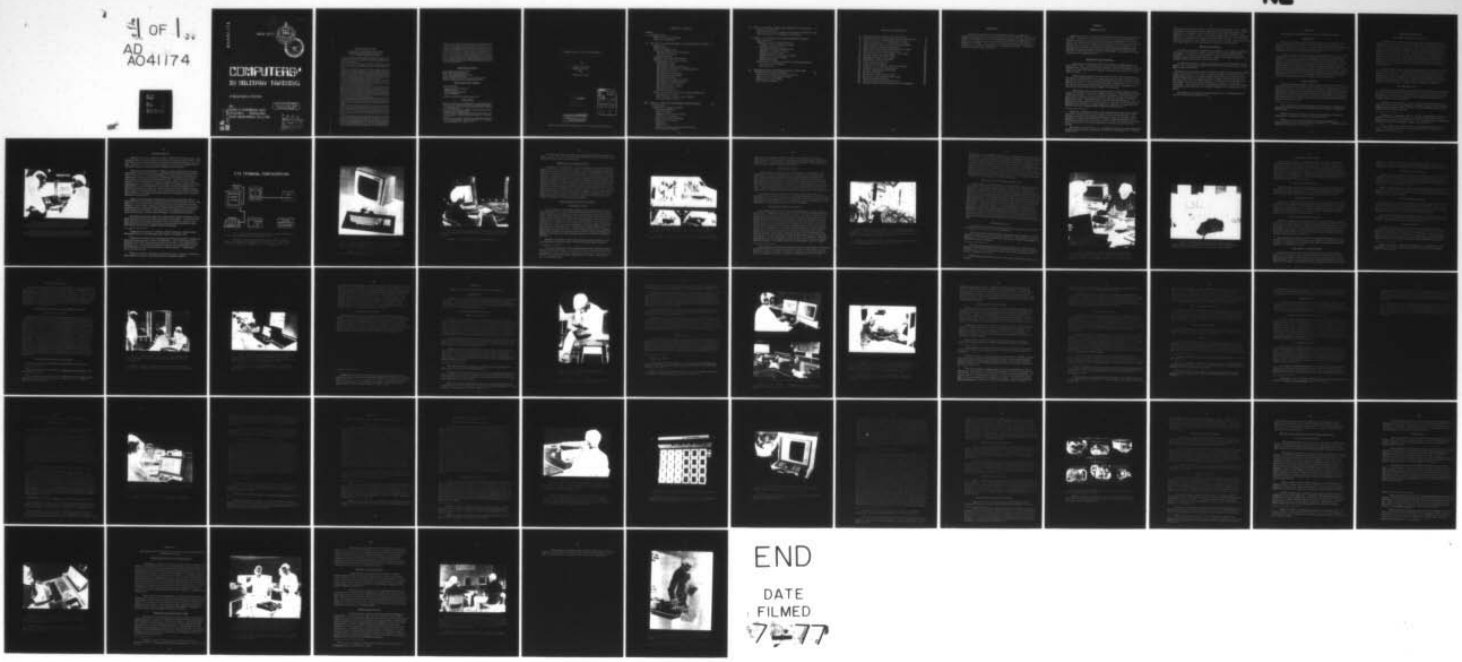
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COMPUTERS IN MILITARY TRAINING

A RESEARCH PAPER

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ABSTRACT OF DISSERTATION

An Examination of the Manpower and Personnel Implications Emerging from the Instructional Use of Computers by the Military Services

The military services have been developing ways of using the computer to assist in the training of their personnel since 1954. By the mid-1960s the feasibility of computer-supported instruction was accepted; yet considerable testing is still needed to establish its cost-effectiveness.

The increased use of computer-based instruction will have a significant effect on the human side of the Army—its manpower and personnel systems. Certainly, user attitudes toward computer systems will have a telling effect on the implementing of these systems.

The impact of computer-based instruction on military manpower and personnel management was examined, focusing on the cross-functional dimensions of information technology and personnel management. The primary data were collected by (1) gathering statistical data at 36 military training and education installations that use computers for instructional purposes, (2) conducting personal interviews with 92 selected staff officials using a structured interview guide, and (3) administering a questionnaire to 409 instructor personnel at 21 military installations.

The data from the statistical survey presented the most accurate assessment that has been made of the progress of the military services toward greater instructional computer use. Measurements of the extent of computer use revealed that the Army leads the other services in four of the five areas measured.

Data from the staff interviews and the instructor questionnaire were used in a complementary manner to produce the other findings. The responses to these two surveys indicated that some form of computer-based training is expected to be prevalent in the 1980s. The driving forces that might cause a significant shift toward increased use of computers are cost-effectiveness, better job performance, and even higher student achievement. In contrast, it was found that the barriers to computer-based instruction are thought to be the high conversion costs, the lack of a clear decision to implement such systems now, and a resistant organizational climate.

It was determined from the research that military students are favorably disposed toward computer-based training. It was found that instructional computer use reduces training time by about 33 per cent by virtue of its self-paced nature and the constriction of lesson material as conventional lesson plans are reoriented and converted to the computer.

Military instructors' attitudes toward computer-based instruction were found to be positive. The instructor for computer-supported courses will take on a new role and will teach in a different manner in the future. As the computer performs the more routine instructional tasks, the instructor is free to work with students as tutor, counselor, and motivator on a one-to-one basis. With the application of machines—computers—the instructional process is less labor intensive, and fewer instructors are needed.

On the basis of the research, it was determined that the introduction of computers into instructional programs necessitates changes in the organizational structure of the training systems. Faculty members will require less control because they will be responding to individual students' demands. This new breed of instructor will require special personnel management practices to insure optimum use of costly and scarce resources. For proper management of these instructors, they should be identified by a unique skill identifier. Further, it was established by the research data that present in-

structor performance standards and staffing criteria will no longer be applicable when the military services change to greater use of computer-based instructional systems.

The research data supports the conclusion that there is a trend toward more centralization of training management at all levels from the Army's training command to the Department of Defense. The centralization of activities within the Army framework is dominated by the zeal with which the Army's Training and Doctrine Command is moving to change Army training by the infusion of modern instructional technology. Concurrently, action is underway to transfer the instructional expertise of the Army schools to benefit the training of individuals at the post level. The Department of Defense has become actively involved in the military services' training programs, which has brought about the consolidation of many training activities. This increased cooperation between the military services has resulted in a saving of millions of dollars in the past few years.

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The Future Use of Computers in Government Training, Paper presented at the Second Instructional Technology Conference for Government Trainers, Washington, D.C., October 7, 1975.

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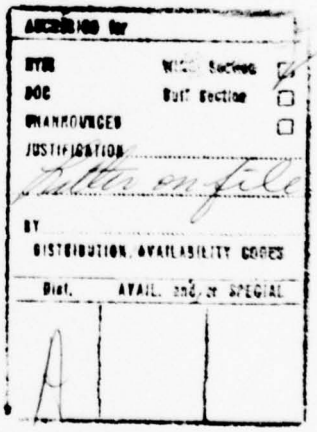
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FOREWARD

The writer of this paper was a Research Fellow at the Industrial College of the Armed Forces during the Academic Year 1973-74. The primary research undertaken focused on the manpower and personnel implications that emerge in the military services upon changing to computer based training systems in the 1980s. The scope of the research was sufficiently broad so as to produce several papers appropriate for separate publication. This paper is the first segment to be published.

Chapter I

INTRODUCTION

Computers have been in use by the military services for over a quarter of a century. Since 1954, the military services have been developing ways of using the computer to assist in the training of their personnel. By the mid-sixties, the feasibility of computer assisted instruction had been accepted, yet, considerable testing was still needed to establish cost-effectiveness. The military services began to publish reports describing their applications and covered such areas as costs, benefits, student achievements and attitudes. But what is the current status of computer use today? Are computers a significant part of the training process?

DoD Education and Training

Last year the Department of Defense trained 1.8 million people at a cost of $6.6 billion. At any given time, 20 percent of the department's total manpower are undergoing some kind of training. While not as large as in recent years, these are still impressive figures, providing some notion of the magnitude of the task.

Instructional programs can teach a student how to do exactly what his job requires--avoiding both over-training and under-training. Such programs call for the creative use of modern audiovisual devices and self-paced, individualized instruction.[1] This use of instructional technology will free the instructor from his role as an animated public address system and will place him in the position of a problem-solving manager of instruction.

The military services are implementing new training strategies which include individualized instruction, modular scheduling, and programmed audiovisual presentations. They are integrating all aspects of computer managed instruction, computer assisted instruction, and other methods of computer based and off-line, individually tailored and administered instruction. Dr. M. Richard Rose has stated that "as far as DoD is concerned, we are beyond the question of the feasibility of using computers in training. Our goal now is to find the best ways of implementing computerized instruction."[2]

---

[1]The term, self-paced, refers to that instructional strategy which allows the student to proceed through the learning situation at his own rate. It is normally contrasted with lock-step instruction in which the students proceed together at some predetermined rate or within a prescribed period of time. Individualized instruction is viewed as an array of patterns of instruction which meets, within limits, the goals, aspirations, abilities, and needs of each student.

[2]Personal interview with Dr. M. Richard Rose, Deputy Assistant Secretary of Defense for Education, Department of Defense, Washington, D.C., 30 November 1973.

This assessment that the military services are now in the "how to do it" phase of computer based instruction is a culmination of a tremendous amount of work and millions of dollars of effort contributed by the civilian, industrial, and military sectors of this nation. As far back as 1960, the University of Illinois began the development of its computer based teaching system. The Air Force was using computers in its training long before then. In 1975, all of the services are using computers in the training and education of their personnel.

Research Methodology

As might be expected of a field that is scarely out of its infancy, published materials on instructional computer use are few in number and not readily accessable. Literature surveys conducted early in the development of the research project seemed to indicate that it would be necessary to draw on all available materials and make visits to the field.

A synthesis of military studies and reports provided the framework for the paper. But, personal and telephonic interviews were essential to gain current and complete information.

Field visits were made to twenty military installations throughout the United States--nine Army, two Air Force, one Marine Corps, four Navy, and four Department of Defense. Through computer and education and training conferences in Washington, D.C. and New York, personal contacts were made with personnel from four additional installations. Hearing of the research project, they asked to have their activity included in the research by on-the-spot-interviews. This extension of the design allowed all twenty-four of the military installations which have an active computer program to be represented in this paper.

The following five chapters contain narrative-type descriptions of each service's instructional computer use.

Chapter II

THE ARMY'S APPLICATIONS OF COMPUTERIZED TRAINING

Introduction

The Army has been involved in the development of a computer-based instructional capability since the mid-1960s. But, when the Secretary of Defense promulgated a letter to the service secretaries concerning innovations in defense training and education, a new interest was generated to move computer technology into enlisted skill training.[1]

The U.S. Continental Army Command (CONARC is now the U.S. Army Training and Doctrine Command--TRADOC) and the Office of the Chief of Research and Development produced separate technical development plans which were then staffed to the Offices of the Secretary of Defense. By early 1967, a single plan emerged which called for (1) the research and development (R&D) of a prototype computer assisted instruction (CAI) system and (2) the conduct of a feasibility study using an existing computer system. The Human Resources Research Organization (HUMRRO) in Alexandria, Virginia, was selected to perform the R&D of the prototype system which was named Project IMPACT.[2] The U.S. Army Signal Center and School was tasked to conduct a feasibility study of computer assisted instruction.

Project IMPACT

The goal of Project IMPACT was to provide an effective, efficient, and economical computer administered instruction system for the Army in a total system framework.[3] Over a period of several years, HUMRRO developed some hardware systems centered around an IBM 360 computer and the Sanders 720 terminal, modified an authoring language, and developed an evaluation procedure for instructional systems. The major contribution by HUMRRO to the Army has been an understanding of the human factors and training implications associated with CAI.

---

[1] U.S. Department of Defense, Office of the Secretary, "Innovation in Defense Training Education," a memorandum for the service secretaries, 29 June 1965.

[2] Interview with Dr. Robert J. Seidel, Human Resources Research Organization, Alexandria, Virginia, 14 September 1973.

[3] Robert J. Seidel, Current Status of Computer-Administered Instruction Work Under Project IMPACT (Alexandria, Va.: Human Resources Research Organization, July 1972), p. 1.

CAI at the Signal School

The IBM 1500 Instructional System

The Army's first CAI project was conceived at CONARC in 1966 and conducted in mid-1967. The Army arranged to use the IBM 1500 system installed at the U.S. Naval Academy to carry out the feasibility study for the Army's Signal School at Fort Monmouth, N.J. This led to favorable test results and an IBM 1500 was installed in 1968 at the Signal School for the practical development and immediate application of CAI lesson material in basic electronics. From mid-1968 and through late 1971, the equivalent of four weeks of instruction in basic electronics training was developed and presented via CAI to over 1,300 soldiers like the one seen in figure 1. The results of the tests showed a reduction in training time, equal or better achievement, and a favorable student attitude toward the use of computers in instruction.[1]

Throughout the past six years, the Signal School has developed considerable staff expertise in CAI. The IBM 1500 system has served its purpose and has been phased out. The development of instructional strategies and techniques for teaching resulted in the creation of a versatile and flexible instructional model. Additionally, the Signal School developed a system for analyzing student performance data to help in pointing up poorly prepared lesson material and identify students who need academic counseling.

