COMPUTER AIDED LEARNING AT UTC

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Introduction

With approximately 8,000 students, 250 plus faculty, and a primarily undergraduate orientation, the University of Tennessee at Chattanooga is very typical, in terms of mission, role, and scope, to other four year state colleges and universities. Somewhat unusual are the computer resources dedicated to instruction and research at UTC. With both a HP2000 and HP3000 allocated solely to instruction and research, with over eighty terminals accessing these computers and with a vigorous acquisition program for selecting quality software, UTC has "infused" computing into many areas of its curriculum including several unusual subjects. Additional computing via the network approach is also done at UTC for both instruction and research. This presentation will detail these efforts in terms of four areas - problem solving, data analyses, simulations, and computer-aided instruction. In addition, the topic of research computing will be discussed in terms of packages, availability, and general utility. The thrust of this presentation will be that of detailing the ingredients for establishing a successful academic computing service and maintaining that service for students and faculty.

General

The program to promote computer literacy at UTC has been in existence for six years. Prior to the establishment of Academic Computer Services student computer programs were run on a local basis on an IBM 360/30 or remotely for a brief period on an IBM 360/65. There was little or no

provision for Computer Aided Learning (CAL).

The Office of Academic Computer Services opened on July 1, 1975 with the objective of providing competent and comprehensive computer facilities to faculty and students in the areas of instruction and research. For the past six years, the Academic Computer Center has sought to fulfill this goal. It was originally staffed by a full-time director and secretary; since then, another full-time employee has been added and student-programmers have been hired on a part-time basis. Funded by the University of Chattanooga Foundation, an HP2000 was installed in October 1975 and was linked to thirty-two terminals located in clusters around the campus. In November 1978, a second academic system, an HP3000, was installed along with additional terminals.

The six years since 1975 have been spent in consolidating these systems and acquiring programs suitable for college level usage. During this time, efforts have been made, using newsletters and workshops, to introduce the faculty to the facilities available and to encourage them to undertake authoring projects and research.

Usage

Departments with heavy usage of Academic Computing include Business Administration, Mathematics, English, Engineering, Computer Science, Psychology, Chemistry, Biology and Physics. Moderate usage is experienced in each of the departments of Economics, Education, Criminal Justice, Political Science and Sociology. Other departments, such as Music and Home Economics,

make occasional use of the services.

More impressive is the fact that departments not normally strongly associated with computer expertise have asked for and received services. Two examples of this spread of computer knowledge are the Music Department, which has a terminal for drilling students in music rudiments, and the English Department, which has a dedicated cluster of terminals for Computer Aided Instruction (CAI).

Faculty Involvement

At this point, it should be emphasized that the faculty participate not only by using our facilities but go far beyond that by being strong initiators of new programs. Many of the faculty have devoted endless hours to writing new packages, creating CAI materials, reading professional journals for software sources, entreating Academic Computing to purchase materials of interest, and evaluating these materials once installed.

One of the most important software sources is CONDUIT, which is located in Iowa City, Iowa on the campus of the University of Iowa. CONDUIT's purpose is to locate quality software appropriate for undergraduate education (which often includes the high school level), to package it in a form that is widely and easily transportable, and to market these materials nationally. CONDUIT, which has some NSF support as well as other federal funding, has published three CAI packages authored at UTC and is currently reviewing two more. In addition, the next issue of the CONDUIT publication, PIPELINE, will contain a panel discussion authored by UTC faculty and staff, on an English CAI project at UTC.

Although not a CONDUIT package, a statistical package for the HP3000 has been developed by a psychologist on the faculty. This interactive package is being marketed by the university with profits being shared by the university, the Psychology Department, Academic Computing, and the author.

Such national recognition is strong motivation for both faculty and administrators becoming involved in instructional computing and chasing those scarce resources of time and money necessary to make it successful.

Academic Computing Services

Throughout the year Academic Computing Services offers free short courses to faculty and staff. These courses cover topics such as authoring languages, as well as EDITOR, EDIT2, SPSS and the BASIC language. The typical course covers a five week period and consists of a one hour meeting per week. In addition, consulting services and portable terminals are made readily available on a reservation basis for faculty and staff.

