THE DESIGN AND DEVELOPMENT OF AN EDUCATIONAL DATA PROCESSING SYSTEM

by

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CHAPTER I

INTRODUCTION

With complex courses and large student enrollment, the problem of how to maintain records and use the data from these records occurs. There are a number of options involving the computer to assist in the maintenance of the course and its records. Computer assisted instruction involves the computer as the presentor of materials to a student with the student responding to it. Computer managed instruction involves the accumulation of data by the computer with decisions made as a function of the data analysis. The use of the computer to record grades and to analyze these data involves education data processing system. These three alternatives should be investigated as ways to eliminate the problems generated by large courses.

The initial use of computer technology in education occurred in the middle fifty's in computer assisted instruction (CAI). Computer assisted instruction involves a series of interactions between the machine and the learner, with the machine functioning in the instructional role (Morgan, 1969). The primary use of computer assisted instruction has been in the area of programmed learning or programmed instruction. This involves the placing of programmed materials onto the computer and then using the computer to present the material (Salisbury, 1971). Salisbury sites three basic programming formats -- the linear or drill and practice type, the branching or tutorial type,

and a type of branching program with the extensive use of dialogue. Each of these types of programmed material formats have been used in computer assisted instruction. In CAI, the computer presents the material and the student is required to respond to the material. Feedback in the form of the correct answer or in remedial material is then presented. At the end of the programmed material unit, the computer can then print an analysis of the student's performance in terms of per cent correct. CAI has the advantage over book presentation of the material in that the student cannot go ahead in the material without at least responding to it and the student cannot reveal the correct answer. However, the use of CAI is at the discretion of the instructor and therefore, may not be used as effectively as possible.

Computer managed instruction (CMI) has been defined by Schure[1] as:

> "... the synthesis of educationally related data to yield information upon which subsequent decisions will be based, regardless of the kinds of organizations or strategies of learning examined."

CMI involves the use of the computer to manage students, personnel, and administrators in an attempt to maximize the effectiveness and efficiency of the educational system. In computer managed instruction, the computer is used as a tool to analyze data about the student's performance and the presentation of the material (Morgan, 1969). The computer is used to aid in the decision making processes to determine

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[1]Schure, Alexander, "Computer Managed Instruction." Proceedings of a Symposium of the Uses of Computers in Education, May, 1969, p. 32.

what material and how much material is to be presented, and when and where the material is to be presented. The computer can be used to individualize instruction for each student, organizing the material so that the student will be able to master it -- starting at a level where he can succeed and going at a pace he can handle.

The possibilities of computer managed instruction are numerous. CMI can be used in the development of course and curriculum objectives (Salisbury, 1971). Systems can be designed to give detailed feedback on student performance in the form of error analyses of the questions. The questions and the corresponding objectives or study questions can then be modified to increase the mastery of the material. CMI can also be used to keep student's records in individual courses and to maintain records of student progress through school. The computer can record student responses to questions and then print out suggested mofifications in the presentation of the material to the student.

Computer management enables the institution to provide detailed academic and career counseling. Records can be kept as to what courses the student has taken and the computer used to determine what courses still must be taken, as well as what courses should be taken (Salisbury, 1971; Dobbins, 1971; Thrasher, Campbell and Bennett, 1971). Using computer management, the student and advisor can better determine what direction the student should take in terms of his academic career, based on his past performance in school.

One of the important roles of the computer in the management of instruction is in the area of placement of the student at the correct

level within the institution and within his courses. The computer can be used to diagnose the student in terms of existing knowledge of the subject matter and from that data, determine what materials he should be presented with, in what sequence and at what rate (Hansen, 1970; Eisele, 1970; Resta, Strandberg and Hirsch, 1969). Then, the records of his course performance can be stored on the computer. Students can be tracked through the course material and from this information, the presentation of the materials modified so that essential material will be remediated before going onto more advanced concepts. Systems can be developed in which the computer specifies what should be remediated, how quickly concepts should be presented, what materials need further clarifications, and predict what will be accomplished in a course for groups of students.

Many times CMI involves aspects of CAI. Some CMI installations are designed so that the computer not only decides what to present and when to present it, but also generates the materials. However, in the majority of cases, the computer is being used to analyze data about student performance and to make decisions as to the presentation of course materials from that data. Fromer (1972) compared computer management to computer assistance. In his comparison, CMI was described as a system involving little direct interaction between the student and the computer, while CAI involved direct interaction between the student and the computer with the computer as the instructor. CMI involved the input of data for analysis with little or no on-line time by the student. CMI typically involved the making of decisions as to what concepts to present to a group of students,

while CAI was specific to each student and to his interaction with the material. The majority of the material for CMI is stored off the computer, while in CAI, the computer stores and presents the material.

CMI and CAI both involve the use of the computer in an attempt to improve education. However, it is in the field of computer management that the majority of research and development is occurring. The computer is no longer substituting for a book, but serving to analyze and aid in the educational planning for students. The computer is being used in the decision making processes to enable educators to better decide what materials to present, at what rate to present them, and whom to present them to. Education can become more responsive to the educational needs of the individual student and more effectively plan his education if the computer is used.

Historical Development of CMI Installations

Although there are a number of places throughout the country using various forms of computer managed instruction, several locations are of significant importance. At these locations, computer management has been pioneered, systems have been developed and implemented on a large scale, and these systems have served as models for others throughout education.

A Management Information System (MIS) has been developed by the Systems Development Corporation for use in the public schools (Bumsted, 1969). The system is designed to make decisions on the basis of student performance inputs, store and retrieve this information for instructors and administrators, and transfer information about students

to different locations. The system was developed to aid in determining the rate of student progress through the curriculum, to enable instructors to modify the student's program as a function of his progress, and to help overcome difficulties encountered in the materials with remedial and review assignments. Teachers were given computer diagnostic and prescriptive information on individual students based on student data inputs and could then modify their teaching. Another similar system has been developed by the New York Institute of Technology called AIMS -- Automated Instructional Management System -- which also provides the diagnostic and prescriptive information for the teacher.

The Learning and Development Center at the University of Pittsburgh has developed an extensive computer management system for an elementary school system (Klaus, 1969). This system involved the individual prescription of the student's level of mastery of the subject matter using pretests and then designing a sequence of materials for the student to follow to reach the course objectives. The system was used to design plans for subjects such as reading, English, science and mathematics. Each subject had its own course objectives with levels equivalent to the year's material. Each student was given a copy of his computer prescription which had his assignments, collected his materials and then studied the assignment. When he had finished the material, he has it checked and if the work passes, he goes to the next unit; if the work does not pass, then he must remediate the material. At the end of each unit sequence, the student is given a unit test which he must pass to go on. If he passes the unit test,

he proceeds to the next unit, and takes a pretest over the new material to determine where he should start.

Project PLAN is an extensive management system used across the United States (Klaus, 1969; Brudner, 1968). Project PLAN uses knowledge about each student's interests, past educational history and abilities to help develop for the student a personalized program for his education. Each student is given a pretest and placed into classes and materials according to the pretest performance. The computer functions to collect, organize, and analyze information based on the student's performance. The computer is also used to score and report test performance, to update weekly files and to suggest guidelines for improving performance.

A number of computer management projects have been undertaken at Florida State University. Hobson (1970) developed a system to evaluate trainee teachers and develop training programs for them to follow to earn a teaching certificate. The trainees were given pretests to measure their existing education repertiore and then, given a curriculum outline to follow. The trainees then went through the training procedure and entered their training data onto the computer. On the basis of these data inputs, trainees were given feedback on performance, feedback on material deficiencies and given a plan to follow to modify their teaching techniques, if necessary.

Hagerty (1970) developed an entirely computer managed course in programmed instruction at Florida State. The students were given pretests and from the results of the pretest, a course outline generated by the computer. The students then followed the outline and took

their quizzes via the computer with all the recording and scoring of the quizzes done via the computer. The computer was responsible for the material programming for the students, the quizzing, grading and recording of the quizzes, for the maintenance of the records for the student and the course, and for summarizing the data obtained from the students on their performance in the course so modifications could be made.

In 1968, a system called TIPS -- Teaching Information Processing System -- was developed for a large lecture type course (Kelley, 1968). The TIPS system involves the collection of information from the students in terms of quiz performance and reaction to the materials and procedures in the course. On the basis of these data, the student is assigned material and graded. His teaching assistant is given information to help him in determining what material to go over in recitation and what students to give additional tutorial help to. The instructor can use the summarized data to determine what topics need further clarification and what topics need not be stressed in future assignments and in lectures. The TIPS system enables the course to be designed to fit the individual's specific abilities in terms of the subject matter.

Other management systems exist throughout the United States. These systems are, however, basically modifications of the systems described. Because computer management is new, few projects have been developed on a large scale. Each year, more and more institutions are developing computer management systems.

Local History

Colleges and universities are facing a dilemma. The cost of education continues to rise and the number of students going onto college is declining. The university is demanding that instructors be held accountable for their teaching and that they increase the number of student credit hours generated. Therefore, many institutions are attempting to develop systems both to improve education and to alleviate the problems they face.

