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ABSTRACT

The University of Texas is heavily involved with computers in instruction. The computation center, with a Control Data 6600 and 6400, has a great number of course programs and a high usage level. With the NSF a southwest regional computer network was established to share in these programs, and there are 23 institutions currently involved. It is theorized that there is a cycle inhibiting the effective use and generation of computer-based education materials, and the NSF has two projects to break this cycle. The Computer-Based Education Project at the University of Texas will seek to produce and demonstrate quality material, while the CONDUIT Project will try to improve undergraduate education in a cost effective manner by the exchange of computer-related curriculum material. The five major computer networks, which include the University of Texas, form the administration structure and control of CONDUIT. There has been some progress, especially in the setting of independent evaluation procedures. At the University of Texas support for the instructional use of computers continues to increase. (WH)

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COMPUTERS IN INSTRUCTION

A Keynote Address to the
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by

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COMPUTATION CENTER

THE UNIVERSITY OF TEXAS AT AUSTIN

COMPUTERS IN INSTRUCTION

Few of you here will immediately relate the name of the University of Texas with computers in instruction. You may be surprised, however, at the degree to which computing has been incorporated into the curriculum on the UT-Austin campus.

For example, computer-assisted instruction is a real on-going practice with hundreds of students in chemistry and geology spending thousands of hours at console terminals interacting with instructional modules. To provide this service, we developed our own conversational language for instructional computing, which is a superset of Coursewriter II and FORTRAN IV, and we have implemented the supporting management software to create a complete CAI system.

With a new computer-augmented lecture technique, instructors are using the interactive system with rear-screen projectors before large classes. This permits instructors to carry out complex calculations before the class, instead of leaving the difficult problems as class exercises.

Other instructional uses of computers at Austin include computer-generated repeatable examinations, simulations, and class record keeping systems for faculty teaching large class sections. Our Computation Center also provides a vast library of instructional programs and general service routines such as mathematical and statistical analysis programs.

Some idea of the amount of computer involvement in instruction can be seen from the following table:

Computing Activity at UT-Austin, 1972-73

	Number Classes	Number Students	Programs Run	Computer Hours	Time Sharing Hours
Undergraduate Classes	497	17,900	293,000	590	20,800
Graduate Classes	223	3,600	72,500	240	7,400
All Other (Including Student Research)	___	___	476,500	6,450	67,600
	720	21,500	842,000	7,280	95,800

During this period, 45 different academic departments used the interactive time-sharing system.

Academic computing has been centralized at UT-Austin for many years. We have a seven-year-old Control Data 6600 and a younger 6400 which are connected through a large core memory and through a large mass storage system. The computers operate independently but share a common file system. They are used exclusively for academic purposes with all data processing being handled in a separate business office computer. The 6400 is serving the interactive users through 128 timesharing ports, and the 6600 is handling the batch load through 16 remote batch entry terminals. There are also other computers serving special academic needs on the campus, but nearly all are interconnected with the 6600 forming a campus computer network. Like most institutions with large computer facilities, Texas has used its computers primarily for support of large research projects, particularly in the natural sciences. Things have changed, however, and we have seen a substantial up-swing in the use of computers in instruction.

Texas served as the host or supplier institution in one of the National Science Foundation regional computer networks during the three academic years 1969 to 1972. We had nine other colleges and universities engaged in that experiment, and it proved to be a successful one. Today we have 23 institutions in our educational network, which is operating without any NSF support.

The success of the southwest regional network was similar to that of other regional networks. That is, we succeeded in the technical aspects of getting terminals and communication lines installed and checked out, and interactive and remote batch services were brought to a stable, reliable state. Unfortunately, however, most of the network projects were too short to do much more than get themselves underway, and even then a number of them faltered and disappeared.

The really important questions relating to the effectiveness of computers in instruction went unanswered for the most part. Therefore, the NSF launched a separate project addressed to these questions with the EDUCOM study on "Factors Inhibiting the Use of Computers in Instruction" which was directed by Dr. Ernest Anastasio.

In the final report, Dr. Anastasio stated that the major question to be answered was "how can <u>evidence</u> of effectiveness be provided?" The following circular sequence of answers evolved: To provide evidence of effectiveness, one must conduct a convincing high quality demonstration; but this requires good computer materials; and good materials can only be prepared by people who know theories and methods of instruction. To get good people, one needs professional recognition and economic incentives, which in turn require evidence of the value of the pursuit and a formal production-distribution system. And these require a market. To get a market one needs a demonstration of effectiveness, and we've closed the loop. Hopefully an infusion of funds somewhere in the loop would help break the cycle.

