

EVALUATION OF COMPUTER ASSISTED INSTRUCTIONAL
PROGRAMS IN PROFITABLE MERCHANDISING ANALYSIS

By

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CHAPTER I

INTRODUCTION

Educators are continually seeking new methods of instruction and the computer has been recognized as a tool that can be used in a number of ways to assist the educator. During the late 1960's and early 1970's, educators significantly increased research relating to use of the computer in the instructional process (Solomon, 1974).

According to Hayman and Mable (1974), the computer represents a highly desirable application of technology in higher education. One of the primary ways the computer may be used is to assist the educator in individualizing learning experiences (Reed, Ertel and Collart, 1974). Computer programs can be developed to supplement traditional types of instruction. They may also be used as the major method of instruction in a course. A major advantage of computer assisted instruction is that it allows the student to progress at his own rate. /

The computer also aids in individualization of instruction by keeping records of individual students' progress and by providing the instructor with feedback on students' progress throughout a course (Hayman and Mable, 1974). The computer frees instructor time for more one-to-one contact with students. The computer can also be programmed to generate tests and analyze test results. This allows the instructor more time to devote to other areas.

Teachers and college instructors participating in computer-related projects have been freed from routine classroom duties and as a result have authored textbooks, articles and curriculum materials that have contributed to the improvement of the profession (Bell, 1974).

The purpose of this study was to analyze, evaluate and make revisions in computer assisted instructional programs designed for the Profitable Merchandising Analysis course and used by students enrolled in the class during the spring semester 1976.

Objectives of the Study

The following objectives were formulated for the study.

To analyze errors made in mathematical problems on unit examinations in order to determine types of errors made and frequency of occurrence.

To compare performance on selected test problems of those students who used the computer assisted instructional programs for the unit with those who did not.

To revise selected computer programs based on the analysis.

To determine student attitudes toward use of the computer.

Limitations of the Study

The computer programs analyzed were limited to the eleven programs available for use by students enrolled in Profitable Merchandising Analysis during the spring semester 1976. Examination problems analyzed were limited to those problems designed to evaluate the specific material covered in the CAI programs.

Definition of Terms

Computer - a machine that performs numerical and logical manipulations as directed by a human programmer (Meadow, 1970).

Computer assisted instruction (CAI) - instruction utilizing the computer in which the computer program controls the amount and sequencing of information given the student through direct student-program interaction (Schoen, 1974).

Program - a sequence of instructions to be carried out by the computer (Watson, 1972).

CHAPTER II

REVIEW OF LITERATURE

Computers are a rapidly growing phenomenon in today's society and educators have found computers to be helpful in many areas. Atkinson and Wilson (1968) listed four factors which influenced the rapid growth of computer usage in education:

1. The potential of computers for supplying today's most pressing need in education: individualization
2. The development of programmed instruction
3. The mushrooming of electronic data processing in general
4. Increasing aid to education by the Federal Government (p. 74).

These factors continue to influence the growth of computer usage today. Perhaps the most important feature of computer use in education is the integration of the computer with programmed instruction making efficient and effective presentation of material possible (Solomon, 1974).

Computer Assisted Instruction

Interest in new methods of instruction and increased knowledge of computer potential have contributed to use of the computer in teaching concepts in the classroom. This application of the computer is referred to as computer assisted instruction (CAI).

Computer assisted instruction is defined by Salisbury (1971) as:

A man-machine interaction in which the teaching function is accomplished by a computer system without intervention by a human instructor. Both training material and instructional logic are stored in computer memory (p. 48).

Educators do not advocate the total elimination of the classroom in favor of total computer usage. Rather, they recognize the need to free the teacher from generalized lecturing and to give him information on student performance.

Computer assisted instruction is an outgrowth of programmed instruction (Dick, 1965). It utilizes many basic principles of programmed instruction; therefore computer assisted instruction is a sophisticated form of programmed instruction.

Modes of Computer Usage

The computer can be used in education in many ways. According to Bell (1972) computers relate to instruction in three ways: (1) as an object of instruction, (2) as a manager of instruction, and (3) as a medium of instruction.

When the computer is the object of instruction, a person learns how to operate a computer or how a computer operates. In this area the teaching methods used may be traditional.

When the computer is used to manage instruction, it can be used to schedule classes before semesters, to schedule classes during drop-and-add procedures, or to grade and record test results for a specific course.

The computer can also be used as a medium of instruction. Bell (1972) identified four modes: tutorial, inquiry, simulation and problem solving.

In the tutorial mode material is presented to which the student responds. The computer branches according to the student response and supplies the student with immediate feedback. Two important characteristics of the tutorial mode are individual pacing and the presentation of information in small steps. An example of tutorial mode would be a computer program that gives the student mathematical problems and several answers to choose from. After the student selects an answer and enters his choice the computer informs the student whether or not the answer he selected was correct. If the answer was incorrect, the computer supplies an explanation of the problem.

In the inquiry mode the student attempts to solve a problem presented by the computer. A list of available assistance accompanies the problem, and the student may ask for help when it is needed. The main task of the computer is to check solutions to the student's problems and give assistance when requested. An example of an inquiry mode is a computer program which presents a problem in home management. A listing of available assistance in several areas of home management is also presented. The student may ask for information which might help in solving the problem. After completion of the problem, the computer checks the solution.

In the simulation mode the computer is utilized as an information processor and problem solver. The computer displays an experiment with options for varying parameters. The experiment is a description of a real-life situation. The student specifies parameters to which the computer supplies the appropriate solution. An example of the simulation mode is a computer program that simulates the operation of a retail store. Students are given various options for managing the

store. The student chooses options and the computer responds with the results that would have occurred under these circumstances.

Finally, the most complex mode is that of problem solving. The student must break down a problem into mathematical formulations which he then enters into the computer. The computer stores the formula. The student then enters data and executes the formula for which the computer provides a solution.

Construction of a Computer Program

The developer of a computer assisted instructional program should have certain characteristics and abilities to enable him to write effective programs. According to Reed, Ertel and Collart (1974) a developer of a CAI program should be a person who:

1. has mastered the proposed content,
2. understands the proposed content, and
3. accepts the challenge of working with new educational medium.

A person who meets these characteristics should be able to write an effective computer program.

Before beginning to write a program, an outline should be developed. To help accomplish this Salisbury (1971) stated that the four steps in developing a computer program are:

1. An objective is prepared.
2. A criterion test is developed to test whether or not the objective is met.
3. Content is embedded in media as required to obtain the objective.
4. Material is tested and revised until the student achieves the objective (p. 48).

Utilizing these precise procedures will help assure the developer of a sound computer program.

Computer Usage at Oklahoma State University

Several departments at Oklahoma State University have utilized the computer in their courses. Subject areas are diversified and range from management and finance to animal science, civil engineering and clothing, textiles and merchandising (Instructional Approaches at Oklahoma State University, 1972).

In the area of management a computer program was developed to generate multiple objective examinations in three sections of two management courses. In a graduate course in finance the computer was used to present students an array of financial decision models. The students would respond to the tasks prescribed by the computer and the computer would monitor the results and print out an evaluation.

A computer simulation program was used in an animal science course to teach the principles of genetic improvement. The program taught students basic genetic principles by simulating a real-life situation. A course in traffic engineering in the department of civil engineering allowed for authentic involvement in actual problems of traffic engineering by conducting a computer traffic analysis of a Stillwater intersection.

Two studies utilizing the computer have been conducted in the department of clothing, textiles and merchandising. Good and Sisler (1975) conducted a study to determine how the cathode ray tube computer terminal could be used successfully for computer-generated testing in a basic clothing construction course. The class was divided into a

control group and an experimental group. Students in the experimental group took the final examination via the cathode ray tube terminal which is a television-like display device which presented the test questions. Students in the control group took a traditional type pencil-and-paper final examination.