At Western Michigan University the psychology department has developed a system that attempts to deal with some of the problems of institutions of higher learning. All courses in the core curriculum for undergraduates use objectives. Small units of material are presented to increase the likelihood of mastery of the subject matter. Throughout the department, undergraduate teaching apprentices and paid student assistants play a major role in the education of other students and in the management of the courses.

Psychology 150 is the introductory core course for an enrollment of one thousand students (Malott and Svinicki, 1969). The course materials are presented in small units with daily quizzes. Along with the reading materials, the students also view videotapes, participate in an animal laboratory, write laboratory reports and have the opportunity to attend bonus point lectures. The classroom activities are supervised by fifty teaching apprentices, each responsible for approximately twenty-four students. These teaching apprentices are responsible for the grading, error analysis and recording of the

scores for the various classroom activities, administration of the quizzes, supervision of the laboratory and the conducting of the remedial activities.

One of the problems in large courses such as Psychology 150 is the management of the system. The system has decreased costs and has increased mastery of the materials, but a disproportionate amount of time is spent in the tedious tasks of record keeping, quiz question analysis and the determination of the materials to be remediated and reviewed. The solution to the problem appeared to be some form of educational data processing as a preliminary step toward computer management.

The use of the computer in the introductory course was attempted in 1966 (Malott, personal communication, 1973). All quizzing was done using mark sense sheets graded by machine, and then with the aid of the Testing Services, the scores recorded and accumulated automatically on a computer. The system proved quite disasterous. Difficulties developed in the speed and accuracy of the operation and extensive manual backup was required to keep it in operation. The system was dropped after one semester.

In 1969, an attempt was made to use the computer and the services of the computer center. The apprentices in the course graded the quizzes and recorded them on a sheet for the section. This sheet was taken to the computer center to be keypunched and later, processed on the computer. This system was tested in a few sections of the course. Difficulties developed because the apprentices had to return to the

psychology office to do the grading and recording for the section. Because of the scheduling problems, the extra time required each day and the inconvenience, the system deteriorated and the grades were not reliably ready to take to the computer center. Subsequently, the system was abandoned.

In the management department at Western, a computer management system has been developed for its large course, Management 102, Computer Usage (Brayton, personal communication, 1973). Students enrolled in the course learn to work with the computer using the BASIC language. This course has its records on the computer and students have access via the teletype to an analysis of their accumulated points for the semester. The system used in the management course has evolved over a number of semesters and has helped to eliminate the bookkeeping tasks and also keep students informed as to their standing in the course. The procedure used could serve as a model for the introductory psychology course in the design of a system to eliminate its record keeping problems.

The management department course, Management 300, has also developed a computerized record keeping system (Keenan, personal communication, 1973). Data are entered using mark sense sheets and then accumulated and stored under a number of column headings. The system has space available for as many as seventy-five column headings to be used one time only. This system, with its numerous columns, looked ideal for the psychology course, but modifications to the system to facilitate use may make the use of it impossible.

CHAPTER II

DEVELOPMENT OF THE SYSTEM: PHASE ONE -- THE APPRENTICE

The Problem

In the fall term of 1972, a new section with an enrollment of 150 students was added to the introductory psychology course. Staff members were hired to do the bookkeeping tasks and to assist in the management of the course. The amount of time spent on record keeping was not only very high, but also very repetitious and boring. In the winter term of 1973, additional staff were hired to aid in the upkeep of the course and to help eliminate some of the problems. The situation, however, did not improve sufficiently.

Analysis of the Problem

Malott (1971) presents six phases of system analysis which can be used to analyze, design, and implement systems. The first step is to analyze the problem. An analysis of the situation showed that the staff had to record 150 students' scores twice a week. These scores had to be recorded by activity classification, that is the area in which the points were earned such as reading points, videotape points, or bonus points, and then accumulated with the points earned in that activity for the semester. Once a week the staff had to accumulate all points earned in all activities for all students. These records had to be recorded on sheets for the students to see and in

a grade book. These operations were time consuming and very aversive. The tasks were completed within two days after the data were available. Along with the bookkeeping tasks, one staff member had to monitor the records for errors. The errors were frequent and this task also tedious. Because of these tedious tasks, the staff had a tendency to complain about the work and were discontent with the situation. The optimum situation would be to continue to have the detailed records, but to eliminate as many of the tedious tasks as possible.

Objectives of the System

The second step in the development of the system was to specify the objectives. The objective was to design an educational data processing system for the introductory psychology course to be implemented in the fall term of 1973. The system should be designed so that apprentices could operate it without having to enter more than the student's score. The data to be entered should be categorized by course activity and accumulate automatically. The system should be designed so that all the apprentices' responses are specified by the computer and so that the apprentice with no more computer skills than being able to type on a teletype could operate the system.

Design of the System

The third step was to design the system. The system required a method to record scores by section under a variety of codes. A

program called RECORD, illustrated in Figure 1, was designed to record scores by section, to classify these scores in terms of classroom activities and to store the scores. The program was designed so that the computer would print a list of the student's names and the apprentice could then record the scores.

To create the file of student names, a program called START was developed as shown in Figure 2. The operator is asked to identify the section, input data on the number of students, and identify himself. Then, the operator is asked to enter the social security number and name of each student in the section. When the last student is entered, the computer then alphabetizes the names, calls exit, and asks the operator to rename the file to save it.

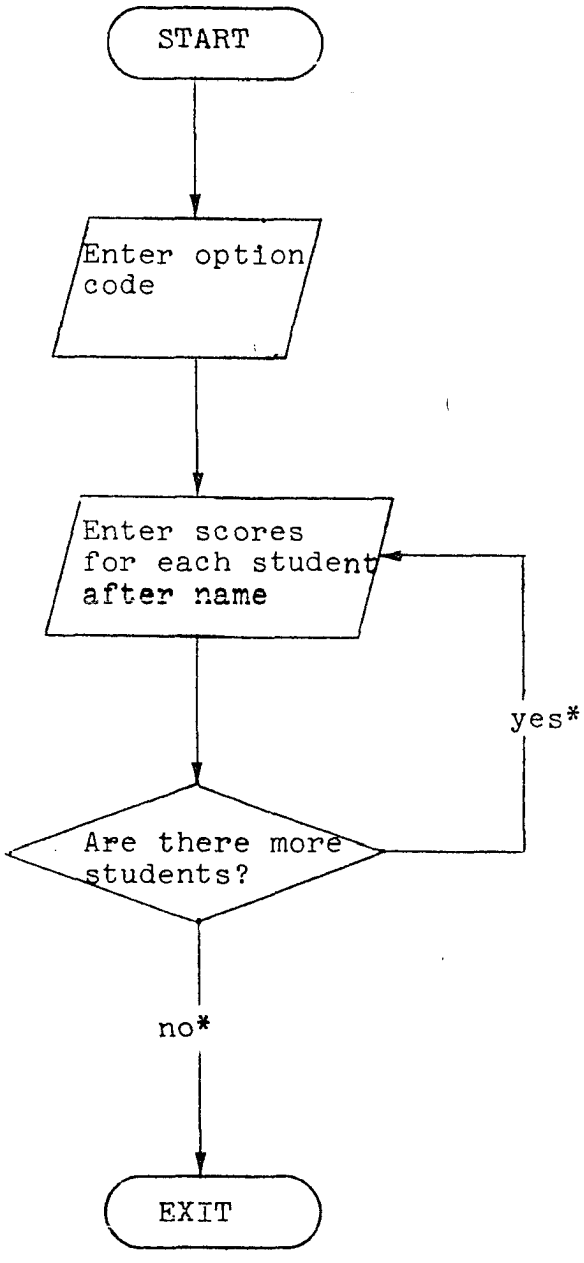
Implementation and Evaluation

Once the programs were developed and put onto the computer, the system was ready to be implemented on a limited basis. During the spring term of 1973, a series of data files was created and the programs extensively tested by the developer of the programs. The programs were tested for flaws and omissions which would cause errors when the programs were run.