Computer-Based Education Project

The National Science Foundation has joined the University of Texas at Austin in an attempt at breaking this cycle in the area of production of quality computer materials and demonstration of these materials. They have established the Computer-Based Education Project, which is a five-year curriculum development effort with four primary goals: (1) to identify the common concepts among disciplines, (2) to develop evaluation schema, (3) to develop transferability criteria, and (4) to develop an implementation model. Directed by Dr. J. J. Allan and Dr. J. J. Lagowski, Project C-BE is applying current technology and currently available devices in concert with sound pedagogical practice.

Ultimately Project C-BE will involve 75 professors and over 4,000 students in 44 different curriculum development and demonstration projects. The project is entering its third year and its impact is readily apparent. For example, this semester 25 of the sub-projects will be testing computer-based instructional modules with 1,200 students averaging 2,000 console hours per week. A wide spectrum of disciplines is represented including physics, chemistry, psychology, engineering, statistics, biometrics, linguistics and home economics.

Without any question Project C-BE is helping to bring about changes in the educational policies of the university, including a change in the university attitude toward the allocation of computer resources.

CONDUIT Project

The National Science Foundation has also launched another project to break the Anastasio cycle by attacking the problem of the formal distribution system. The NSF brought together five of the successful regional computer networks, including Texas, to undertake a study of transportability and dissemination of computer-related curriculum materials. The name of the project is CONDUIT.

The five computer networks comprising CONDUIT include those centered at Dartmouth College, the University of Iowa, the North Carolina Educational Computing Service, Oregon State University, and the University of Texas at

Austin. Each of these institutions offers a unique set of resources: No two have the same type of computer system, and together they provide instructional computing services to 275,000 students at some 100 institutions of higher education. Representing almost 5% of the institutions of higher education, the CONDUIT networks provide an ideal experimental base for a study of the transportability and dissemination of computer-based teaching materials.

CONDUIT Objectives

The visionary goal of CONDUIT is to use the computer to improve undergraduate education in a cost-effective manner by the exchange of computer-related curriculum materials. We believe that exchange can significantly multiply the benefit of expenditures on curriculum development. However, we realized that an attack on this problem required a study of the movement and dissemination of curriculum materials. This study became our operational goal. The curriculum materials being studied run the gamut from simple computing exercises, to instructional modules, fully integrated curricula, computer-oriented texts and other adjunct materials. In planning the research program to study the movement of curriculum materials, we realized that we had an excellent model before us in the text book publishing industry. Unfortunately, though, we were also aware of numerous failures in attempts to use this industry for the distribution of computer-related materials.

Our primary objective is to look for the requisites for achieving transferability by looking at different methods of transfer. This, in turn, breaks down into some 10 sub-objectives:

1. Creating dissemination strategies which differ in the manner in which they perform their various functions.
2. Obtaining quantitative measures of "success" of dissemination.
3. Determining subjective aspects of computer-based material dissemination such as acceptance and attitudes.
4. Determining guidelines for technical transport.
5. Establishing a small, high-quality reservoir of materials based on experimentation with disciplinary review and technical verification of the materials.
6. Publicizing the availability of materials.
7. Obtaining cost-effectiveness data.
8. Determining the irreducible minimum of procedures for dissemination.
9. Providing insight into the human interrelationships that must necessarily accompany distribution activities on a national scale.

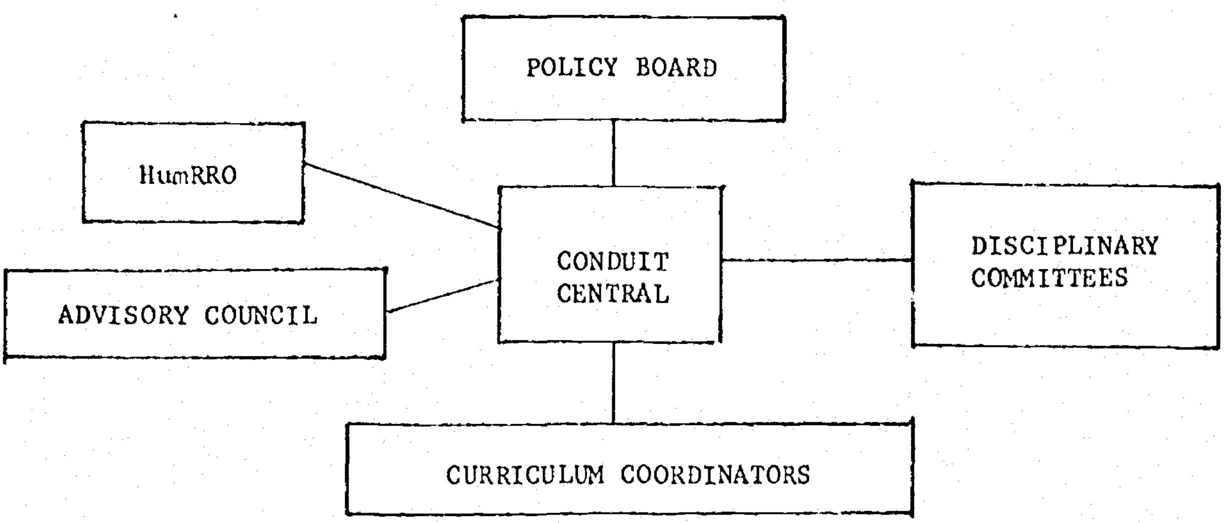
10. Determining which CONDUIT services could be made wholly or in part self-supporting and what the long-range role of CONDUIT should be in the dissemination of computer-related curriculum materials.