Students filled out an attitude questionnaire to determine advantages and disadvantages of the computer-generated test. The majority of students preferred computer-generated testing to paper-and-pencil testing.

Analysis of performance of both groups based on final examination scores showed no significant difference. Based on this analysis Good and Sisler (1975) concluded that computer-generated testing is at least as effective as paper-and-pencil testing. Good and Sisler (1975) also concluded that the most important advantage of computer-generated testing is the added time it allows the teacher for individualizing instruction.

Shell (1975) conducted a study in which she developed and evaluated one tutorial computer-assisted instructional unit for use in Profitable Merchandising Analysis in the Clothing, Textiles and Merchandising Department. Forty students participated in the study. The students completed the unit, an attitude form and the Coopersmith Self-Esteem Inventory and took a test over the CAI unit.

CAI test scores were correlated with six variables using the Spearman Rank Order Coefficient of Correlation. The six variables were: computer-assisted instruction attitude scores, mathematics pretest scores, American College Test (ACT) mathematics scores, Coopersmith Self-Esteem Inventory scores, average scores on all unit

tests in the course and final grades in the course. Results indicated that students did as well with the CAI unit as when the information was presented by the instructor.

Results of the student attitude form revealed that a high percentage of students reacted favorably to the CAI unit. Suggestions for improvement of the unit included more problems and more detailed instructions and explanations.

Shell (1975) also determined cost and time used in developing and programming the computer-assisted instructional unit. Analysis revealed that writing and programming the lesson required approximately 14-15 hours while the average time required for a student to complete the lesson was 26 minutes. Cost of programming the lesson was \$18.65 while the average amount required for a student to use the unit was approximately \$1.24.

Research in Computer Assisted Instruction

Researchers in the area of computer assisted instruction have attempted to determine its effectiveness. Suppes and Morningstar (1969) have conducted several such studies. One study was designed to evaluate a drill-and-practice program in elementary-school mathematics while a second study was designed to evaluate a tutorial program in elementary Russian.

The drill-and-practice program in elementary-school mathematics was introduced to students in grades 1 through 6. The study was conducted over a three year period with approximately 2700 students in three states participating in the program. The primary goal of the program was to provide drill and practice in the skills of arithmetic,

especially computations, as a supplement to regular classroom instruction.

The computer program consisted of problems presented on a teletype in the classroom. The student typed in the answer. If his answer was correct, he proceeded to the next problem. If the answer was incorrect, the teletype told the student to try again and presented the problem again. If the student made a second error, he was given the answer.

To evaluate the effectiveness of the drill-and-practice program, the arithmetic portion of the Stanford Achievement Test was administered to both control and experimental classes in October and again in May. Suppes and Morningstar (1969) found that the increase in performance level for students in the experimental classes was significantly greater than that for students in the control classes.

The second type program that was evaluated was a tutorial computer program designed to teach first- and second-year courses in Russian at the college level. Course materials were presented by the computer. The study was conducted over a period of three quarters. Two sections of the courses served as the control group and two sections were asked to volunteer for the CAI courses. To evaluate the CAI program students were ranked according to their performance on the final examination. Suppes and Morningstar (1969) found that the average number of errors on the examination was lower for the computer-based students during each quarter. The difference was statistically significant for two of the three quarters. Suppes and Morningstar (1969) also found that 73 percent of the students originally enrolled in the computer-based program completed all three quarters compared to only 32 percent in

the regular class. Suppes and Morningstar (1969) suggested that this might be an indication that the computer-based class held the interest of the students better than the regular class did. ✓

Durrett, Browne and Edwards (1974) developed a computer-based module on the physical development of young children. The module consisted of a set of slides on the various stages of a child's growth. The computer presents the student with a checklist that checks the knowledge obtained by the students from the slides. The computer then provides immediate feedback and assistance. The computer then asks the students to identify certain characteristics of stages of physical development. To help identify the characteristics the student may ask the computer for more information. The student is then given feedback on the characteristics that should have been identified. ✓

/ The module was tested by use of an experimental group and a control group which were two sections of a beginning course on child development at the college level. The control group observed children in a nursery school while the experimental group used the module. To test the effectiveness of the module both groups were given a test which contained five questions pertaining to physical development. The experimental group scored higher on the five questions than the control group while the overall test average was the same for both groups. Durrett, Browne and Edwards (1974) concluded that the computer offers students a useful and valid substitute for direct observation when learning physical development concepts. /

In addition, Durrett, Browne and Edwards (1974) concluded that . . . the higher percentage of accurate answers by the experimental group would seem to indicate that accurate observation

of physical characteristics in children was easier using the mechanical devices of slides and computers than it was for the control group observing active children in a real-life setting (p. 21).

Young (1974) conducted a study in which he used the computer in a course of quantitative methods of management at the college level. The computer was used to assist in providing feedback in the form of solutions to student-worked problems. The computer printed out problems for the student. The student worked the problem, entered his solution and the computer compared his solution with the correct one. If it was not, it also gave the student the correct solution. The computer problems were used in conjunction with eight modules which students completed at their own pace. Young (1974) evaluated the computer problems by comparing the grade distributions of the computer module course with the grade distributions of the conventional method which had been used the previous term. Results indicated that the grades were higher in the computer-module course.

/ Hall (1974) used a computer assisted instructional program to teach modern mathematics teaching methods to 387 elementary and secondary teachers. The tutorial computer program was integrated with printed instructional materials. The participants were administered a pretest and posttest of mathematics content and a posttest of attitude toward CAI. Results of the achievement test showed that the mean performance of the students advanced from 53 percent correct on the pretest to 73 percent correct on the posttest. Results of the posttest of attitude toward CAI revealed a strong positive attitude toward the individualized instruction provided by computer assisted instruction.

Solomon (1974) conducted a study using a tutorial CAI system to teach a college level accounting principles course. Instruction was on a computer terminal with the computer program consisting of both presentation of material and questions. To evaluate the CAI programs the time required by the instructor to present the material was compared with the time required by the CAI program to present the material. Results of the study revealed that tutorial CAI can present material in 33 to 41 percent less time than traditional lecture methods.

Research Conducted by the IBM Corporation

Willey (1975) conducted a study to determine the relationship between computers and instructional productivity. Experienced leaders in instructional computing from Federal agencies, private foundations and other organizations involved with educational technology were interviewed. Instructional computing in operation was observed and related materials and reports were examined. From the interviews and observations Willey (1975) selected fifteen examples that illustrated how computing has improved instructional productivity. Willey (1975) found the results of his study could be classified into five categories: (1) cost avoidance, (2) course content, (3) student enrollment, (4) student efficiency, and (5) test results.

Cost Avoidance. In the first category, cost avoidance, no examples were found of reduction of current instructional costs resulting from use of computers. Willey (1975) concluded that cost avoidance dealt with curtailing future cost increases through instructional computing without causing student performance to decline.

An example of cost avoidance was the Journalism Computer Assisted Instruction (JCAI) program at the University of Michigan (Willey, 1975). JCAI was used to analyze, evaluate, and comment on individual student's articles. The result of the use of the computer program was that enrollment in the journalism course was doubled without adding any faculty of staff. Estimated future costs avoided for the course were \$8,500.

Computer-based drills, exercises, quizzes and tests were used in a business data processing course at Florida State University. Student enrollment increased in the course to a point where 1.5 additional faculty would have been allowed under budgeting procedures. The additional faculty were not assigned to the course due to the computer instruction. Willey (1975) therefore concluded that the additional costs of the equivalent of 1.5 faculty members were avoided as a result of computer use.

