COMPUTERS AND TESTING, A NEW APPLICATION

by

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I. Introduction and Rationale

In today's world, especially where public education is concerned, financial austerity is the name of the game. In the last election, none of the state (California) or local (San Francisco) ballot propositions allocating money to schools, passed by the voters. All expenditures for instructors are closely supervised and frequently vetoed by agencies of the state legislature. California, once a large spender for public education, has joined the ranks of those state governments who are enforcing the voters' mandate to keep taxes down. The reduced funding that is trickling down from the Statehouse has been badly eaten away by inflation. Private institutions will feel the same pinch if the current trend of declining enrollment persists.

The California State University and Colleges (CSUC), an institution with nineteen campuses and enrollment in excess of 200,000 students and serving a geographic area of 158,693 square miles, is feeling the pinch. Computing is funded two ways. Most of the hardware and some of the computer center staff are funded by the Division of Information Systems of the CSUC Chancellor's Office. The remainder of the staff, timesharing peripherals, data communications, and supplies, are funded by each campus.

At the campus level, computing competes with the remainder of the educational support services. Unfortunately, the allocation of funds can be extremely competitive and the political climate is often anti-computer. CSUC does not maintain separate instructional and administrative computing facilities. Timesharing has been reserved for instruction and batch is shared by both sides of the house with prime time being used for academic applications. The administration does not have to be convinced to use computers, but soliciting support from the instructional powers is often difficult.

San Francisco State University is divided into eight schools. The major computer users are Business, Behavioral and Social Sciences, Education, and Natural Sciences. The Schools of Creative Arts, Ethnic Studies, Health PE and Recreation, and Humanities, for all practical purposes, do not use computing. When the equipment budget is allocated, each school dean has an equal vote. There are other competing expenses in the schools that see the value of the computer center. In view of impossible financial circumstances, the computer center must not only provide a high level of services to the traditional users, but it must strive to develop applications universal to every discipline on the campus. These applications must foster absolute dependence of the curriculum on computing. Computer services must strive for the same status of being indispensable as held by the library and the audio visual center.

One such application is computer assisted testing. CSUC has made some progress in this area, generally, and some of the campuses have been developing specialized computerized testing applications at the local level. The remainder of this paper will describe our efforts and plans for the future. It is important that our hardware and data communications configuration is understood. CSUC supports a central batch and a central timesharing facility that are accessible from each campus. Each campus has a local batch facility that also

handles RJE to the central site and their own timesharing mini-computer. The mini-computers were supplied by a single vendor and have a common operating system. A procurement planned for the near future will also standardize the local batch systems. At this time, central and local batch systems can communicate. At this time, a high speed data network that will ultimately interface with all CSUC computers is undergoing installation. (See Figure 1 for details.)

There are three major applications that make up computer assisted testing.

1. Examination scoring and analysis systems.
2. Systems of programs to construct examinations from large data bases containing test items.
3. On-line tests administration, construction, and analysis systems.

CSUC is participating in the development and implementation of all three systems.

II. Computer Assisted Test Scoring and Analysis

Most instructors find automated scoring and analysis of objective exams to be desirable, not only from the standpoint of convenience, speed, and accuracy, but because the computer can provide item response statistics too tedious and complex to be calculated without a computer. Test scoring and analysis services are easily provided by the smallest computer center. These programs are relatively easy to write, but are also readily available. Test data can be read in from keypunched cards or a timesharing terminal, but the use of mark sense cards or forms eliminates a tedious step.

Each campus within CSUC handles test analysis locally. Different procedures and programs are used. At San Francisco State University, test scoring and analysis is overseen by the employees of the testing office. Mark sense cards are processed by an IBM 519 Reproducer, and forms are read by an Opscan 100 mark sense reader. All test response data and keys are assembled on a magnetic tape and processed daily. Overnight turnaround is generally guaranteed.

Other campus computer centers handle test scoring themselves. The typical user will blame the computer center for problems with test analysis even though it may not be directly responsible for test scoring. There are several practices that will help to provide satisfied users and reduce the frustration of the computer center staff.

1. A users manual for the preparation of test data should be available. This manual should include a description of how the student must mark the test card or form, how the instructor should prepare the correct answer key, and most importantly, how the response data should be identified to prevent loss (all of the procedures we programmers take for granted!).
2. If the tests given to a number of classes are to be scored simultaneously, care should be taken to make sure that the output is very clearly labeled. It might help to separate the output for each class with a few blank pages.
3. Many analysis programs provide too much information that nobody uses. While it is important to provide necessary information, extraneous output should be removed.
4. To insure that the user understands the analysis, it would help eliminate confusion if the output includes a description of the test analysis.

III. Computerized Test Construction

Preparation of exams is a difficult and time consuming task for the instructor. Selection of good items is not easy. The maintenance of a large data base of test items multiply-keyed by discipline and item characteristics will facilitate item selection. Many faculty members can contribute to the item pool and share each others' efforts. Tests can be used for individualized or traditional group instruction.

The faculty of CSUC has developed SOCRATES (Student Oriented Classroom Analysis and Test Evaluation System), a test item management and selection system. The system is written in ANSI COBOL and is implemented on the CSUC central batch facility. Data bases are currently maintained for twenty disciplines. The editing, addition, and deletion of test items in each data base is supervised by a faculty member teaching in the discipline covered by the data base.

Interaction with the data bases does not require any knowledge of computers. Requests can be made by telephone, by RJE using data cards at the campus computer center, and soon via the CSUC central timesharing system. The instructor can request to see test items on the basis of discipline, topic, and sub-topic within the discipline, difficulty key word or concept, and type of knowledge. As each test item has a unique identification number, the instructor can request items that he is already familiar with. SOCRATES will produce, either at the central site or on the printer at the campus, a 'rough draft' of the test. The instructor can review and revise the test by printing 'drafts' until he is satisfied. At that time, a mimeograph master of the test can be processed by the printer. It is possible to request alternate forms of the test; the order of the items can be scrambled. Some instructors prefer to have a copy of an entire data base. Microfiche output is available for this purpose.