In the spring of 1979, we undertook a new procedure. At the request of the Nursing Department we instituted an intensive two and one-half day seminar on Instructional Dialogue Facility (IDF), an HP2000 CAI authoring language. Participants were taught how to use the facility to write and edit their course material. Each person produced a mini-package containing four or five multiple choice questions related to the nursing instructor's area of teaching. This project was well received and successful enough to encourage us to utilize the same format again.

UTC has obtained a program from CONDUIT which enables the user to translate packages written in IDF into BASIC. Thus, it is not necessary

for our faculty authors to learn a computer language in order to produce a transportable CAI package.

When a package is needed on the HP3000 that is indigenous to a special computer or authoring language, student programmers convert this package into HP3000 BASIC or FORTRAN.

Documentation is accomplished by producing a quarterly newsletter and manuals appropriate for local use. Manuals in production are Pocket Guide to the HP3000, HP2000 Users Guide, UTC User's Guide to the HP3000, Computer Assisted Instruction at UTC, Users Guide to IBM 370 System at UT-Knoxville, and many short pamphlets on miscellaneous subjects such as EDITOR, BASIC, and COBOL.

Inventory of Courses

Every second year, all departments are contacted and asked to return a one-page questionnaire on each course within their department which made use of the computer. These questionnaires ascertain which computer systems were utilized, how many students were involved and whether the role the computer played in relation to the course was required, enhancement or supplementary. Table I, based on data collected in these inventories of courses, shows the increase in computer usage over the period 1976 to 1980.

TABLE I

Inventory of Computer Usage in Courses by Discipline

Department	Number of Courses Utilizing Computing 1976	1978	1980
Art	0	0	2
Biology	0	2	2
Business Administration	8	8	14
Chemistry	7	7	8
Computer Science	10	13	20
Criminal Justice	0	0	3
Economics	1	3	0
Education	2	9	3
Engineering	16	15	19
English	0	2	3
Foreign Language	0	0	10
General Science	1	2	4
Interdisciplinary Studies	0	0	1
Health and Physical Education	1	1	1
Home Economics	0	2	4
Mathematics	11	14	11
Music	4	4	5
Nursing	0	0	1
Physics	5	7	3
Political Science	1	1	2
Psychology	8	9	5
Social Work	0	0	3
Sociology	1	1	3
Total	76	100	127

These inventories enable Academic Computing to keep, in a centralized location, instructions on how to utilize the computer materials, the end to which they are intended, and other pertinent information the instructor deems appropriate. This is abstracted each year into the form required to update the CAI manual for UTC.

Focus for Academic Computing

Through surveys, needs analyses, departmental self-studies, and literature research, Academic Computing focuses perceived needs into a five-year plan that is updated each year and extended for one year. This is presented to the Chancellor and his staff for review, critique, and approval. When finalized, it generally becomes a part of the projected capital budget plan. Hence, the finance officer is able to plan in a consistent, open fashion for legitimate, required computer expansions.

UTC early opted for the complete separation of academic and administrative computing. Each area has its own equipment and each is headed by its own director. Furthermore, the Director of Administrative Computing reports to the Vice Chancellor for Administration and the Director of Academic Computing reports to the Vice Chancellor for Academic Affairs. These separated organizational lines are important in keeping Academic Computing's interest visible, viable, and paramount to the university community. By tying Academic Computing into the instructional side of the university, its success is ensured in meeting student, faculty and curricular needs. By keeping Academic Computing free of Administrative Computing's control, the "water trickling down hill" analogy does not nurish Administrative Computing by

diverting needed resources from the academic side. On any campus, organization and staff are major ingredients in the success of a successful instructional/research computing endeavor.

Problem Solving

Problem solving at UTC is defined as the process wherein the student designs, constructs, tests, and evaluates his/her own program, and is distinguished from other computing by calling it programming. The two dominant programming languages at UTC are BASIC and FORTRAN. These account for well over 90% of programming activity. Surprisingly, BASIC is firmly entrenched in Engineering and more problem solving is done among engineers in BASIC than in FORTRAN. Computer Science, on the other hand, favors FORTRAN over BASIC and, except in personal computing and service type courses, BASIC is not used. PASCAL is a major need at this institution since our campus is about to shift from FORTRAN as the basic Computer Science course to PL/I on a remote computer. UTC believes that the imminent HP announcement of PASCAL's availability on the HP3000 will be attractive and cause UTC to review its decision to use PL/I.