Course Content. Results in the category of course content consisted of two types: "(1) Advances in level of sophistication of student exercises, and; (2) Increases in quality and quantity of student exercises" (Willey, 1975, p. 10). Students in a business investment course at Dartmouth's School of Business had access to a financial performance data bank of corporations through the computer. They utilized the data bank to compile and compare portfolios. They also used the computer to make all calculations and computations. Changes in course content were (1) an increase in the number and types of cases/problems completed by students, and (2) an increase in understanding and use of advanced techniques for analysis and problem solving (Willey, 1975).

A second example of changes in course content occurred at Ohio State University. Students enrolled in a computer-based statistics course were guaranteed completion of course materials. Students were able to complete required materials using the computerized approach as compared to traditional instruction where some students did not complete the required materials. Students using the computerized approach could use the computer as many times and as often as needed. Students in the traditional instruction group met class a set number of times. Therefore the students using the computerized approach had an opportunity to finish all materials.

Student Enrollment. Willey (1975) found that an increase in student enrollment was another result of the use of computers. The Arithmetic Proficiency Training Program (APTP), a computerized drill-and-practice program in basic arithmetic skills, used by the Newark Board of Education (New Jersey) improved student attendance (enrollment) by 7 percent in an elementary school. Success which students had with the program was cited by Willey (1975) as the primary reason for an increase in attendance (enrollment).

Attraction to instructional computing resulted in an increase in enrollment in a psychology course at Dartmouth College. A computer-based evaluation system was used to individualize the course. According to Willey (1975) the result was that the average enrollment increased from 50 to 195 students.

Student Efficiency. Student efficiency was defined in terms of student time. Students in all studies either completed courses in less time or finished more course materials in a fixed amount of time (Willey, 1975). In either case the student could work individually

at his own pace.

Results of using a computer program called Computer Assisted Elementary Accounting at the University of Illinois illustrated both types of student efficiencies. Students enrolled in the computer assisted course took 24 to 33 percent less time to do the required homework assignments than students in the traditional class, and students in the experimental group completed 19 to 31 percent more problems during the course than the students in the traditional class. Both of these examples indicate the contribution of computer use to student efficiency.

Another example of student efficiency was in the area of medical education where students are under heavy time pressures. A computer assisted evaluation system at the University of Iowa's College of Medicine was developed for use in general and systemic pathology courses. The computer program allowed students to proceed through the courses at their own pace. On the average students completed course units $3\frac{1}{2}$ weeks early, laboratory examinations 6 weeks early, and case analysis examinations $2\frac{1}{2}$ weeks early. These results have important implications for medical students who must budget their time carefully. Any savings in time in one area of study would allow them more time to devote to other areas.

Test Results. The final category, test results, dealt with comparisons of instructional computing with traditional methods of instruction. One example of test results was the comparison of final examination scores of a group of students at the University of Wisconsin who used a computer program in an economics course with those students in the course who did not. The computer program called

Teaching Information Processing System (TIPS) individualized homework assignments in the undergraduate economics course. Average students using TIPS scored 15 percent higher on the final examination than comparable students who did not use TIPS. Below average students scored 19 percent higher than matched students who had not used TIPS. Differences in test scores were significant in both groups (Willey, 1975).

The Computer Assisted Elementary Accounting program provided another example of significant test results. Students enrolled in the computer assisted accounting course scored 9 to 10 points higher on the 182 point final examination than a comparable group of students who were enrolled in the course taught by traditional methods. Differences in the test scores were statistically significant (Willey, 1975). It can be concluded that the use of the computer was a superior teaching method in the above examples.

From the five categories of results and taking into consideration the declining or leveling enrollments and increased financial pressures in American education, Willey (1975) reached several conclusions.

(1) The growth of instructional computing has been justified as an added cost because it can displace added labor costs. (2) Instructional computing can increase the quality and/or quantity of course content. (3) Instructional computing can increase the capacity of student enrollment without increasing other costs. (4) Instructional computing shows promise for advancement in use in the next two to three years. The results of this broad study have indicated that computer assisted instruction is a very effective system that can assist the educator in many areas of the educational process.

Summary

Research has shown that the computer can be used in several ways to help the educator without sacrificing student performance. In some instances performance may be increased. Some students meet the required objectives in less time than students using traditional methods. This is an advantage to both the student and the educator.

Results of two research studies, one of which used a tutorial CAI program to teach accounting principles and the other which used a CAI program to provide drill and practice in skills of arithmetic, indicate that computer assisted instruction can be used to teach mathematics effectively.

The computer is a valuable tool to the educator. Its uses should not be overlooked but explored to the fullest extent. Research has shown that it is possible to couple traditional and computer methods to obtain an efficient teaching method.

CHAPTER III

METHOD AND PROCEDURE

The study was conducted as part of an ongoing study on computer assisted instruction (CAI). Profitable Merchandising Analysis is a senior level course required of all fashion merchandising majors. A topical outline of the course may be found in Appendix A, p. 57. To achieve the overall objectives of the course students should recognize and be able to define terms used in merchandising, develop skill in doing selected mathematical calculations, identify elements that affect profit and develop an awareness of the relationship among those elements, and acquire minimum skill in analyzing and interpreting figures. Students are expected to learn to work calculation problems dealing with open-to-buy, markup, markdown, turnover and stock-sales ratio.

Development of Computer Programs

Course materials for use during the spring semester, 1976, were revised based on results of a departmental survey of recent graduates employed in retailing and selected employers. A graduate assistant (the writer) was employed to assist in revision of the course and in the development and programming of computer assisted instructional programs designed to teach specified concepts in the course.

Topics selected for the course were divided into five units. Objectives for each unit were formulated. Introductory material,

explanations and problem assignments were developed to accompany each unit. All of these materials were then incorporated into a self instructional course guide for the students so the course could be taught on an individually paced basis. Explanation of course materials, the grading system and the schedule of examinations were included with other general information at the beginning of the course guide.

Unit Examinations

Examinations were developed to measure achievement of objectives in each of the five units. Two types of items were used in each examination: objective questions measured objectives which specified recognition, definition or explanation; mathematical problems tested ability of students on objectives requiring calculation.

A pool of test items was developed for each unit. The items were divided to form three similar examinations for each unit. All three forms of the examination covered the entire unit and an attempt was made to make them as nearly equal in length and difficulty as possible. Students were allowed to retake an examination if they scored 83 percent (a grade of C) or less. If a student repeated an examination the two scores were averaged together to determine the student's final score on the examination. Students who made an A or B on an examination were considered to be progressing satisfactorily.

Description of Computer Programs

Computer assisted instructional (CAI) programs were designed to assist students in learning selected mathematical concepts involved in the operation of retail stores. The CAI programs covered concepts in

four of the five units in the course. One CAI program had previously been developed. The unit was revised according to the suggestions of Shell (1975). Eleven other concepts for which CAI seemed appropriate were identified and programs were developed. The majority of CAI programs were developed to teach a single concept. Students were instructed to read the assigned material pertaining to a specific concept before using the program; however, the majority of the programs contained only computational problems and related explanation.

The CAI programs utilized the branching technique. The programs consisted of computational problems and three to four possible answers for each problem. Each time the student selected an answer to a problem, the computer responded with an appropriate reply. The distractors represented answers a student would give if he had made a particular type of error in his computations. Many of the distractors used were determined from an analysis of errors made by students on previous examinations.

As the student worked at the computer terminal he was given one problem and a set of answers to choose from. If he selected the correct answer he was given the next problem. If he selected an incorrect answer, the student was told what mistake had been made and a hint was given to help him rework the problem. The student was then required to select another answer. If the second answer was incorrect, the same type of branching occurred and he was given further explanation of his error. The student could not proceed to the next problem until the correct answer had been selected or until he had made the maximum number of errors allowed. If the student made the maximum number of errors without selecting the correct answer, the computer printed out

a step-by-step explanation of how to work the problem and then sent him to the next problem.