Evaluation showed that a number of additional safeguards were needed. With RECORD, if the apprentice failed to type the specified response correctly, the program would end. There was no way for the apprentice to check his scores for correct read in by the computer. With START, instructions to the apprentice had to be more clearly specified to eliminate input errors. Apprentices were required to

Figure 1

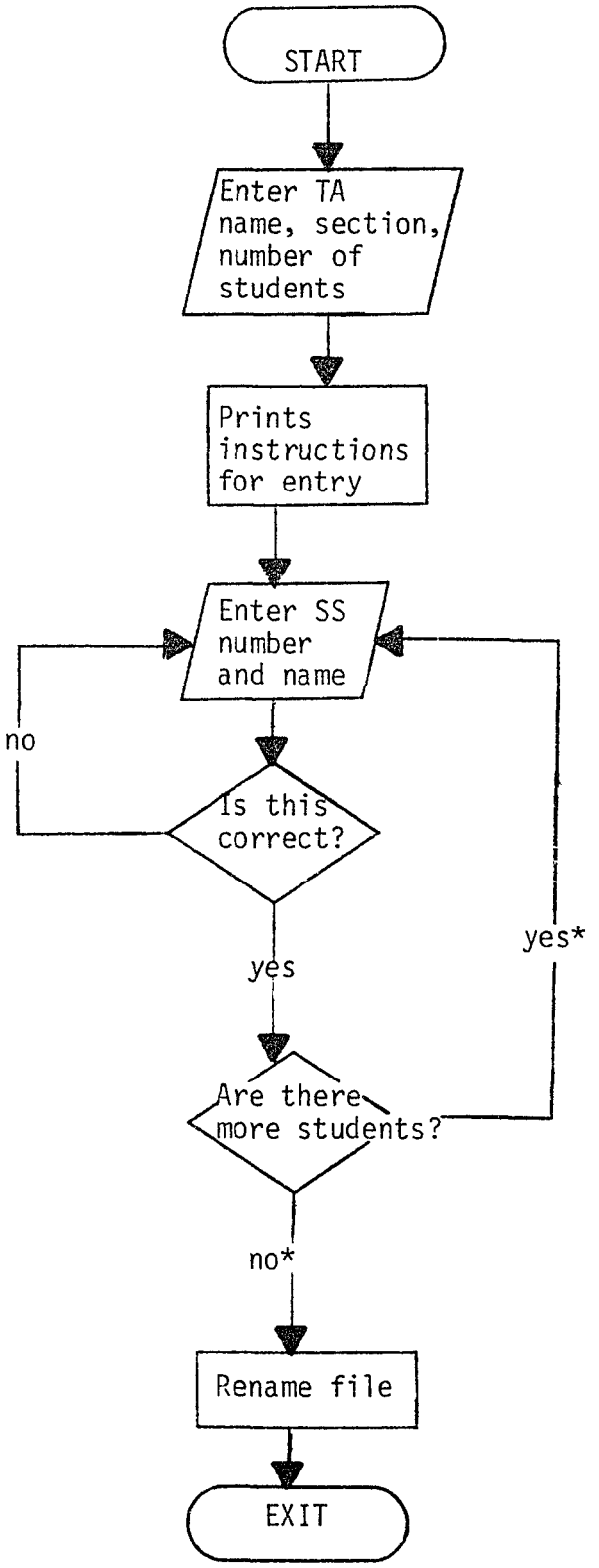
Flowchart of the original RECORD program.



*=computer decision

Figure 2

Flowchart of the program, START.



*=computer decision

enter the social security number of the students in a specified format, but had a tendency to enter the social security number with dashes or spaces, names in reverse order, or to reverse the input of the name and the number.

Recycling

After a series of tests, the system was ready to be recycled. The program called RECORD needed major revision and was redesigned as shown in Figure 3. Changes were made so that the apprentice had to enter the total possible points for an item and if any data entry exceeded the total possible points, an error message would be printed and the apprentice asked to re-enter the score. The total possible points for any item is defined as the maximum number of points a student could earn on that day for that particular option code. A lockout was put on the system so that the apprentice could not enter scores into a category that already had scores in it for that week. RECORD was further modified so that the apprentice could correct errors in their data inputs. However, a protection was added to the system so that the apprentice could not correct scores on a previous day's score entry. A listing, as illustrated in Figure 4, was added to the end of each run of the program so that the apprentice received a record of the entry of new points as well as the new cumulative points for each student. This additional feature of the daily update of the cumulative scores for the week and the semester was a feature not available in the manual system.

Figure 3

Flowchart of the program, RECORD.

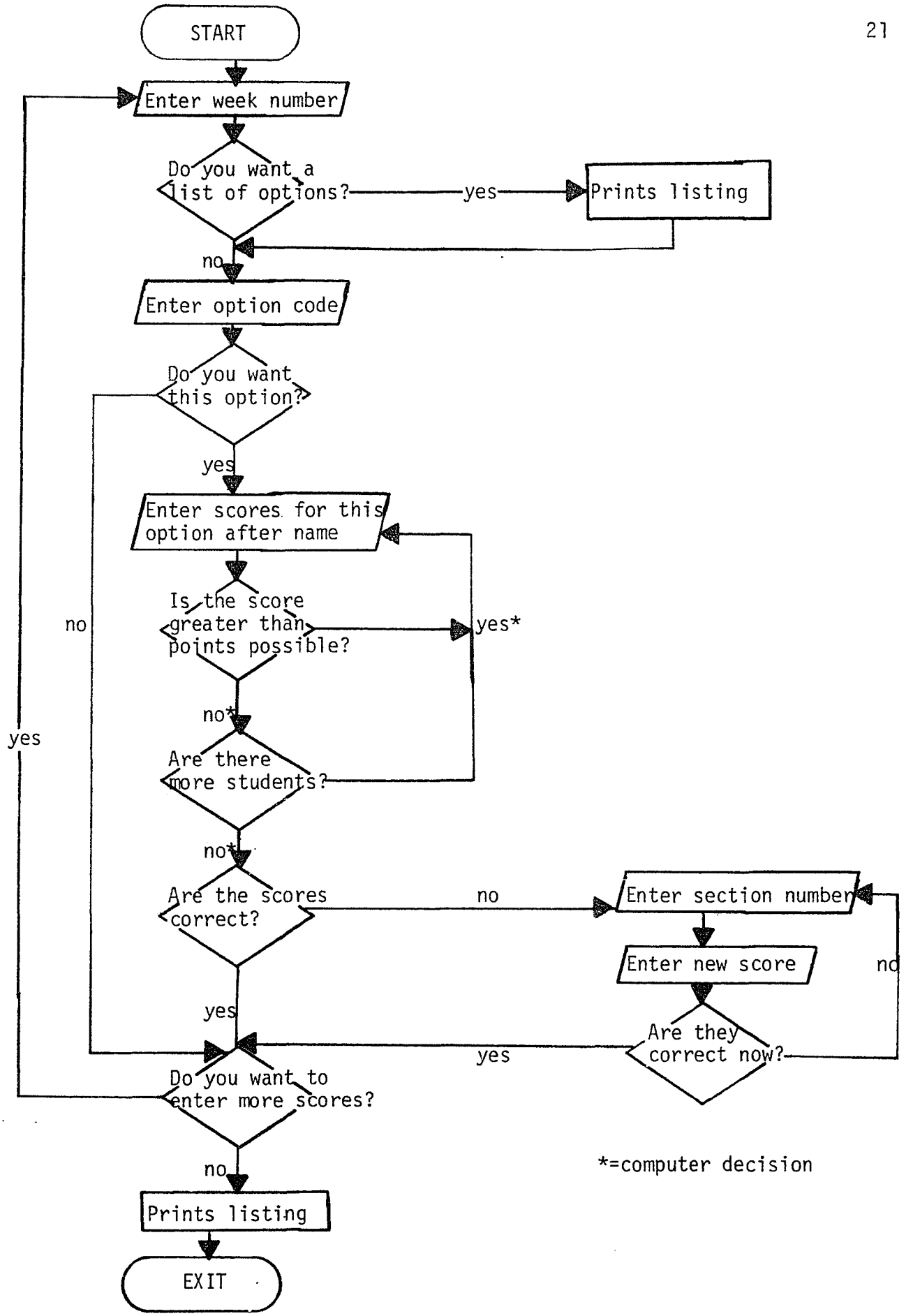


Figure 4

Sample of the output from the program, RECORD.

NEW SCORES FOR 6-AUG-73 SECTION CA

NAME	MNRQ	MUPC	CUMW	CUMS
TOTAL POSS	20	0	20	489
ADAIR,LESL	18	0	18	470
BEDECS,P	20	0	20	462
BOLDEN,VIO	15	0	15	367
CLARK,LIND	18	0	18	480
CLOS,CARLA	20	0	20	503
CRANKSHAW	20	0	20	475
CRONICAN,C	20	0	20	467
FACEN,DEBR	0	0	0	115
HANLEY,ALV	18	0	18	464
HAWKINS,KA	0	0	0	172
JOHNSON,CL	19	0	19	457
KELLY,GERA	17	0	17	428
MATTHEWS,C	17	17	34	445
OWNING,JIM	18	0	18	443
PORTER,MAR	19	0	19	449
REED,CHARL	0	0	0	340
SMITH,RONN	20	0	20	477
STRZYSEWSK	0	0	0	191
WASZKIEVRI	19	0	19	433
WEBB,MIKE	18	0	18	472
YOUNG,DAVI	19	43	62	435

To facilitate use by other courses, RECORD was further modified so that the option codes could be changed for different courses. Instructors of other courses then could specify the categories in which their data were to be stored and modify the system to fit their course.