The CAI Task Group

The success of these early studies in CAI led the Department of the Army to direct the establishment of a CAI task group to study the cost effectiveness and academic justification for the application of computer based training for technical-type training at installations where technical training constitutes a major portion of the curriculum.

The task group completed its study in April 1972 and concluded that the Army should take action to develop and test a large-scale prototype computer-supported instructional system.[2] Within a matter of months this led to the establishment of Project ABACUS.

---

[1] Alexander A. Longo and Frank E. Giunti, "A Sequential Evaluation of Computer Assisted Instruction in U.S. Army Basic Electronics Training," paper presented at the annual convention of The Association for the Development of Instructional Systems, Quebec, Canada, 8-10 August 1972.

[2] U.S., Department of the Army, U.S. Continental Army Command. "Task Group Report on Computer Assisted Instruction," Fort Monroe, Virginia, April 1974, p. xxv.



Fig. 1. An Army student learning basic electronics on an IBM 1510 Display Console and an IBM 1512 Image Projector (components of the IBM 1500 Instructional System) during a 1967 feasibility study

SOURCE: Stanley Winkler, A Feasibility Study of Computer Assisted Instruction in U.S. Army Basic Electronics Training (Gaithersburg, Maryland: International Business Machines Corporation, February 1968), p. 2-3.

Project ABACUS

Briefly stated, the purpose of Project ABACUS is to develop, test, and evaluate a large-scale prototype Computerized Training System (CTS), which combines the advantage of computer assisted and computer managed instruction. The project covers a four-year time span from 1972 to 1976 under the direction of product manager at Fort Monmouth, New Jersey.[1]

The project has five phases. Phase I is that of system design which involved the establishment of the requirements and preparation of specifications for the system. System development is Phase II and is basically the contractor's phase of providing the hardware and software for the system. The contract was awarded to GTE Sylvania, Inc., in late 1973 for a 128 terminal, multi-minicomputer system. Figure 2 shows the CTS terminal configuration. The computer system consists of six Digital Equipment Corporation PDP-11/35 minicomputers with a GTE Sylvania Challenger 4000 terminal modified (see figure 3) so as to meet the on-line graphic requirement of the system specification. The contractor's role in software development includes a CAI language (CLASS I) and the maintenance of the software through the project cycle.

Concurrent with system development, the Project ABACUS staff is developing course material or courseware [2] for the CTS prototype system (see figure 4). For the past year, while awaiting their own authoring language, members of the Project ABACUS staff have been participating in a project of Advanced Research Projects Agency (ARPA) utilizing the PLATO IV System of the University of Illinois. Their objective is to experiment in areas of course development, instructional strategies, and authoring techniques.

The operational phase (Phase IV) begins upon receipt of sufficient hardware and software to permit final courseware development. Full-scale operations are scheduled to begin by August 1975 at Fort Gordon, Georgia, with three electronics courses[3] at the Army's Southeastern Signal School where CTS will be operating in a regular school environment.

---

[1] Interview with Col G. B. Howard, Project Manager, Computerized Training Systems, Fort Monmouth, New Jersey, 21 August 1973.

[2] Courseware refers to all of the material which the student is presented via the terminal through a course of instruction. The actual instructional material may be that which is used on-line or off-line. U.S., Department of the Army, U.S. Army Computer Systems Support and Evaluation Command. "Concept Plan for a Multi-Minicomputer Training System." Washington, D.C., 16 March 1973.

[3] The three courses included: Field Radio Repair, Avionics Communications Equipment Repair, and Teletypewriter Equipment Repair.

CTS TERMINAL CONFIGURATION

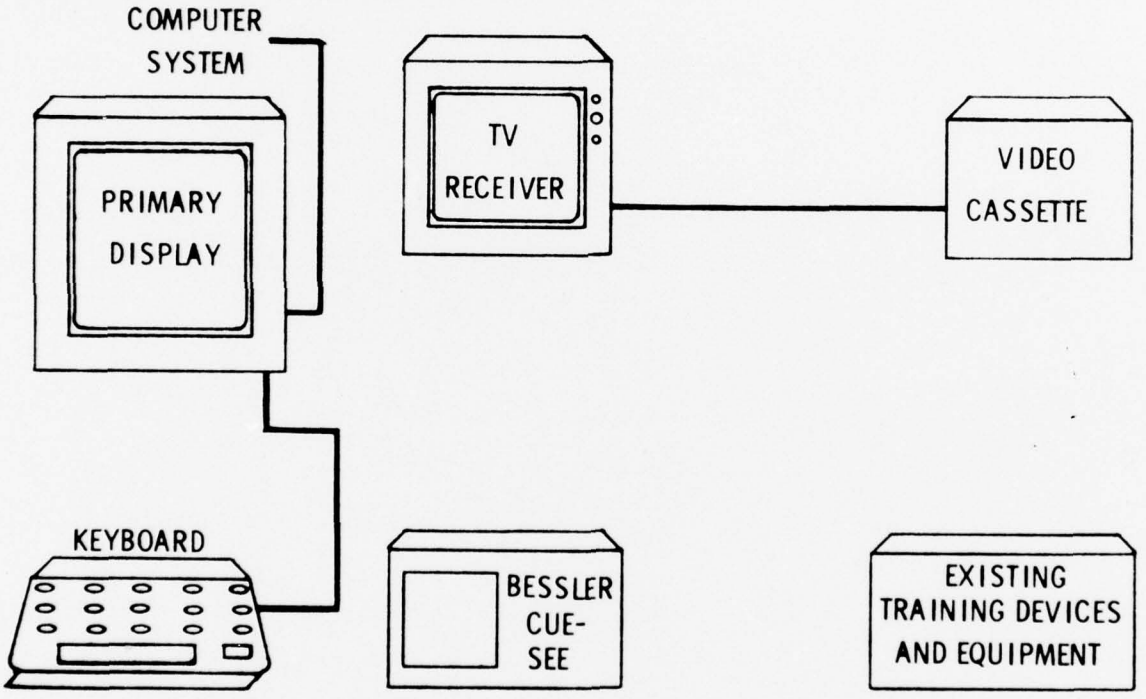


Fig. 2. A schematic of the multi-media terminal configuration of the Army Computerized Training System (CTS)

SOURCE: Personal letter from Frank E. Giunti, Technical Director, Computerized Training System Project, U. S. Army Signal Center and School, Fort Monmouth, N. J., 21 January 1975.



Fig. 3. The GTE Sylvania visual display unit and keyboard designed for student interface with the Army Computerized Training System. It features a 1500 character capacity screen, solid-state video refresh memory, and video inversion for highlighting.

SOURCE: Personal letter from Robert G. Foster, CTS Field Office, Fort Gordon, Georgia, 13 March 1975.



Fig. 4. An Army instructor uses a PLATO IV terminal to assist in the development of course material for the Computerized Training System

SOURCE: U.S. Army Photo Lab, Fort Monmouth, N.J.

The fifth and final phase will be an evaluation which will culminate the project in late 1976. The evaluation plan centers on three areas--cost, training effectiveness, and system efficiency.

TRADOC Educational Data System

In addition to the classroom use, the computer has been tested over the past several years at four branch schools[1] to manage academic records and support the non-resident instructional programs. The TRADOC Educational Data System (TREDS) supports the management of resident students at branch schools by maintaining course and class records; statistical files; individual records; examination grading; examination, courses, and class analysis; and generating reports to satisfy both school and training command requirements. Another subsystem of TREDS supports the non-resident students in the Army extension course program by controlling course material, maintaining individual course records, grading lessons and course examination, and providing statistical reports to management. The Secretary of the Army has recognized the prototype tests to be successful and has approved the operational use and expansion of TREDS to all branch schools. At the present time the system has been expanded to another school and a plan for the proliferation of the system to all branch schools has been developed.

The Computer at the Service School

The Infantry School

The commander's helicopter mobility of the Vietnam era gave rise to the development of a system which trained staff officers as a team to deal with the sophisticated weaponry and increased mobility of the modern battlefield. What began as a helicopter mock-up to meet this training need is now an operating Combined Arms Tactical Training Simulator (CATTS) driven by a Xerox Sigma 9 computer. While this system continues to be used in the classroom, as shown in figure 5, a follow-on version is being developed to stimulate the major functions and operations of ground combat such as fire and maneuver, supporting fire, reconnaissance, supply maintenance, replacement, and communications. As the students act and react to changing battle field conditions, the current tactical situation will be graphically displayed to instructors for real-time assessment of the effects of command decisions.

In 1968, the Infantry School began developing CAI programs for use on a Honeywell Model 200 computer with fifty Bunker-Ramo Model 312

---

[1] The four schools are: The Transportation School, the Quartermaster School, the Engineer School, and the Armor School. Interview with Robert P. Schloesser, System Resource Management and Policy Group, Management Information Systems Directorate, Department of the Army, Washington, D.C., 17 January 1974.

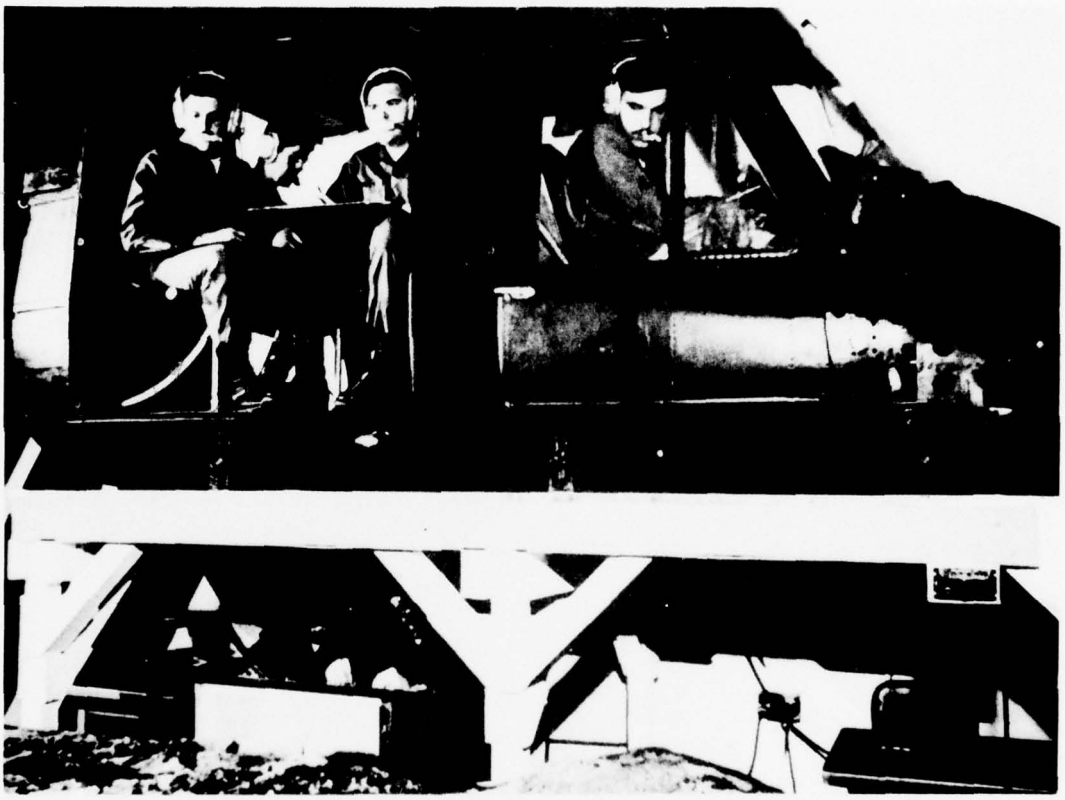


Fig. 5. Infantry Officer Advance Course students conduct practical exercises on a combined arms tactical training simulator

SOURCE: "Combined Arms Tactical Training Simulator (CATTS)" (Fort Benning, Georgia: U.S. Army Infantry School, 1 August 1972), p. 1.

cathoderay tube display terminals. Lessons were written to instruct in fire direction center procedures, data processing fundamentals, and management problems. Seven different courses now use CAI in a drill and practice mode to carry out the program of instruction.

The Aviation School

Another type of simulation that is growing in use is the Army's new Synthetic Flight Training System (SFTS) – a ground based training device which adds a realism to instrument training never before even remotely approached in any flight trainer. This system has proven that students can learn instrument flying faster, more effectively, and at a saving of seventy-five dollars an instructional hour compared to actual helicopter flying time. This Singer Corporation system, driven by three minicomputers (Honeywell's DDP - 516s) is now operational at the Aviation School (see figure 6) and is scheduled to be installed at six stateside and overseas posts in the near future.