Some problems in the programs were not readily adaptable for multiple choice answers. When these problems appeared in a program, the student was asked to type in his answer. The computer was programmed to print explicit instructions regarding the form in which to type the answer because the answer had to be exactly the same as the programmer had entered it in order for the computer to read it correctly. The form used by the programmer included the use of dollar and percent signs where appropriate and the exclusion of commas in large numbers.

Branching was also used with this type of problem when an incorrect answer was given. The student was told what type of error he might have made and was given a hint on how to work the problem. He was required to enter another answer. If his second answer was incorrect, he was given the correct procedure for working the problem and the correct answer.

Optional practice problems were provided in some of the programs. If a student chose to work the practice problems, he was given a problem and told to type in his answer. If the answer was correct, he was given another problem. If the answer was incorrect, an explanation of how to work the problem and the answer were given; another problem then followed. The procedure continued until the student had completed all of the practice problems.

Testing of Computer Programs

After the lessons were programmed the writer tested the programs by working them. First all of the correct answers were selected.

The programs were worked a second time with the writer selecting all the incorrect answers. The programs were checked for proper sequencing and proper branching. They were also checked for grammatical, spelling and programming errors.

Programs were then tested by asking a student to work the program and give comments and suggestions. Students were encouraged to talk with the writer about the programs and to seek help if difficulties arose. Students also informed the writer of any errors they discovered.

Evaluation of CAI Programs

Computer assisted instructional programs in Profitable Merchandising Analysis were evaluated by determining number and types of errors made on computational problems in the unit examinations and by comparing errors made by students who used the CAI programs with errors made by students who did not. Students also completed an evaluation of the CAI programs. The evaluation was used to determine student attitudes toward the CAI programs. Necessary revisions of the CAI programs were determined by considering the number and types of errors made and by considering student attitudes toward the CAI programs.

Description of Sample

The sample for the study consisted of the unit examinations of 39 students who were enrolled in Profitable Merchandising Analysis during the spring semester 1976. The computational problems on the examination were matched with corresponding CAI programs. Then the analysis was made using the examination problems of students who had used each CAI program as Group A, and the problems of students who had

not used the CAI program as Group B. Since students were encouraged to use the CAI programs but were not required to do so, a different number of students used each program.

Analysis of Unit Examinations

Four of the five examinations contained problems similar to those which had been covered in the CAI programs. Each of the problems was examined to identify errors which had been made by one or more students. Errors for each problem were categorized into the following types: omitted step, used incorrect procedure, made mathematical error, counted dates incorrectly, computed markup on retail rather than cost, reversed sign of step, reversed formula, and placed parentheses incorrectly in formula.

At the end of the semester students were asked to indicate which of the CAI programs they had used on a chart which contained names of all students enrolled in the course and a listing of all CAI programs available. The chart was used in determining the total number of students that had used each program and which students had used each program.

Each CAI program was related to at least one examination problem. The examinations were divided into two groups for each CAI program. One group consisted of the examinations of students who had used the CAI program and the other consisted of the examinations of those who had not. The number of students in each group differed for each problem because students were encouraged to use the CAI programs when they needed help but were not required to. Therefore a different number of students used each program. The examination problems related to the

CAI programs were re-examined and the errors were categorized into the types described above. The types of errors for each CAI program for each of the examinations were counted. The total number of errors made on the examinations, the number of each type of error made, and the percent of total possible errors were determined for each group.

Student Evaluation of CAI

At the end of the semester students were asked to complete an evaluation sheet (Appendix B, p. 59) which had been developed to determine student attitudes toward the use of the computer. Frequency and percentages were used to analyze responses of the students. The written comments of the students made concerning the CAI programs were also noted.

Revision of Selected CAI Programs

Three CAI programs were selected for revision. Two were chosen because of the large number of errors made by both groups. These programs were Terms of Purchase and Unit Open-to-Buy. The third program, Markup on Cost, was selected because Group A (those students who used the computer) made more errors than Group B (those students who did not).

Recommended revisions for all three programs were designed to give more detailed explanation and to emphasize selected segments of information already included in the programs. Revisions were written in the exact form needed for programming the computer, so a programmer could enter the statements and revise the existing programs. (See Appendix C, p. 65.)

CHAPTER IV

FINDINGS AND ANALYSIS

Computer assisted instructional programs were developed to assist in teaching several concepts included in Profitable Merchandising Analysis. During the spring semester, 1976, an attempt was made to evaluate the CAI programs by analyzing errors made on problems in the unit examinations. The errors made by students who used the CAI programs were compared with errors made by students who did not.

Analysis of Examination Problems

Examinations were developed to measure achievement of objectives in each of the five units of the course. The examinations contained two types of items: objective questions and computational problems. Eleven CAI programs were developed to present mathematical concepts needed in the computational problems on four of the five unit examinations. (See Table I.)

Examination papers of 39 students were analyzed and types of errors made on computational problems related to each CAI program were identified and totaled. Total possible errors for (1) the group of students who used the CAI programs (Group A) and (2) those who did not (Group B) were determined by multiplying the number of students in each group by the number of examination problems covering the concept presented by the CAI program. The number of students in each group

TABLE I
 CAI PROGRAMS RELATED TO EACH UNIT IN THE COURSE
 AND NUMBER OF EXAMINATION PROBLEMS
 RELATED TO EACH PROGRAM

Unit	Name of Program	Number of Problems
Unit I	Terms of Purchase	3
Unit II	Markup on Retail	1
	Markup on Cost	1
	Initial Markup	1
	Maintained Markup	1
	Gross Margin	1
Unit III	Stock Turnover	1
	Stock-Sales Ratio	1
	Sales Planning	2
Unit IV	Dollar Open-to-Buy	1
	Unit Open-to-Buy	1
Unit V	None	<u>0</u>
	Total	14

differed for each problem because students were encouraged to use the CAI programs when they needed help but were not required to. Therefore a different number of students used each program. The types of errors made, the total number of errors made and the percent of total possible errors were determined for both Group A and Group B. The number and percent of each type of error for both groups was also determined.

Types of Errors

Eight types of errors were identified from the students' examinations. The types of errors are defined as follows:

1. Omitted step - students omitted a necessary step in the computation of a problem.
2. Used incorrect procedure - no part of the problem was worked correctly.
3. Made mathematical error - an error was made in the mathematical computation of the problem.
4. Reversed sign of step - student subtracted when addition was required or vice versa; or student multiplied instead of dividing or vice versa.
5. Reversed formula - student transposed numbers in a formula.
6. Counted dates incorrectly - incorrect dates were determined because wrong number of days were counted.
7. Placed parentheses incorrectly in formula - correct numbers used in formula but parentheses were incorrectly placed resulting in an incorrect answer.
8. Computed markup on retail rather than cost - markup on retail was determined where problem required markup on cost.

Total Errors

Analysis of all problems covering mathematical concepts presented by the 11 CAI programs revealed that in all but one of the 14 problems the group of students who did not use the CAI programs (Group B) made more errors than the group of students who used the CAI programs (Group A).

A total of 157 errors were made on the mathematical problems covering material presented in the CAI programs. Group A made 26.7 percent of the total errors while Group B made 73.3 percent of all errors. (See Table II.) The most commonly made error occurred when students used the incorrect procedure. This type error represented 31.9 percent of total errors made and was made by only 6.4 percent of students in Group A compared to 25.5 percent of the students in Group B. Four other errors were made by ten percent or more of the students. These errors were counted dates incorrectly, made mathematical error, omitted step and reversed sign of step. All four types of errors were made more often by students in Group B than by those in Group A. One type of error was made more often by students in Group A than students in Group B. This type error occurred when students computed markup on retail rather than on cost. It represented only 2.5 percent of total errors related to each CAI program made, however.

Terms of Purchase. Results from the analysis of errors on the examination problems related to Terms of Purchase indicated that the group of students who did not use the CAI program (Group B) made 34 errors (14.9 percent of total possible errors) while Group A made 18 errors (7.5 percent of total possible errors). (See Table III.)

