide variety of educational opportunities and services that are not ordinarily provided through regular instructional programs. (Renzulli, 1981)

In a position paper prepared for the 1960 White House Conference on Children and Youth, problem areas in the education of the gifted and talented were identified as most pressing:

1. Improvement of procedures for locating the potential underachiever at an early stage to prevent negative attitudes, learning patterns, and self-concepts from forming and choking his capabilities.

2. Development of means for keeping abreast of new knowledge and revision of instruction to include these new insights and understandings.

3. Development and appraisal of instructional techniques, materials, and resources that will yield deeper learnings for the gifted.

4. Increased understanding of the kinds of learning experiences that will nourish a love of learning; foster independence in thinking; feed the desire to experiment, to test, and to venture forth; and create a built-in standard

of excellence in performance. (Passow, 1981)

The understanding of the complexities of nurturing creative and gifted children can be enhanced through the study of such children who are not "making it." Studies of gifted underachieving children have revealed a number of correlates. Among these are negative schooling experiences and more general motivational considerations. Due to family, cultural, or peer influences, the child's achievement capabilities may center on non-academic areas. Academic accomplishment per se may not be as reinforcing or gratifying for the child as other areas such as mechanical or social endeavors. Many underachieving children are of low self-esteem or may be acting out anger or rebellion through their poor achievement pattern. Aside from parents who discourage the child with demands for high constant performance, more common among underachievers are parents who have low expectations and who do not adequately encourage and support their gifted child. Given this review of some of the dynamics and characteristics of underachievement in gifted children, it is apparent that the underachievement and related personal difficulties are likely to remain long term characteristics of the individual. (Fine, 1981)

LIMITATIONS

The following limitations were inherent in the study:

1. The population for the study was limited to those students who were selected to take the CAI course in drafting during the spring of 1984.

2. The generalizability of the study was limited due to the small number of participants and the selection of the sample.

3. The number of teachers and supervisors was limited.

4. Geographically the study was limited to six secondary York County Public Schools.

5. The amount of time in which the study was conducted was limited. (Short term impact).

ASSUMPTIONS

It was assumed in this study that:

1. Course design met the needs of the research goals.

2. Drafting and computer professionals possess the basic skills needed.

3. The student population had potential capability in the computer graphics field and could benefit from the experience.

PROCEDURES

1. The identification of vocationally talented students was evaluated by determining if the assessment procedure identified students interested in participating in the exploratory high tech course.

2. Course curriculum was developed by drafting and computer instructors and courses taught in an area regarded as high tech

field as follows:

Grades 7 - 9 - Exploratory courses in drafting and graphics

3. Performance and interest in the exploratory high tech program were assessed through observation, teacher evaluation and student evaluation. (See Chapter 4)

4. A pre and post assessment of attitudes were analyzed to determine the changes that occurred as a result of the high tech exploratory courses.

DEFINITION OF TERMS

The following terms were used in this study and were defined for clarification:

1. Algorithm - A procedure that produces quick lines and curves.

2. CAD - Computer assisted design

3. CAI - Computer Assisted Instruction

4. Canned Program - Preprogrammed software; a complete, ready-to-use program, usually stored on cassette or diskette.

5. Clipping - A special form of picture transformation. Certain parts of a picture are selected and the rest are discarded.

6. Computer Graphics - Creation and manipulation of pictures with the aid of a computer.

7. Courseware - Software designed for educational applications.

8. CRT - Cathode Ray Tube - Similar in appearance to a television screen; a computer output device.

9. Cursor - Small lighted rectangle on the screen of a video terminal or microcomputer that indicates the location where the next character will appear on the screen.

10. Diskette - A small, flexible disk with a magnetic surface for recording data and programs often referred to as a "floppy" disk.

11. Graphics Package - Subroutines to support the writing of application programs.

12. Graphics System - Any collection of hardware and software designed to make it easier to use graphic input and output in computer programs.

13. Hardware - The physical equipment that makes up a computer system.

14. Input/Output - The hardware used to enter data into, and to extract data from, a computer system.

15a. Interface - The connecting device between a computer and peripheral device, such as a printer, allowing the two to communicate.

15b. Interface - Parts of the computer program that link the user to the computer and enable him to control it.

16. Light Pen - The light pen is a pointing device. If it is pointed at an item on the screen, it generates information from which the item can be identified by the program.