Air Traffic control procedures are taught at the Aviation School in a simulation mode using cathode ray tube terminals operating from a Honeywell 801 computer. The system features a radar-type screen which displays many different types of aircraft in flight which provides realistic training for ground controllers, tower operators, and air traffic controllers.

The Logistics Management Center

For thirteen years, the Army Logistics Management Center (ALMC) at Fort Lee, Virginia has been making extensive use of simulation and gaming for teaching both officers and enlisted personnel. The first simulation to be developed was a forty-hour computer-assisted basic supply management simulation for enlisted personnel. Since that era, various simulations have been implemented which give students an opportunity to make decisions and learn the consequences of their actions in a compressed time period. The instructional system has gradually become a multimedia approach to learning with the use of programmed text, television, tutorial CAI, and computer-managed instruction. Today their system of simulation is build around a concept of ten simulation rooms where classes of students can be divided and interactively play the same problem on a UNIVAC Spectra 70 using UNIVAC 70/752 cathode-ray tube terminals or Port-A-Punch[1] for data input. Computer simulations are used in all fifteen ALMC courses to train over four thousand students annually. The subject matter of the simulations varies to include

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[1]Port-A-Punch is a device for punching cards by hand which was developed developed by IBM. It does not need electricity and is small enough to carry. Charles J. Sipple and Charles P. Sipple, Computer Dictionary and Handbook, 2d ed. (Indianapolis, Indiana: Howard W. Sams and Co., 1972) p. 326.



Fig. 6. The instructor operator control console (foreground) is capable of monitoring all four training modules simultaneously through flight progress displays. The module cockpit (background) is an exact replica of a HU-1H (Huey) helicopter cockpit.

SOURCE: Frederick H. Stubbs, "Synthetic Flight Training System," U.S. Army Aviation Digest, September 1972, pp. 7-11.

such areas as: commodity management at a national inventory control point, management of a complex developmental project utilizing program evaluation and review technique (PERT), repair parts, and property disposal. Figure 7 shows a typical simulation room with one student using the terminal and other preparing card input with a portable hand punch. Additionally, this computer system is programmed for overall control of simulation scheduling, student administration, and testing. On a recurring basis students are brought in from the Ordnance School, Aberdeen Proving Ground, Maryland; the Transportation School, Fort Eustis, Virginia; the Women's Army Corps School and the Chemical School, both located at Fort McClellan, Alabama, to learn logistics management through simulation.

The Army Security Agency Training School

The grinding and often monotonous task of learning Morse Code has been made more efficient and effective by a Morse Code Trainer (MCT-4) developed by Sylvania Electronic Products for the U.S. Army Security Agency Training School at Fort Devens, Massachusetts. Under development and testing for eight years, the first trainer was installed in early 1970. Each trainer can accommodate sixty-four students and the school now has four systems in operation. The computer (Honeywell DDP-516) presents visual and audio stimuli in the form of lights or code characters at a rate determined by the automatic analysis of each student's past performance, error patterns, and response times (see figure 8). The system provides individualized instruction, immediate feedback, real-time evaluation, automatic scoring and advancement, and accurate diagnosis of individual learning problems. Although the MCT-4 can teach typing and Morse Code, a successful student must be motivated, making the instructor's active participation in his learning process essential. This computerized learning system has cut down on student attrition, reduced requirements for instructors, and lowered training costs.

The Ordnance School

The Ordnance School began teaching its first course using CAI in April 1974 and now has two other courses operational.[1]

This is an ARPA sponsored test to examine the practicability of cross-service development of CAI courseware materials.[2] The students are actually operating on a CDC 6400 computer at the University of Illinois via Magnavox's PLATO IV plasma terminals.

---

[1] The courses are Basic Machinist, Test Construction, and Instructor Training. Interview with Frank Dare, CAI Project Officer, Office of Training and Education, U.S. Army Ordnance Center and School, Aberdeen Proving Ground, Maryland 11-12 1974.

[2] ARPA (Advanced Projects Research Agency) is a Department of Defense activity.

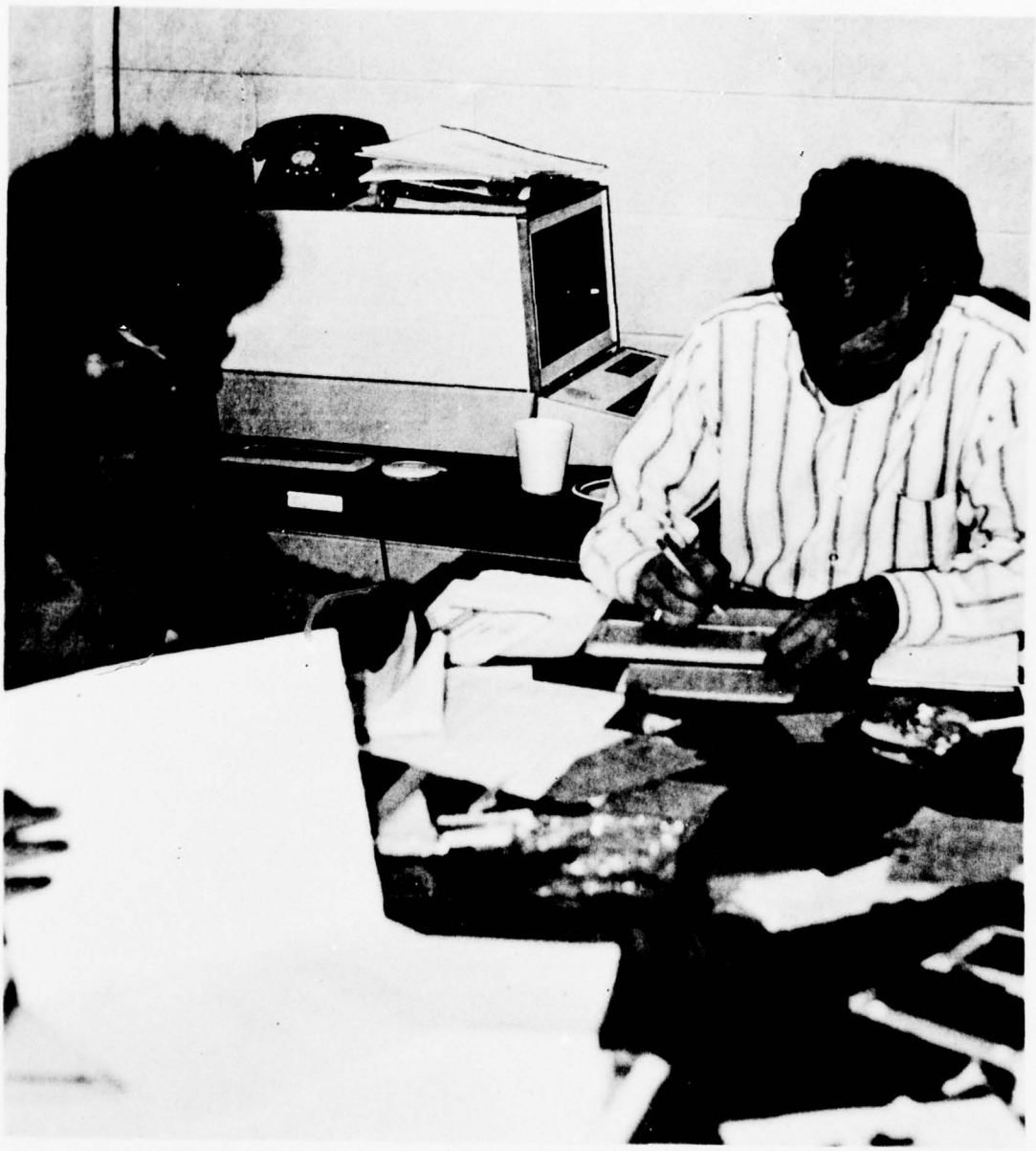


Fig. 7. Department of the Army civilians learn supply management by simulation at the Army Logistics Management Center at Fort Lee, Virginia. The student is "punching" data using a Port-A-Punch and can access the computer using the CRT terminal in the rear.

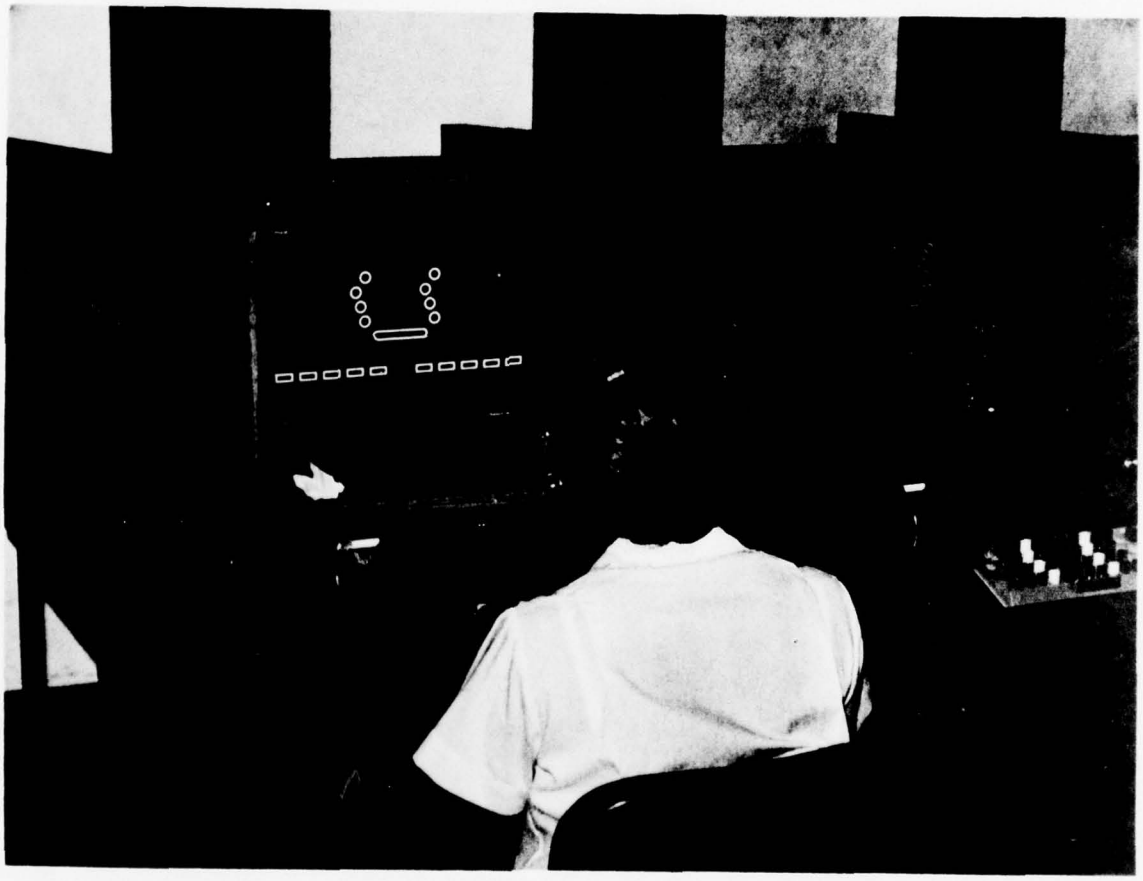


Fig. 8. An Army WAC learns Morse code by computer assisted instruction on the Morse Code Trainer, Mark IV at the Army Security Agency Training School at Fort Devens, Massachusetts

The Quartermaster School

The computer assisted simulation has been a part of the curriculum at the Quartermaster School at Fort Lee, Virginia, since 1963. Currently seven simulations are available to support a wide variety of school courses. Additionally, eight new exercises are scheduled for development between 1974 and 1977. This pervasive array of self-paced simulations is supported by seventeen IBM 1050 CRT terminals and a UNIVAC 740 line printer terminal on-line to a UNIVAC 70/45. Additionally, orientation and operator courses are given on the NCR 500 which is the computer system used in the direct-support level supply units in the Army.

The Transportation School

All of the officer advance course students participate in a transportation simulation exercise at the Transportation School at Fort Eustis, Virginia. Operating on a CDC 6400 computer as part of the CYBERNET, the students interact through CRT terminals in a simulation that runs for a week.

The Engineer School

The Army's Engineer School at Fort Belvoir, Virginia has had a modest involvement with computer assisted training for several years now. Using a time sharing system, the students have been using the computer in a variety of engineering-related problems. More recently a Hewlett-Packard 2000E with sixteen terminals has been purchased to allow an expanded use of the computer in instruction of engineer officers.