COBOL or COBOL II, coupled with IMAGE Data Base package, is the resource used in teaching our data base course. Some use of KSAM may occur in conjunction with this. APL is utilized by an advanced language course but is a disappointment in terms of system's load, requirements for special terminals, and minimal desirability for either Computer Science or Engineering. Although SPL has been taught once to students in Computer Science, it is neither a popular language nor a necessary language. Students requiring assembler

language are required to utilize IBM's Assembler at our remote IBM computer.

The growth in all areas of computing, particularly in problem solving, is indicated by the statistics kept on the three systems available at UTC. In 1979 and 1980, usage on the HP2000 system was 42,757 hours and 42,810 hours, respectively. On the HP3000 system, installed in 1978, connect time (in hours) increased from 9,183 hours in 1979 to 18,607 hours in 1980. The number of jobs submitted via RJE to a remote IBM system increased from 35,924 jobs in 1978 and 39,074 jobs in 1979 to 50,997 jobs in 1980; this is an increase of 42% between 1978 and 1980.

The PLOT10 graphics package of Tektronix is widely utilized on the HP 3000 and is accessed by both Tek4010 and 4025 type terminals. PLOT10 is a set of graphics subroutines callable from FORTRAN. Hence, PLOT10 users write programs calling these routines, which makes this package also problem solving. This package has been available from Tektronix at a one time purchase cost of $500, and is vary satisfactory.

The use of terminals to send programs and data to UT at Knoxville, which has twin IBM 370/3031's, has accelerated from nearly nothing to several hundred per day. Although currently this transfer is performed on the HP2000, it will be shifted to the HP3000 this summer using MRJE, SPOOK, and the Robelle editor QEDIT. All departments are de-emphasizing cards and instead focusing on distributed computing via terminals including the HP2621 and others.

MPE III and apparently MPE IV are excellent operating systems that are

both capable and friendly. Problem solving fits well within the system. PASCAL, when available, will be of major utility. It is needed now. On the other hand, the HP3000 needs a new ANSI package, FORTRAN 77, on the software side. On the hardware side, HP limitations on the multiplexor throughput, response time degradation in a loaded system, and relatively slow internal speeds, could be alleviated by going to a 32 bit architecture or providing a floating point hardware box to accelerate such computations.

Data Analysis

Data analysis, a euphemism for statistics, is accomplished largely with canned packages. UTC utilizes a wide variety of these on both the HP 2000 and the HP3000. Sources vary from proprietary to contributed library to home grown.

On the HP2000, UTC maintains IDA developed at the Unviversity of Chicago, GUS from the University of Iowa, SPSSHP from DePaul University, and PSY developed at UTC. IDA and PSY are complimentary packages and each has been modified to accommodate easy transfer from each to the other. Although many institutions are familiar with IDA, they may not know about PSY, which provides inferential tests of statistics in a IDA type environment of commands and data. Questions concerning SPSSHP must now be forwarded to SPSS, Inc. as the authors are no longer with DePaul University.

On the HP3000, UTC utilizes the very excellent versions of SPSS and BMDP (BioMedical Data Package) that are available from McMaster University. SPSS is the primary package for research, but the many specific models

available in ANOVA make BMDP a valuable tool within instructional computing. The previously mentioned packages, BMDP and SPSS, are both for research and instruction but are batch oriented. A major instruction system at UTC is QSTAT, which was written locally. It is an extension of the previously mentioned PSY and utilizes an IDA approach to commands and data within the inferential area. It also maintains an extensive HELP command and a very flexible BACK command to allow users to undo mistakes in commands.

Interactive Statistical Economic Analysis, ISEA, is available from Dr. John Eaton, London Graduate School of Business. Our economists are funding this package, which provides the specialized statistical tools required in economics. Instead of depending on remote IBM usage of SAS, our institution is making extensive use of ISEA.

The use of these statistical packages in instruction varies from beginning statistics courses to graduate courses requiring analyses. Although most usage is in basic statistics courses, educationists, sociologists, psychologists, economists, and political scientists routinely require computer analyses of data bases as part of course requirements.