TABLE II

ERRORS MADE ON ALL PROBLEMS RELATED TO CAI PROGRAMS

Types of Errors	Group A ^a		Group B ^b		Total Errors ^c	
	N	%	N	%	N	%
Used incorrect procedure	10	6.4	40	25.5	50	31.9
Counted dates incorrectly	12	7.6	15	9.6	27	17.2
Made mathematical error	6	3.8	15	9.6	21	13.4
Omitted step	3	1.9	15	9.6	18	11.5
Reversed sign of step	3	1.9	14	8.9	17	10.8
Placed parentheses incorrectly in formula	3	1.9	6	3.8	9	5.7
Used incorrect formula	2	1.3	5	3.2	7	4.5
Computed markup on retail rather than cost	3	1.9	1	0.6	4	2.5
Reversed formula	<u>0</u>	<u>0.0</u>	<u>4</u>	<u>2.5</u>	<u>4</u>	<u>2.5</u>
Total	42	26.7	115	73.3	157	100.0

^aNumber of errors made by students who used the computer programs.

^bNumber of errors made by students who did not use the computer programs.

^cTotal number of errors made by students.

TABLE III
 TYPES OF ERRORS ON EXAMINATION PROBLEMS
 COVERING TERMS OF PURCHASE

Type of Error	Total Possible Errors ^a	Number ^b	Percent ^c
<u>Group A (N=20)^d</u>			
Omitted step	60	2	0.8
Used incorrect procedure	60	3	1.3
Made mathematical error	60	1	0.4
Counted dates incorrectly	60	12	5.0
Total	240	18	7.5
<u>Group B (N=19)^e</u>			
Omitted step	57	5	2.2
Used incorrect procedure	57	9	3.9
Made mathematical error	57	5	2.2
Counted dates incorrectly	57	15	6.6
Total	228	34	14.9

^aNumber of students in the group multiplied by number of problems (3).

^bNumber of students who made the error.

^cNumber of students making the error divided by total possible errors.

^dNumber of students who used the computer program on terms of purchase.

^eNumber of students who did not use the computer program on terms of purchase.

Counted dates incorrectly was the type of error made most often by both groups. Group A made 12 errors of this type and Group B made 15 errors. The majority of students making the error used the correct procedure for determining the dates of the terms of purchase but began counting days allowed for the discount on the wrong day. This resulted in an incorrect answer.

Markup on Retail. Analysis of the examination problem related to Markup on Retail revealed that only one error was made in each group. (See Table IV.) Neither of these students worked any part of the problem correctly.

Markup on Cost. Analysis of the examination problem related to the CAI program Markup on Cost revealed that Group A made five errors (5.5 percent of total possible errors) and Group B made four errors (6.3 percent of total possible errors.) (See Table V.) In Group A three students computed markup on retail instead of markup on cost. In Group B one student made this type error. The students correctly computed markup on retail in these cases, but the problem required computation of markup on cost. The markup on cost problem followed the markup on retail problem so this may have been an indication that the students had not read the problem carefully enough to distinguish between cost and retail.

Two students in Group B and one student in Group A made errors which were classified as used incorrect procedure; therefore they did not work any part of the problem correctly.

Initial Markup. On the examination problem covering Initial Markup Group A made one error (1.6 percent of total possible errors) as compared to 15 errors (16.4 percent of total possible errors) made

TABLE IV
 TYPES OF ERRORS ON EXAMINATION PROBLEMS
 COVERING MARKUP ON RETAIL

Type of Error	Total Possible Errors ^a	Number ^b	Percent ^c
<u>Group A (N=25)^d</u>			
Omitted step	25	0	0.0
Used incorrect procedure	25	1	1.3
Made mathematical error	25	0	0.0
Total	<u>75</u>	<u>1</u>	<u>1.3</u>
<u>Group B (N=14)^e</u>			
Omitted step	14	0	0.0
Used incorrect procedure	14	1	2.4
Made mathematical error	14	0	0.0
Total	<u>42</u>	<u>1</u>	<u>2.4</u>

^aNumber of students in the group multiplied by number of problems (1).

^bNumber of students who made the error.

^cNumber of students making the error divided by total possible errors.

^dNumber of students who used the computer program on markup on retail.

^eNumber of students who did not use the computer program on markup on retail.

TABLE V
 TYPES OF ERRORS ON EXAMINATION PROBLEMS
 COVERING MARKUP ON COST

Type of Error	Total Possible Errors ^a	Number ^b	Percent ^c
<u>Group A (N=23)^d</u>			
Omitted step	23	0	0.0
Used incorrect procedure	23	1	1.1
Made mathematical error	23	1	1.1
Computed markup on retail rather than cost	<u>23</u>	<u>3</u>	<u>3.3</u>
Total	<u>92</u>	<u>5</u>	<u>5.5</u>
<u>Group B (N=16)^e</u>			
Omitted step	16	0	0.0
Used incorrect procedure	16	2	3.1
Made mathematical error	16	1	1.6
Computed markup on retail rather than cost	<u>16</u>	<u>1</u>	<u>1.6</u>
Total	<u>64</u>	<u>4</u>	<u>6.3</u>

^aNumber of students in the group multiplied by number of problems (1).

^bNumber of students who made the error.

^cNumber of students making the error divided by total possible errors.

^dNumber of students who used the computer program on markup on cost.

^eNumber of students who did not use the computer program on markup on cost.

by Group B. (See Table VI.) The one error made by Group A occurred when a student added cash discounts instead of subtracting them. Seven errors of this type were made by Group B. Four students added cash discounts instead of subtracting them while three students subtracted alteration expenses instead of adding them.

Of the remaining eight errors made by Group B, three errors were mathematical errors, three errors were incorrect procedure and two errors consisted of omission of a necessary step in the calculation. These two students omitted a portion of the formula for initial markup.

Maintained Markup. Group A made only two errors (3.8 percent of total possible errors) on the examination problems related to Maintained Markup. (See Table VII.) Group B made nine errors (8.6 percent of total possible errors). Five students used the incorrect procedure in the problem. One student in Group A made this type of error while four students in Group B made the error.

Four students in Group B also omitted a step in the calculation. In order to use the formula for maintained markup, cost of markdowns must first be calculated. Three of the students did not calculate cost of markdowns.

Gross Margin. Analysis of the examination problem related to Gross Margin revealed that Group A made two errors (3.8 percent of total possible errors) while Group B made eight errors (7.7 percent of total possible errors.) (See Table VIII.) The majority of the errors resulted from incorrect procedure. One student in Group A made this type error while six students in Group B made the error.

One student in Group A and two students in Group B made errors when they reversed the sign of a step. All three students subtracted

TABLE VI
 TYPES OF ERRORS ON EXAMINATION PROBLEMS
 COVERING INITIAL MARKUP

Type of Error	Total Possible Errors ^a	Number ^b	Percent ^c
<u>Group A (N=16)^d</u>			
Omitted step	16	0	0.0
Used incorrect procedure	16	0	0.0
Made mathematical error	16	0	0.0
Reversed sign of step	<u>16</u>	<u>1</u>	<u>1.6</u>
Total	64	1	1.6
<u>Group B (N=23)^e</u>			
Omitted step	23	2	2.2
Used incorrect procedure	23	3	3.3
Made mathematical error	23	3	3.3
Reversed sign of step	<u>23</u>	<u>7</u>	<u>7.6</u>
Total	92	15	16.4

^a Number of students in the group multiplied by number of problems (1).

^b Number of students who made the error.

^c Number of students making the error divided by total possible errors.

^d Number of students who used the computer program on initial markup.

^e Number of students who did not use the computer program on initial markup.