A program called ADD was also developed to enable instructors and apprentices to add additional people to their sections and to have these new names put in alphabetical order. As shown in Figure 5, the operator executes the program and then is asked to enter the data about the student's name and social security number. The operator is asked if he wants to enter scores, given a listing of the score options, and permitted to enter the points. At the end of the run, a listing of the new student and his scores are printed.

Another program called SEE was developed to give the operator access to the student's entire data file. The operator can get a printout from the teletype of a student's day-by-day entry of points with a weekly and semester total of the points he has earned as shown in Figure 6. This program, illustrated in Figure 7, was developed so that the operator could produce the records for an individual student without having to have a complete listing of all students in the file printed and without going to the computer center to get this listing. A safeguard was put into the program enabling the operator to exit the program without having to type in a student number should he enter it by mistake.

Figure 5

Flowchart of the program, ADD.

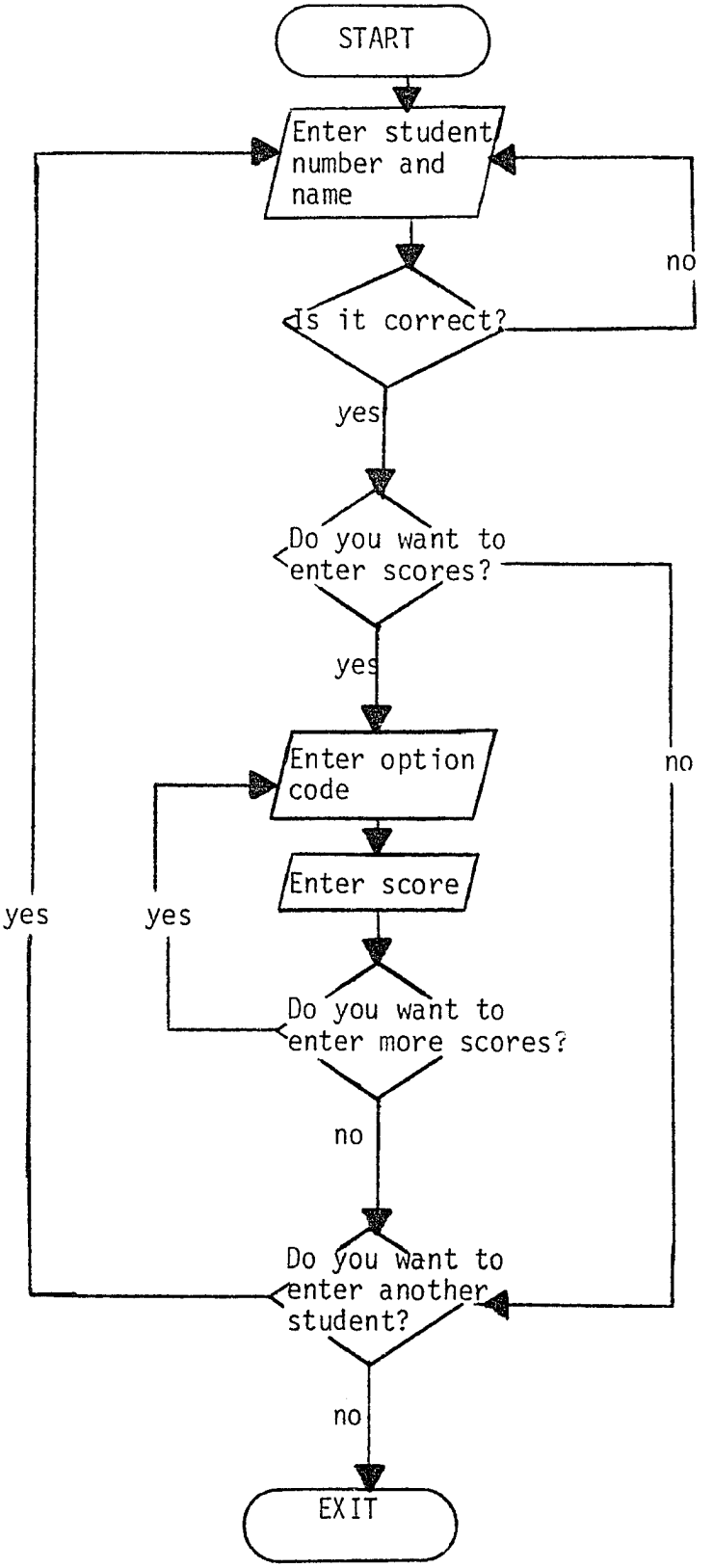


Figure 6

Sample of the output from the program, SEE.

RECORDS FOR CRANKSHAW

MNRQ	TSRQ	WERQ	THRQ	MNTV	TSTV	WETV	THTV	LABQ	LABR	FRBP	MUPC	MUPO	MUPT	MISC
0	0	0	19	0	0	0	10	0	0	0	0	0	0	0

CUM FOR WEEK 1= 29

19	20	0	17	18	20	0	14	0	0	4	0	0	0	0

CUM FOR WEEK 2= 112

20	20	20	19	14	0	0	0	10	0	4	0	0	0	0

CUM FOR WEEK 3= 107

4	10	10	20	0	0	0	0	0	0	4	0	0	0	0

CUM FOR WEEK 4= 48

9	19	0	20	0	0	0	0	0	0	4	0	0	0	0

CUM FOR WEEK 5= 52

20	29	20	20	0	0	0	0	9	0	7	0	0	0	2

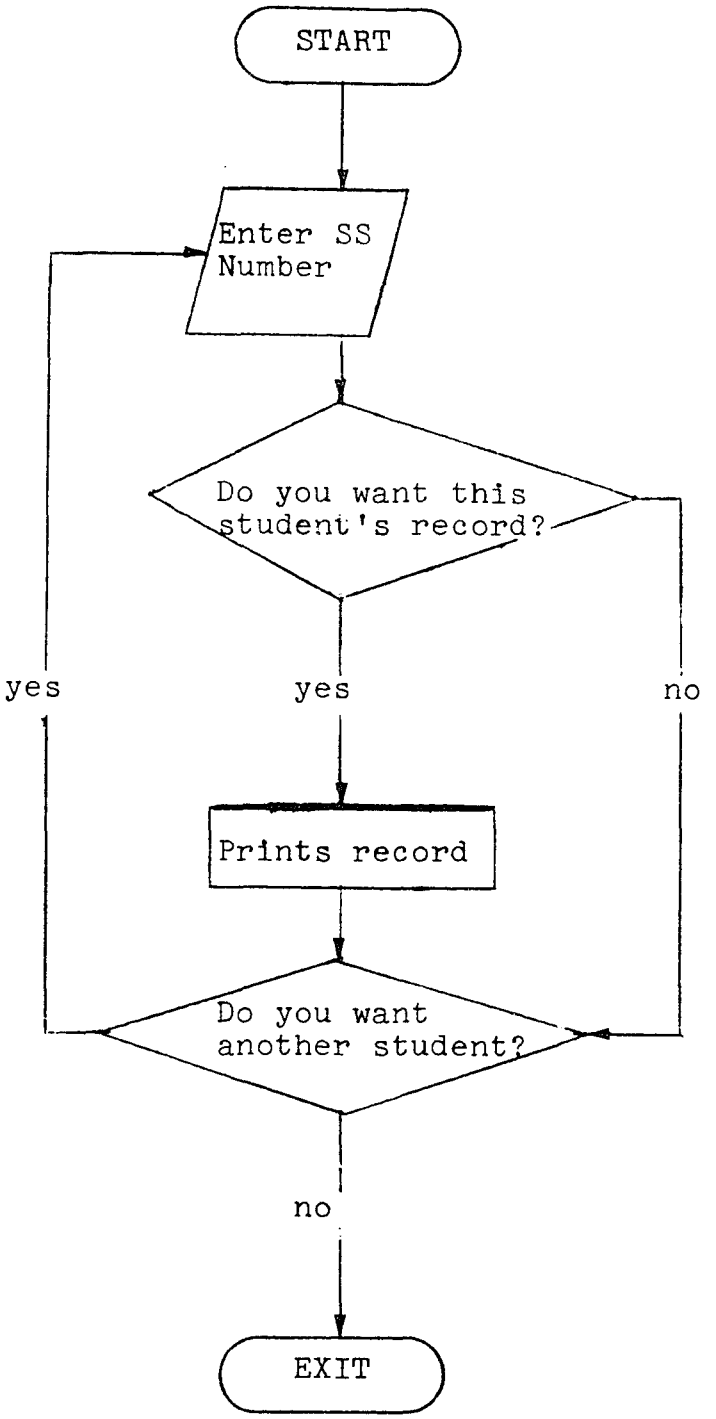
CUM FOR WEEK 6= 107

20	10	0	0	0	0	0	0	0	260	3	0	0	0	0

CUM FOR WEEK 7= 293
TOTAL POINTS TO DATE= 748

Figure 7

Flowchart of the program, SEE.



Implementation

In the summer term of 1973, the redesigned system was tested on seven different sections of students enrolled in six different courses. The courses varied from the introductory psychology course, for which the system was originally designed, to graduate psychology courses. All courses had a series of activities with point values that had to be recorded, updated, and cumulated. The people involved in the running of these courses used a number of methods to maintain their records and all had expressed dissatisfaction with those methods.