Many old, but still good, data sets on Sociology and Political Science are available from CONDUIT. National Opinion Research (NORC) has a major data base of 9120 cases with 640 variables on sociological issues and trends for the years 1972 to 1977 available from CONDUIT. Four major historical demographic data bases are available from the Laboratory of Political Research at the Univeristy of Iowa. The U.S. government and its agencies, such as the Census Bureau, also have many data bases of interest to educators.

Certainly local faculty are capable of building important data bases to support their research. For example, a faculty member is currently examining thousands of pieces of data collected from German cities circa 1600 to determine principal food grains and how the fluctuation in grain prices related to taxes, inflation, and standard of living.

A somewhat unusual data base and package is a nutrition package, written in COBOL, acquired from Clarke College, Dubuque Iowa. The package was modified from a PDP II system to accept KSAM and EDITOR input files. This program analyzes an individual's diet for a one meal, one day, or several days, in terms of basic nutritional requirements. It is an unusual data base in that individuals may select dietary needs from categories such as lactating mothers, small children, or adults with low sodium diets and have their diets analyzed in terms of calories, fats, minerals, and vitamins for hundreds of food items. Such data bases and associated packages are a good means of introducing computing into departments traditionally not computer oriented.

Simulations

For many students, especially those in the Natural and Social Sciences, simulations via the computer offer possibilities otherwise unavailable. Of course, simulations do not have to be performed on the computer, however, such simulations offer the speed, interaction, and graphics necessary for viable, realistic curricular experiences. For UTC the most important simulations have been those from CONDUIT (see Table II).

TABLE II
CONDUIT SIMULATION TYPE PACKAGES

BIOLOGY
- ANAEROBIC GLYCOLYSIS
- COEXIST - Population Growth
- COMPETE - Plant Ecology
- ECOEXX 1 - Mark Recapture Experiment
- ECOEXX 2 - Population Growth Models
- ECOLOGICAL MODELING
- ENZKIN - Enzyme-Catalyzed Reactions
- ENZYME - SEQUEN:
  - Enzyme Substrate Interactions
  - Amino Acid sequences of proteins
- EVOLUT - Evolution Genetics
- LINKOVER - Genetic Mappings
- TRIBBLES - Scientific Method

CHEMISTRY
- FIRSTLW - First Law Thermodynamics
- HABER - Haber Simulation Ammonia
- IDGAME - Qualitative Organic Identification
- KSIMS - Kinetic Experiments
- NEUTRON - Neutron Activation
- NMR - Nuclear Magnetic Resonance
- RKINET - Chemical Reaction Kinetics
- QUANTUM - Quantum Chemistry
- TITRATION - Titration Ionic Equilibria
- XRAY - Xray Crystallography

SOCIOLOGY
- CHANGE AGENT
- DEMO-GRAPHICS
- PROFIS - Introductory Sociology
- USPOP - US Population Studies

PSYCHOLOGY
- COGNITIVE PSYCHOLOGY
- IMPRINTING
- SCHIZOPHRENIA

PHYSICS
- ENERGY and ENVIRONMENT
- GROUP VELOCITY
- ICBM I - Computer Based Mechanics
- INTERP - Wave Superposition
- MECHANICS - Physical Mechanics
- NEWTON - Satellite Orbits
- QUANTUM MECHANICS
- SCATTER - Nuclear Scattering
- USING COMPUTERS IN PHYSICS

MANAGEMENT
- BUSINESS DECISION SIMULATIONS
- BUSINESS - Management Laboratory
- COMPUTER MODELS IN OPERATIONS MANAGEMENT
- COMPUTER MODELS IN OPERATIONS RESEARCH
- EXECUTIVE GAME
- FINANSIM - Financial Management
- MARKETING IN ACTION
- SIMQUEUE - Queueing Theory

OTHERS
- INS2 - Inter-NationSimulation
- CRITICAL INCIDENTS IN EDUCATION
- COMPUTER SIMULATIONS MACROECONOMICS
- MODSIM - Economic Modeling

Several of these from CONDUIT can be used to illustrate the concept of simulation. Critical Incidents in Education is a set of twenty plus scenarios on classroom management problems such as breakage of science equipment, passing of love notes, and obscene phone calls. This is excellent exposure for the student teacher before the real classroom experience. Another simulation is HABER, which involves the synthesis of ammonia commercially. The actual experiment is lengthy (over six weeks) and so expensive it is seldom done in the classrooms. Hence, HABER is realistic for collegiate education since it can be done quickly and at low cost on the computer.