17. LOGO - A programming language best known for its turtle geometry in a graphics environment.

18. Microcomputer - Hardware composed of a group of separate elements, including read-only memory and random-access memory, microprocessor, interface logic for input/output, and timing circuitry for transmitting signals from one element to another.

19. Monitor - A video display unit that uses a cathode ray tube to display information.

20. Mouse - A small plastic box, when rolled on a flat surface, produces orthogonal lines on the display - a device for pointing.

21. Non-Interactive Graphics - The observer has no control over the image.

22. Point Plotting Display Device - The smallest picture unit accepted by such displays is a single dot, termed a point or a pixel.

23. Portable Programs - Programs that can be run on different computers and with different displays.

24. Program - A series of computer-language instructions to cause the computer to perform a certain task.

25. Raster-Scan Displays - The image is scanned onto the screen surface in a raster sequence, ie., as a succession of equidistant scan lines, each scan made up of pixels.

26. Software - Computer programs; also used to refer to everything that is not equipment (hardware).

27. Tablet - A flat surface on which the user draws with a stylus. The similarity of the tablet and stylus to paper and pencil makes them a particularly natural combination for graphical input.

28. Terminal - An input/output device linked directly to the computer by data lines; a device for communicating with a computer using a keyboard and an alphanumeric printer or cathode - ray tube (CRT) display.

29. Turtle - A cursor that moves in straight lines, curves, circles according to appropriate commands.

30. Windowing - Use the window (port) to define what we want to display; we use the viewport to specify where on the screen to put it.

OVERVIEW OF CHAPTERS

Material selected for this study was organized into five chapters. Chapter I has presented information relevant to the general understanding of the topic. Futhermore, it has described the theoretical framework from which the study was devised as well as defined terms, discussed limitations, stated the general research goals, listed the assumptions, and outlined procedures for the study. Chapter II presents a review of the related literature. Chapter III examines the methods and procedures of this research. Included in this chapter are population, instruments, and design. Data collected is presented in Chapter IV. A summary of the study and its conclusions, a discussion of the findings, implications and recommendations for further research are found in Chapter V.

CHAPTER II

REVIEW OF LITERATURE

Computer graphics has become an important aspect in the computer field. It is an extremely effective medium for communication between man and computer. Video games represent the first major use in the home of computer graphics i.e. the creation and manipulation of pictures with the aid of a computer. Such pictures may be generated on paper or film, using a computer-controlled plotter (computer art). Images like this are examples of non-interactive or passive computer graphics; the observer has no control over the image. Provide him with an input-device, such as a joystick, so he can signal his requests to the computer. This is an example of interactive computer graphics. (Newman and Sproul, 1979)

Complex drawings take a long time to produce and an equally long time to redraw in the event of modification. Using an interactive graphics system, the drafter can make the drawing in a much shorter time. He can use the computer to help in checking the design and can effect modifications to the design in a matter of minutes.

Architectural students can explore alternative solutions to design problems at an interactive graphics terminal. The main reason for the effectiveness of interactive computer graphics in the applications is the speed with which the user of the computer can assimilate the displayed information. He can then interact with the computer to quickly correct a design error, and see a revised picture of the drawing.

Pictures are displayed with incredible response. They can be made to grow, shrink, and rotate. Clipping may be used to select just those parts of a large picture one wishes to study. The user is also able to create pictures directly on the display screen using such input devices as a light pen, tablet, or mouse.

CAD equipment translate engineering drawings into three-dimensional (3-D) renderings of the object on a video screen. It can be looked at from all sides, even from inside in many cases. A number of designs can be analysed without the expense of building models. Computer graphics can produce realistic images of 3-D objects showing depth, hidden details, color, shadows, texture and perspective.

A graphics package (general purpose) consists of a set of subroutines that provides high-level access to the graphics input-output hardware. A good graphics package simplifies the programmer's task and makes it possible to write portable programs that can be run on different computers and with different displays. This greatly reduces the cost of writing software for graphics applications.

Straight line segments produced by line-drawing algorithms are used a great deal in computer-generated pictures. They occur in block diagrams, bar charts and graphs, mechanical engineering drawings and architectural plans. Circles, arcs, and curves can also be displayed.

Many graphics application programs give the user the impression of looking through a window at a very large picture. Through the

use of clipping and windowing a large architectural plan or
portions of it may be viewed at different scales in a variety
of different views.