The intent, then, of CONDUIT is to accomplish as many of the objectives as possible during the study phase of the project.

The determination as to whether the objectives are met is a responsibility which should not reside internally but rather should be vested in a body outside of those of us actually conducting the experiment. For the evaluation function we engaged the Human Resources Research Organization (HumRRO). As it turned out HumRRO became an important contributor to the design of the experiment; that is, in the design of the vehicles through which data could be collected for evaluation.

CONDUIT ORGANIZATION

CONDUIT has developed a formal structure to accomplish its goals.



The Policy Board consists of the directors of the five computer centers that make up the CONDUIT consortium. They are Dr. Lawrence C. Hunter of Oregon State, Dr. Thomas E. Kurtz of Dartmouth, Louis T. Parker of North Carolina ECS, Dr. Gerard P. Weeg of Iowa, and myself. As its name implies, the Policy Board is the ultimate authority for all actions in CONDUIT. As such it sets or approves the long-range goals and activities of the organization.

CONDUIT Central is the executive branch of CONDUIT. It is charged with (1) the direction of the activities of CONDUIT, (2) the two-way liaison among all constituencies of CONDUIT, (3) the creation of directions and activities for CONDUIT, and (4) the liaison with the evaluation agency, HumRRO. Mr. Jim Johnson of the University of Iowa is the Director of CONDUIT and heads the CONDUIT Central organization. During the first phase of the project, Dr. Ronald Blum served as CONDUIT Director.

The Curriculum Coordinators are located at each of the five nodes of CONDUIT and are charged with implementing all local aspects of CONDUIT activities.

These three components were envisioned in the original design of the CONDUIT organization. As we moved along in the project, we recognized the need to concentrate our attention to a small number of disciplines. We also realized that we needed help from the leading proponents of instructional computing in those disciplines. We selected seven disciplines for which computer based curriculum materials were known to exist. These are: Biology, Business, Chemistry, Economics, Mathematics, Physics, and the Social Sciences.

We then set up a committee for each of the disciplines consisting of four persons with experience in and a commitment to the use of computers in the undergraduate teaching of their disciplines. The disciplinary committee members are not necessarily from CONDUIT schools. Each committee has elected its own chairman, and the seven chairmen and Dr. Karl Zinn of the University of Michigan constitute the Advisory Council. This council provides the Policy Board and CONDUIT Central with a panel which reviews plans and activities and suggests new directions for investigation.

In fact, the establishment of the disciplinary committees is one of the most important things we've done. The committees have worked wonders in locating existing computer-based curriculum materials in their disciplines. They have reviewed them and passed on to CONDUIT the materials worthy of consideration in a program of testing and evaluation.

The organization diagram does not show the indirect but very important contributions made by the NSF project monitor, Dr. Andrew Molnar. His suggestions have certainly been invaluable to us.

CONDUIT Activities

Specific activities carried out by CONDUIT thus far include regional workshops, national classroom tests, hypothesis tests, video-tape seminars, and independent transfer.

Each of these has the dual role of providing information to identify critical factors in the movement of computer-based curriculum materials, and helping to determine the relationship between dissemination strategies and user adoption.

Generally, the classroom tests have been preceded by national workshops in which faculty from schools in the CONDUIT networks are instructed in the pedagogical design and use of curriculum materials passed on by the disciplinary committees. The CONDUIT nodes have assumed responsibility for activities in one or two disciplines and the workshops for the different disciplines have been held at these sites. For example, we are handling the chemistry materials out of Texas. The attendees at the workshops come from all of the CONDUIT networks which gives a nation-wide character to the groups.

The workshop instructors have often been the authors of the computer-based curriculum materials which will be tested by the attendees back in their respective classrooms. The authors have discussed their approaches in the development of the materials, techniques of their use and experiences with the materials.

The materials presented at the workshops have been installed at all of the CONDUIT networks, and the workshop attendees have now conducted many classroom tests of the materials. This national classroom test effort has been carefully monitored by a series of 18 data collection instruments ranging from a programmer transport log to student evaluation of materials. The collection and analysis of data are being performed by CONDUIT with the results being reported to HumRRO for evaluation.

The national workshops have been followed-up with regional workshops conducted by attendees to the national ones. This secondary effort has been very important in spreading the classroom tests throughout each region.