The Missile and Munitions School

Missile maintenance, ammunition logistics, and missile direct support are the subjects of three simulations used by the Missile and Munitions School at Redstone Arsenal, Alabama. These computer assisted simulations provide the capstone exercises in seven different courses. Students generate their card input using the Port-A-Punch and stylus. Current computer support is on the post's IBM 360/65 in a time-share mode using the TREDS Terminal (a DATA Model 70-2) as the interface.

The school has developed a dozen or more tutorial programs to use on the pair of PLATO IV terminals provided by ARPA for test purposes. Due to a lack of terminals these lessons are only used experimentally with small groups of students and the faculty.

The Institute of Administration

The Army's Finance and Adjutant General Schools are now combined under the organization referred to as the Institute of Administration which also provides computer support for both schools. General purpose operator and application training is accomplished with an IBM 360/30 system and IBM 2260 CRT terminals. The Institute conducts training for punch card machine

operators, programmers, and systems analysts. Additionally, all basic and advance course students learn computer fundamentals and data processing management by case studies and practical experience using the computer.

The Military Police School

In 1972 the Military Police School gained a computer assisted instruction capability when they acquired a remote teletype computer terminal. The computer support is provided by a leased time-sharing Honeywell 225 computer in Atlanta. Within a year, five different courses were programmed to use CAI as part of the instructional media. [1]

Interest in CAI waned at the school in late 1974 and, for budgetary reasons, the leasing arrangement was canceled. Such actions provide evidence that CAI must have the support of school instructors and the commander's financial backing or the program will die.

The Field Artillery School

The major use of computers in support of training at the Artillery School is the Field Artillery Digital Analytical Computer (FADAC). This is an operational system used to solve gunnery problems in the field and the classroom. Thus, the practical work with FADAC in the classroom allows more efficient and effective training in the many aspects of gunnery training.

The school is exploring other potential uses for the computer as a training medium with a PLATO terminal connected to the Air Force's Burroughs B3500 at Sheppard AFB, Texas on a time-sharing mode.

The Armor School

All advance course officers are exposed to management information system concepts with a two-day practical exercise by leasing a time-sharing Hewlett-Packard 2100B with access via teletypewriters. Throughout the elective program, students develop and de-bug programs to augment instruction in tactics, personnel, and logistics. The commercial time-sharing system is also used to manage a four-day brigade map maneuver exercise.

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1 Surry P. Everett and Robert A. Hallowell, Jr., "Computer Assisted Instruction at USAMPS," Military Police and Law Enforcement Journal, Winter 1974, pp. 46-47.

The Air Defense School

The computer courses offered at the Air Defense School are divided into two categories -- digital and computer fundamentals. In support of the computer fundamentals courses, several computer systems are employed. Five Varian Data 620-A computers are used to teach fundamentals of assembly and machine languages. Teletype terminals (ASR-33 and ASR-37) serve as remote terminals for commercial time-sharing use of a CDC 6600 computer in Bethesda Maryland. This system is used to practice FORTRAN programming language and support the operations research/systems analysis portion of the aeronautical engineering courses.

The Army's Academy and Service College Applications

U.S. Military Academy

The Military Academy ranks among the first institutions to have used computers in education. Its experience began in 1961 and has progressed to a center that operates a large-scale, multi-programming Honeywell H-635 system.[1] The cadets access the computer through anyone of 136 terminals located in campus computer clusters in living, study, office, and laboratory areas as seen in figure 9. Currently, the computer is used in the computational mode for seventy courses to include engineering, physics, economics, and mathematics and in the tutorial (CAI) mode for foreign language instruction. The dominant use of the computer at West Point centers around the newly developed (1972-73) Graphics Compatibility System. This is a computer graphics software system designed for interactive use on a wide variety of terminals. The cadet programs an engineering, physics, or math type problem while on-line using a CRT terminal and receives a solution in a matter of moments on the CRT screen which can then be duplicated in hard copy through an adjacent graphics plotter (see figure 10).[2] Seven of the twelve academic departments require the use of the computer by the cadet in order to successfully complete their assignments. Additionally, the computer is used in direct classroom or laboratory instruction in those same departments.

The Command and General Staff College

For several years, the Command and General Staff College at Fort

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[1] "On-line Instruction at West Point," Government Data Systems, May/June 1973, pp. 37-38.

[2] U.S., Department of the Army, U.S. Military Academy. Introduction to the Graphics Compatibility System (West Point, N. Y.: U.S. Military Academy, March 1974), p. 2.



Fig. 9. Cadets make use of the computer (a Honeywell H-635) via terminals located in clusters throughout the Military Academy at West Point, N.Y.

SOURCE: William F. Luebbert, Director, Information Systems Department, U.S. Military Academy, West Point, New York, 6 May 1974.



Fig. 10. A USMA cadet, using a Data Point 3300 cathode-ray tube terminal with an associated TSP Plotting System, performs a graphic application for a hard science course to obtain a nonpermenant output (CRT) or a permanent output (hard copy graphics)

SOURCE: Francis Kaye, Deputy Director of the Information Systems Department, U.S. Military Academy, West Point, N.Y., 8 May 1974.

Leavenworth, Kansas has been integrating the use of the computer into their map exercises by providing classroom terminals for the students to assist in computing various items of data and providing force and logistics information on a query basis. Using the local CDC 6500, the college is developing a computerized division tactical operations center which will allow the students to integrate the various tactical data systems (intelligence, fire control, and operations) into the management of tactical operations on a compressed-time scenario through simulation. Additionally, all new students will be given an eighteen-hour "solo" course to learn BASIC programming and a general knowledge of computer technology so they can use the computer via classroom or portable terminals.[1]

U. S. Army War College

In the late 60s, the Army War College at Carlisle Barracks, Pennsylvania, made use of West Point's time-sharing system to assist in instruction concerning force development and economic forecasting. The college now has its own Honeywell 6060 and conducts numerous core curriculum courses by computer supported instruction. Currently, the students used a budget projection model, a cost-effectiveness model, a force costing model, and are able to make queries of the Digital International Data Base and Retrieval System when developing their various strategic appraisals.

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[1] BASIC (Beginner's All-purpose Symbolic Instruction Code) is a programming language developed at Dartmouth College which achieves its greatest utility from the fact that it is easy to learn, easy to use, and easy to remember. Harry Katzan, Jr. Information Technology: The Human Uses of Computers (New York: Petrocelli Books, 1974), p. 146.

Chapter III

THE U. S. NAVY AND COMPUTER BASED TRAINING

A Philosophy

For almost a decade the Navy has been investigating ways of individualizing instruction and seeking more efficient training methods via computer technology. Their approach has been on a broad front and with an open mind. The Navy's interest in CAI dates back to the mid-sixties when several CAI studies were initiated at the Naval Academy.

Current Navy Computer Systems

The Naval Academy

In 1966, the Navy embarked on a two-pronged CAI effort aimed at improving education through the use of computer technology. A CAI-Teletype project was the first system developed and was used to teach science, engineering, and naval science. The project used nine Model 33 Teletype terminals accessing remote commercial time-sharing computers during the first few years of operation. This system proved to be an effective means of improving the academic level of the courses involved and provided a powerful tool to apply techniques which were not feasible without the use of a computer.

The CAI-1500 Project was built around the IBM 1500/1800 system (see figure 11) which included twenty-seven instructional display stations.[1] Whereas the teletype project focused on the computer's computational powers, the IBM 1500 system features the tutorial mode.[2]

With this approach, it was thought that the computer presented instruction could replace parts or all of the conventional instruction in selected situations. At the Academy, the random-access, audio capability of the system was used to assist in the course on basic Russian. Additionally, parts of the physics, chemistry, and operations analysis courses were converted for IBM 1500 presentation.[3]

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[1]The IBM 1500 system included: a cathode-ray tube, keyboard, and light pen; an image projector; and an audio unit.

[2]Tutorial CAI is that mode in which instructional material is presented by a computer in an interactive dialogue between the student and the author. The material presented and its sequence are usually varied to meet the individual characteristics of the student.

[3]Jesse L. Koontz, Final Report on the Naval Academy's CAI Project, a report (PR-0571-43) prepared by the Educational Systems Center, U.S. Naval Academy, Anapolis, Md., February 1972. p. iii.



Fig. 11 Midshipman using a CAI terminal (Teletype Model 33 ASR) in the Honeywell 635 System at the U.S. Naval Academy

SOURCE: U.S. Navy Photo Lab, U.S. Naval Academy, Annapolis, Md., 28 March 1974.

The examination of the IBM 1500 system ended in 1971 when the Academy concluded that it was not operationally or cost effective for their environment.[1]

Faculty acceptance gradually caused the single Teletype terminal system to supplant the IBM 1500 system as seen in figure 12. But, a reliable and operationally-proven software system that was written specifically to handle large numbers of computer programs typical of those utilized in an undergraduate environment was needed. This led to the Dartmouth Time-Sharing System (DTSS) which uses the BASIC computer language designed to serve both technical and non-technical student needs.[2]

In 1971, Honeywell 635 computer and DTSS produced an instructional system that brought forth greater acceptance and more reliance on the computer to assist in the instructional process.[3]

By academic year 73-74, one hundred and eighty terminals were available to midshipmen for application to over two hundred courses. The growth in the number of users has peaked out because virtually all the midshipmen use the computer--see figure 13. However, the faculty continues to develop more and more learning applications. This has resulted in the continual growth in central processor utility. In 1973,its use rate was up sixty percent in two years.

CMI at Memphis

During the past seven years the Naval Technical Training Command in Memphis has developed a computer managed instructional system (CMI) which uses a computer to monitor and direct learning of each student on an individual basis. Yet, the actual instruction takes place off-line or away from the computer as illustrated in figure 14. This system uses a Data 100 terminal to interface with a Xerox Sigma 9 computer at Memphis State University. The

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[1] Ibid., pp. 78-79.

[2] U.S. Department of the Navy, U.S. Naval Academy Computers and Education at the United States Naval Academy (Annapolis, Md., U.S. Naval Academy, 1973), p. 5.

[3] W. H. Sandeford, "Computer Center Gets a Smooth 'Welcome Aboard' at Annapolis" College Management, November 1972, p. 35.



Fig. 12. Midshipman using an IBM 1500 instructional display, image projector and audio unit



Fig. 13. A CAI-Teletype classroom at the Naval Academy

SOURCE: Jesse L. Koontz, Final Report on the Naval Academy's CAI Project (Annapolis, Maryland: U.S. Naval Academy, February 1972), p. 19.



Fig. 14 Under CMI direction, a sailor receives audio visual instruction (tape unit, lower left and 35 mm carousel slide unit projecting into a rear view screen, upper right) as he reads the programmed instruction text on basic electricity and electronics. This study carrel also has a capability for microfiche projection (lower right).

SOURCE: Henry Edsall, Educational Adviser, Naval Air Technical Training Center, Naval Air Station Memphis, Millington, Tennessee, 5 March 1975.

students communicate with the computer using mark-sense forms and in a matter of minutes the student is given his next instruction.[1] At the present time, the system manages a workload of five-hundred students a week but they are developing a capacity to manage one hundred or more courses with ten thousand students. Applying this instructional technology, the two courses that were converted to CMI are training students in about half the time it took using conventional instruction.

San Diego Naval Service School

In the area of Navy enlisted training, several modules of CAI have been developed for teaching electricity and electronics at the Basic Electricity and Electronics School by the Naval Personnel and Training Research Laboratory at San Diego. Again, the IBM 1500 System with thirty-two terminals were used. In their final report, it was concluded that the CAI students scored consistently higher than students given conventional classroom training. Time comparisons show that training objectives were met in significantly less time.[2]

During the several years of testing, experiments were conducted in such areas as: student control; maximum vs minimum training; student data and summaries; paired student performance; and techniques of branching. As a follow-on to the IBM system, the PLATO IV system of the University of Illinois is in its third and final year of evaluation for possible applications to the Navy's training situation.

With the Plasma tube[3] terminal of the PLATO IV System, a unique opportunity exists to determine whether information displays using graphics

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[1] Mark sensing is the process of placing data (marking with a pencil) on a special form which is subsequently read by a device to generate input for a computer.

[2] John D. Ford, Jr., Dewey A. Slough, and Richard E. Hurlock, Computer-Assisted Instruction in Navy Technical Training Using a Small Dedicated Computer System: Final Report, a research report (SRR 73-13) prepared by the Naval Personnel and Training Research Laboratory, San Diego, California, November 1972, p. iv.

[3] The Digivue Plasma Display Panel is a recent development of Owens-Illinois, Inc. in response to the University of Illinois to provide a desirable low-cost display device with some flexibility for writing and storing information at a student station. Somewhat like a TV tube, it is a flat, gas-filled panel for display of characters and diagrams by electronic signals. Jack Stifle, A Plasma Display Terminal (Urbana, Ill.: University of Illinois, March 1971), pp. 2-5.

and rear projected image overlays might better instruct and train students with low aptitude and low verbal background scores.[1]

In 1974 the CMI system, developed at Memphis, was put into use by the school. An IBM System 7-Intelligent Terminal-is connected to the Xerox Sigma 9 in Memphis to provide the same computer management functions for two schools located thousands of miles apart. Progress is under way to develop programs to allow the computer to administer the courses that lead to the twenty-two different ratings offered by the school.