Dynamically changing displayed pictures appeal to the user.
They attract because they are so unlike the static pictures
habitually drawn on paper. One of the most popular and effective
uses of the digital computer is in the abstract representation of
physical systems. They permit students of architecture to test
certain aspects of their designs and to generate plan and per-
spective views. (Newman and Sproul, 1979)

Computer graphics allow for positioning techniques (locating).
The need for positioning occurs very often in geometric model
applications, where the user frequently wishes to define a new
element of the model or to reposition an existing one.

As raster-scan graphics increase in capability and drop in
price, their range of usefulness increases. Applications in
high-precision engineering drafting and solid object design can
be generated on the raster-scan display. These images can assist
designers greatly in their work. They can display images contain-
ing solid areas, lines of various thicknesses, colored geometric
shapes in diagrams and 3-D objects.

Specification of hardware and software grows out of explicit
educational objectives tied to grade level, subject area, and the
specifics of the implementation plan, tempered by the limits of
the budget. It is important to observe ground rules for graphics
software design. They should contain the characteristics of
simplicity, consistency, completeness, robustness, performance,
and economy. (Newman and Sproul, 1979)

The proliferation of hardware and software products has made it a problem finding software that lets the instructor create individualized programs that match the student's pace. The drafting instructor will be exposed to different graphics package designs. He should look for a design that has possibilities for his program. The following functions are part of CAD capabilities that would be of interest to the drafting instructor:

1. a small part of the picture changes, and the rest remains unchanged

2. selective modifications i.e. add new parts, move them around, and delete them without disturbing the rest

3. allowing segments to become temporarily invisible

4. a geometric model may be displayed showing hidden lines, the same view with hidden lines removed, and an orthographic projection

National institutions such as NASA and Newport News Shipbuilding in the Tidewater area of Virginia make extensive use of CAD/CAM equipment. Employment opportunities at these centers and other facilities in and around the Peninsula make computer aided drafting in the high school essential and current.

Computer graphics is being used extensively in engineering and manufacturing. But the level of complexity of its programs makes the researcher's task of collecting data and devising an instrument to prove its worth for a high school CAD program a difficult task.

Computer games and canned programs provide the user with some understanding of the capabilities of computers and introduce

the basic elements of computer graphics. One of the first elements, for example, is the horizontal and vertical line restrictions. Diagonal and curved lines can only be simulated by creating a stair-step effect of small horizontal and vertical lines. On low resolution graphics, the effect is very obvious, but is minimized in high resolution graphics which reducethe size of the steps. (Ettinger and Rayola, 1983)

Typing instructions into the computer is not the only way to make computer images. Many companies sell a device called a graphics pad with an electronic stylus for drawing very much as one would with a ball point pen. Graphic pads and the other items mentioned below are called peripherals because they are not part of the basic components of a computer but instead are added on. A variation of the stylus is a little circle with cross hairs which can be used for tracing a picture. This stylus is sometimes called a mouse. Another peripheral for computer graphics is a light pen similar to the stylus, but used on the face of the computer's display screen. Whenever the display screen is touched with the light pen, the computer will make a mark visible on the screen. Another peripheral, especially suited to making line drawings, is called a plotter. It involves an inked pen for outputting architectural and engineering drawings. All of these devices are referred to as hardware and can only work with the programs, or software, the user puts in. In most cases these devices were developed for technical drawings. (Ettinger and Rayola,'83)

Perhaps the most widely accepted value of CAI is that it involves the individual actively in the learning process. It is

totally impossible for the student to be a passive member of the situation, and this very activity and involvement facilitate learning. Another much touted value is the ability of the learner to proceed at his own pace, which has strong implications for both the slow learner and the gifted person.

Reinforcement of learning in such situations is immediate and systematized, which should result in more effective learning. In addition, the computer in a simulation mode permits students to explore time and space. The use of computers in this manner frees faculty members or training coordinators to devote more time to the personal, human considerations of their students. Time thus spent with students has been found to be the most important factor, in students' opinions, in the development of their creative abilities. Thus the use of the computer in these modes should result in an educational environment in which individuals learn more and in which their potential for innovative and creative professional work is more fully developed. Similarly, there should be greater acceptance of the computer as a helpful tool after the student has used simulations, games, or tutorials. (Chambers and Sprecher, 1983)

Peer instruction can be very effective. Adults are accustomed to turning to one another for information - and in a learning mode tend to prefer asking a friend rather than an instructor with whom they are unfamiliar. It is helpful to organize a class of students in pairs or in threes. This means that as one student is working at the terminal the other is watching. It is amazing how many errors are caught in this way. The error correction is

immediate; the partner points out a potential or actual error and it is immediately corrected. This not only saves the instructor, but provides for more rapid and comprehensive feedback for all than any one teacher could ever provide. Immediate feedback is one of the powerful learning adjuncts of computer-assisted education. (Hedges, 1983)

SUMMARY

After reviewing the related literature, one may perceive the tremendous potential and capability of computers in education. In order to keep pace with the advances in technology we must begin in the classroom. For his part, the drafting instructor has to know his options. Now is the time for him to make his decision and act. The introduction of CAI in high school drafting is inevitable.