TABLE VII
 TYPES OF ERRORS ON EXAMINATION PROBLEMS
 COVERING MAINTAINED MARKUP

Type of Error	Total Possible Errors ^a	Number ^b	Percent ^c
<u>Group A (N=13)^d</u>			
Omitted step	13	0	0.0
Used incorrect procedure	13	1	1.9
Made mathematical error	13	0	0.0
Reversed sign of step	<u>13</u>	<u>1</u>	<u>1.9</u>
Total	52	2	3.8
<u>Group B (N=26)^e</u>			
Omitted step	26	4	3.8
Used incorrect procedure	26	4	3.8
Made mathematical error	26	0	0.0
Reversed sign of step	<u>26</u>	<u>1</u>	<u>1.0</u>
Total	106	9	8.6

^aNumber of students in the group multiplied by number of problems (1).

^bNumber of students who made the error.

^cNumber of students making the error divided by total possible errors.

^dNumber of students who used the computer program on maintained markup.

^eNumber of students who did not use the computer program on maintained markup.

TABLE VIII
 TYPES OF ERRORS ON EXAMINATION PROBLEMS
 COVERING GROSS MARGIN

Type of Error	Total Possible Errors ^a	Number ^b	Percent ^c
<u>Group A (N=13)^d</u>			
Omitted step	13	0	0.0
Used incorrect procedure	13	1	1.9
Made mathematical error	13	0	0.0
Reversed sign of step	<u>13</u>	<u>1</u>	<u>1.9</u>
Total	52	2	3.8
<u>Group B (N=26)^e</u>			
Omitted step	26	0	0.0
Used incorrect procedure	26	6	5.8
Made mathematical error	26	0	0.0
Reversed sign of step	<u>26</u>	<u>2</u>	<u>1.9</u>
Total	104	8	7.7

^a Number of students in the group multiplied by number of problems (1).

^b Number of students who made the error.

^c Number of students making the error divided by total possible errors.

^d Number of students who used the computer program on gross margin.

^e Number of students who did not use the computer program on gross margin.

cash discounts and added alteration expenses when calculating gross margin. To calculate gross margin in this problem cash discounts should have been added and alteration expenses subtracted.

Stock Turnover. Only three errors were made on the examination problem related to Stock Turnover. (See Table IX.) Students in Group B made all three errors (2.7 percent of total possible errors). Each of the three errors was of a different type. One of the three errors occurred when a student omitted a necessary step and one occurred when a student made a mathematical error. The third error occurred when a student worked the problem completely incorrectly.

Stock-Sales Ratio. Results from the analysis of the examination problem related to Stock-Sales Ratio indicated that Group A made two errors (3.4 percent of total possible errors) while Group B made eight errors (5.9 percent of total possible errors). (See Table X.) Two types of errors made most often occurred when students reversed a formula or used the incorrect procedure. Three students in Group B reversed the divisor and dividend in the formula for stock-sales ratio. In all three instances the numbers in the formula were correct. This may have been an indication that the students did not understand the procedure for finding stock-sales ratio and were relying totally on memorization of a formula. No student in Group A made this type error. Two students in Group B and one student in Group A used the incorrect procedure which may have indicated that these students neither knew the procedure for finding stock-sales ratio nor were able to recall the formula.

Sales Planning. Only two errors were made on the examination problems related to the CAI program Sales Planning. (See Table XI.)

TABLE IX
 TYPES OF ERRORS ON EXAMINATION PROBLEMS
 COVERING STOCK TURNOVER

Type of Error	Total Possible Errors ^a	Number ^b	Percent ^c
<u>Group A (N=11)^d</u>			
Omitted step	11	0	0
Used incorrect procedure	11	0	0
Made mathematical error	11	0	0
Reversed formula	<u>11</u>	<u>0</u>	<u>0</u>
Total	44	0	0
<u>Group B (N=28)^e</u>			
Omitted step	28	1	0.9
Used incorrect procedure	28	0	0.0
Made mathematical error	28	1	0.9
Reversed formula	<u>28</u>	<u>1</u>	<u>0.9</u>
Total	112	3	2.7

^aNumber of students in the group multiplied by number of problems (1).

^bNumber of students who made the error.

^cNumber of students making the error divided by total possible errors.

^dNumber of students who used the computer program on stock turnover.

^eNumber of students who did not use the computer program on stock turnover.

TABLE X
 TYPES OF ERRORS ON EXAMINATION PROBLEMS
 COVERING STOCK-SALES RATIO

Type of Error	Total Possible Errors ^a	Number ^b	Percent ^c
<u>Group A (N=12)^d</u>			
Omitted step	12	0	0.0
Used incorrect procedure	12	1	1.7
Made mathematical error	12	0	0.0
Reversed sign of step	12	1	1.7
Reversed formula	<u>12</u>	<u>0</u>	<u>0.0</u>
Total	60	2	3.4
<u>Group B (N=27)^e</u>			
Omitted step	27	0	0.0
Used incorrect procedure	27	2	1.5
Made mathematical error	27	2	1.5
Reversed sign of step	27	1	0.7
Reversed formula	<u>27</u>	<u>3</u>	<u>2.2</u>
Total	135	8	5.9

^aNumber of students in the group multiplied by number of problems (1).

^bNumber of students who made the error.

^cNumber of students making the error divided by total possible errors.

^dNumber of students who used the computer program on stock-sales ratio.

^eNumber of students who did not use the computer program on stock-sales ratio.

TABLE XI
 TYPES OF ERRORS ON EXAMINATION PROBLEMS
 COVERING SALES PLANNING

Type of Error	Total Possible Errors ^a	Number ^b	Percent ^c
<u>Group A (N=8)^d</u>			
Omitted step	16	0	0
Used incorrect procedure	16	0	0
Made mathematical error	<u>16</u>	<u>0</u>	<u>0</u>
Total	48	0	0
<u>Group B (N=31)^e</u>			
Omitted step	62	0	0.0
Used incorrect procedure	62	2	1.6
Made mathematical error	<u>62</u>	<u>0</u>	<u>0.0</u>
Total	124	2	1.6

^aNumber of students in the group multiplied by number of problems (1).

^bNumber of students who made the error.

^cNumber of students making the error divided by total possible errors.

^dNumber of students who used the computer program on sales planning.

^eNumber of students who did not use the computer program on sales planning.

No errors were made by Group A. Group B made two errors (1.6 percent of total possible errors) when students used the incorrect procedure.

Dollar Open-to-Buy. Analysis of the examination problem related to Dollar Open-to-Buy indicated that no errors were made by students in Group A compared to seven errors (6.3 percent of total possible errors) made by Group B. (See Table XII.) Four of these errors occurred when the incorrect procedure was used. Two errors occurred when students reversed the sign of a step and one error occurred when a student made a mathematical error.

Unit Open-to-Buy. Results from the analysis of the examination problem related to Unit Open-to-Buy indicated that Group A made 12 errors (18 percent of total possible errors) while Group B made 25 errors (15 percent of total possible errors). (See Table XIII.) Two students in Group A and seven students in Group B made errors as a result of not working any part of the problem correctly.

Three students in Group A compared to six students in Group B placed parentheses incorrectly in at least one of the formulas necessary in the calculation of unit open-to-buy. When using a formula the calculations inside the parentheses must be done first. If the parentheses are not properly placed, the answer will be incorrect.