Each instructor was allowed to designate up to fifteen options for point entry. Then, each instructor designated one person to be the teletype operator. Each operator was assigned an operator number and given a manual (Appendix A) on the use of the system. Some of the operators were given individual sessions to aid them in the use of the teletype. After each operator had read his manual and had received any necessary instruction on the teletype, he was told to enter his file according to the program instructions. The operators worked independently of the head operator on the entry of the file and the use of the record keeping programs. The head operator was available for any questions and problems.

CHAPTER III

DEVELOPMENT OF THE SYSTEM: PHASE TWO -- THE HEAD OPERATOR

Analysis of the Problem

An analysis of the situation showed that a system needed to be designed to protect the record files. Although the individual files of each apprentice were protected from tampering by other apprentices, an experienced computer operator could enter the file and modify it. The nature of the protection problem is a function, not only of the possibility of tampering by outside sources, but also a function of programmer paranoia as to the availability of the record files and the programs. Therefore, it was imperative to develop some method to avoid this possibility.

Objective of the System

The objective of the system to be developed was to be able to protect the files from tampering by outside sources. The system to be developed should protect the data files and also be able to be used as a backup record in case of computer failure.

Design of the System

A program called UPDATE was designed and written to copy the data files. The system would make a duplicate record of all the data files under the protection of the head operator's user number and then would

have these files copied onto magnetic tape. The system would also generate a complete listing of the data inputs into the file for that week and cumulate it, and then print a grading scale for the section as shown in Figure 8. The listings were printed in triplicate to have a paper backup in case of computer malfunction.

Implementation and Evaluation

The system was implemented during the summer term of 1973. Once a week, UPDATE was run, the files copied, and the listings printed. During the implementation phase of the system development, another check on the tampering with the data files was discovered. It was found that unless the operator who went to modify the files knew how the files were arranged, his modifications would result in the operator getting a message that in effect said the program would not run. This feature provided additional safeguards for the files.

Evaluation of the system showed that some problems existed. First, if any apprentice had not entered his data for the week, the program would not run. Second, if the head operator failed to execute two commands prior to running the program, it would not run. These errors were errors in the design of the system. Finally, because the apprentices made errors in data entry and failed to change them at the time of entry, a method to change the data files was necessary.

Recycling

After evaluating UPDATE, a number of revisions were designed. The program was modified so that the head operator received a listing

Figure 8

Sample of the output from the program, UPDATE.

WEEKLY OUTPUT FOR SECTION:CB COURSE:150 APPRENTICE:REYNOLDS,DIANE WEEK ENDING 16-AUG-73

WEEK 2		MNRO	TSRO		THRO	MNTV	TSTV		THTV			FRBP				MISC	CUMW	CUMS
TOTAL POSS	0	20	20	0	20	20	20	0	20	0	0	0	0	0	0	0	120	150
ADAIR,LESL	385623981	20	20	0	18	18	20	0	12	0	0	4	0	0	0	0	112	138
BEDECS,P	370609452	20	16	0	19	18	14	0	18	0	0	4	0	0	0	0	109	132
BOLDEN,VIO	366626832	9	17	0	13	14	14	0	20	0	0	4	0	0	0	0	91	110
CLARK,LIND	371507728	20	18	0	20	14	18	0	20	0	0	0	0	0	0	0	110	140
CLOS,CARLA	368587604	9	20	0	20	20	18	0	18	0	0	4	0	0	0	0	109	139
CRANKSHAW,	382509856	19	20	0	17	18	20	0	14	0	0	4	0	0	0	0	112	141
CRONICAN,C	373567580	20	19	0	20	20	16	0	20	0	0	4	0	0	0	0	119	149
FACEN,DEBR	386586224	0	13	0	14	4	14	0	16	0	0	4	0	0	0	0	65	84
HANLEY,ALV	386569420	20	20	0	20	14	18	0	14	0	0	4	0	0	0	0	110	139
HAWKINS,KA	386547220	14	0	0	12	20	20	0	14	0	0	0	0	0	0	0	80	102
JOHNSON,CL	366540604	17	18	0	20	18	16	0	16	0	0	4	0	0	0	0	109	134
KELLY,GERA	376387435	13	15	0	15	14	20	0	18	0	0	4	0	0	0	0	99	116
MATTHEWS,C	435908388	18	18	0	19	18	16	0	20	0	0	0	0	0	0	0	109	137
OWEN,JIM	378549176	11	18	0	14	20	18	0	18	0	0	4	0	0	0	0	103	130
PORTER,MAR	363602424	18	18	0	18	16	16	0	12	0	0	4	0	0	0	0	102	128
REED,CHARL	382509704	18	15	0	16	14	16	0	14	0	0	4	0	0	0	0	97	119
SMITH,RONN	387444780	13	17	0	17	20	20	0	18	0	0	4	0	0	0	0	109	138
STRZYSEWSK	365465060	20	19	0	16	14	20	0	16	0	0	4	0	0	0	0	109	115
WASZKIEURI	377545644	19	17	0	20	16	12	0	20	0	0	4	0	0	0	0	108	133
WEBB,MIKE	363526388	18	19	0	18	12	18	0	16	0	0	4	0	0	0	0	105	135
YOUNG,DAVI	306548080	17	19	0	19	18	16	0	20	0	0	0	0	0	0	4	113	132

of who failed to enter data for the week without ending the execution of the program. Next, changes were made so that, if the head operator failed to perform the two preliminary tasks, the program told him what to do and allowed the operator to execute the commands. A change subroutine was added to the system. By specifying the student number, the head operator could change any previous data entry. The revised UPDATE program is shown in Figure 9.

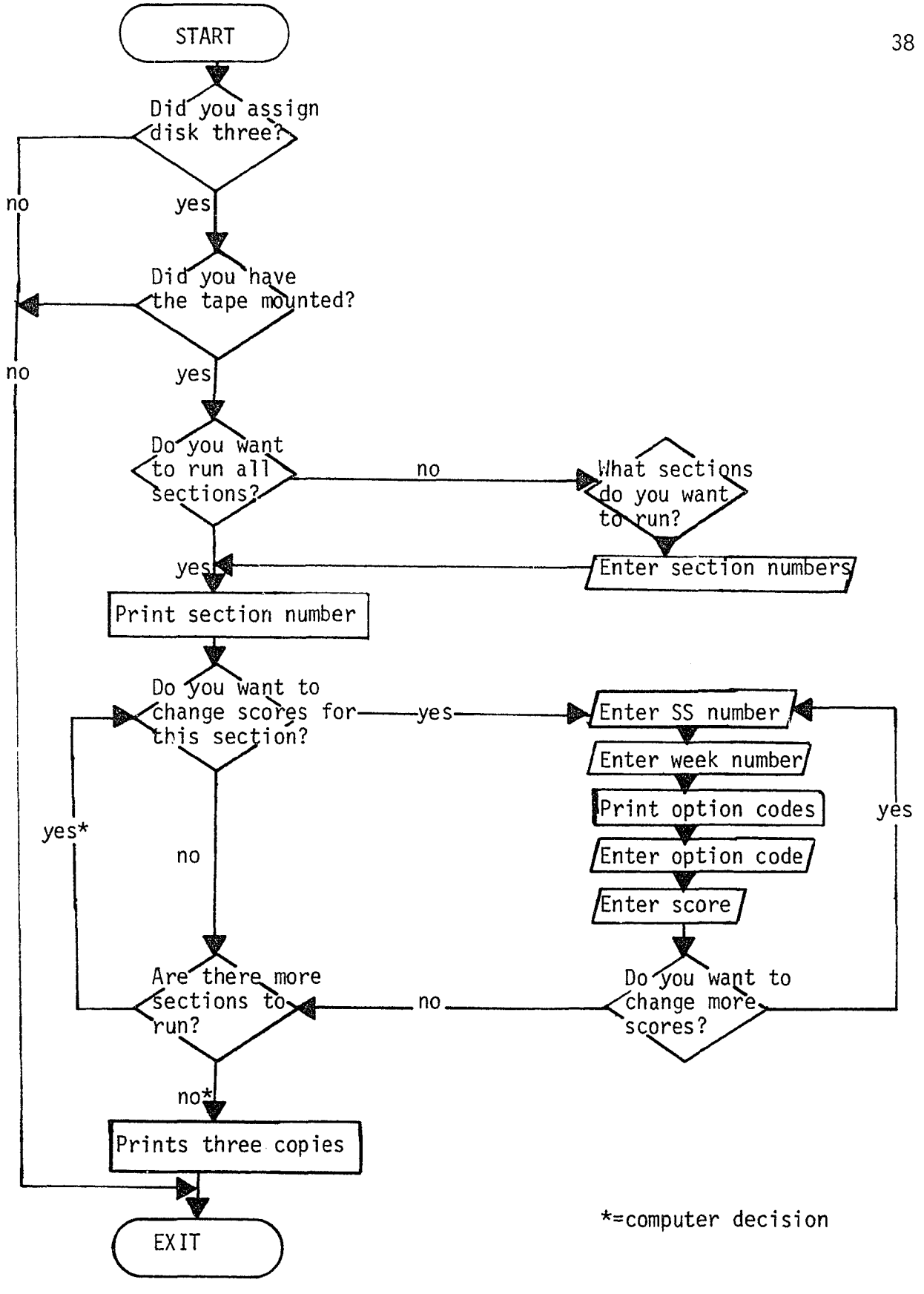
With the change subroutine available, a system was developed to reliably receive changes from the apprentices. If the apprentice had a change, he filled out a change form and gave it to the head operator (see Appendix B). This procedure was designed to increase the likelihood that the right person would get his change done correctly and within one week from when the change was submitted.