S-3A Aircrew Training

The application of modern simulation techniques is illustrated by the instructional system for the Navy's newest carrier-based antisubmarine warfare aircraft, the S-3A. At the present time, the S-3A has one of the most highly developed and integrated operational flight training systems in the current inventory. This training device is the core of an instructional system which is capable of taking a crew, individually and collectively, from self-paced classroom instruction through integrated, mission-oriented crew training in a simulator.[2]

The heart of this instructional process is the instructional design which began as a systems approach to this requirement for crew training. This was followed by task analysis which leads to the logical question of what is to be taught and how. A flowcharting approach assists in the selection of the proper method and media which fits the specific training requirement. An inherent feature of the system is the idea of hierarchical complexity of the subject matter and the cost of the training medium. For example, printed programmed instruction costs only pennies a page, but flying the aircraft for crew training runs into hundreds of dollars an hour.

The Time-Shared, Interactive, Computer Controlled Information Television System (TICCIT), being developed by MITRE Corporation, is a unique CAI system which incorporates in its software most of the instructional strategy elements of the instructional design. TICCIT combines both computer

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1 U.S., Department of the Navy, Office of the Chief of Naval Operations, "Navy-ARPA Joint PLATO IV Technology Assessment and Research Program," a letter from the Chief of Naval Operations to the Office of Naval Research, 28 September 1972.

2 Interview with Commander Richard A. Walker, S-3A Fleet Introduction Team, Anti-Submarine Warfare Wing, San Diego Naval Air Station, California, 3 June 1974.

and television technologies. Each student terminal employs an ordinary television set, an off-the-shelf keyboard, and a video tape recorder, plus a special receiver. The student, via a keyboard, communicates with the computer lesson material stored on magnetic discs. When frames are selected from the data base, they are converted into a composite video signal, transmitted in time-shared sections over coaxial cable and presented as "stills" on the student's television screen in an individualized, self-paced mode.[1]

Air Crew Training – Miramar

A computer-managed training program is in use at the Naval Air Station in Miramar, California, to teach aviation maintenance to crew members of the F-14 aircraft. A Burroughs B3500 computer, located in Los Angeles, is linked via land line to a Miramar minicomputer. Hazeltine 2000 terminals are used by the student to select from a series of lessons from the fourteen courses in the program.[2]

Other CAI Developments

Consistent with the Navy's wide-ranging investigation for techniques to apply instructional technology to the learning process, a description of several smaller projects will serve to typify this interest.

SCHOLAR

Bolt, Beranek and Newman are pursuing research with a system named SCHOLAR, which is characterized as a mixed-initiative dialogue between the student and the computer. This term indicates a man-computer relationship in which either party can take the initiative, i.e., ask and answer questions and engage in discussion.[3] Such a computer language represents a breakthrough

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[1] "TICCIT," The Journal Technological Horizons in Education, December 1973, pp. 16-20.

[2] Morris G. Middleton, Clarence J. Papetti, and Gene S. Micheli, Computer-Managed Instruction in Navy Training, Orlando, Fla.: Naval Training Equipment Center, March 1974, pp. 77-78.

[3] Jaime R. Carbonell, Mixed Initiative Man-Computer Instructional Dialogues (Cambridge, Mass.: Bolt, Beranek and Newman, Inc., 31 May 1970) p. 5.

in software development by relieving the instructor of the burden of preparing frame-by-frame strategies and calls on SCHOLAR to generate the material to be presented to the student in reasonably natural conversational English.

TASKTEACH

The University of Southern California is developing a tutorial system to help trainees learn serial tasks from operating equipment to electronic trouble shooting. Named TASKTEACH, this system provides the student with variable amounts of learning material as he requests it, to help him organize the material and the processes which lead to its mastery. [1]

Shipboard Computer Integrated Instruction

The Navy has recently contracted with System Development Corporation (SDC) to design and install a shipboard instructional management system. This system–Computer Integrated Instruction (CII)– will incorporate the functions of on-line student testing, student progress reporting, assignment of training resources aboard ship, and administrative reporting. A mini-computer system (the NOVA 1200) will be installed aboard the guided missile frigate – U.S.S. DAHLGREN. This application will be more along the lines of CMI than CAI. Yet, it will feature a multi-media approach which includes programmed instruction, audio-programmed instruction, sound and slide self-instruction, and computer assisted testing and evaluation.

U.S. Naval War College

At the Naval War College, there is no concerted effort or part of the curriculum to instruct all of the students how to effectively utilize the computer. The management department does, however, conduct two case studies whereby the students are taught trade-off analysis with the aid of a computer. In several elective courses, students may solve computational problems by using a teletype terminal for access to a GSA UNIVAC computer in Atlanta or the CSC INFONET time-sharing system. Most research work by staff or student is done on the latter.

The major computerization effort at the college is the development of the Warfare Analysis and Research System (WARS). This naval warfare gaming system will be one of the most sophisticated digital gaming simulation devices ever developed for instruction. WARS uses the computer power of

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[1] Marshall J. Farr, "Computer Assisted Instruction Activities in Naval Research" Computer and Automation, January 1973, p. 11.

UNIVAC 624Bs with an added half million bit bulk core memory. The system will have over a dozen terminals for student and fleet decision gaming play. A large screen display will be able to illuminate and process kinematics activity of three hundred platforms (ships, planes, commands, etc.) at any one time.

The college is about at midway point in making this gaming simulation device an operational part of the college's instructional program. Thus, by 1979, this deliberate phased development should produce an educational model through which naval officers can gain unique insights into the complexities of a modern decision process, under induced time constraints and resource limitations.

Chapter IV

THE U.S. MARINE CORPS AND COMPUTER TECHNOLOGY

Production Level CAI

The major effort to introduce CAI to the Marine Corps is at the Communication-Electronics School at Twentynine Palms, California.

For testing purposes in 1970, the system featured UNIVAC's Computer-Oriented Programmed Instruction (COPI) in a tutorial mode to teach the radio fundamentals course.[1] A follow-on CAI pilot program has since been conducted wherein this CAI method was determined to be academically better not only as a method of instruction, but through shortening course length and instructor reductions, $2-1/2 million could be saved over an eight-year period.[2] Additionally, it was shown that the school's enlisted instructors could convert conventional instruction courses to the CAI format with a minimal amount of training. The Navy has approved of the installation of an operational CAI system (UNIVAC 60 terminals operating on a time-sharing UNIVAC computer in Corona, California) at the school in early 1973 and it has been running at "production level" for over a year. The blending of hands-on training directed by the computer is shown in figure 15.

The Tactical Warfare Analysis and Exercise Evaluation System

The Tactical Warfare Analysis and Exercise Evaluation System (TWAES) is a tool for the control of tactical exercises, the pre-exercise planning for experiments to evaluate combat systems, and the evaluation of these systems during and after tactical exercises. TWAES makes use of a digital message entry device, (DMED) in the hands of field umpires, to transmit digitally encoded messages on significant troop and enemy activity via a portable tactical radio (AN/PRC-25) to an exercise control center. Receiving the message at the van-mounted computer (the AN-UYK-6 which is a militarized revision of the UNIVAC 1108) selected information is displayed on a cathoderay tube, and automated situation map and then automatically posts unit locations on a map, assesses casualties, and updates the logistical and support situation.[3]

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[1] Bill Gnatzig, "C-E BN," Leatherneck, February 1971, pp. 15-16.

[2] U.S., Department of the Navy, U.S. Marine Corps, "Computer-Aided Instruction (CAI) in the Marine Corps," a talking paper prepared for use by the Commandant of the Marine Corps, Washington, D.C. 2 April 1973.

[3] K.C. Shumate, "Tactical Exercise Simulation," a paper presented to Seminar VII- The Use of Computerized Gaming Applications in Military Education, Defense Computer Institute, Washington, D.C., 27 October 1971.

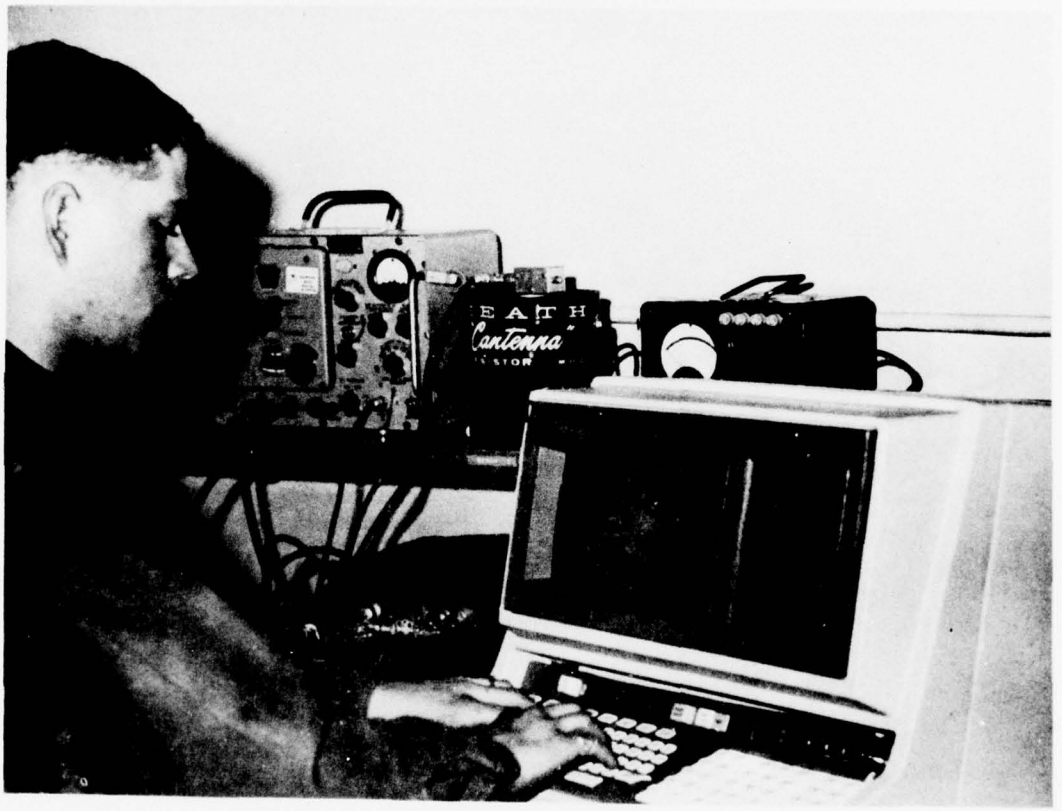


Fig. 15. A Marine takes the Radio Fundamentals Course using a UNISCOPE 300 terminal in a Computer Aided Instruction mode at the U.S. Marine Corps Communications and Electronics School.

SOURCE: W.G. Kemple, CAI Project Officer, C-E School, Marine Corps Base, Twentynine Palms, California, 5 April 1974.

The TWAE system is operational and has supported exercises on the West Coast for several years. During its first operational use at Camp Pendleton, California, a brigade landing exercise clearly revealed the superiority of TWAES compared to any existing manual system for controlling major exercises.[1]

More recently the TWAES was used in June of 1973 to control an eighteen-thousand man reserve and regular Marine exercise in Southern California. This was its most extensive and successful automated processing of exercise performance data ever attempted by any service to date.[2]

The Tactical Exercise Simulator and Evaluator

The Tactical Exercise Simulator and Evaluator (TESE) project was conceived of an interim computer assisted combat simulation for use in conjunction with TWAES. During the development of TESE at Quantico, it became apparent that such a system could very easily serve as a computer assisted war game for teaching tactical decisionmaking in officer courses taught in the Marine Schools. So in 1971, they began developing a real-time and continuous computer simulation to provide Marine officers with a decision-making arena wherein participants (up to 180 at a time) would be confronted with some of the dynamic aspects of a combat situation.[3] At this time, the next phase of TESE development is to be shifted to Camp Pendleton, California, where the system will be tested on the TWAES van-mounted computer. By the time TESE is made operational (1976 time frame), a TWAES/TESE computer will be available at Quantico, Virginia, and the system can be brought back to its home to train Marine officers at the school and Marines in any east coast exercises.

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[1] Noah C. New, "Executive Summary--TWAES & TESE," a memorandum for the Commandant of the Marine Corps from the Director of the Development Center, Marine Corps Development and Education Command, Quantico, Va., 30 June 1973.

[2] "Reserves in BEAGLE DANCER," Marine Corps Gazette, July 1973, p. 5.