Maximum stock and average stock are two elements necessary in the calculation of unit open-to-buy. Both are calculated from formulas in which parentheses occur. Two students in Group A incorrectly placed the parentheses in the formula for the calculation of maximum stock and two students incorrectly placed parentheses in the formula for average stock. The incorrect placement of parentheses may have resulted because the students could not remember the mathematical procedure for

TABLE XII
 TYPES OF ERRORS ON EXAMINATION PROBLEMS
 COVERING DOLLAR OPEN-TO-BUY

Type of Error	Total Possible Errors ^a	Number ^b	Percent ^c
<u>Group A (N=11)^d</u>			
Omitted step	11	0	0
Used incorrect procedure	11	0	0
Made mathematical error	11	0	0
Reversed sign of step	<u>11</u>	<u>0</u>	<u>0</u>
Total	44	0	0
<u>Group B (N=28)^e</u>			
Omitted step	28	0	0.0
Used incorrect procedure	28	4	3.6
Made mathematical error	28	1	0.9
Reversed sign of step	<u>28</u>	<u>2</u>	<u>1.8</u>
Total	112	7	6.3

^aNumber of students in the group multiplied by number of problems (1).

^bNumber of students who made the error.

^cNumber of students making the error divided by total possible errors.

^dNumber of students who used the computer program on dollar open-to-buy.

^eNumber of students who did not use the computer program on dollar open-to-buy.

TABLE XIII
 TYPES OF ERRORS ON EXAMINATION PROBLEMS
 COVERING UNIT OPEN-TO-BUY

Type of Error	Total Possible Errors ^a	Number ^b	Percent ^c
<u>Group A (N=11)^d</u>			
Omitted step	11	1	1.5
Used incorrect procedure	11	2	3.0
Made mathematical error	11	4	6.0
Reversed sign of step	11	0	0.0
Parenthesis incorrectly placed in formula	11	3	4.5
Incorrect formula	11	2	3.0
Total	<u>66</u>	<u>12</u>	<u>18.0</u>
<u>Group B (N=28)^e</u>			
Omitted step	28	3	1.8
Used incorrect procedure	28	7	4.2
Made mathematical error	28	2	1.2
Reversed sign of step	28	2	1.2
Parenthesis incorrectly placed in formula	28	6	3.6
Incorrect formula	28	5	3.3
Total	<u>168</u>	<u>25</u>	<u>15.0</u>

^aNumber of students in the group multiplied by number of problems (1).

^bNumber of students who made the error.

^cNumber of students making the error divided by total possible errors.

^dNumber of students who used the computer program on unit open-to-buy.

^eNumber of students who did not use the computer program on unit open-to-buy.

using formulas.

Two students in Group A and five students in Group B used an incorrect formula when calculating unit open-to-buy. Many formulas are used in the calculation of unit open-to-buy. The students were not given any formulas on the examination and therefore had to recall the formulas in order to use them.

Students in Group A were required to refer to a sheet of formulas during the time they used the CAI program; therefore these students may have had more practice using the formulas than students who used only their textbooks for studying the concept.

Student Evaluation of CAI

Evaluation forms were used to determine which CAI programs had been used most often and to determine student attitudes toward computer assisted instruction (Appendix B, p. 59). The students were also asked for suggestions concerning the CAI programs. The evaluation forms were filled out by 37 of the 39 students enrolled in the course. Two students did not fill out an evaluation form because they were absent the day the forms were distributed and never returned to class.

Two CAI programs were used by more than 60 percent of the students. The CAI program Markup on Retail was used by 67.6 percent of the students and the CAI program Markup on Cost was used by 64.9 percent. (See Table XIV.) The CAI program Initial Markup was used by 54.1 percent of the students.

All students in the class were asked to indicate their feelings about the CAI programs. More than half (56.8%) of the students indicated that the CAI programs were helpful, 37.8 percent indicated they

TABLE XIV

TOTAL RESPONSES OF 37 STUDENTS ON THE
STUDENT EVALUATION OF CAI

Item	Number of Responses ^a	Percent ^b
Please check which of the following computer programs you used.		
Markup on Retail	25	67.6
Markup on Cost	24	64.9
Initial Markup	20	54.1
Maintained Markup	18	48.7
Gross Margin	16	43.2
Stock Turnover	15	40.5
Terms of Purchase	14	37.8
Stock-sales ratio	13	35.1
Unit Open-to-Buy	11	29.7
Dollar Open-to-Buy	10	27.0
Sales Planning	8	21.6
Please check the terms which describe how you felt about the computer programs		
helpful	21	56.8
interesting	14	37.8
challenging	8	21.6
waste of time	6	16.2
boring	0	0.0
other	17	46.0
What suggestions do you have regarding use of the computer in this class?		
Have more detailed explanation of how to work the problems	11	29.7
Eliminate the use of the computer	9	24.3
Have more lessons on the computer	8	21.6
Have more problems in each lesson	8	21.6
Have fewer problems in each lesson	3	8.1

^aNumbers on each item may not equal total sample number because students were allowed to answer more than once on some items or not answer at all.

^bPercentages based on total number of responses to each item as a percentage of the 37 students.

were interesting and 21.6 percent indicated they were challenging. Of the 17 students who checked other, four students stated that the CAI programs were good review for the tests and one student stated that it was helpful in understanding procedures. Two students stated that they did not always need the CAI programs, two students disliked the fact that the computer would only accept one exact answer and two students found the CAI programs confusing.

On the section of the evaluation form requesting students to indicate suggestions regarding use of the computer, 29.7 percent indicated that the CAI programs should have more detailed explanations of how to work the problems. Elimination of the use of the computer was indicated by 24.3 percent of the students. More lessons on the computer and more problems in each lesson were two separate suggestions each indicated by 21.6 percent of the students. Only 8.1 percent of the students indicated that there should be fewer problems in each lesson.

Revision of Selected CAI Programs

Three CAI programs were selected for revision. Two were selected because of the large number of errors made by both groups. On the problems related to Terms of Purchase Group A made 18 errors and Group B made 34 errors. On the problem related to Unit Open-to-Buy Group A made 12 errors and Group B made 25 errors.

On the problems related to Terms of Purchase the largest number of errors occurred when students counted dates incorrectly. To attempt to reduce the number of errors of this type a detailed explanation of the correct method for counting dates is recommended as a revision of the Terms of Purchase program. (See Appendix C, p. 65).

Revisions of the CAI program Unit Open-to-Buy are recommended to attempt to reduce the occurrence of two types of errors made frequently by the students: parentheses incorrectly placed in formula and incorrect formula. Shell (1975) recommended that an explanation of the procedure in working problems with parentheses be included in a general information sheet. This information was used to formulate revisions to be included within the CAI program. Revisions that emphasize the proper selection of a formula for use in calculating unit open-to-buy are also recommended.

The third program was selected for revision because Group A (those students who used the computer) made more errors than Group B. On the examination problem related to Markup on Cost Group A made five errors and Group B made four errors. Computed markup on retail rather than cost was the type error made most often by the students in Group A. To help reduce the occurrence of this type error revisions that emphasize the difference between markup based on retail and markup based on cost are recommended.

CHAPTER V

SUMMARY, CONCLUSIONS AND RECOMMENDATIONS

The study was conducted as part of an ongoing study on computer assisted instruction (CAI) in the Profitable Merchandising Analysis course. Prior to 1976, computer assisted instructional programs were developed to assist in teaching several concepts included in the course. During the spring semester, 1976, an attempt was made to evaluate the CAI programs by analyzing errors made on mathematical problems in the unit examinations. The errors made by the students who used the CAI programs were compared with errors made by students who did not.

Eleven CAI programs were developed to teach concepts in four of five units in the course. Unit examinations covered mathematical concepts included in the course and in the CAI programs. Types of errors students made on the computational problems were identified. Types of errors made on the examination problem related to each CAI program were counted. Total possible errors for the group of students who used the CAI programs (Group A) and those who did not (Group B) were determined. Total number of errors, types of errors and percent of total possible errors were determined for both groups.

Analysis of all examination problems covering concepts presented in the eleven CAI programs revealed that in all but one problem Group B made more errors than Group A. Of the total errors made on the

examination problems Group A made 26.7 percent while Group B made 73.3 percent. The most commonly made error was used incorrect procedure which accounted for 6.4 percent of the errors made by students in Group A and 25.5 percent of the errors made by students in Group B.