Two additional subroutines were designed and the initial programming begun. A subroutine called SEARCH was designed to print out a listing by section of the students, ranked in order of the percentage points accumulated in the course thus far. This system was designed so that students having difficulty with the course could be identified enabling the course instructors to arrange for help for these students.

A system called MONITOR was also designed so that a message would be printed on a listing for the head operator specifying what options had not been used for entry of points for every data file under his protection code. With this capability, the head operator could monitor which apprentices had entered what data and give performance feedback as a function of these data. MONITOR was designed

Figure 9

Flowchart of the program, UPDATE.



so that a listing was also printed for the apprentice with any options he failed to fill for the week and a report of any changes made to his file. This enables the apprentice to receive feedback on his performance and to monitor the head operator's changes of his file.

Cost-Benefit Analysis

The computerized system was tested in six courses -- Psychology 150, Psychology 160, Psychology 250, Psychology 510, Psychology 595, and Psychology 661 during the summer term of 1973. Two of the six instructors stopped using it during the middle of the term. They stated that they spent more time using the computer to record scores than in recording scores by hand. In both cases, the courses were designed with the students being quizzed once a week with no other classroom activities. Because of this structure, there was little computation and the computerized system was less valuable.

Time comparisons were made between the manual systems and the computerized systems for the other four courses. Data were recorded using a stop watch for the manual systems by the experimenter, during the last two weeks of the term and using the attached time print out from the computer for the computerized system accumulated during the term. The attached time to the computer does not include the amount of time used in travel to and from the teletype. In Psychology 510, the students are quizzed once a week with no remedial testing. As shown in Table 1, for a section of 20 students, it took the apprentice an average of 18 minutes to record and cumulate the scores by hand for three sessions. With the computerized system it took less than half

Table 1

N = 20

Psychology 510

Manual System	Computer System
17 minutes	7.5 minutes
13	9.0
24	7.5
$\bar{X}$ = 18 minutes	$\bar{X}$ = 8.0 minutes

as much time, 8 minutes, to record and cumulate the scores. The computerized system elminated the time spent accumulating the scores which, in this case, were large, three digit numbers. However, the apprentice using the system found the duplication of entering the scores both manually and on the computer to be tedious. Because the instructor of the course wanted the records to be done manually as a backup and check on the computer, the apprentice found the system aversive.

In Psychology 160 and Psychology 250, the system has saved time, but more important, the system frees assistantship time and enables the apprentices to do the bookkeeping. Psychology 160 is designed with a weekly quiz and remedial quiz, and bonus point activities such as lectures and movies. All quizzes and activities have point values assigned. In the past, because of a high apprentice error rate, the tallying of the scores was left to the assistants. With the computerized system, it is hoped that the apprentices will be able to record the scores for their students and free the assistantship time for other things. As shown in Table 2, to record and accumulate points for a section of 18 students, it took an average of 24 minutes per week using the manual system for three sessions. With the computerized system, it took an average of 16 minutes per week to enter and cumulate the points for all activities. For Psychology 250, the results are very similar. The course is designed with weekly quizzes and remedials and various bonus point activities. Manual record keeping for a section of 24 students took an average of 27 minutes per week for three sessions, while the computerized system

Table 2

N = 18

Psychology 160

Manual System	Computer System
30 minutes	21 minutes
18	18
24	15
$\bar{X}$ = 24 minutes	11
	15
	$\bar{X}$ = 16 minutes

N = 24

Psychology 250

Manual System	Computer System
35 minutes	33 minutes
25	24
21	18
$\bar{X}$ = 27 minutes	14
	21
	$\bar{X}$ = 22 minutes

took an average of 22 minutes per week.

In Psychology 160 and Psychology 250, although the system did not drastically reduce the amount of time spent on record keeping with the small sections, the system has been favorably accepted and the instructors of these courses anticipate using the system in the fall term. They site increases in the number of students during the regular school year as a major factor in their decision. Psychology 160 will have an enrollment of approximately 500 in the fall and Psychology 250, approximately 200. Using the computerized system, they hope to be able to train apprentices to enter the data rather than hire people to do the bookkeeping. They also site the accuracy of the computer and the features of the system such as adding students, the itemizing of points, and the storage and monitoring capabilities as reasons why they want to use it. Psychology 160 has requested that a modification be made so that the computer will stop tallying points once it reaches a designated criterion for the week. This modification is being worked on at the present time.

In Psychology 150, the course for which the system was originally designed, much more time was saved. The course is set up so the students earn points in ten activities weekly, with these points being accumulated and recorded daily by the apprentice. Both systems require that the apprentice grade the quizzes, a task that involves approximately three minutes per day, four days per week or 12 minutes per week. With the manual system, the apprentice must then record the points in the grade book for his section, check to make sure the scores are entered correctly and then put the points on a listing

for the students to see. This operation took an average of 23 minutes per day for a section of 24 students for six sessions, as shown in Table 3. The apprentice spent an average of 33 minutes per week for two weeks in the totaling of scores for the week. This made a total of 125 minutes per week for the bookkeeping activities.

With the computerized system, once the apprentice graded his quizzes, he then recorded them on an alphabetized list for entry onto the computer. This recording took an average of 85 seconds per day for four sessions. The apprentice then went to the teletype, logged onto the computer, called the appropriate program and entered the points for the day. Entry of these data took an average of 7.5 minutes per day or a total of 35 minutes per week. The computer then printed out a listing for the apprentice to post for the students with the new data inputs and weekly and semester points accumulations.

The computerized system will be used in the fall in Psychology 150 in nine experimental sections. The system will not be implemented in the entire course because of a lack of trained staff to help administrate it and use of a large amount of computer storage space. Because of this, the storage of the data on private storage space is best. To access this space, a recording device must be mounted and remain on the computer as long as there is data input. The computer center will allow the psychology department two hours to do this entry of data. Because the introductory course is in operation for 13 hours daily and the apprentices do their record keeping prior to their inclass activities, it is impossible to implement the system within the confines of the computer center and Psychology 150 in the

Table 3

N = 24

Psychology 150

Manual System Daily Point Entry	Computer System Daily Point Entry
25 minutes	9.5 minutes
23	9.0
27	6.0
22	5.0
21	8.0
19	7.0
$\bar{X}$ = 23 minutes	8.5
	6.0
	$\bar{X}$ = 7.5 minutes
Score Totaling	**Score Totaling**
35	
31	Ø minutes
$\bar{X}$ = 33 minutes	

fall term. Therefore, restructuring of the introductory apprenticeship, the purchase of equipment for use at the computer center or some other alternative is necessary before the system can be implemented course wide.

The system has reduced the amount of time spent on record keeping by the apprentices. However, the actual attached time to the computer does not reflect the amount of time consumed in the transport to and from the teletype. Likewise, it does not reflect the amount of time that would be used during the regular terms when usage of the computer increases. For these reasons, the data are ideal. During the regular term it could be expected that occasionally no teletype or no line might be available to the computer.

From the data obtained in the cost-benefit analysis and the feedback from instructors and apprentices, guidelines for who should use the system can be derived. First, as the number of students enrolled increases, the amount of time that the computerized system saves increases. With 24 students and only two or three activities, the amount of time the system saves is not significant. However, as the number of students increases, the amount of time staff members must spend on record keeping increases and therefore, to reduce this, the computerized system can be used. Second, for courses set up for numerous activities, the system save time. Therefore, one can say that for small seminars with weekly quizzes, the system is of little value. But for courses such as Psychology 150 -- small sections with numerous activities, or larger courses with enrollments like Psychology 160 or Psychology 250, the system is valuable in freeing time otherwise spent

recording, adding and monitoring. For a course such as Psychology 350 which has four quizzes and then a remedial quiz for those students who fail to meet a specified mastery criterion, a subroutine needs to be developed so they can use the system without modifying their recording keeping procedures drastically. Until such a subroutine is designed, the use of the system may be impractical.

CHAPTER IV

DISCUSSION

The educational data processing system that was developed and tested completes the end of the first phase in the development of a computer managed introductory course. The system enables one to record scores and to have them accumulated and stored.