[3] U.S., Department of the Navy, U.S. Marine Corps, "Charter for Tactical Exercises Simulator and Evaluator (TESE) Working Group," a letter from the Commanding General Marine Corps Development and Education Command, Quantico, Virginia, 25 May 1971.

Chapter V

THE U.S. AIR FORCE AND COMPUTERIZED TRAINING

The Early Years

Air Force interest in the use of computers in training dates back to t Semi-Automatic Ground Environment System (SAGE)[1] of 1955 when computer based on-the-job training was instituted as an integral part of the system design. The training of the operators of the SAGE system employed the use of millions of feet of magnetic tape and 70 mm film which created a realistic simulation for over a thousand exercises. This system represented the firs military application of computerized on-the-job training via simulation. An updated version of this training concept is currently a part of SAGE's back-up system--the Back-Up Interceptor Control System (BUIC). Automated Program Instruction (API) was designed into this general purpose, large-scale military system operating in real-time.[2] BUIC was designed to detect identify, and, if necessary, intercept incoming hostile aircraft. The training of personnel to operate this complex machinery was compounded by (1) the requirement to place the system in remote site locations and (2) the scarcity of experienced teaching personnel. The instructional package of all-purpose instructional materiel (API) uses the operational BUIC console as the teaching medium to realistically simulate air defense situations, record the performance of operational personnel, and furnish planners and commanders with tools to evaluate and improve air defense capabilities.

Currently with the Air Defense Applications, the Air Force has initiated research in CAI applications to teach electronic trouble-shooting, medical diagnosis, and accounting; and to teach the use of computer networks and on-line use of computer based systems.

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[1] SAGE is a computer-driven system for determining the location, course, and speed of enemy aircraft, and of calculating and controlling the course of intercepting aircraft and their defensive missiles. It was heralded as the mating of man and machine. Operators provide the judgment for decisionmaking and the IBM computer gives six one-millionths of a second speed of information. Hansown W. Baldwin, "SAGE," New York Times, 18 January 1956, p. E1.

[2] Real-time is a term used to describe the calculation or processing of data fast enough to permit the results to influence the related process underway.

Current Air Force Computer Systems

Computer-Directed Training System

The Air Force has applied lessons learned in job-situation training as it uses the Computer-Directed Training System (CDTS) at the base (installation) level. The existence of many thousands of computer-based information systems in the Air Force has resulted in the need for cost-effective methods of on-the-job training thousands of personnel to use these systems. CDTS is CAI applied at the operating level at 125 bases throughout the Air Force.[1] Figure 16 shows an airman learning how to perform his job at his normal place of work. The system consists of executive software and programmed instructional courseware recorded on computer tapes which are distributed Air Force-wide for use on the Phase II base level computers (Burroughs B3500), which primarily support the base level management information system. Students receive training on-line through the functional area remote terminal by interacting with the B3500 system in a computer-directed mode. CDTS has eleven operational courses which support training related to the functional areas of finance and accounting, civil engineering, and management of military and civilian personnel, and computer operations to include FORTRAN and COBOL programming. This concept has proved to save both money and time by training personnel at the base rather than at some distant school. Additionally, there is a high degree of user acceptance: CDTS is just the first step for the Air Force in achieving the man-machine interface on the job. In the 1980s, the Air Force will be training people by CAI to do their computer-based jobs at several sites on each base in the Air Force.

Lincoln Terminal System

Since 1970, the M.I.T. Lincoln Laboratory (birthplace of SAGE) has been developing an automated training system to support individual, self-paced instruction inside and outside the classroom. The system, now referred to as the Lincoln Terminal System (LTS), uses microfiche to deliver audio and visual instructional material and a small computer to control interactions with the student. It has proven possible to include both the digital information and an audio channel on the fiche as shown in figure 17. A completely stand-alone (or distributed), portable, self-contained model (LTS-4) is presently under development.[2] Figure 18 shows the LTS-3 which has been replaced with an LTS-3S (stand alone).

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[1]Sylvia R. Mayer, "Computer-Directed Training Systems," paper presented at the Second Symposium on Cost Effective Learning Learning Through the Application of Computer Technology, Washington, D. C. 21-22 February 1973.

[2]Allen H. Hammond, "Computer-Assisted Instruction: Many Efforts, Mixed results," Science, 2 June 1972, pp. 1005-1006.

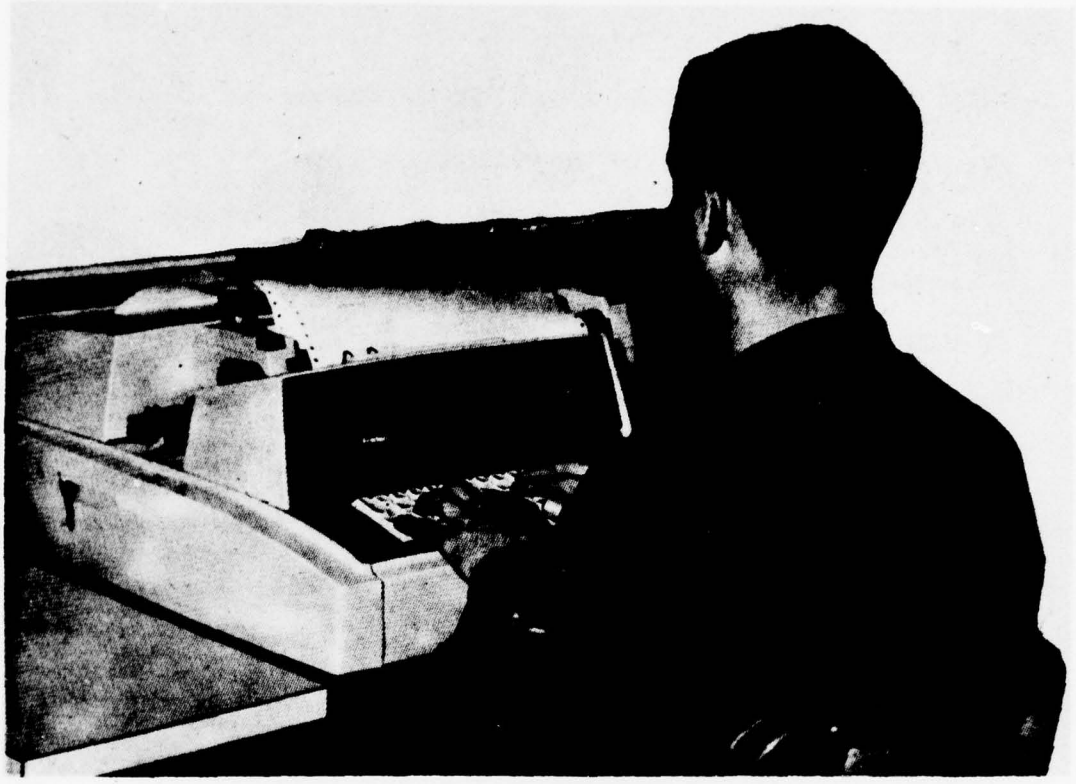


Fig. 16. Trainee learning how to perform his job using a remote terminal (Friden 7311) as a functional part of the Computer-Directed Training System (CDTS). The terminal interfaces with the Phase II Base Level System Burroughs B3500 computer.

SOURCE: Sylvia R. Mayer, "New Directions in Human Factors Engineering for Military Information Systems: Automated Training Systems," Proceedings of the L. G. Hanscom Field Science and Engineering Awards Meeting (Bedford, Massachusetts: Air Force Cambridge Research Laboratories, 3 November 1970), p. 127.

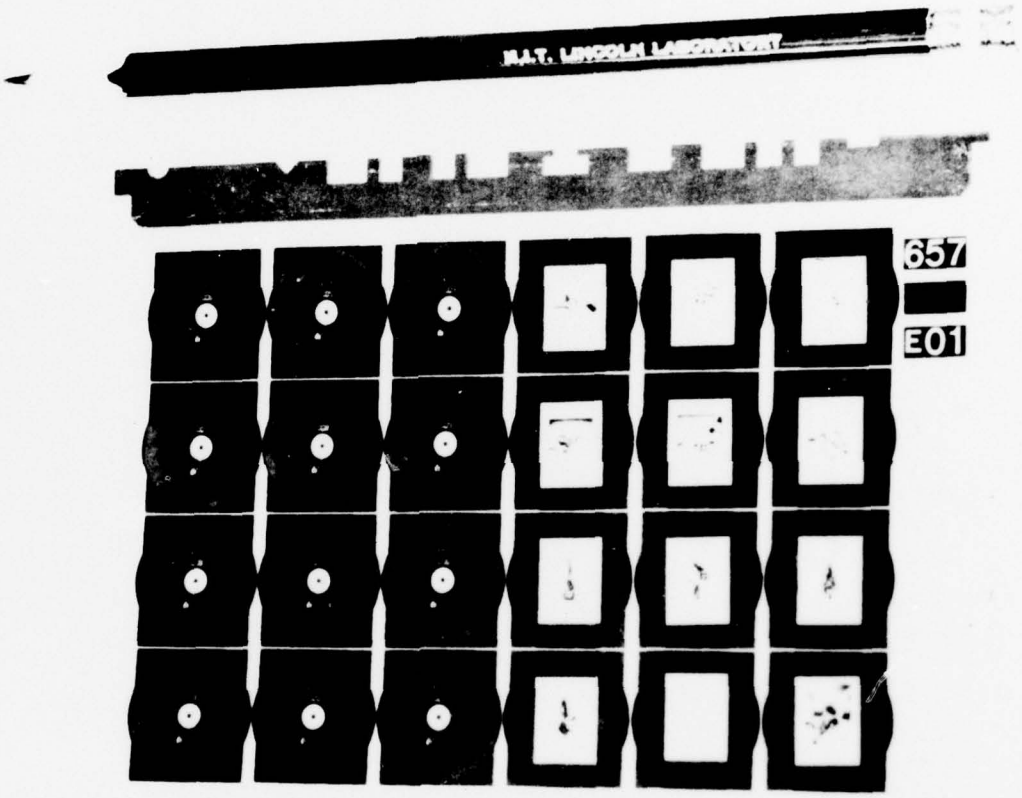


Fig. 17. A 4 x 6 inch LTS-3 audiographic microfiche containing 12 visual images and corresponding 28-second audio recordings

SOURCE: R. C. Butman and F. C. Frick. The Lincoln Training System: A Summary Report (Lexington, Massachusetts: Lincoln Laboratory, 3 October 1972), p. 7.

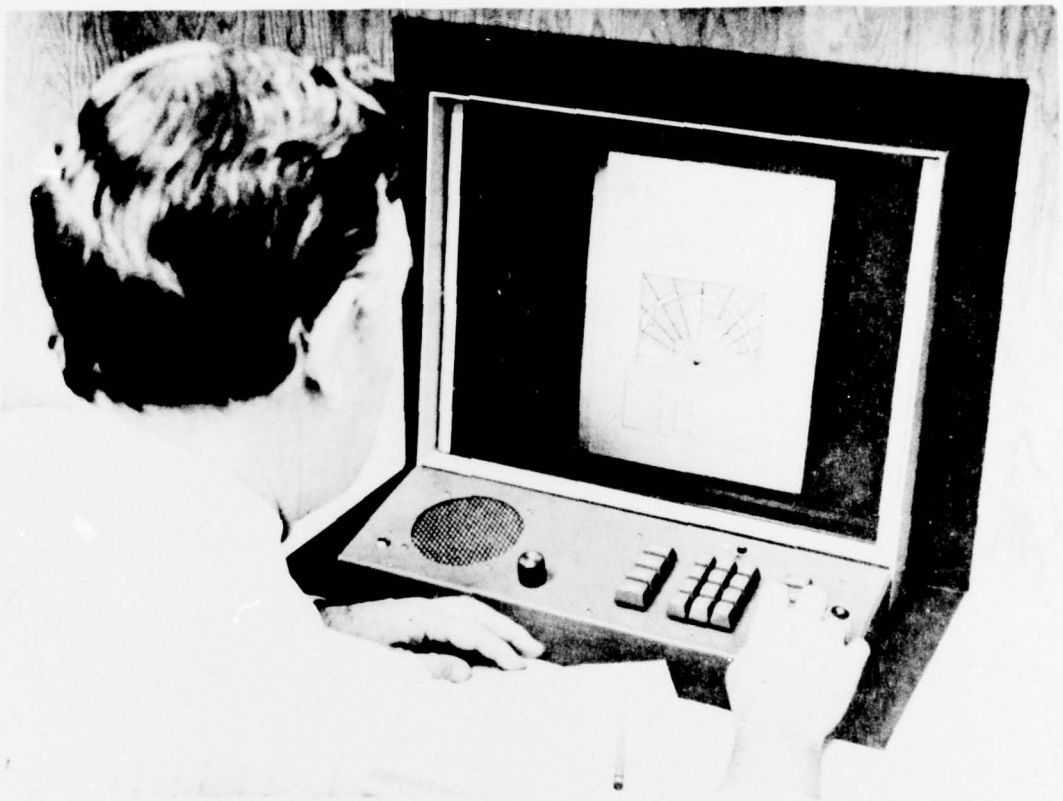


Fig. 18. An LTS-3 (Lincoln Training System) terminal, under computer control, can select an image and produce sound from any one of up to 750 microfiche stored in its carousel fiche holder

SOURCE: R. C. Butman and F. C. Frick. The Lincoln Training System: A Summary Report (Lexington, Massachusetts: Lincoln Laboratory, 3 October 1972), p. 5.