In the next chapter, the methods and procedures to show how CAI lends itself to drafting will be presented.

CHAPTER III

METHODS AND PROCEDURES

This chapter deals with the assessment procedure used to identify vocationally talented students interested in the exploratory CAI program, to develop the program and curriculum to be used, and to describe the evaluation procedures.

PROCEDURES OF IMPLEMENTATION

IDENTIFICATION AND SELECTION OF POPULATION

An assessment procedure to identify vocationally talented students was developed including the use of the following instruments:

1. Interest Inventories: SAGE Vocational Interest Inventory (also other available interest inventories such as COPS, IDEAS)

2. The Cognitive and Conceptual Abilities Test (C-Cat) (also other available standardized test information such as SRA,DAT)

3. The Vocational Aptitude Battery, SAGE, to assess eleven aptitudes through kits with manipulative materials designed to measure the following skills: general, verbal, numerical, spatial, form perception, motor co-ordination, finger dexterity, manual dexterity, eye-hand-foot co-ordination, and color descrimination.

4. Interview questionnaire

5. Assessment procedures were conducted by a trained guidance and counseling staff at the Educational Assessment Center, located at York High School in the geographical center of the school district. Students were transported to the center by school bus.

6. A screening committee composed of a guidance counselor, an administrator, a vocational teacher, and a science/math teacher identified the students through the use of the developed assessment profile.

PROGRAM DEVELOPMENT AND IMPLEMENTATION

Course curricula were developed and courses taught in an area regarded as high tech field as follows: grades 7-9 Exploratory course in drafting and computer graphics.

Courses were offered during the seventh period during the 1983-84 school year, once a week for eight weeks for a total of eight sessions for each student. A second group participated for a total of five sessions, once a week.

Class size was limited to fifteen. The courses were taught at the York County Instructional Resource Center. Students were transported by school buses. A plan to expand these courses so that they could be incorporated into the regular curriculum in 1984-85 could be developed. Course content also included information on careers available in high tech fields. The course concluded with a visit to NASA where the students were given demonstrations of sophisticated computer graphics capabilities.

IDENTIFICATION AND ASSESSMENT PROCEDURE

Six member schools in the Yorktown Public School System were informed of the intended CAI project in the fall of 1983 by the project director Joan S. Byrne, Director of Evaluation, Research and Gifted. They were requested to identify potential candidates for the exploratory program in the field of computer graphics. These students thus identified underwent an assessment procedure

to identify the vocationally talented (Oct. - Dec. 1983,
Jan. - Feb. 1984). The following instruments were used to
develop the assessment procedure:

1. Interest inventories

2. The Cognitive and Conceptual Abilities Test

3. The Vocational Aptitude Battery, and

4. An interview questionnaire

Assessment procedures were conducted by a trained guidance and
counseling staff at the Educational Assessment Center, located
at York High School in the geographical center of the school
district. A pre- and post- assessment of work attitudes to
determine if any changes occurred as a result of the computer
graphics course were also given to the students. At the
conclusion of the exploratory course, evaluation forms were
completed by both the participants and instructors involved in
the project.

CHAPTER 4

FINDINGS

The purpose of this chapter was to present the results of the data collected. The problem of this study was to determine whether a CAI program in drafting could be designed and used to motivate underachieving vocationally talented students. The objective of this research was to determine if the curriculum foundations provided an educationally sound basis for CAI in drafting and to determine if changes in attitude occurred as a result of the CAI exploratory courses.

To aid in the determination of whether a CAI program in drafting could be designed and used to motivate underachieving vocationally talented students, it was necessary to formulate a program design to identify, profile, classify and assess students selected.

The program design was described in Chapter 3. Profile forms were developed by the Educational Assessment Center to use in identifying the target population (see Appendix A for forms). The profiles of twenty-seven students, referred by participating schools, classified students into three types as shown in TABLE 1.