Future development may involve placing the course materials onto the computer, automatic error analysis and direct read-in of the data. The computer management system may involve a direct read-in of scores from a quiz grading machine into the computer via a teletype phone hookup. This would involve the use of mark-sense sheets and coding on the quizzes for the student name and quiz answers. The operator would log onto the computer, identify the section and quiz, type of data entry, and process and record the scores. This would eliminate the possibility of error in the entering of scores, reduce computer-operator interaction time, decrease the computer cost time, and make the system more valuable.

Another development may involve the addition of an error analysis program. This program would record what questions were missed on each form of the quiz and classify the information by section and course. Using the accumulated data, the course administrators could get an accurate and up-to-date record of what questions were being missed and who was missing them. With the addition of an item error analysis for multiple choice type quizzing, one would know what

alternatives were causing problems.

Still further developments could involve the placement of all course quizzes onto the computer. With the quiz questions on the computer, the course could be individualized for each student. Students would be assigned computer numbers and given a list of assignments. They would be able to take a quiz on a teletype which would send the information to the computer which would grade, record and update the student's file. The system could be developed so that if a student failed a particular unit, he could not go on until he had remediated and passed that unit.

Additional features which could be developed involve the averaging of the number of points earned under a particular option by section and by course. This could be used to identify possible difficulty with the materials. Limits could be placed on particular options so no more than the specified number of points would be accumulated. Also, the development of an accumulation system so that points could be tallied by option code for the semester could be produced.

The system has reduced the number of hours spent by the apprentice. It has also eliminated errors due to faulty arithmetic by the apprentices. The apprenticeship may need to be re-evaluated in terms of number of credit hours received for it because of the time reduction or other activities developed for the apprentice to participate in. The system eliminates much of the aversive and time-consuming activities involved in record keeping and gives the apprentice more time to spend interacting with students and other staff members.

The system also has eliminated much of the time spent monitoring

the record keeping. With the manual system, an advanced apprentice spent time checking for correctness of point entry and addition of scores. His behavior was monitored by a paid assistant who was also monitored by another paid assistant. They, too, checked for point entry accuracy and addition. The new system enables one person to check for point entry correctness and eliminates the need for the arithmetic check.

What of the reaction to the system by the apprentices and the students? Some apprentices were ill at ease with the teletype at first, but with training and repeated exposure, they became less afraid of it. It was also the case that if the system was down for a day, the apprentices expressed dislike for having to return to the slower manual system. The students whose grades were stored on the computer had little reaction to the system -- except when the grades were not entered onto the computer and they did not have the new totals of their points accumulated. The students had no trouble reading the records and understanding them.

The system and the guidelines for who should use it are specific to instructor-paced courses, that is, courses in which the instructor specifies the assignments and the schedule of testing. But what of use of the system in courses that are student-paced, that is, courses in which the student determines the schedule of tests and possibly, the assignments? In a student-paced course in which the assignments are determined by the instructor and the students take the quizzes at their own pace, the system can be used by simply recording the data weekly. Data would have to be stored off the computer and then at

the end of the week, entered for each option for each student. In a student-paced course in which the student determines the assignments and the instructor schedules the quizzing, the system can be used with some modifications. Records would have to be kept off the computer as to what assignments the student was taking to insure that the student is on schedule with the assignments and not duplicating them. In a student-paced course in which the assignments and the schedule of quizzing are determined by the student, the existing record keeping system would be impractical to implement, although some computerized system would be beneficial to this type of student-paced course.

For one term of use, the time-sharing system costs averaged approximately $70.00 per section to run for eight weeks. For fall or winter terms, a cost of $125.00 per section is anticipated. This money is imaginary money and is not charged to any department's account. However, if the computer center were to charge for the use of the computer, it would cost over $5000.00 a term to operate the system for 50 sections of 40 students. Alternatives to the system need to be investigated.

With the problems of computer scheduling, the weekly processing of data may be one solution to decreasing costs and minimizing problems with the computer center. With the weekly processing of data by the apprentices, the possibility of errors due to fatigue and sloppiness in the use of the system increases. There is also the alternative of hiring someone to enter all the data. However, the present system is designed for use with groups of 40 students. Therefore, a batch processing system may be more practical, with the hiring

of a key punch operator and the development of a different type of record keeping system. The development of another system brings about the problem of programming cost. The system that was developed involved approximately 150 hours of time, 50 hours of the programmer's time, and 100 hours of developer's time. At the rate of $10.00 per hour for programming and $5.00 per hour for development, it cost $1000.00 to develop the system. However, these costs were avoided because of the nature of the project. Additional developments will have to account for these costs.

The implementation of the system surfaced a number of possible problems with the use of the system and the corresponding use of the computer. If it is to be implemented in Psychology 150 in the winter term in the entire course, investigations into the most practical way to use it need to be conducted. If the system as it is now is used, it means the tying up of one teletype line to the computer for 13 hours a day. The course would have to purchase or rent a teletype and maintain it. Arrangements would have to be made with the computer center for storage of the data in some form, either by having a private disk mounted or by storage of data on magnetic tape. Both possibilities should be explored.

There also is the possibility of hiring a person to enter the data with the present system or to redesign the system so it will handle large amounts of data. To enter data with the present system, the operator would have to spend between 6 and 10 hours to enter the scores for 1000 students daily, not accounting for loss of time due to fatigue. To redesign the system would involve programming and

development costs, but if a single operator was used, this is a necessity. These alternatives should be explored keeping in mind the problems that developed in the systems developed in earlier attempts to computerize the course.

The possibility of purchasing a small computer for the purposes of record keeping is another option. For between $12,000.00 and $16,000.00 a new small computer system could be purchased and the programs modified to fit it (Snapper, personal communication, 1973). If used equipment were purchased and teletype used instead of a high speed DEC Writer, a system could be purchased for approximately $7,000.00. With the new system the reprogramming would be covered in the costs; however, in the inexpensive system, the programming costs are not included and could cost several thousand dollars.

The purchase of an intelligent terminal is another possibility. This involves a small computer, disk storage, an input device such as a teletype of DEC Writer, an output device, and the use of DEC tape. Apprentices would add to the files daily and edit and change them using this terminal. At the end of the day, the data would be placed onto the large computer at the computer center for storage. Two problems exist with the use of intelligent terminal. One, the apprentices would have to be carefully trained to use the system to avoid adding data in the wrong part of the DEC tape and second, the expense of the intelligent terminal. The intelligent terminal installation costs approximately $70,000.00 but is expected to decrease in cost as demand from them increases and as the number of producers increase.

All possibilities for system development should be explored. At the present time, the most feasible system involves the use of the computer center and development of additional systems for use with their equipment. However, further exploration into different possibilities may reveal a combination of them to most effectively use what has been developed and what is planned to be developed.

CHAPTER V

CONCLUSIONS

This study traced the development of an educational data processing system for use in the psychology department at Western Michigan University. The system developed and tested enabled inexperienced teletype operators to record on the computer student data on performance in courses and then, to have these data accumulated and stored. Additional programs were designed so that the student names could be added to the data files, the files copied and changed, and listing printed ranking students by the number of points accumulated in the course.

As a result of testing the system, a series of recommendations can be made as to the further development of it. Investigations into the feasibility of purchasing hardware to facilitate use of the system, investigation into the use of a different type of record keeping and investigation into the modification of what had been developed to fit the existing available hardware all need to be researched. Prior to implementing the system on a wide scale basis, the hardware problems need to be thoroughly investigated and a careful analysis as to the most beneficial way to process large amounts of data minimizing cost and maximizing flexibility and ease of operation must be conducted.

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APPENDIX A

The Operator's Manual

How to Get Onto the Computer

1. First, find a teletype. There are three located in Wood Hall, next to the main office, in Dr. Snapper's lab and in the Geography offices. All can be used with permission of the instructor. Also, there are 15 teletypes across the street in Rood Hall on the third floor. These also can be used. The system can be accessed between the hours of 2 and 4 in the afternoon. It is available only during those hours. It should take an average of 10 minutes to enter the scores with the exception of the first day.

2. Turn on the teletype by turning the knob on the lower right to the left. On some teletypes, this will say LINE IN or ON.

3. Call the computer center on the phone by dialing 3-6250. If you get an answer of a high pitched tone, place the receiver on the coupler with the spending end of the receiver toward the top of the coupler. If the light goes on, then you have it right.

4. The computer will type LOGIN or ATTACH. When you see this message, you should type in the work LOGIN and push the return key. The computer will then type back a message and then type a #. You should then enter your user number code separated by commas and then push the return key. The computer will then ask for your password and you should type it in. The password will not print back on the console for your protection. If you have done all of this right, the computer will type back a message and a period. You are now in control and telling the computer what to do. If you want to perform some type of action, type in the appropriate command. If you want to terminate you job, type K/K and the computer will log you off. Whenever you want to finish using the computer and have a period, be sure to type in K/K and the computer will log you off. If not, you will be on even if you disconnect the phone line and that costs you money!!! Be sure to log off. Below is an example of the log in procedure.