Working with HumRRO we have also developed a set of hypotheses regarding the transportation of curriculum materials. To test the validity of the hypotheses we are using the data generated from the classroom tests. Some specific activity toward testing hypotheses has also been undertaken. There are ten hypotheses in all, but I will mention only a few. For example

Hypothesis: A market for educational computer usage and program exchange does, in fact, exist.

Hypothesis: Workshops are necessary to provide a unique combination of motivational and informational factors for the user.

Hypothesis: The greater the physical and psychological distance of the potential user from a CONDUIT network, the less likely the chance of adoption of the educational technology.

Specific activities undertaken to test hypotheses have included the design of alternate dissemination systems for materials in biology and social science. These materials were put in self-demonstrable form to compare this form of introduction with workshops. Notification to make faculty aware of the self-demonstrable materials included brochure mailings and telephone contacts. As a control, workshops were held in two different regions. We have also tested the use of video tapes as a substitute for workshops.

Some independent transfer has occurred involving the movement of materials that were not part of the formal CONDUIT classroom tests. This activity has been initiated by CONDUIT personnel who have made use of personal relationships cemented by the CONDUIT study.

CONDUIT Products

The entire evaluation effort of CONDUIT is directed toward producing several final products that will be useful for developers, for persons involved in transporting materials, and for users of transported curricula. These user products are designed to provide the academic community with information that will facilitate curriculum innovation using computer-based materials. Specifically,

Documentation guidelines will be prepared to provide a systematic set of standards for documentation of computer-oriented materials.

Selection guidelines will establish standards to guide selection of computer-based materials to be moved from one site to another.

Technical verification guidelines will define procedures for determining the correctness of a computer-oriented package after it has been imported and installed in a computer facility. Such procedures will serve to ease the process of testing and detecting errors that are either the result of technical mistakes in translation or the result of machine dependent characteristics of program operation.

Technical transport guidelines will contain a list of the common problems encountered in movement of computer-oriented materials.

The most important product of the CONDUIT experiment will be the libraries of tested and validated curriculum materials installed and in use at the CONDUIT networks and available to all who wish to acquire and use them. These will be complete packages in that programs will be backed up with all appropriate textual materials.

We have already established an on-line catalog of available materials on the Dartmouth computer for use, at present, by the CONDUIT participants.

Accomplishments to Date

In little over a year and a half CONDUIT has defined the major factors involved in the movement of computer related curriculum materials. We have established hypotheses related to these factors and engaged in activities to test the hypotheses. We have collected data on activities and published preliminary findings and guidelines suggested by the data. Our major activity has been the selection, dissemination, and local installation of 87 program modules. We have moved two integrated courses, that is, courses where computer work is an integral part of the entire course, and we have moved 9 data bases in seven disciplines for use by over sixty classroom instructors. Some 7,600 students have been exposed to CONDUIT materials, and 500 questionnaires from students has indicated positive attitudes on their use.

Future CONDUIT Activities

The results of this experiment together with other CONDUIT activities will provide valuable information about the dissemination process heretofore unavailable to the academic community. More significantly it will suggest cost-effective methods to overcome psychological and technical barriers to the movement and use of computer-based instructional materials.

While the five networks comprising CONDUIT share an interest in the experimental results of the CONDUIT study, their involvement is more basic. Each is convinced that higher education can be significantly improved through the use of computing, and each is determined to spearhead that improvement.

They have devoted personnel, resources and creative effort to the CONDUIT experiment that could have been directed toward other projects. They are determined that during the third year, CONDUIT will produce the products mentioned and will publish a definitive report on the dissemination process that will give effective direction to future transportation of computer-related curriculum materials. We also anticipate that the CONDUIT project will expand as additional schools enter the experiment.

TEXAS Outlook

At "Texas" the attention of the academic administration has turned to instructional computing in a very real sense. For example, the Provost has recently established a committee on computer-based education to advise him and the deans on directions to be taken on the use of computers in instruction. But the real evidence is that the Board of Regents has allocated one million dollars for the further development of instructional computing during the next 12 months. The University-wide Faculty Computer Committee requested the funds and is responsible for their allocation. Approximately one-quarter of the amount will go into console terminals in new teaching centers to be established in the various UT-Austin colleges. About $500,000 will go into the expansion of the interactive service, with particular attention to the support of students interacting with instructional modules. The balance will go into remote batch computer terminals and equipment for special teaching projects.

The University of Texas at Austin is in a unique position today with regard to instructional computing. This uniqueness derives from the University's large capital investments in academic computing, from the Administration's drive to incorporate this technology, and from the direct thrusts of the CONDUIT and C-BE projects on the UT-Austin campus. Texans do not undertake things in a small way. We expect large successes, and we expect to share them to the general benefit of higher education.