% OF STUDENTS	TYPES
52%	Type 1
30%	Type 2
18%	Type 3

TYPE 1: Demonstrates potential academic ability but academic achievement performance is low and mechanical/practical performance is high.

TYPE 2: Demonstrates potential as a candidate for a career
goal in high tech but lacks direction or commitment.

TYPE 3: Demonstrates both academic and mechanical/electronic/
practical interests and achievement.

The classroom teacher identified the following student
behaviors most frequently in referring students:

1. exhibits mechanical interests

2. exhibits computer interests

3. exhibits communication skills

4. exhibits an inquiring mind (see Appendix A)

Grade level distribution of the selected students is
as follows:

7th GRADE	1
8th GRADE	11
9th GRADE	15

Achievement information on the identified students is
summarized in TABLE 2.

AVERAGE STANDARDIZED ACHIEVEMENT SCORES (SRA) MEAN = 50th percentile		
	STUDENT AVERAGE SCORE	NATIONAL MEAN
COMPOSITE MATH SCIENCE	80th percentile 78th percentile 81st percentile	50th

APTITUDE TEST (DAT) MEAN = 50th percentile		
	STUDENT AVERAGE SCORE	NATIONAL MEAN
Abstract Reasoning	66th percentile	
Mechanical Reasoning	79th percentile	50th
Space Relations	72nd percentile	

VOCATIONAL ASSESSMENT (SAGE)			
	STUDENT AVERAGE SCORE	NORM	STANDARD DEVIATION SAMPLE MEAN
Reasoning	9.65	7.2	2.8
Eye-Hand-Foot Co-ordination	19.05	15.0	8.8
Spatial Relations	8.4	5.0	2.8
Finger Dexterity	17.9	12.1	4.0

GRADE POINT AVERAGE ON A SCALE OF 0 - 4.0 (GPA)		
English	1.7	C
Math	2.2	C
Science	2.2	C

As shown in TABLE 2 the scores on standardized tests of identified students were well above the national mean, while classroom performance, as measured by grades, was low, suggesting underachievement.

Career interests indicated by students were

1. Technology professional

2. Science professional

3. Business professional

Participating students rated courses in terms of how useful they regarded them. The questionnaire (see Appendix B) was completed both prior to and following the exploratory program and are compiled in TABLE 3.

SUBJECT	PRE TEST	POST TEST (Group 1)	POST TEST (Group 2)
English	3.0	2.7	2.9
Math	3.7	3.8	3.6
Science	3.3	3.1	3.0
Foreign Language	1.7	2.2	2.0
Social Studies	2.1	1.9	2.2
Computers	4.0	3.7	4.0

It appears from the data in TABLE 3 that there was no change in how students perceived usefulness of courses due to the treatment (exploratory program).

STUDENT EVALUATION DATA

At the completion of the program the students were asked to assist the researcher by rating items on a student evaluation form (see Appendix B). Responses to the evaluation form and that data extracted from it are as follows:

STUDENT EVALUATION DATA
GROUP # 1   X = 13

Range: 4 (excellent) to 1 (poor)
Average rating on a 4-point scale

1.   Overall rating   3.3
2.   New skills or ideas gained   3.2
3.   Effectiveness of instruction   3.2

4. Activities provided   3.4
5. Knowledge of high tech careers   3.1

6. The program seemed to assist the students in learn-
   ing more about a career in a computer field.

7. Most of the students indicated that their educational
   program included advanced math classes (at least
   through Algebra II) and computer math.

8. Generally no change in the educational program was
   evident since most students already planned to take
   advanced classes.

9. The hands-on experience with the computers and the
   process of drawing graphically using the computer
   seemed to be the most interesting aspects to the
   students.

STUDENT EVALUATION DATA

GROUP # 2   X = 14

Range: 4 (excellent) to 1 (poor)
1. Overall rating   2.9
2. New skills or ideas gained   3.1
3. Effectiveness of instruction   3.0
4. Activities provided   2.8
5. Knowledge of high tech careers   3.0

6. Generally the group felt that the program did not
   help in identifying new careers, although several
   did feel it provided some assistance.

7. Most of the students have advanced courses in their
   programs including courses in computers and electronics.

8. Those students who already have computer courses in
   their programs saw no changes in their educational
   program as a result of the workshop.

9. What they liked best about the program was the use of computers as a design tool and their being able to view the drawings on the computer screen.