SOCRATES has been in operation for several years and is receiving heavy use. The addition of a scoring system that is under development will add to the power of SOCRATES, allowing response data to be stored with each item. The instructor will then have additional data upon which he can accept and reject items.

It should be noted that systems such as SOCRATES are not extremely difficult or expensive to write. Although the programs might be somewhat hardware-dependent since a great deal of I/O is required, the expensive part of such a system is the data bases. The data bases are transportable and at most may require some easy formatting.

IV. On-Line Test Administration Systems

Perhaps the most promising and attractive application of the computer in testing is the use of computers to administer tests in an on-line mode. Individualization of instruction is a growing concern of education. It is common for fifty students in the same course to all be at different places. Some form of automated evaluation of student learning is needed. It was that need that prompted the School of Education and San Francisco State University to seek a solution.

For two years, TESTS (Terminal Entry Student Testing System) has been under development at SFSU. TESTS consists of three subsystems: 1) The test administration system, 2) The test editing system, and 3) The test analysis system. The system was originally written in FORTRAN and run on our old statewide central timesharing system (a dual CDC 3300). The system was overcommitted, making the programs run slowly. After the installation of DEC PDP 11/45 with the RSTS/E operating system on each campus, the decision was made to rewrite TESTS in BASIC PLUS, Digital's extremely extended dialect of BASIC.

The test administration subsystem generates the tests for the student at a terminal and records student responses. The instructor can specify that a student be given up to 200 questions out of a 256-question data base. The questions can be presented in fixed or random order. The student may be allowed to change answers. Time limits may be enforced or not used. The student may be allowed to take the test one time, any number of times, a specific number of times, or until a certain score is achieved. Hints or reading references pertaining to missed questions may be displayed.

As the system may be used in a class having little student-instructor contact, full communications capabilities are included. The teacher may leave messages for single students or for all students. The students can leave general messages for the instructor or specific messages that pertain to specific test questions where the question is printed out with the student's name and comments.

The system is extremely easy for the student to use. After logging in, the student calls the testing system as a library program. If there are any outstanding tests caused by computer failure, they will be restarted. There is on-line help available to the student at each point in the program which is extremely well error-trapped. Any improper responses return prompts for possible legal responses.

The test editing system allows instructors to create exams, add, delete and modify items, maintain student lists, rekey answers, change grades, and set parameters that determine how the test is to be given and graded. The editor is extremely simple to use and forces the instructor to reconfirm any changes made to the tests. All editing functions are performed interactively at a terminal.

The test analysis system runs in background after prime time hours. The request for analysis is made interactively and the output is later produced on a high speed line

printer. Overnight service is guaranteed.

TESTS has been well liked by students and faculty. It has been used by 700 students in the past two years. More instructors request the use of the systems each semester. Future plans include the use of SOCRATES to directly create test data bases for TESTS.

V. Conclusions

Computer assisted testing has been an application that has been well used and accepted by the faculty of CSUC. It has attracted a number of new users who are now also using the computer for other instructional purposes. I have several suggestions for smoothly developing computerized testing at your institution:

1. Involve the faculty at each stage of planning. Make your system(s) flexible without providing too many confusing and unneeded options.

2. Document your programs well. Write manuals for everything that concerns the user. Seminars and instructional video tapes are useful.

3. Expect to revise the system several times. People keep coming up with useful ideas. Flexibility and modularization are essential!

4. Protect your data bases well, especially if your school has a computer science program and does not charge back for computer time.

5. Allow plenty of time to debug and test the system. Then, in the case of on-line testing, service only one class the first semester. They will find a lot of bugs that you never thought to check for.

We have found that testing as an application does not demand much of the system's resources with the exception of disk storage where data bases are needed. At this point, we don't have a disk storage problem, but have been discussing the possibilities of using cassette drives if that problem arises. The effort expended to develop and implement testing applications has paid off in generating new usage, support, and helping to make faculty and students more favorably disposed towards computing.

FIGURE 1. California State University and Colleges Computer Network

CENTRAL TIMESHARING SYSTEM: CDC Cyber 70-173, 104 interactive ports
CENTRAL BATCH SYSTEM: Dual CDC 3300's with a CDC 3170 front end

CAMPUS FACILITIES:

CAMPUS	LOCAL BATCH SYSTEM	PDP 11/45 LOCAL TIMESHARING PORTS	CENTRAL TIMESHARING PORTS
Bakersfield	Honeywell 2020	8	2
Chico	CDC 3150	24	6
Dominguez Hills	Honeywell 2020	8	2
Fresno	CDC 3150	24	8
Fullerton	CDC 3150	24	7
Hayward	CDC 3150	16	8
Humboldt	CDC 3150	16	3
Long Beach	CDC 3150	32	11
Los Angeles	CDC 3150	32	12
Northridge	CDC 3170	32	12
Pomona	CDC 3150	24	6
Sacramento	CDC 3150	32	8
San Bernadino	Honeywell 2020	8	2
San Diego	IBM 360/50	32	12
San Francisco	CDC 3150	24	8
San Jose	CDC 3300	32	12
San Luis Obispo	IBM 360/40	32	7
Sonoma	NCR Century 200	8	3
Stanislaus	Honeywell 2020	8	2

Campuses are linked to the State University Data Center in Los Angeles by a high speed data communications network. RJE is transmitted at 9600 baud. Timesharing terminals operate at 300 baud.