Please Login or Attach
.LOGIN↵
Job 12 TTY 0063
67200, 67***↵
Password: _____
Messages of the Day↵

.

↵ = return key

YOUR ACCOUNT NUMBER IS _____ _____ PASSWORD: _____

Starting the Semester

1. Follow the procedures on the preceeding page to access the computer. After it prints out its messages, it will print a period. After the period, you should type in the words R PIP and push the return key. The computer will type back a * and you should type in the command DATOP.DAT<155>= OP150.DAT[67200, 67200] and push the carriage return. The computer will then type back another * and you should hit the Control key and the C at the same time. The computer will type back ↑C.
An example would look like this....

.R PIP

*DATOP.DAT<155>= OP150.DAT[67200,67200]

*↑C

2. The computer will then print a period and you are ready to enter your class list. If you have more than 40 students, you will need to break down your class into smaller units. A class of 40 is enough bookkeeping for any computer to do. After the period, you should type in the message EX START.F4[67200,67200] and push the return key.

3. You are now ready to enter your students' names and numbers. Simply follow the instructions about the number and name entry. You need not enter the names in alphabetical order as the computer will sort them for you. When you have entered all the data for START, then the computer will ask you to rename your file. Make sure you do this or else you may not have what you expected the next day. You rename your file by typing

.RENAME FORØ1.DAT<155>=FORØ1.DAT

NOTE: ON the FOROl, that is F..O..R..Zero..One!!

4. When completed with this, the computer will type back a period. If you have data to enter, see RECORD. If you are done for the day, type the words K/K and the computer will log you off.

How to Enter Scores

1. If you want to enter scores, type in the following command after the period.

   .EX RECORD.F4[67200,67200]↵

2. The computer will then let you keep records. Remember that when you are entering scores, to check them carefully. The computer will let you correct typing errors. Also, be sure that if you change the week number that you have entered all points for the previous week.

3. If you need a list of option codes, the computer will type one on command.

4. If a student is absent, enter a zero for the points earned that day, except if it is TV points. These points are prorated.

5. If you are entering bonus points, makeup points or miscellaneous points, and do not want them entered into the total points possible, type a zero for total points. If you type in a number, the computer will not accept points greater than that number.

6. After entering all the scores you want to, the computer will type an updated listing for you to post in the hall. Weekly you will receive a detailed listing for your records.

7. Remember to log off the computer by typing in K/K if you are done.

Preparation of Scores for the Computer

1. After running the papers through the quiz grader, you should then record the scores on your section score sheet. At the top of the score sheet is a listing of the option codes. To aid you in the use of the program, put the option code at the total of the list and then enter the scores on the list below. Be sure to specify how many points were possible for that day.

2. At the beginning of the semester, you will be asked to fill out your section names on a master list in alphabetical order. Fill this out as soon as possible and give it to the head operator. He will have copies made for you.

ENTER ZERO POINTS IF ABSENT, PRORATE TV POINTS

MNRQ Monday Reading Quiz
TSRQ Tuesday Reading Quiz
WERQ Wednesday Reading Quiz
THRQ Thursday Reading Quiz
MNTV Monday TV Quiz
TSTV Tuesday TV Quiz
WETV Wednesday TV Quiz
THTV Thursday TV Quiz
LABR Lab Reports
LABQ Lab Quiz
MUPC* Makeup Points for the Current Week
MUPO* Makeup Points for One Week Ago
MUPT* Makeup Points for Two Weeks Ago
MISC* Miscellaneous Points
FRBP* Friday Bonus Points

* = zero points possible unless otherwise specified

Week _____ Section _____ TA _____

OPTION CODE										
1. Total Possible										
2.										
3.										
4.										
5.										
6.										
7.										
8.										
9.										
10.										

How to Add Students to Your File

1. If you want to add a student to your file, type in the following command after the period.

   .EX ADD.F4[67200,67200]↵

2. The computer will then allow you to add names to your files. You should know the student's name and social security number to add them to your file.

3. If you want to add students' scores to the file, the computer will ask you to. The computer will type out a list of the option codes without the corresponding meanings. You simply specify the code and the week and then enter the score. You then check the entry for correctness.

4. If you have more than one student to add, repeat the above procedure when the computer asks.

5. When you are done adding students, simply log off the computer as usual and when you run the file again, your new students will appear.

If a Student Wants to See His Scores for the Semester

1. After logging onto the computer, type the following command.

   .EX SEE.F4[67200,67200]↵

2. The computer will ask for the social security number of the student in question. Type it in without dashes or spaces and the computer will search for and list the record.

3. When you are done looking at the requested files, remember to log off the computer by typing in K/K after the period.

If You Want to Change a Student's Score

1. Fill out a change form found in the TA room. Be sure you specify exactly what you want changed and why. You will be notified on the following Monday of the change.

OFFICIAL CHANGE FORM

Section _____

TA _____

Student SS No.	Week No.	Option Code	New Score	Why?

We must have the social security number to change scores.
Please specify the reason why by putting in the following code.

1. change because of error in input of scores

2. change because of change in question scoring

3. change because of _____(specify)

APPENDIX B

Once a Semester Jobs

1. Arrange with the computer center to obtain one user number for every section and for larger sections, one number of every 40 students.

2. Arrange with the computer center to have a time set up and arranged for the disk to be mounted on the private drive. Also find out from the consultant at the computer center the procedure for having the disk mounted.

3. Arrange for a teletype operator's orientation for the TA's, ATA's and assistants who will be using the system. Also arrange for them to get user manuals and to be quizzed over them.

4. Make sure there are forms for changes, that there are books for storing the records, that the mag tape is ready by the beginning of the first week of the semester.

5. Get by the end of adds, a filled out listing of the students in each section in alphabetical order from each TA and have 50 copies of each run in the main office. You may have to Xerox enough for the first week until the printer can get to them.

6. Arrange to get the different course options from instructors using the system by day one of the semester. These need to be on the computer by day one.

7. Also run MAKES by the end of week one so you will be able to update the files.

8. Make sure that when you run update the first week, you K/I prior to the run and after the run to erase and protect the files.

Making Option Code Files

1. Type in the command (fill in the course number).

   .MAKE OP_____.DAT↵

2. The computer will type back a star (*) and you should type in an I and then the number of options plus three. So if you have 15 options, you would enter the following:

   *I 18
   NOTE:YOU CAN HAVE NO MORE THAN 15 OPTIONS

3. Then enter the codes for the items you want to call your options. They must be at least four characters in length and no more than four characters in length. They also must all be alphabetical characters.

   Enter them by first spacing over one space and type in the first ten (10) codes separated by single spaces. Repeat this same procedure for the next line if necessary. Once you have finished with your options, push the return key.

4. You are now ready to define what the option codes mean. For each option code you type in the following:

   (1X, 'TYPE"_____" TO FNTER _____')↵

   Start at the beginning of the line and make sure you include every quote and double quote, comma, etc. Do this for every option until you reach the end.

5. When you reach the end, you must exit. Do this by typing or hitting the esc key twice. The computer will then allow you to type in EX and hit the esc key.

6. Remember to rename the file by typing

   .RENAME OP____.DAT<157>=OP____.DAT↵

Making the Names File

1. At the beginning of the semester, you create the name file of who has what account. This is to aid in the running of UPDATE.

2. You type in the command

   .MAKE NAMES.DAT↵

3. The computer will type back a star (*) and you should type an I and then the account numbers.

   ```
   *I67200,67201,AA,150
    67200,67202,AB,150
    67200,67203,AC,150
   ```

   You enter the project and programmer numbers separated by commas, then the section letters and then the course number for each section of each course using the system.

4. When you have the completed list in, you hit the esc key twice and then type in EX and the esc key. Be sure that you protect this file.

How to Update the Files

1. Once a week you should run the program called UPDATE.

   .EX UPDATE.F4 ↵

2. Before running the program, you must

   a. AS DSK 3
   b. Have the mag tape mounted
   c. Collect any change requests that have been made

3. You should run update for all sections unless specified otherwise.

4. If you have to change a record in a file, remember to R PIP the change over to the file.

5. If you want to run the search subroutine, type yes when asked by the computer.

6. Make sure that you consequate according to the monitor listing.

7. At the end of UPDATE be sure to type in the command,

   .PRINT FORØ3.DAT/COPIES:3 ↵

   and go pick them up at Rood Hall and distribute them as follows:

   1. for our records
   2. for the instructor
   3. for the instructor or apprentice to post for the students

Jobs to do by the Week

Pre-Week One

1. All computer center jobs must be done.
2. Get options from instructors and make them.

Week One

1. TTY orientation for the apprentice and quiz.
2. Get system operation started.
3. Make NAMES.
4. Run UPDATE and K/I before and after running the program to delete last semester's records and save this semester's records.
5. Arrange for the change forms to be ready.
6. Get the score forms ready.

Week Two

1. Change protection code on START to 177 by Friday.

Week Three

1. Change Protection code on ADD to 177.