Because all lesson-specific information -- audio and visual displays and branching logic -- is located at the student's terminal, it is possible to load terminals with different lessons and no competition among students for computer resources exists. The system now features a carousal fiche holder that stores 9,000 images or 180 hours of instruction. This will be replaced with microfiche cassettes. Such an approach to CAI avoids the expense of a large central computer and peripherals, a wide-band communications systems, environmental controls, and a large school staff. The fact that the system requires only a very limited supplementation of a trained instructor suggests its suitability for on-the-job training and other applications outside the conventional school setting.[1] LTS has been successfully tested in training applications, and is now being tested as a unique interactive aid in a maintenance management application.

The Advanced Instructional System

For over four years, the Air Force has been developing the concept of the Advanced Instructional System (AIS). This system incorporates methods for integrating the latest advances in individualized instruction, including instructional techniques and media, instructional management, and computer hardware and soft ware to improve the cost effectiveness of Air Force technical training and education. It constitutes a prototype, individualized, multimedia training system as well as a research facility to allow the systematic evaluation of innovations in instructional technology. Several basic concepts are being designed into AIS. First, the instruction is to be individualized by providing the student a wide variety of instructional materials, media devices, and teaching methods which are most appropriate to both the student and the learning task. The system will also be able to constantly predict the graduation date based on the student's daily progress so that the personnel section can assign the student directly to the field upon graduation. The second concept envisions the changed role of the training staff, especially the instructor. He is still involved with course development and making decisions, but many of his routine duties will be automated. This will give him more time to become involved with the students as individuals, so that their individual needs in terms of both personal and course requirements can be met. The third concept, which is necessitated by the large-scale implementation of individualized instruction and resources utilization, is management support. To manage thousands of students who are progressing at their own rates, to select the media and techniques most appropriate to each student, and to efficiently allocate all resources, a large-scale computer (the CDC CYBER 73-74) will be used to manage this process.[2] One example of its capability

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[1]Frederick C. Frick, "The Lincoln Terminal System (LTS)" Journal for Educational Technology Systems, Fall 1973, pp. 87-98.

[2]Roger L. Grossell, "The U.S. Air Force Advanced Instructional System," a paper presented at Seminar X on the Use of Computers in Military Education, sponsored by the DOD Computer Institute, Wash, D.C., 12-13 September 1973.

is the student characteristic file. It will contain information about each student: his aptitude, interest, and background; each student's response; a running record of his progress through the course; and, periodically inform the student, instructor, and administrator of each student's progress. The scope of AIS is portrayed in figure 19. This $10.7 million project has a phased implementation character, for example 75,000 student hours have been saved by the self-pace mode of training already in use in the system. The initial adaptive model (the first computer application) will be operational in August 1975. The entire system will be up and running in 1976 with a contractor termination date of October 1977.

Intelligence Training at Lowry

At the Armed Forces Air Intelligence Training Center at Lowry AFB, an Environmental Training System has been developed to simulate the job of the intelligence analyst in the field. Army, Navy, and Air Force personnel use IBM 2260 terminals, on-line, to an IBM 360/40 computer to learn how to search and update intelligence files in a real-world type of classified files.

About half of all intelligence training is accomplished in the field at the intelligence specialists' place of work. So, mobile training teams go out from the Center and instruct the analysts using the Lowry computer's file system which has been loaded on the host computer. In this manner, the student is able to use a realistic system without jeopardizing their highly sensitive files until he gains proficiency.

Supply Training at Lowry

Like the Intelligence Center, the Department of Logistics Training has developed a Simulated Supply Complex at Lowry to train personnel in the operation of the standard base supply system. Using the basic supply system computer – the UNIVAC 1050 – students are given numerous problems which cause them to interact with the computer on the typical supply system terminal. Four different supply specialists and supervisor courses are run on this system.

Chanute Vehicle Maintenance Training

The Air Force's center for special vehicle training, Chanute Technical Training Center has been developing the PLATO IV[1] system as

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[1]PLATO (Programmed Logic for Automatic Teaching Operations) is a computer based teaching system which provides a means for individualizing student instruction. PLATO I, with one terminal, was operational in 1960. By late 1972, the system had evolved to PLATO IV with over 250 terminals in operation at more than fifty locations. Telephonic interview with David V. Meller, Computer-Based Educational Research Laboratory, University of Illinois, Urbana, Illinois, 23 August 1973.

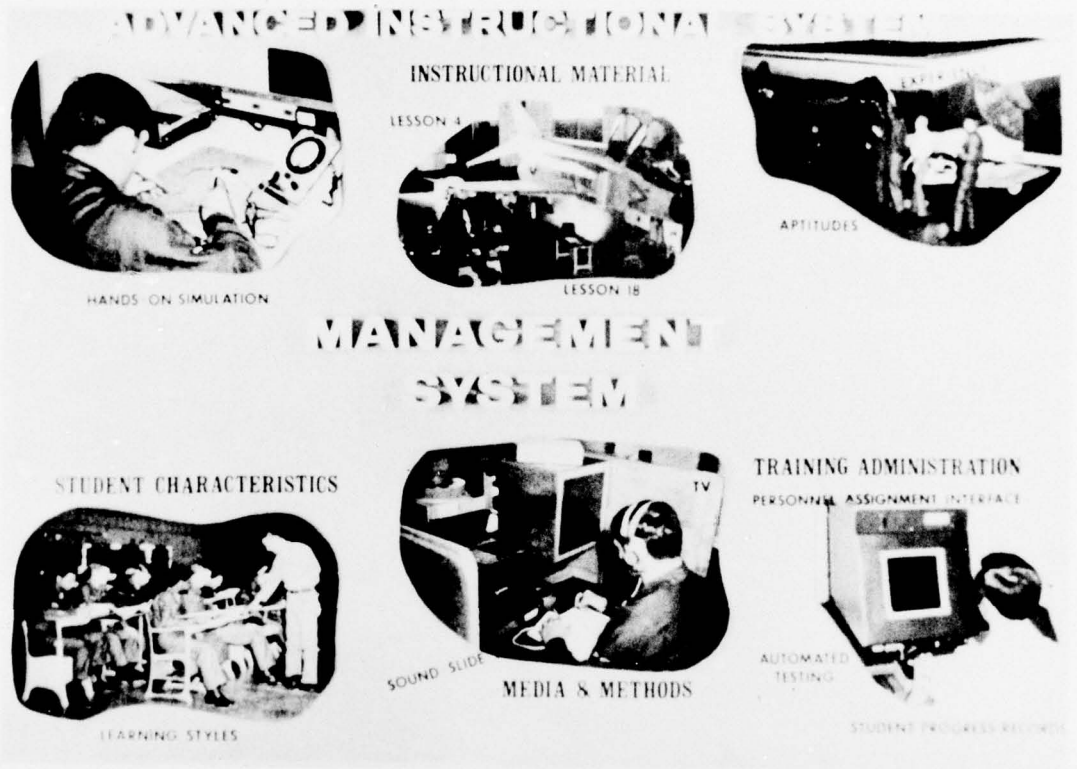


Fig. 19. An overview of the Air Force's Advanced Instructional System currently under development

SOURCE: Robert E. Wilkinson, Science and Technology Division, Directorate of Development and Acquisition, Department of the Air Force, Washington, D.C., 28 March 1974.

a methodology of instruction for its maintenance courses. Starting in early 1975, students began using twenty-five PLATO terminals as part of the teaching methodology in the Special Vehicle Repairman Course. About forty of the course's two hundred contact hours are on the computer. The goal of this test is to develop a PLATO-based instructional training system by the middle of 1976.

Keesler Electronics Training

The Keesler Technical Training Center is the focal point for electronics training in the Air Force. For a number of years, communications-electronics instruction for officers and airmen has been presented in a self-paced, modular manner using audio-visual learning centers. [1]

Keesler Technical Training Center has been working on the integration of the computer into the learning process. Lesson material for the Consolidated Base Personnel Office, and a CAI course for the World Wide Military Command and Control System are developed at Keesler. Each course is reviewed world wide,on-site, and both courses employ operational computers as the delivery system. Additionally, Keesler has tested the Lincoln Training System (LTS-3) in their electronics training mission.

A computer-driven radar approach simulator became operational in April 1974. This simulator will assist in the training of over 1000 air traffic controllers each year.

Sheppard Training

As part of an ARPA program, dozens of PLATO systems are being tested by the services. Just such a test is underway at the USAF School of Health Care Sciences at Sheppard AFB, Texas. A problem-oriented medical curriculum is being developed to teach students at the physician assistant level. Using PLATO IV terminals on-line to the University of Illinois, 200 hours of a 1400 hour curriculum have been programmed as CAI lessons and subject to validation. The project is scheduled for evaluation in early 1976.

Also at Sheppard is another of the Air Force's school of applied Aerospace Sciences. The CAI computer operations, FORTRAN programming, and COBOL programming courses mentioned earlier in this section under CDTS were developed, tested and distributed to 128 Air Force CDTS installations as a school mission.

Work is also underway at Sheppard to link the Air National Guard and Air Force Reserve Bases with the Regular Air Force. A Remote Job Entry System (RJETS) which features a Honeywell H-725 computer is being tested

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[1] Dennis J. Sullivan, Edgar A. Smith and Ronald H. Filinger, A Survey of the Present State-of-the-Art in Learning Center Operations, Brooks Air Force Base, Texas: Air Force Human Resources Laboratory, February 1974, p. 32.

as the potential interface for the standard base level computer system (the Burroughs B3500) and the standard supply computer (the UNIVAC 1050). Such a communications arrangement is intended to bring the activities and needs of the National Guard and Reserve units on a par with the regular Air Force operations.

The Air Force's Academy and Service College Applications

U. S. Air Force Academy

The educational process at the Air Force Academy is facilitated by the use of computers in several important ways. During the course of a semester, more than 2,000 cadets and approximately 400 faculty members make extensive use of a large-scale Burroughs B6700 computer system.[1]

The Academy divides the computer use into six categories: problem solving, simulation, methodology instruction, experimental control, computer science education, and tutorial. Every graduate of the Academy has successfully completed at least one course in computer science. Cadets are taught fundamentals of problem solving via computer, flow charting, and basic file handling. They design and write moderately complex programs in both a high-level compiler language (ALGOL) and a simulated machine language. They are taught to use an on-line teletype terminal to access library routines or conceptualize their own program. Their work is normally accomplished using one of three self-service remote job entry card reader/line printer stations or one of more than sixty typewriter or cathode-ray tube terminals located throughout the cadet area, including the dormitories and the library.

Many academic courses require extensive use of the computer for problem solving. Students either write original programs or access utility programs through the use of punched cards in order to calculate solutions to problems in such diverse fields as astronautical engineering and economics.

Both X-Y plotters and cathode-ray tube graphics display units are available for cadet and faculty use. "Intelligent" (programmable) graphics terminals, which are actually mini-computers in themselves, interface with the Burroughs B6700 computer which is capable of generating the complex mathematical functions to be displayed graphically. Rotational three-dimensional display is currently available on some graphics terminals.

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[1]Monti D. Callero, "Computers in Education at the United States Air Force Academy," paper presented at Seminar VIII - The Use of Computers in Military Education, Department of Defense Computer Institute, Washington, D. C., 20 March 1972.

A CAI-CMI package allows instructors whose area of expertise is other than computer science to design lessons which are presented on-line to students at terminals. The package provides for on-line testing and evaluation, and features several unique methods for optimizing instructor-student rapport via a computer terminal device.

Air University

The Air University is an organizational structure that focuses on officer education. The University includes two schools, three institutes, and two colleges.[1] With one exception, these activities are located at Maxwell AFB, Alabama.

Several different simulations are used in each of the major courses. Simulations began in 1974, when the International Relations Exercise was offered to students of the Air War College (AWC). The Force Posture Planning Model is the largest application for the AWC. As part of a National Security study, it includes 35 hours of computer support. In the area of student research, the Army War College's Digital International Data Base and Retrieval System has been adapted for AWC use.

The Air Command and Staff College students receive a tactical theater air warfare simulation and a systems analysis exercise. Simulations, models, exercises, and games of the University are executed on a Honeywell 6060 computer which is located a short distance away at Gunter Air Force Station.[2] Students access this system through one of fifty-six remote terminals (portable and nonportable) located in various classrooms. Figure 20 shows a typical terminal device used for simulations conducted at the Air University.