AN ANALYSIS OF BOTH GROUPS SHOWED THE FOLLOWING COMPARISONS:

Range: 4 (excellent) to 1 (poor) Student Ratings (Groups I & II) Exploratory Program		
	Group 1	Group 2
Overall rating	3.3	2.9
New skills or ideas gained	3.2	3.1
Effectiveness of instruction	3.2	3.0
Activities provided	3.4	2.8
Knowledge of high tech careers	3.1	3.0

An analysis of the ratings indicated a positive reaction. However, the differences between Group 1 and Group 2 may be due to the project duration, since Group 1 attended the program eight weeks whereas Group 2 attended five weeks.

Students of Group 1 - the group that took a field trip to NASA - indicated a more positive response to the question where they were asked if the program assisted them in identifying potential careers.

With reference to question No. 7 it was evident that both groups had advanced courses in their educational program. Both groups did not see any changes in their educational program as a result of the Technetronics Workshop. It should be mentioned here that students of both groups already included computer courses in their program or had planned to take advanced courses.

The activities involving computer graphics seemed to be most interesting to them. It was apparent they especially enjoyed drawing and viewing their work on the computer screen.

TEACHER EVALUATION DATA

The teachers involved in developing and instructing the technetronics course evaluated the course by completing a teacher evaluation form (see Appendix B). Data from these forms is given below:

RANGE: 4 (excellent) to 1 (poor)	INSTRUCTOR 1	INSTRUCTOR 2
1. Student competence	4	4
2. Student motivation	4	3
3. Group atmosphere	3	3
4. Accomplishment of objectives	3	4
5. Facilities and materials	4 (2)	3
6. Administrative support	3	3

As for the strengths of the program, it afforded a hands-on experience with computers. The conversion of drawings from paper to computer screen was successful and enjoyable. With the limited software it was still possible to create fascinating computer graphics. Observation by the staff indicated that drafting can indeed be taught by CAI.

SUMMARY

In this chapter the method used to identify the student population who participated in this research was discussed. Various findings were presented in tabular form and the evaluative questionnaire results highlighted.

CHAPTER V

SUMMARY, CONCLUSIONS AND RECOMMENDATIONS

The problem of this study was to determine whether a CAI program in drafting could be designed and used to motivate underachieving vocationally talented students. This chapter summarizes the procedures used in this research, draws conclusions about the findings of the study, and makes recommendations based on these research findings.

SUMMARY

In reviewing the literature, it was noted that the most widely accepted value of CAI was that it involved the individual actively in the learning process. It was impossible for the student to be a totally passive member of the situation, and this very activity and involvement facilitated learning. Another much touted value was the ability of the learner to proceed at his own pace, which had strong implications for the gifted/talented person.

One tool used to verify this posture was designed by this researcher - a curriculum, entitled Computer Graphics in Drafting. Methods and procedures were designed to validate the CAI project. After the identification and selection of the target population for this research was determined, pre- and post- assessment questionnaires of work attitudes as well as student and teacher evaluations were completed according to schedule. The information scores from the Career Interest/Aptitude/Educational Assessment Profile and the responses from the questionnaires and evaluations

were gathered and the data was processed. This information has served as the basis for the conclusions and the recommendations of this research.

CONCLUSIONS

The results of this research indicated that the instruments identified vocationally talented students. Evaluation of the students revealed no change in attitude toward their coursework as a result of the exploratory program. Students exhibited positive responses to the computer graphics program. Group I showed a more positive response than Group 2. It must be mentioned that Group I was involved in an eight-week program culminating with a trip to NASA, while Group 2 participated in a five-week program without the benefit of a field trip. At the conclusion of the exploratory program, students showed an awareness and increased knowledge of career opportunities. The computer graphics program could be used to teach elements of drafting. The motivating factor could not be assessed although the attitudes and responses were positive because of the short term program. It was not documented in the analyses. Further research needs to be done to answer the problem.

RECOMMENDATIONS

Based on the results, observations, and conclusions in this research, the following recommendations were submitted:

1. The program should be lengthened and intensified to draw more comprehensive conclusions.

2. A variety of software would enhance the program.

3. On-site visits to see computers at work would add

fascination, interest, and motivation.