Another simulation is the NDTRAN (available for the HP3000) simulator from Notre Dame. This package allows one to construct the equations governing a model and its constraints, to model the system over a speeded-up time period, and to summarize the results for easier interpretation.

UTC has acquired also simulations from the chemistry departments at Western Washington State and Illinois Institute Technology, as well as from the Hewlett Packard 2000 Contributed Library (HPGSUG). A number of other sources exist, including Lehigh's Economics and Limits to Growth, University of Wisconsin at Madison's FCHART simulation of a solar dwelling, Hunington II simulations from DEC, and numerous packages detailed both in Creative Computing and BYTE magazines.

Although canned programs to find the solution to a specific class of problems may not be simulations in a literal sense, the inherent model is there for use by the student. More importantly, they can be adapted from textbook exercises. As examples, consider the canned programs to calculate a bond return, worth of a stock portfolio, drawing of random phone numbers for interviewing, electrical values for a circuit, or the size of structural members for a building. These valuable programs are available through the HPGSUG contributed tape library. Good programs can be rented or purchased from software and engineering firms. Through shared national facilities such as EDUNET, an individual anywhere can access over twenty major campuses with extensive software libraries of heterogenous and complimentary holdings (EDUNET may be contacted directly or through EDUCOM).

CAI

The largest CAI project at UTC has been one involving basic English skills. In the spring of 1977 the Administration, the English Department and the Office of Academic Computing jointly endorsed a proposal to use a major English CAI package for at least one year. Initial planning called for this package to be assigned to one third of the freshman class, with each of the 600 student participants being allocated from nine to twelve hours of CAI work during the Fall 1977 semester. The package was developed by the Computer Curriculum Corporation (CCC) of Palo Alto, California. This firm no longer markets Basic English for Remedial Students as a software package, but instead includes it with hardware on a turn-key basis. CCC is a valuable source for other CAI software in the areas of reading and mathematics. At the conclusion of the first semester of using the English CAI, a survey established that, of the students using the CAI, 23% felt that access to these programs had materially altered their grade. At the end of four years of operation, a new English course was established with this package as an integral, operating mode of instruction.

Eleven units of descriptive statistics for use in graduate education courses and nearly twenty units of freshmen chemistry were acquired from the University of Akron. Although originally in IBM's CW III, they were converted to HP's CWF and are currently being translated into BASIC.

Two major systems in remedial algebra, drill and practice, have been authored for our Mathematics Department. In addition, a faculty member in Sociology has written one dealing with basic sociological terms.

A music package covering theory from the Music Department at the University of Iowa has had considerable success. With over twenty programs, it can give students extensive drill and practice in this innovative area.

CONDUIT has two notable CAI packages. The first is DIALOGUE for the area of English grammer and the other is SPANCOM for the teaching of Spanish. Another major source for quality CAI is the Association for Development of Computer Based Instructional materials, (ADCIS), which has many member firms and individuals who sell, swap, and distribute CAI.

The process of developing CAI is in a continual state of evolution and development. However, experience has shown us that the usage of CAI is increasing and has a definite educational value. Our academic departments are increasingly finding that extending their computer literacy is a worthwhile investment of their time.

Summary

In this paper we have described the sources for the academic software available to UTC users. This paper thus may provide fledging computer centers or new HP3000 users with a list of places which can be contacted for academic software. HP users entering the area of instructional computing frequently call UTC to determine where applicable software can be obtained or purchased. Although UTC has a small department of Academic Computing Services, it has been able to provide the faculty with a full range of CAI, simulations problem solving, and data analysis, in part because of the wide range of nationally obtainable software.

UTC's Office of Academic Computing is a major strength for the support

and effectiveness of computing at UTC. UTC particularly espouses the enrichment of the curriculum with computer related experiences. To that end, a continual and diligent search is made to secure quality educational software that is relevant to UTC's academic programs.