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[1]The Air University consists of: Squadron Officer School, Academic Instructor and Allied Officer School, Air University Institute for Professional Development, Air Force Institute for Technology, Aerospace Studies Institute, Extension Course Institute, Air Command and Staff College, and Air War College. Frederic R. Westfall, "An Air War College Computer Step Forward," Air University Review, March-April 1974, p. 72.

[2]The Honeywell 6060 is the standard Worldwide Military Command and Control System computer (WWMCCS) being installed in the major service headquarters throughout the world. Interview with Eldon F. Oldnettle, Director of Data Automation, Air University, Maxwell AFB, Alabama, while in Washington, D.C., 3 April 1974.



Fig. 20. An Air War College student enters data for the force posture planning model phase of the National Security Study using a Hazeltine 2000 cathode-ray tube terminal which is on-line to a Honeywell 6060 computer.

SOURCE: Joseph P. Brazy, Instruction & Resources Division, Directorate of Curriculums & Instruction, Air University, Maxwell AFB, Alabama, 6 May 1974.

Chapter VI

THE DEPARTMENT OF DEFENSE INSTITUTIONS AND COMPUTER ASSISTED TRAINING

The Industrial College of the Armed Forces

The Industrial College of the Armed Forces (ICAF), located at For McNair in Washington, D.C., is a tri-service senior service college with a mission of preparing selected senior officers and civilian officials for key policymaking roles in the national and international security structure. In this context, three simulations are conducted each year to focus attention on the dynamic aspects of national security affairs. The earliest version of the Management Decisionmaking Exercise was conducted at ICAF in 1961.[1] This simulation deals with decisions concerning the maximum effective allocation of limited resources in a simulated, competitive business situation. The second simulation is the International Relations Exercise which places students in key roles in one of eight nations with conflicting goals. Finally, the Defense Management Simulation calls for the students to procure a surface-to-surface missile with specified time, budgetary, and performance constraints.

These simulations are supported by several computer options. The students use teletype terminals located in the classrooms to interface with the College's General Electric 105 computer (see Figure 21) which serves as a front-end processor to one of three time-share computers available for the simulations--Rome Air Development Center's Honeywell (GE) 635 at Griffiss Air Force Base, New York; Honeywell's 6080 in Minneapolis; Leasco's Hewlett Packard 2000 in Bethesda, Maryland.

Defense Systems Management School

The Defense Systems Management School located at Fort Belvoir, Virginia provides training for middle-level managers of the military services in systems management. The class is divided so that five students are assigned to each of the twelve simulation rooms to engage in group exercises that deal with materiel acquisitions. They interface with the General Services Administration's time-sharing UNIVAC 1108 via a General Electric Terminal 300 keyboard terminals. Additionally, TV monitors are located in each room for use by the instructors to send messages to the students during the exercises.

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[1] William T. Minor "Computer-Assisted Simulation at the Industrial College." Perspectives in Defense Management, February 1969, p. 33.



Fig. 21. Industrial College students engage in computer-assisted simulations via the TI Model 700 portable terminal (shown above), the Hazeltine 2000 CRT terminal, the Western Union ASR Model 33, and Model 300. Data is transmitted to time-sharing computer systems using the General Electric Model 105 (background) as a front-end processor.

SOURCE: Charles M. Crawford, Visual Aids Section, Support Services Branch, Industrial College of the Armed Forces, Washington, D.C., 12 December 1974.

The System X management system operates as a series of twenty-nine cases spaced throughout the course, tracing the acquisition life cycle of a weapon system. Program management simulation exercises are processed through the school's Honeywell (GE) 105 to a leased computer system. This cost, negotiation, and trade-off expertise serves as the capstone problems for the twenty-week course. A 1974 edition to the curriculum is the Multiple Incentive Contract Analysis Program which complements the System X series by allowing the student to analyze the implications of alternative incentive contract structure.

Armed Forces Staff College

The Armed Forces Staff College at Norfolk, Virginia, brings together officers from all the military services for a five-month course of study in joint and combined operations to include planning, operations, and related aspects of national and international security. During the course, three major exercises or games are conducted which are assisted by the student use of teletype terminals connected to the college's Hewlett Packard 2000F minicomputer. [1]

A one-day game called Resource Optimization Model Exercise provides the students with an opportunity to apply their newly acquired knowledge on the budgeting funds in the procurement of new weapons systems. For a tactical model, the college also offers a Simulation of a Nuclear Strike Plan. The largest simulation is the Joint Operations Planning Exercise which causes the students to develop time-phased transportation and deployment plans for a theater-size operation. In Figure 22 students are shown making input into the exercise by remote terminals.

DOD Computer Institute

The Department of Defense Computer Institute (DODCI) was established as a joint activity in 1964. Since its inception, about 16,000 senior and mid-management level officers and civilian executives have attended regular resident courses at the Washington Navy Yard facility. Additionally, over 4,000 students have been taught on-site by DODCI travel teams at DOD organizations worldwide. DODCI presents both general and technical management-oriented education in computers and computer-based information systems. The DODCI policy of student immersion dictates heavy exposure in a remote terminal time-sharing computer environment to acquire an appreciation of software program development and capabilities. As part of the training environment, students get hands-on experience with computer terminals and a Hewlett Packard 2000 minicomputer.

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[1] Patrick Ward, "Military College Selects In-House Mini for T/S Use," Computerworld, 27 March 1974, p. S/16.

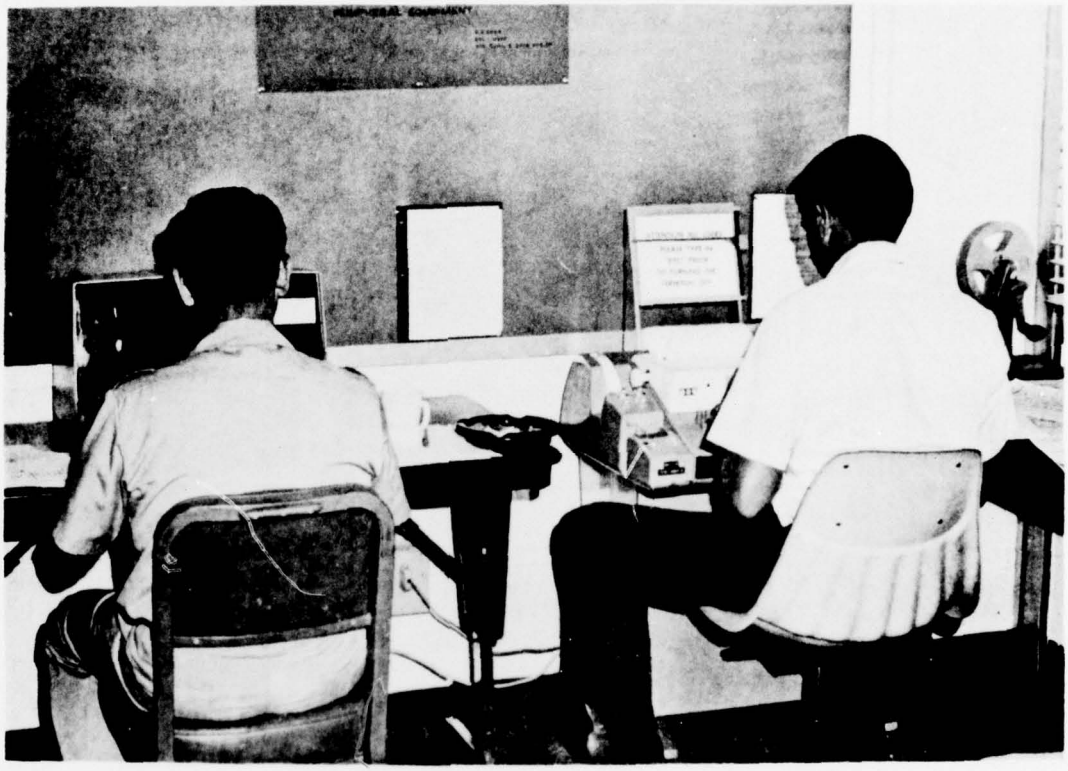


Fig. 22. An Army student (left) checks the accumulation of exercise data by making a query of the data bank on a Hewlett Packard 2600A (also identified as a Data Point 3300) cathode-ray tube terminal in order to obtain a visual display of data. Meanwhile, an Air Force student (right) sends input data over a Teletype Model 33 terminal to the college's Hewlett Packard 2000F minicomputer.

SOURCE: John I. Kineke, Deputy Director, Evaluation and Data Systems, Armed Forces Staff College, Norfolk, Virginia, 9 May 1974.

This institution is unique in that its highly qualified and experienced faculty is a balanced mix of officers representing all the military services plus civilian personnel. See Figure 23 for a classroom application.

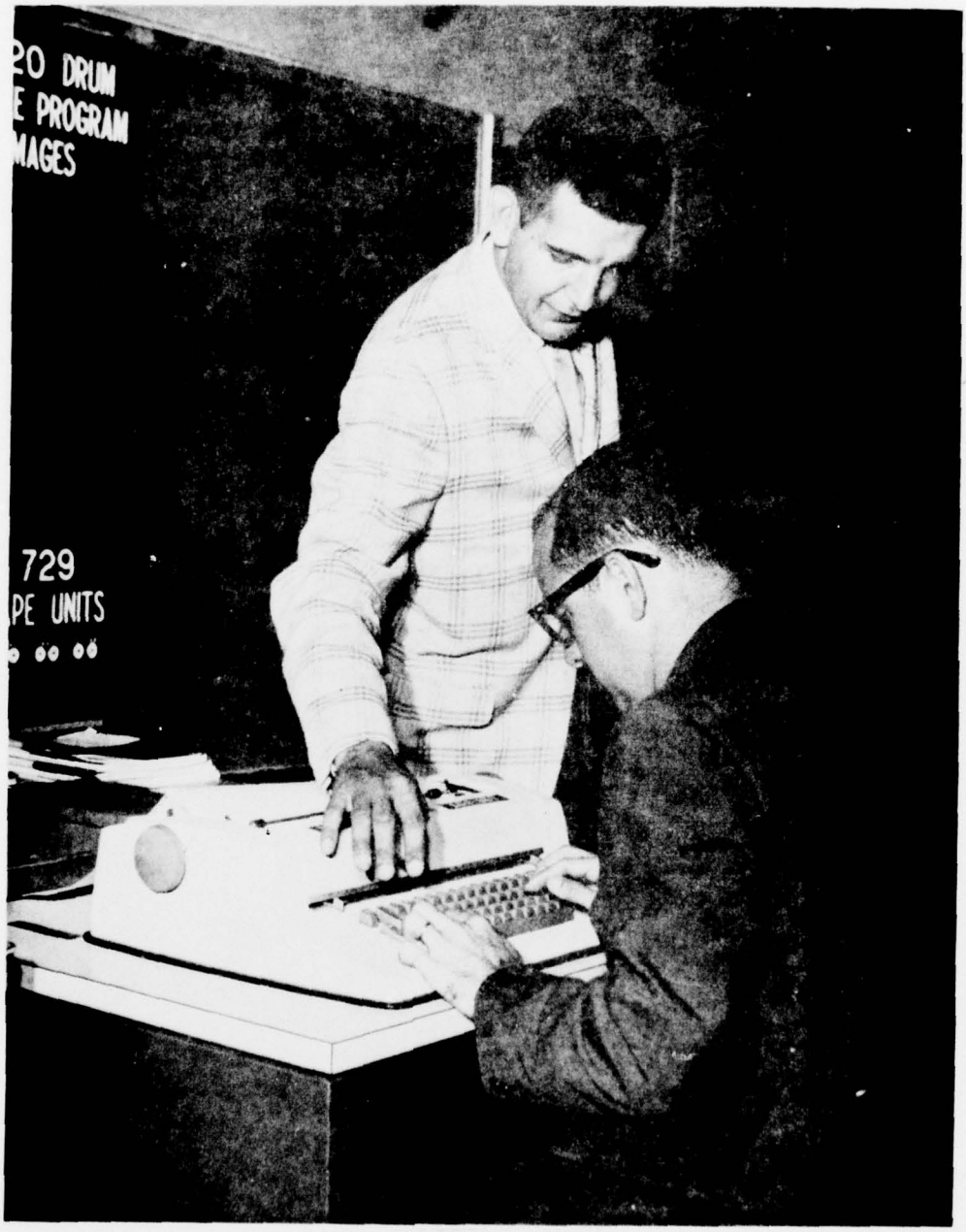


Fig. 23 A DoD Computer Institute student learns how to enteract with a time sharing system using an IBM Communicating Magnetic Card Selectric Typewriter in an on-line mode

SOURCE: Robert Best, Chief Visual Aids, Department of Defense Computer Institute, Washington, D. C., 31 March 1975.