Students in Group B made more errors than students in Group A on problems related to ten of the eleven CAI programs. The three programs in which there was the greatest difference in the number of errors made between Group A and Group B were: Terms of Purchase, Initial Markup and Dollar Open-to-Buy. On the examination problems related to Terms of Purchase students in Group A made 18 errors (7.5 percent of total possible errors) while students in Group B made 34 errors (14.9 percent of total possible errors). On the examination problem related to Initial Markup students in Group A made one error (1.6 percent of total possible errors) while students in Group B made 15 errors (16.4 percent of total possible errors). On the examination problem related to Dollar Open-to-Buy students in Group A made no errors while students in Group B made 7 errors (6.3 percent of total possible errors).

Three CAI programs were chosen for revision. Two were chosen because of the large number of errors made by both groups. On the problems related to Terms of Purchase Group A made 18 errors and Group B made 34 errors. On the problem related to Unit Open-to-Buy Group A made 12 errors and Group B made 25 errors.

The third program (Markup on Cost) was selected because Group A (those students who used the computer) made more errors than Group B. On the examination problem related to Markup on Cost Group A made five errors and Group B made four errors.

Analysis of the student evaluation of CAI revealed that 56.8 percent of the students indicated that the CAI programs were helpful, 37.8 percent indicated that they were interesting and 21.6 percent indicated that they were challenging. Students also said the CAI programs were good review for tests and helpful in understanding procedures.

Over a fourth (29.7 percent) of the students indicated that the CAI programs should have more detailed explanations of how to work the problems.

Conclusions

On the examination problems related to ten of the eleven CAI programs the group of students who used the CAI programs (Group A) made fewer errors than the group of students who did not (Group B). This seemed to indicate that the CAI programs helped the students in Group A to understand the mathematical concepts presented and/or make fewer errors on the examinations than students who had not used the programs.

On problems related to two CAI programs both groups made a large number of errors. On one problem related to one CAI program the students who used the computer (Group A) made more errors than the students who did not (Group B). This seemed to indicate that three CAI programs needed to be revised.

Student evaluation indicated that the majority of the students found the CAI programs helpful, however some students desired more detailed explanations of how to work the problems in the CAI programs.

Recommendations for Further Study

The following recommendations are suggested for further study.

1. The study could be repeated with a larger sample so that the students could be divided into two groups: control and experimental. The control group could use a traditional method of instruction while the experimental group could use the CAI programs and performance of students in the two groups could be compared.
2. The study could be repeated using more students so a statistical analysis of results could be made.
3. The study could be repeated with all students using the CAI programs. Student performance could be compared to performance of students who had previously completed the course.
4. Simulation computer programs could be developed and evaluated for other courses in fashion merchandising.

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APPENDIX A

TOPICAL OUTLINE FOR PROFITABLE MERCHANDISING

ANALYSIS - SPRING 1976

PROFITABLE MERCHANDISING ANALYSIS

UNIT I - TERMS OF PURCHASE

Trade Discounts
Cash Discounts and Dating

UNIT II - MARKUP AND MARKDOWN

Calculating Individual Markup
Calculating Cumulative Markup
Calculating Average Markup
Calculating Initial Markup
Calculating Maintained Markup and Markdowns
Calculating Gross Margin

UNIT III - PLANNING AND CONTROL - PART I

Planning Stock Turnover
Sales Planning and Forecasting
Stock Planning Dollars
Price Lining

UNIT IV - PLANNING AND CONTROL - PART II

Planning Purchase - The Merchandise Plan
Planning Open-to-Buy Controls
Planning Model Stocks

UNIT V - INVENTORY VALUATION AND THE OPERATING STATEMENT

The Retail Method of Inventory Valuation
The Retailer's Operating Statement

APPENDIX B

STUDENT EVALUATION FORM

OF CAI

EVALUATION FORM

Please check which of the following computer programs you used.

- Terms of Purchase
- Markup on Cost
- Markup on Retail
- Initial Markup
- Maintained Markup
- Gross Margin
- Stock Turnover
- Stock-Sales Ratio
- Sales Planning
- Dollar Open-to-Buy
- Unit Open-to-Buy

Please check the terms which describe how you felt about the computer programs. (Check as many as apply.)

- interesting
- boring
- helpful
- challenging
- waste of time
- other (please list) _____

What suggestions do you have regarding use of the computer in this class?

- Have more lessons on the computer
- Have more problems in each lesson
- Have fewer problems in each lesson
- Eliminate the use of the computer
- Have more detailed explanations of how to work the problems

Other specific comments regarding use of the computer

APPENDIX C

RECOMMENDATIONS FOR REVISIONS OF
SELECTED CAI PROGRAMS

After reviewing the types of errors made the following recommendations are suggested for revisions of the programs Terms of Purchase, Markup on Cost and Unit Open-to-Buy. The recommendations are written in the exact form needed for programming the computer. Line numbers for each statement are included so that a programmer could enter these statements as they are and revise the existing programs.

TERMS OF PURCHASE

The following suggested revisions for the CAI program are made in an attempt to reduce the number of errors resulting from the incorrect counting of dates.

641: ? 'In order to determine the period of discount and the net period, the number of days are counted from the proper date whether it is date of invoice, date of receipt of goods, or end of month. There are two ways one can easily determine the correct dates. For example, if the terms are 2/10, n/30 DOI and the date of invoice is May 10, the discount period may be determined by adding May 10 + 10 which will = May 20. The discount period is May 10 through May 20. If a calendar is used to count the days then you must count May 11 as the first day of the discount period, then May 20 will be the tenth day. When the terms are EOM you begin counting on the first day of the following month. For example, if the terms are 2/10, n/30 EOM and the invoice is dated June 15, the discount period would be the 1st through the 10th of July.'

MARKUP ON COST

The following suggested revisions for Markup on Cost are made in an attempt to reduce the number of errors resulting from the calculation of markup on retail rather than markup on cost.

- 35: ? 'When working with markup you must remember that MU on cost is different from MU on retail.'
- 50: ? 'When MU is based on retail, retail = 100%; however when MU is based on cost, cost always equals 100%. Since . . .
- 60: ? 'C = 100% and $C + MU = R$, the retail price must always be greater than 100%.'

UNIT OPEN-TO-BUY

The following suggested revisions are made to help reduce the number of errors resulting from incorrect placement of parentheses in formulas and use of incorrect formulas.

Shell (1975) recommended that information pertaining to parentheses be included in a general information sheet. This information has been utilized as part of the recommended revisions of the program.

- 75: ? 'When working with the formulas used in the calculation of unit OTB remember that parentheses dictate the order in which the problem is to be calculated. For example, in the following problem, $72 + (2 + 2) \times 50$, the addition inside the parentheses should be worked first, $72 + (4) \times 50$. Next, the multiplication should be performed, $72 + (4 \times 50)$. Then the addition outside the parentheses can be performed, $72 + 200 = 272$. Always remember calculations inside the parentheses should be performed

first; the multiplication or division outside the parentheses should be performed next. Subtraction or addition outside the parentheses should be performed last.'

360: ? 'Which formula do you use to find MAX in this problem? Use the list of formulas. In order to determine which formula to use for MAX, determine whether R is given in weeks or units.'

490: ? 'You did not add DP and RP and multiply by rate of sale before adding to R. Remember that the parentheses dictate the order in which the problem is worked. Please refer to the information given at the beginning of the lesson and then try again.'

1155: ? 'Remember you must determine whether you are looking for average stock in weeks or units.'

1400: ? 'You added the R to $\frac{1}{2}$ RP before multiplying by S. Remember the parentheses dictate the order in which the problem is worked. Please refer to the information about parentheses given at the beginning of the lesson and then try again.'

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