4. Elements of computer graphics should be infused into the regular program.

5. Long term follow up studies are needed in order to find out if there was any impact or continued interest.

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APPENDIX A

Identification Forms

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YORK COUNTY PUBLIC SCHOOLS

CAREER INTEREST/APTITUDE/EDUCATIONAL ASSESSMENT PROFILE

NAME:_____ SCHOOL:_____

ADDRESS:_____ GRADE:_____

STUDENT NO.:_____ DATE OF BIRTH: _____ DATE OF EVALUATION:_____

MEDICAL CONDITIONS: (If any) _____

MEDICATIONS: (if any) _____

Recently you completed the SAGE VOCATIONAL APTITUDE BATTERY. The SAGE identified your degree of aptitude development as defined and used by the United States Department of Labor. The Department has determined 11 aptitude requirements and 12 interest factors for most job areas.

SAGE APTITUDE PROFILE

	Low 1	2	Average 3	4	High 5
GENERAL					
VERBAL					
NUMERICAL					
SPATIAL					
FORM PERCEPTION					
CLERICAL PERCEPTION					
MOTOR COORDINATION					
FINGER DEXTERITY					
MANUAL DEXTERITY					
EYE-HAND-FOOT COORDINATION					
COLOR DISCRIMINATION					

	1	2	3	4	5	6
REASONING						
MATH						
LANGUAGE						

It is useful at frequent intervals to examine career interests in terms of your academic strengths. Your latest standardized achievement scores and grades are shown below:

ACHIEVEMENT PROFILE

SCHOOL PERFORMANCE			STANDARDIZED TEST INFORMATION Date:_____											
Grades		Academic Areas	Performance Profile Based on National Percentile**											
7th	8th		5	10	20	30	40	50	60	70	80	90	95	99
7th	8th	Composite*												
		English												
		Mathematics												
		Language Arts												
		Social Studies												
		Science												

* The composite score on this test is a combination of the Reading, Math, and Language Arts scores.

** Scores on standardized tests are normally reported in national percentiles. These scores show how you compare to other students tested throughout the country. For example, if you score at the 65th percentile in Reading, it means that you scored the same or better than 65% of those who took the test.

In combining your tested interests, stated interests, the results of the SAGE Vocational Aptitude Battery, and your Achievement Profile, some suggestions for job exploration, subject planning, and level of schooling have been made. These suggestions may assist you in planning your future career. All jobs assume a high school diploma. Job training is included as part of employment. Additional training needs are indicated below but these are dependent on individual motivation, career goals, and commitment to additional education. Your top three interest areas were as follows:

I.

Interest Area
_____

Examples of Jobs		Subject Related Areas		Additional Training				
				Job Training	Voc. Training	Tech. School	Military	College
A. _____		A. _____		A. ___	___	___	___	___
B. _____		B. _____		B. ___	___	___	___	___
C. _____		C. _____		C. ___	___	___	___	___

CAREER INTEREST/APTITUDE/EDUCATIONAL ASSESSMENT PROFILE

II.

| Interest Area |
| _____ |

Examples of Jobs	Subject Related Areas	Additional Training
		Job Training / Voc. Training / Tech. School / Military / College
A. _____	A. _____	A. ___ ___ ___ ___ ___
B. _____	B. _____	B. ___ ___ ___ ___ ___
C. _____	C. _____	C. ___ ___ ___ ___ ___

III.

| Interest Area |
| _____ |

Examples of Jobs	Subject Related Areas	Additional Training
		Job Training / Voc. Training / Tech. School / Military / College
A. _____	A. _____	A. ___ ___ ___ ___ ___
B. _____	B. _____	B. ___ ___ ___ ___ ___
C. _____	C. _____	C. ___ ___ ___ ___ ___

A solid foundation in English and Math are necessary for most occupations. Your Profile indicates additional effort is needed in the following academic areas to support your career interests.

_____   _____   _____

_____   _____   _____

The information here is only a reflection of your current career interests and you must remember that career interests and plans change as you grow. Hopefully, this profile, and future profiles, will help you explore and become aware of the many career alternatives available to you.

Profile developed by:

_____   _____
Signature   Date

TECHNETRONICS PROJECT

New occupations for the year 2000 and beyond will require preparation in high tech fields. In order to prepare students for jobs in the high tech workplace, educational and career guidance are important.

The York County School Division has a small grant to develop two exploratory high tech courses and identify students to participate. in an after-school program which explores technical career fields through simulated experiences.

Your assistance in identifying potential candidates for the exploratory program in high tech fields such as computer applications (i.e. robotics, computer assisted design) is needed.

NAME: _____

ADDRESS: _____

SCHOOL: _____ GRADE: _____

Please read the statements below and rate student performance based on your observations or information, using the following scale:

Seldom or Never	Occasionally	Frequently	Extensively
1	2	3	4

_____ 1. Demonstrates perceptual-motor skill

_____ 2. Exhibits mechanical interests, i.e. automobiles

_____ 3. Exhibits interest in computers

_____ 4. Demonstrates reasoning or problem-solving skills

_____ 5. Demonstrates communications skills

_____ 6. Demonstrates interest in academic areas

_____ 7. Demonstrates interest in "hands-on" or practical projects

_____ 8. Completes regular assignments quickly and needs additional work to meet his/her needs

_____ 9. Asks questions involving why, how, where - i.e. where will I use it? What use will it be to me? Why does it work that way?

_____ 10. Appears to have interest in futuristics or related fields, such as space exploration

_____
Total

TECHNETRONICS PROJECT

The students the project intends to serve might typically be described in the three types below. There is a special interest in Types 1 and 2 who may not currently be stimulated by education's academic orientation.

Check One

_____   TYPE 1   Demonstrates potential academic ability but academic achievement performance is low and mechancial/practical performance is high.

_____   TYPE 2   Demonstrates potential as a candidate for a career goal in high tech but lacks direction or commitment.

_____   TYPE 3   Demonstrates both academic and mechanical/electronic/practical interests and achievement.

ACADEMIC PROFILE

Psychometric Information:		School Achievement:	
DAT	SRA	Grades:	
Verbal Reas. ____	EAS ____	English ____	
Numer. Reas. ____	Read. ____	Math ____	
Abstract Reas. ____	Math ____	Science ____	
Mech. Reas. ____	Comp. ____	Soc. Studies ____	
Space Relations ____	Language ____	Health/P.E. ____	
	Science ____		

SAGE:		Teacher Ratings:	
Reasoning ____		Type 1 [ ]	
Eye-Hand-Foot ____		Type 2 [ ]	
Spatial Relations ____		Type 3 [ ]	
Finger Dexterity ____		Score: _____	

CAREER INTERESTS:

_____

_____

_____

APPENDIX B

Questionnaire and Student/Teacher

Evaluation Forms

TECHNETRONICS PROJECT

QUESTIONNAIRE

NAME:_____   DATE:_____

SCHOOL:_____   GRADE:_____

1. Please rate from the following those courses that you are
    taking in terms of how useful you think each is for your
    future career interests:

		Very Useful			Not Useful
a.	English	4	3	2	1
b.	Math	4	3	2	1
c.	Science	4	3	2	1
d.	Foreign Language	4	3	2	1
e.	Social Studies	4	3	2	1
f.	Electives (please list)				
	_____	4	3	2	1
	_____	4	3	2	1
	_____	4	3	2	1

2. List as many high tech career fields that you can think of.
    _____
    _____
    _____
    _____
    _____

3. If you are interested in pursuing a career in any of the above
    fields, please circle.

4. If you are interested in a high tech career, what courses
    related to high tech are in your four-year program of studies?

TECHNETRONICS PROJECT

STUDENT EVALUATION FORM - 1984

During the last of the 1984 school year you were involved in an exploratory course in Computer Graphics. Please assist us in evaluating the program by rating the following items:

		4 (excellent)		to	1 (poor)
1.	Overall rating	4	3	2	1
2.	New skills or ideas gained	4	3	2	1
3.	Effectiveness of instruction	4	3	2	1
4.	Activities provided	4	3	2	1
5.	Knowledge of high tech careers	4	3	2	1

6. Did this program assist you in identifying potential careers? If so, how?

7. Which science, math, technological courses does your educational program include?

8. Do you foresee any changes in your educational program as a result of the Technetronics Workshop?

9. What did you like best about the program?

10. Was the interaction with students from other schools valuable to you? (circle one)

4 (very valuable) to 1 (not valuable)

4   3   2   1

11. Comments or suggestions:

TECHNETRONICS PROJECT

TEACHER EVALUATION FORM - 1984

You have been involved in developing and instructing a technetronics course. Please assist us in evaluating the course by completing the following.

		1 (poor)	to	5 (excellent)	
1.	Student competence	4	3	2	1
2.	Student motivation	4	3	2	1
3.	Group atmosphere	4	3	2	1
4.	Accomplishment of Objectives	4	3	2	1
5.	Facilities and materials	4	3	2	1
6.	Administrative support	4	3	2	1

7. Strengths of the program:

8. Changes that would improve the program:

9. Comments or suggestions: