METHODS OF LEARNING IN A MICROPROCESSOR APPLICATIONS COURSE

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CHAPTER I

INTRODUCTION

More than 50 years ago Sidney Pressey, a professor at Ohio State University, hailed "the coming industrial revolution in education", and described a machine that "tests and also teaches" (Skinner, 1986, p.103). Dr. Pressey conducted experiments and introduced program instruction into the classroom almost thirty years before the introduction of the computer as a component of education.

The introduction of computers is considered by many to be the third revolution in education; the first was the printing of books the second the introduction of libraries (Heinich, 1985). The development of the computer in the 1950's was impressive in design and function and its potential in the field of education was obvious. B.F. Skinner and others in the field of educational research helped to develop programmed instruction for use with computers but the factors of cost, hardware reliability, and the availability of adequate materials remained major barriers to the widespread adoption of computers for instruction (Heinich, 1985). The first microprocessors were produced in 1971 for use in hand held calculators (World

Book Encyclopedia, 1987). This development resulted in the advent of the first microcomputer in 1975. The development of the first microprocessor chip and the subsequent development of the first microprocessor has revolutionized education. Those factors that were major barriers to the widespread adoption of computers for instruction were gone.

The historical components of education; the classroom, the teacher, the student, the book, the journal article, and the printed word, were joined by another educative force - instructional technology (Boaz, 1983). This study explored the application of the microcomputer to the educational experience. The use of the microcomputer in instruction must be analyzed and its effectiveness evaluated so that it can be applied in an effective and beneficial manner to student understanding.

Statement of the Problem

To meet the needs of students and to better facilitate their learning to use computers in industry, information on what methods of instruction can best be used to achieve this goal was needed. Such understanding may lead to a better structured and more beneficial course.

Need for the Study

Schools exist to help prepare those who attend to meet the needs of industry and society. It is important to both Oklahoma State University Technical Branch, Okmulgee and the students of the institution that teaching methods be efficient and effective. The explosion in information and resulting advancements in technology require that more be taught in the amount of time that a student spends in any given course. Methods of instruction need to be examined in an objective manner. The needs of the student must be met through effective instruction in the classroom. There was a need to examine the present methods used in instruction and compare other methods to determine if change was needed. Change must be based upon a study which objectively relates the teaching methods used to the achievement of the individual student.

Purpose of the Study

The purpose of this study was to compare student learning in a Microprocessor Applications course at Oklahoma State University Technical Branch, Okmulgee when taught using traditional teaching methods and when taught using computer aided instruction in addition to the traditional teaching methods.

Hypothesis

The basic assumption in this research was that there was no significant difference in student learning, in a microprocessor applications course, when taught using traditional teaching methods and when taught using computer aided instruction. To investigate the basic question, three hypothesis were formulated as follows:

1. There is no significant difference in the overall student learning in a microprocessor applications course when taught using traditional methods and when taught using traditional teaching methods in combination with computer-aided instruction.

2. There is no significant difference in the learning in a microprocessor applications course of those students enrolled in the technology programs of study when taught using traditional teaching methods and when taught using traditional teaching methods in combination with computer-aided instruction.

3. There is no significant difference in the learning in a microprocessor applications course of those students enrolled in the mechanical programs of study when taught using traditional teaching methods and when taught using traditional teaching methods in combination with computer-aided instruction.

Assumptions

The following assumptions were included in this study.

1. That the grade achieved in the Microprocessor Applications course was a true evaluation of the student's ability to utilize the computer in industrial applications.

2. That the factors included in this study are relevant to achievement in a Microprocessor Applications course.

Limitations of the Study

This study was limited by three major components.

1. The population for this study consisted of fifty five students who were enrolled in Microprocessor Applications, TEC 1193, in the 1987 summer trimester.

2. The population for this study was limited to full time students who were enrolled in regular day classes at Oklahoma State University Technical Branch, Okmulgee in the summer trimester 1987.

3. The Microprocessor Applications course is a basic computer usage class that relates the use of the computer to industrial applications.

Definition of Terms

Program of Study-- A training program in a specialized area of study.

Trimester-- A sub-division of the academic year at Oklahoma State University Technical Branch, Okmulgee, fifteen weeks in length.

OSU-Tech-- Oklahoma State University Technical Branch, Okmulgee.

Microcomputers-- Smallest of three main computer types. A desk top computer the size of a typewriter.

Computer-- For the purpose of this report all references to computers can be termed same as microcomputers.

Microprocessor Applications-- A course offered at OSU-Tech, which relates microprocessor uses to industrial applications.

<u>CAI</u>-- Computer-aided instruction or Computer-assisted instruction - Instruction delivered directly to learners by allowing them to interact with lessons programmed into the computer system.

<u>CBI</u>-- Computer-based instruction - Instruction concept that encompasses two major catagories: computer-aided instruction (CAI), and computer-managed instruction (CMI).

<u>CMI</u>-- Computer-managed instruction - The use of a computer system to manage information about learner performance and learning resources options in order to prescribe and control individual lessons.

<u>Cognitive domain</u>-- The domain of human learning involving intellectual skills, such as assimilation of information or knowledge.

<u>Traditional Methods of Instruction</u>-- The illustrate lecture, the demonstration, the lesson, the discussion, and independent study.

<u>Study Guides</u>-- Questions with answers and remediation programmed on computers as CAI coverage of a particular subject.

CHAPTER II

REVIEW OF RELATED LITERATURE

The literature related to this study is presented in four catagories. The catagories include:

1. Methods of instruction,
2. Needs for and/or uses of new technology,
3. CAI - Modes of delivery and interaction, and
4. Related studies involving CAI.

Methods of Instruction

"Facilitation begins when a method is identified which gives purpose and direction to the learning task" (Davies, 1981, p.32). The instructor in any field in education must present material to the student in a manner that will convey meaning and understanding. Human nature leads us to do what we feel most comfortable doing and so we tend to use methods in teaching which were the same methods we experienced as learners. Kemp (1977) asks the question "What instructional methods and instructional resources will be most appropriate for accomplishing each objective?"

Instructors and teachers are often bewildered by the range and variety of the instructional methods available to them. Although the variety seems endless, there are really only four broad classes of strategy involved. They are the lecture, the demonstration, the discussion, and independent study (Davies, 1981). The use of the computer in the classroom for instructional purposed combines these four strategies because the computer in a certain fashion, was able to communicate with the learner (Sullivan, 1985).

The idea at the center of individualizing instruction was to return the focus of instruction to the individual. Rather than one teaching strategy it is a group of strategies aimed at improving the individual's interaction, in terms of quality and quantity, with the subject matter (McEwing and Roth, 1985). Combining the four broad classes of strategy, described by Davies, presented variety to the student and enhanced learning and at the same time it individualized instruction.

Research indicated that many effective learning programs had characteristics which can easily be built into computer software (McEwing and Roth, 1985). "Officials estimate that by 1990 the number of microcomputers available in public schools will grow to more than three million" (Caldwell, 1986, p.13). The availability of computers in the classroom combined with their flexibility and power for use in presentation in instructional materials led to exploration of how best to use the new technology.

Needs For and/or Uses of New Technology

"To use the computers as tutor and tool can both improve and enrich classroom learning, and neither requires student or teacher to learn much about computers" (Taylor, 1980, p.132). Software was available for specific areas of instruction in tutorial form, or software was available for authoring course work. The development of instructional software was in response to needs in education concerning how best to utilize the microcomputer in the classroom. The continued interest of educators in teaching higher cognitive skills, i.e., problem solving, and the more recent trend in teaching "thinking" as a subject in our schools has given even greater momentum to the computer-in-education movement. Many have a strong belief that "computers will facilitate the teaching of problem-solving processes" (Gallini, 1985 p.7).

"Computer systems can deliver instruction directly to students by allowing them to interact with lessons programmed into the system; this was referred to as computer assisted instruction (CAI)" (Heinich, 1985, p.167). This use of the microcomputer to deliver instruction was still very much undeveloped. It was being rapidly researched and integrated into use in the classroom, and was accepted by most educators as a classroom reality. "[They] are beyond asking whether they should use the computer in instruction. The question now was, 'How do I use it and what kind of computer set-up and curriculum design are best for my class or school?'" (Manion, 1985, p.25)

CAI Modes of Delivery and Interaction

The intellectual origins of CAI go back to Thorndike's theory of stimulus-response and B.F. Skinner's development of teaching machines and programmed learning. According to Skinner, the aim of designing programmed learning was to construct a series of questions that almost every student could answer correctly. "The act of giving the correct answer and the reinforcement that followed served to plant the knowledge more firmly in the student's mind" (Bok, 1985, p.10). Computer Aided Instruction is programmed instruction and can be used in this method. The sophistication is unlimited however, because of the computer system basis for delivery. The various utilization possibilities can best be discussed in terms of the various instructional modes that the computer can facilitate most effectively: drill and practice, tutorial, gaming, simulation, discovery, and problem solving (Heinich, 1985 and Manion, 1985). It is interesting to note that B.F. Skinner, who pioneered programmed learning in 1954 refers to the small computer as the ideal hardware for programmed instruction. "It is not functioning as a computer, of course; it is teaching. It should be called a teaching machine" (Skinner, 1985, p.110). Skinner today sees his early ideas expanded by the use of the various CAI modes of delivery and interaction. Figure 1 summarizes the utilization of the various CAI modes

(Heinich, 1985), by relating the description, role of teacher, role of computer, role of student and applications or examples to the particular mode of computer aided instruction desired.

Modes	Description	Role of Teacher	Role of Computer	Role of Student	Applications/Examples
Drill and Practice	Content already taught Review basic facts and terminology Variety of questions in varied formats Question/answer drills repeated as necessary	Arranges for prior instruction Selects material Matches drill to student Checks progress	Asks question "Evaluates" student response Provides immediate feedback Records student progress	Practices content already taught Responds to questions Receives confirmation and/or correction Chooses content and difficulty level	Parts of a microscope Completing balance sheets Vocabulary building Math facts Product knowledge
Tutorial	Presentation of new information Teaches concepts and principles Provides remedial instruction	Selects material Adapts instruction Monitors	Presents information Acts questions Monitors responses Provides remedial feedback Summarizes key points Keeps records	Interacts with computer Sees results Answers questions Asks questions	Clerical training Bank teller training Science Medical procedures Bible study
Gaming	Competitive Drill and practice in a motivational format Individual or small group	Sets limits Directs process Monitors results	Acts as competitor judge score keeper	Learns facts/strategies/skills Evaluates choices Competes with computers	Fraction games Counting games Spelling games Typing (arcade-type) games
Simulation	Approximates real-life situations Based upon realistic models Individual or small group	Introduces subject Presents background Guides "debriefing"	Plays role(s) Delivers results of decisions Maintains the model and its database	Practices decision making Makes choices Receives results of decisions Evaluates decisions	Trouble-shooting History Medical diagnosis Simulators (pilot/driver) Business management Laboratory experiments
Discovery/ Inquiry	Inquiry into data base Inductive approach Trial and error Tests hypotheses	Presents basic problem Monitors student progress	Presents student with source of information Stores data Permits search procedures	Makes hypotheses Tests guesses Develops principles/ rules	Social science Science Food intake analysis Career choices
Problem Solving	Works with data Systematizes information Performs rapid and accurate calculations	Assigns problems Checks results	Presents problem Manipulates data Maintains database Provides feedback	Defines the problem Sets up the solution Manipulates variables Trial and error	Business Creativity Troubleshooting Mathematics Computer programming

Figure 1. Utilization of Various CAI Modes

Related Studies Involving CAI

The educational benefits of technology remained in dispute. Various studies showed that CAI resulted in substantial gains in learning while other studies indicated that learning improvements from computer assisted instruction shrank to virtually nothing when the same teacher taught both the experimental and the conventional classes with comparable amounts of preparation. Similarly, the gains achieved in computer experiments lasting less than four weeks dropped by more than two-thirds when the experiments continued beyond eight weeks and the novelty of the new technology began to wear off (Bok, 1985).

In February 1985, the Computer Science Department at Brigham Young University tested CAI in a study of experimental design. Four hundred and forty one students enrolled in a basic computer programming course were divided into two groups. Two hundred students were randomly selected to receive their instruction from the automated ELROND Project (CAI in design). The rest of the 441 students, known as the Apple group, received all of their instruction and assignments from the instructor hired to teach the basic computer programming course. Both groups were given three identical examinations in the Brigham Young University Testing Center. The results of the exams are given in figure 2 (Christensen, 1986).

	ELROND	APPLE
Test	81.18	82.41
Test #2	72.97	72.20
Test #3	64.71	65.27
Score (150 points) programming assignments	109.90	110.96
Students dropping course	32	34
Percentage of total points	75.44	75.88

Figure 2. ELROND STUDY RESULTS. February 1985 study testing CAI. Conducted by Computer Science Department at Brigham Young University.

The results of the ELROND Project are subject to interpretation but there would appear to be no conclusive evidence of gains in learning. The change in instruction delivery may have other beneficial by products such as better utilization of time and classroom space. Also more effective allocation of money and favorable student acceptance should be a consideration in the study's findings.

The School of Library Science at the University of Southern California offered some self-paced individualized courses (CAI) along with other sections of the same courses offered in traditional classroom settings, over a period of two years. The scores from examinations administered in the two types of courses showed little difference in test results (Boaz, 1983). Again the gain in learning appeared to be the same but the study reported the advantage of technology is it promotes self-paced, self-motived, individualized learning.

CAI addresses the need for improved effectiveness in teaching basic skills. In addition, CAI naturally lends itself to individualizing and self-pacing, while at the same time being able to carry out the testing and management tasks associated with self pacing (Taylor, 1980). Not all course work will be able to be adapted to CAI, but research needs to be conducted so that CAI can be used in those areas of course work for which it is best suited.

Summary

The use of the microcomputer in the education process has been hailed as a coming revolution in education for years. "The computer promises to change all. With respect to the school, what we are possibly seeing for the first time is a machine that will be a figure as opposed to ground in the education ecology" (Sullivan, 1985, p.3). The promise that has been held out has today becoming a reality with the use of computer aided instruction (CAI).

Computer aided instruction offers not only a delivery system for information it presents education with an effective design of instruction.

Effective design of instruction depends on an

> understanding of how different cognitive tasks require different kinds of thinking and learning. Bloom's taxonomy of cognitive tasks can help with this. However, consideration of the level of cognitive task alone is not enough. Instruction must also be properly organized and sequenced (Bramble, 1985, p.117).

Use of the computer allows effective design in the form of assisting in the instruction. CAI addresses the need for improved effectiveness in teaching basic skills. In addition, CAI naturally lends itself to individualizing and self-pacing, while at the same time being able to carry out the testing and management tasks associated with self pacing (Taylor, 1985).

The classroom teacher can, with the aid of the computer, become more effective and responsive to the needs of individual students. "Computerized coaching and counseling cannot encompass all of the counseling needs of individual students" (O'Neil, 1981, p.87), but it can reduce the time of required work in these areas by the teacher and allow the teacher to meet the individual needs of students not met by the computer. CAI offers the teacher assistance in the classroom that can, if used effectively, add reward to the teaching profession.

CHAPTER III

METHODOLOGY

The purpose of this study was to compare two methods of instruction and student learning in a Microprocessor Applications course at Oklahoma State University Technical Branch, Okmulgee. The first steps were to identify the students to be studied and formulate a data collecting instrument. Next, the instrument was utilized in collecting the data needed and the data was statistically analyzed. Details of these activities are discussed in this chapter.

Selection of the Subjects

The subjects selected for this study were students enrolled at Oklahoma State University Technical Branch, Okmulgee during the summer trimester of 1987. Ideally a random sample drawn from all students required to take the Microprocessor Applications course would have given a better basis for generalizations beyond the group participating in the study. Such a random sample was, however, impossible for administrative reasons. The students who comprise the group participating in the study were enrolled in the course by their individual departments and assigned to sections by the registrars office. They were enrolled in Microprocessor

Applications Course, TEC 1193, which is required coursework for all students enrolled in Air Conditioning Refrigeration, Diesel and Heavy Equipment, Automotive Mechanics, Industrial Electrical Technology, and Computer Integrated Systems Service programs of study. The students were not beginning students but rather students who had completed an average of three trimesters of the six trimester coursework in their program of study.

To facilitate the study students were placed in two groups. All students enrolled in Diesel and Heavy Equipment and Automotive Mechanics programs of study were grouped and the grouping was labeled as a Mechanic Cluster. All students enrolled in Industrial Electrical Technology, Air Conditioning and Refrigeration and Computer Integrated Systems Service programs of study were grouped and the grouping was labeled as a Technology Cluster.

Collection of Data

The instrument used to obtain the needed data for this study was a test designed to assess student understanding of basic computer programming (Appendix A). The instrument was a twenty five question test which was scored on a scale of 0 to 100 with each correct answer carrying a weighted value of four points. The test questions were a mix of true and false, fill in the blank, multiple choice, matching, and short answer questions.

The instrument devised was used as a pretest and a posttest. Two qualified instructors were involved in the administration of the test. The pretest was administered during the first class meeting prior to actual instruction in the subject matter. The posttest was administered during the fifth class meeting after the subject matter had been fully covered. The collection of data took place within the summer trimester, 1987, and the research was conducted in the manner of an experimental design. Three sections of the Microprocessor Applications Course, TEC 1193, were selected as the control group for the study, and three sections of the Microprocessor Applications Course, TEC 1193, were selected as the experimental group.

The coursework for the control group was administered in a traditional manner. The class consisted of lecture and assignments administered by a classroom instructor. The coursework for the experimental group was administered in a traditional manner with additional coverage of coursework provided by computer. The computer aided instruction consisted of study guides which are question and answer excersises taken by the individual student at a computer terminal. The study guides provided additional coverage of the microprocessor application coursework. Three of these study guides were developed which supplemented the classroom coverage of basic programming and were available as a student help session outside of the classroom.

With both the control group and the experimental group the subject matter was covered fully using the same lesson plan coverage.

Analysis of the Data

The t-test for a difference between two independent means is used to determine whether the performance difference between two groups of subjects is significant (Popham 1973). The t-tests allow the analysis of the collective and separate contributions of two or more variables. A pretest score was considered to be the independent variable and the gain in learning, as measured by the posttest, was the dependent variable.

Calculations necessary for t-test scores are sums, means and sum of squares. Additional statistics needed are standard error of the difference, $S_{D\bar{X}}$ and a calculated t value to locate position in the t distribution for the purpose of acceptance or rejection of the null hypothesis.

The basic computational formula for the t-test of a difference between two independent means is:

$$t = \frac{\bar{X}_1 - \bar{X}_2}{\sqrt{\left(\frac{\Sigma(X_1-\bar{X}_1)^2 + \Sigma(X_2-\bar{X}_2)^2}{(N_1+N_2)-2}\right)\left(\frac{1}{N_1}+\frac{1}{N_2}\right)}}$$

where

X_1 = mean of the first group of scores
X_2 = mean of the second group of scores
ΣX_1 = sum of the squared score values of the first group
ΣX_2^2 = sum of the squared score values of the second group
$(\Sigma X_1)^2$ = square of the sum of the scores in the first group
$(\Sigma X_2)^2$ = square of the sum of the scores in the second group
N_1 = the number of scores in the first group
N_2 = the number of scores in the second group

The basic computational formula was worked in parts with means $\bar{X}$, calculated for each group then standard deviation S, calculated for the means then standard error of the difference calculated $S_{D\bar{X}}$, and the t-test calculated.

Standard Deviation:

$$S = \sqrt{\frac{\Sigma X_2}{N} - \bar{X}^2}$$

Standard Error of the Difference:

$$S = \sqrt{\frac{N_1 S_1^2 + N_2 S_2^2}{N_1 + N_2 - 2}\left(\frac{1}{N_1} + \frac{1}{N_2}\right)}$$

t-test:

$$t = \frac{\bar{X}_1 - \bar{X}_2 - 0}{S_{D\bar{X}}}$$

The calculated value of t was used to test for a significance between two means. The degree of freedom df, was computed by setting df = $(N_1 + N_2) - 2$ and then using a table for values of t at the 0.05 level of significance for a two tailed test the hypothesis was accepted or rejected. The t value was used to test hypothesis one, two, and three at the 0.05 level.

For this study, the Pearson product moment correlation, designated r, was used to provide information regarding the relationship between the independent variables. The Pearson product moment correlation coefficient r is a parametric statistic that can be used to describe the relationship between two variables (Van Dalen 1979). The use of the Pearson product moment correlation in this study does not try to draw conclusions proving the independent variables but makes a tighter design in that the value of r (rho) expresses the degree of relationship, that, is the nature and strength of the correlation.

Scatter diagrams were created to provide a visual concept of the relationship between variables used in this study. The pretest score and posttest score as achieved by the individual student of each group was plotted so that a tendency in learning can be observed.

Scatter diagrams are provided for the mechanic cluster control group, the mechanic cluster experimental group, the technology cluster control group, and the technology cluster experimental group. These diagrams are presented by Figures 3 through 6 in Chapter IV.

CHAPTER IV

RESULTS

Identification of Data

Data was gathered from all students enrolled in Microprocessor Application, TEC 1193, in the summer trimester, 1987. Data from 82 students were examined with 55 accepted for analysis and 27 rejected. The most common reason for rejection was failure to complete all questions on the pretest. Failure to complete a majority of questions on the pretest was considered noncompliance with instructions given prior to testing and those tests were rejected from the study. Because all tests were signed by those tested corresponding posttest scores were also rejected.

The control group was taught microprocessor applications using traditional teaching methods only. A pretest was given prior to actual coverage of the course material and a posttest was given at the end of the presentation of the course material. The control group consisted of twenty five students from five programs of study taught at Oklahoma State University Technical Branch, Okmulgee. Table I lists the program of study as well as the pretest and posttest score achieved by each student making up the control group.

TABLE I

INDIVIDUAL PRETEST POSTTEST SCORES IN THE CONTROL GROUP

Group A Student No.	Program of Study	Test Score Pretest	Test Score Posttest
1	AUM[1]	64	76
2	AUM	44	60
3	DHE[2]	56	80
4	ACR[3]	36	82
5	DHE	26	78
6	AUM	38	60
7	ACR	48	90
8	ACR	51	80
9	AUM	28	60
10	IET[4]	66	90
11	CISS[5]	84	94
12	DHE	51	82
13	IET	70	72
14	CISS	72	84
15	DHE	38	72
16	DHE	53	70
17	AUM	32	60
18	AUM	76	88
19	CISS	86	86
20	IET	88	92
21	CISS	42	80
22	CISS	38	82
23	CISS	74	84
24	ACR	74	90
25	ACR	48	68

1 AUM Automotive Mechanics
2 DHE Diesel and Heavy Equipment
3 ACR Air Condition and Refrigeration
4 IET Industrial Electrical Technology
5 CISS Computer Integrated Systems Service

The experimental group was taught microprocessor applications using computer aided instruction in addition to the traditional teaching methods. A pretest was given prior to actual coverage of the course material and a posttest was given at the end of the presentation of the course material.

Table II lists the program of study as well as the pretest and posttest score achieved by each student making up the

TABLE II

INDIVIDUAL PRETEST POSTTEST SCORES IN THE EXPERIMENTAL GROUP

Group B Student No.	Program of Study	Test Score Pretest	Test Score Posttest
1	AUM[1]	80	92
2	CISS[2]	64	84
3	CISS	78	82
4	CISS	82	88
5	DHE[3]	46	74
6	DHE	38	80
7	AUM	54	74
8	CISS	76	80
9	ACR[4]	48	82
10	ACR	60	80
11	ACR	59	84
12	ACR	63	82
13	IET[5]	72	84
14	IET	92	90
15	ACR	57	86
16	ACR	39	88
17	ACR	48	76
18	ACR	59	96
19	ACR	50	72
20	AUM	56	82
21	ACR	84	96
22	ACR	46	90
23	AUM	63	82
24	DHE	19	78
25	AUM	34	68
26	AUM	67	88
27	AUM	44	70
28	DHE	42	86
29	DHE	60	86
30	DHE	68	96

1 AUM Automotive Mechanics
2 CISS Computer Integrated Systems Service
3 DHE Diesel and Heavy Equipment
4 ACR Air Condition and Refrigeration
5 IET Industrial Electrical Technology

experimental group. The experimental group consisted of thirty students from five programs of study taught at Oklahoma State University Technical Branch, Okmulgee.

Statistical Method

For this study, the Pearson product-moment correlation, designated r, was used to provide information regarding the relationship between the pretest scores and posttest scores for all students within each group. The independent t-test was used to test the null hypothesises.

Information presented in Table III shows the mean score for each group and the standard deviation (SD) based upon

TABLE III

COMPARISON BY GROUP OF PRETEST AND POSTTEST SCORES

Cluster/Group	Pretest Mean	SD	Posttest Mean	SD	r
Mechanic Cluster Control Group	46	14.924	71.5	9.764	0.66
Mechanic Cluster Experimental Group	51.6	15.877	81.2	8.059	0.66
Technology Cluster Control Group	62.6	17.654	83.8	7.15	0.47
Technology Cluster Experimental Group	63.4	14.709	84.7	6.133	0.38

pretest scores, and the mean score for each group and the standard deviation based upon posttest scores. The value of the correlation coefficient r is included in the table to show the relationships that exist between the independent variables.

Data in Table IV is a summary of the results of the t-test for the mechanic cluster, technology cluster and the overall population of the study.

TABLE IV

t - TEST RESULTS

Name of Test	t - Test	df	Disposition
Mechanic Cluster Pretest control/experimental	-0.8495459	22	Not Rejected
Mechanic Cluster Posttest control/experimental	-2.5725616	22	Rejected
Technology Cluster Pretest control/experimental	-0.1181568	29	Not Rejected
Technology Cluster Posttest control/experimental	-0.3440109	29	Not Rejected
Overall Pretest control/experimental	-0.6169032	53	Not Rejected
Overall Posttest control/experimental	-1.9713479	53	Not Rejected

In each case the rejection level was 0.05

Information presented in Table IV reveals that for the mechanic cluster there is a significant difference at the 0.05 alpha level and the disposition was to reject the null hypothesis. For the technology cluster and the overall population of the study the t-test showed no significant difference at the 0.05 alpha level and the disposition was to not reject the null hypothesis.

The correlation diagram (scatter diagram) provides a visual concept of the relationship between variables. These diagrams are represented by Figures 3 through 6. The cluster of the scores as seen in the scatter diagrams makes visual the moderate positive correlation that exists between the pretest and posttest scores. The data collected for the control group and used in compiling the scatter diagrams for group A was presented in Table I. The data collected for the experimental group and used in compiling the scatter diagrams for group B was presented in Table II.

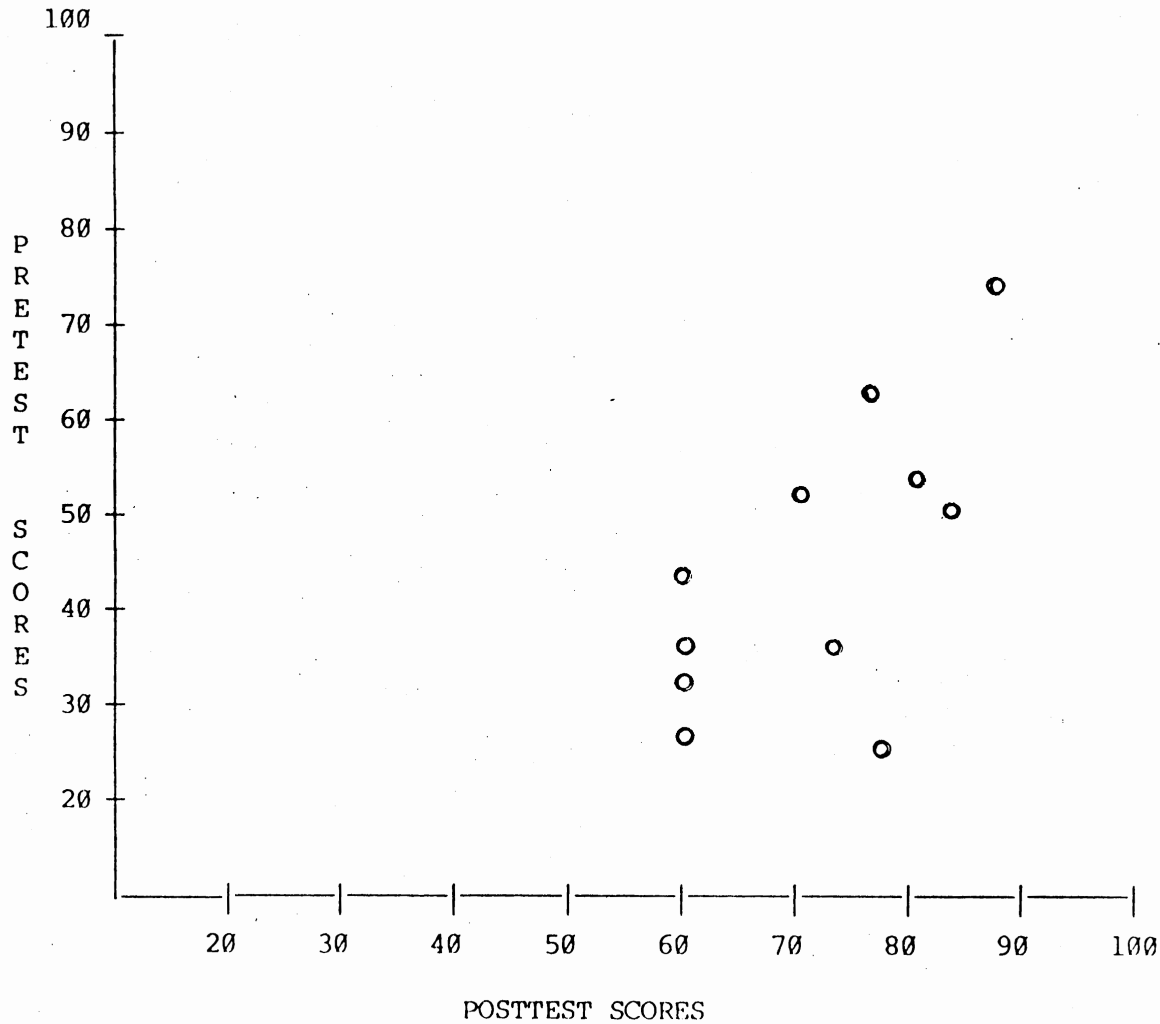

Figure 3. A scatter diagram of the pretest scores and the posttest scores as achieved by the mechanic cluster control group

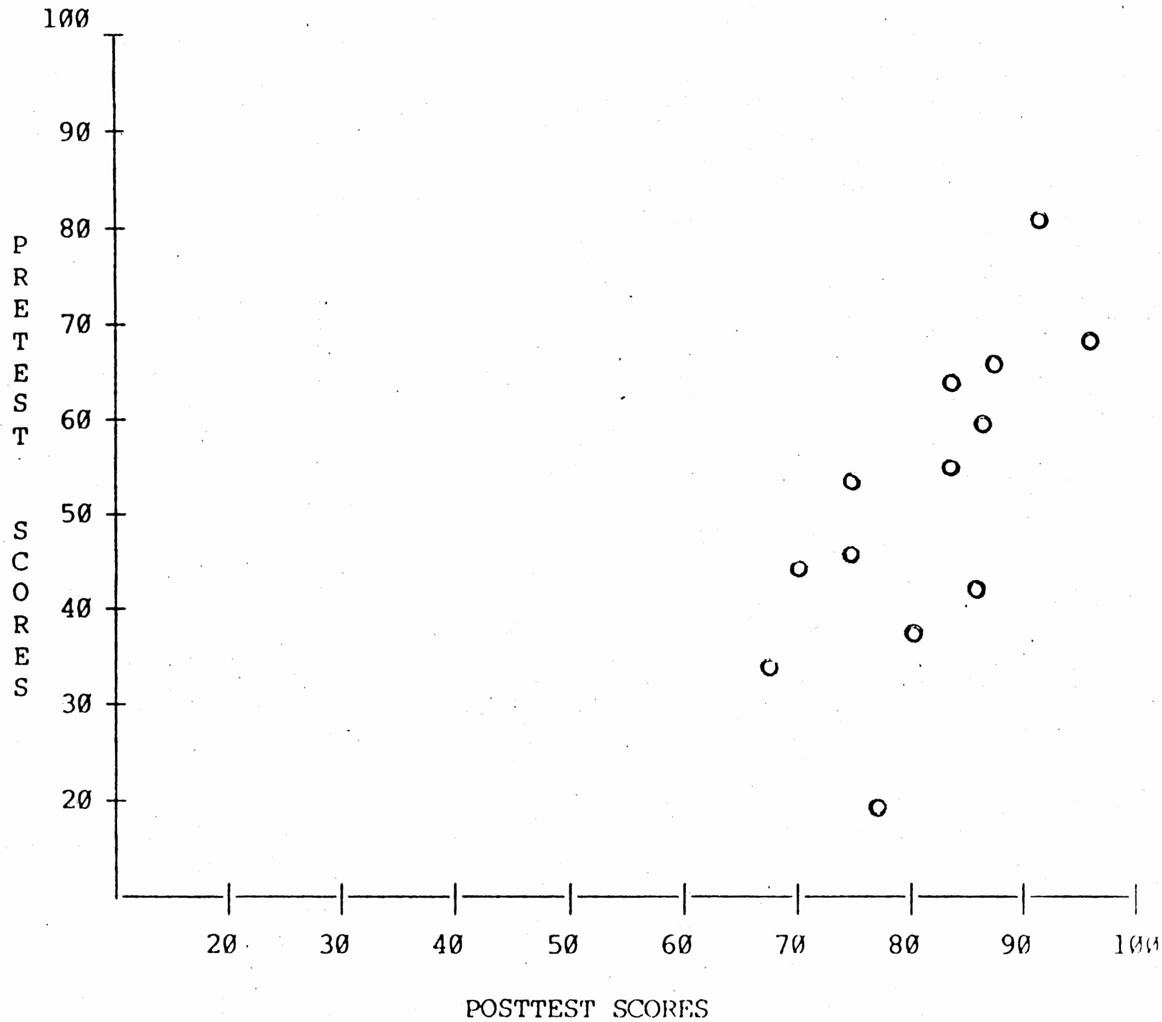

Figure 4. A scatter diagram of the pretest scores and the posttest scores as achieved by the mechanic cluster experimental group

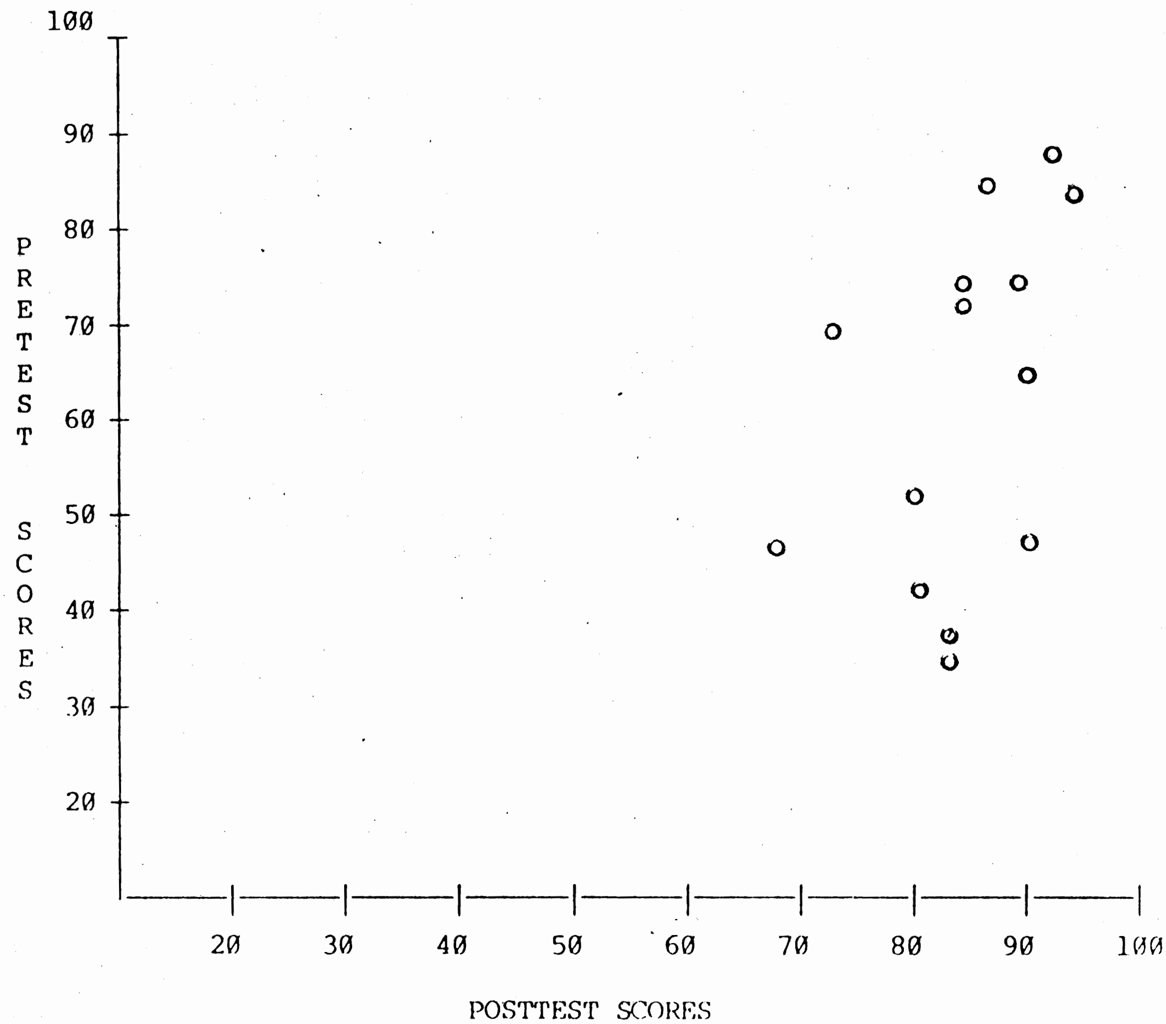

Figure 5. A scatter diagram of the pretest scores and the posttest scores as achieved by the technology cluster control group

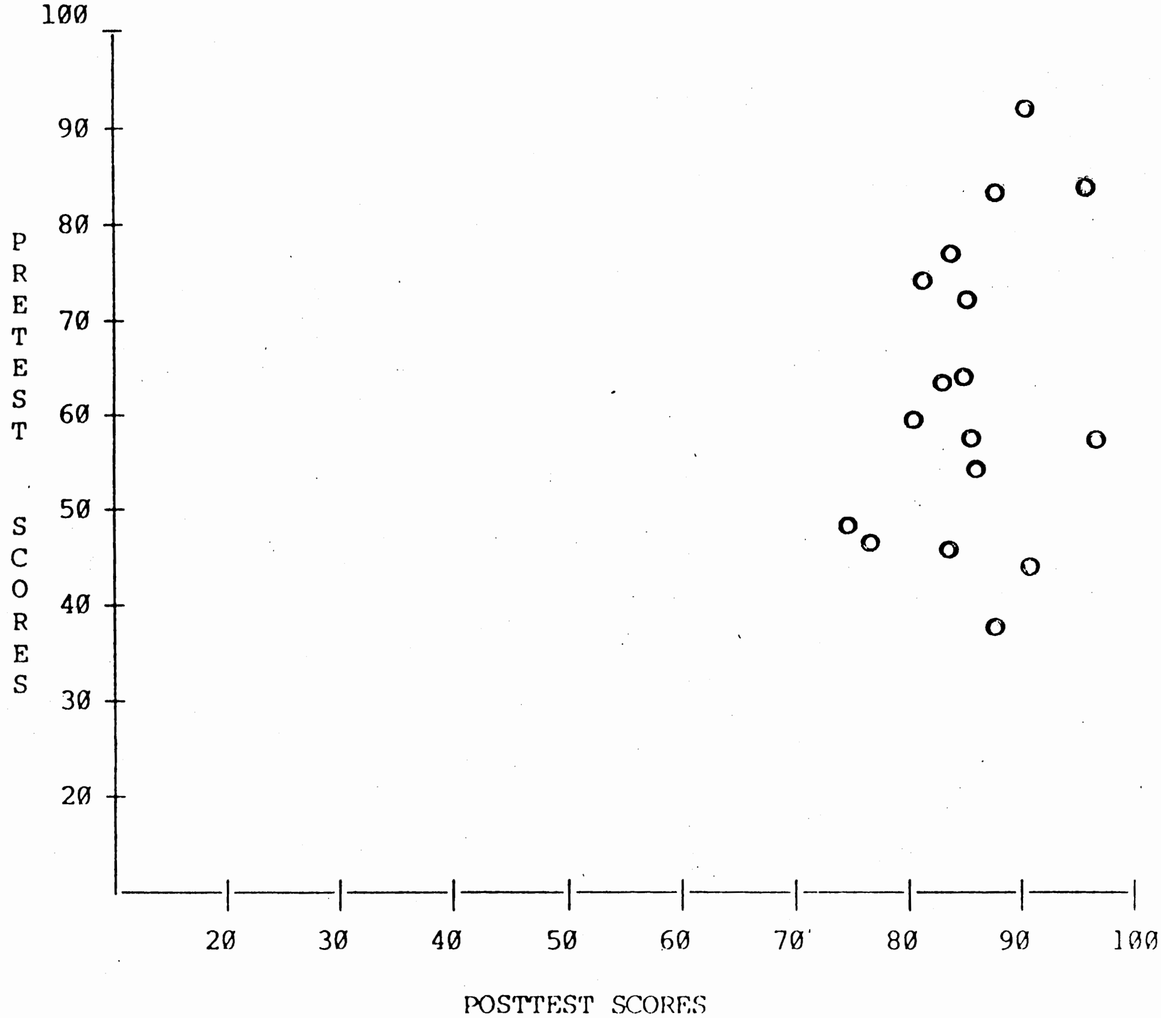

Figure 6. A scatter diagram of the pretest scores and the posttest scores as achieved by the technology cluster experimental group

CHAPTER V

SUMMARY, FINDINGS, CONCLUSIONS, AND RECOMMENDATIONS

The purpose of this study was to compare student learning in a microprocessor applications course at Oklahoma State University Technical Branch, Okmulgee when taught using traditional teaching methods and when taught using computer aided instruction in addition to the traditional teaching methods. More specifically, the study sought to:

1. Determine if there was a significant difference between overall student learning in a microprocessor applications course when taught using traditional teaching methods and when taught using traditional teaching methods in combination with computer-aided instruction.

2. Determine if there was a significant difference in learning in a microprocessor applications course of those students enrolled in the technology programs of study when taught using traditional methods of instruction and when taught using traditional teaching methods of instruction in combination with computer-aided instruction.

3. Determine if there was a significant difference in learning in a microprocessor applications course of those students enrolled in the mechanical programs of study when

taught using traditional teaching methods and when taught using traditional methods in combination with computer-aided instruction.

The statistics used to establish the validity of the independent variable was the Pearson product moment coefficient of correlation. The independent t-test was then used to determine whether the null hypothesis would or would not be rejected.

Findings of Study

The findings of the study include:

1. Based upon the results of the pretest there was no significant difference between the level of achievement of students in the control group and the level of achievement of students in the experimental group before instruction in a microprocessor applications course. After instruction in a microprocessor applications course there was no significant difference between the level of achievement of the students in the control group and the level of achievement of the students in the experimental group based upon the results of the posttest. The study did reveal a tendency of greater understanding in the experimental group but not significant at the 0.05 level.

Based upon these findings the disposition was to not reject the null hypothesis.

2. Based upon the results of the pretest there was no significant difference level between the level of

achievement of the technology students in the control group and the level of achievement of the technology students in the experimental group before instruction in a microprocessor applications course. After instruction in a microprocessor applications course there was no significant difference between the level of achievement of the technology students in the control group and the level of achievement of the technology students in the experimental group based upon the results of the posttest. The study did reveal a tendency of greater understanding in the experimental group but not significant at the 0.05 level.

Based upon these findings the disposition was to not reject the null hypothesis.

3. Based upon the results of the pretest there was no significant difference between the level of achievement of the mechanical students in the control group and the level of achievement of the mechanical students in the experimental group before instruction in a microprocessor applications course. After instruction in a microprocessor applications course there was a significant difference between the level of achievement of the mechanical students in the control group and the level of achievement of the mechanical students in the experimental group based upon the results of the posttest. The study did reveal a tendency of greater understanding in the experimental group that was significant at the 0.05 level and the disposition was to reject the null hypothesis.

Conclusions

1. The mechanic cluster showed a significant difference in learning when taught microprocessor applications using computer aided instruction in combination with traditional teaching methods. The difference in learning was significant for those students in the mechanic cluster and, it is concluded that the computer aided instruction in the form of the computer presented study guides, reinforced and strengthened learning for students who were enrolled in the Automotive Mechanic and the Diesel and Heavy Equipment programs of study.

2. The technology cluster did not show a significant difference in learning and it is concluded that for those students in the technology programs of study the use of computer aided instruction, while helpful, does not make a significant difference in their learning microprocessor applications coursework.

3. Computer aided instruction offers students an alternative approach to learning. It is concluded that an alternative approach to learning is most helpful to students enrolled in the Automotive Mechanic and the Diesel and Heavy Equipment program of studies. Traditional classroom teaching without the alternative approach offered in the form of the computer aided instruction is sufficient in teaching microprocessor applications to students enrolled in the Air Conditioning and Refrigeration, Industrial Electrical Technology, and Computer Integrated Systems

Service program of studies.

Recommendations

The following recommendations are made based upon the findings of this study:

1. Computer aided instruction in addition to traditional teaching methods achieved increased student learning for Automotive Mechanic and Diesel and Heavy Equipment students enrolled in a microprocessor applications course. It is, therefore, recommended that computer aided instruction be incorporated in addition to the traditional classroom approach to instruction in teaching microprocessor applications to Automotive Mechanic and Diesel and Heavy Equipment students.

2. It is recommended that the by-products of adding computer aided instruction be the subject of future studies. As brought out in the review of related literature computer aided instruction might add efficiency and effectiveness to instruction in some areas of education. The questions of how and where could be identified through further studies.

3. This study identifies two groups of students and tests the effect of computer aided instruction on their ability to learn microprocessor applications. It is recommended that further study be done to support the findings presented in this study and explore more fully learning through computer aided instruction.

A specific area in which research would be useful would be a study of the relationship between higher cognitive skills, i.e., problem solving, as these skills relate to a technically related area and learning to do computer programming of a technical nature.

The use of the computer as a tutor and tool is proven. What is needed is further study to determine how best to put the computer to work as a teaching machine.

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APPENDIX

MICROPROCESSOR APPLICATIONS
*** TEST ***

MATCH THE FOLLOWING STATEMENTS TO THE MOST CORRECT ANSWER OR ANSWERS. (4 POINTS EACH)

_____ 1. It is any characters inside of quotation marks.

_____ 2. It wipes the memory clean in the computer.

_____ 3. It rubs out characters one at a time.

_____ 4. It will look at the program lines that are currently in the computer's memory.

_____ 5. It will allow the computer to repeat your program lines over and over again.

_____ 6. A statement that executes the program in memory.

_____ 7. A statement that gives the computer the ability to make decisions.

_____ 8. A square shape, it indicates where the next character is placed on the display.

_____ 9. A statement which allows the user to assign the value to a variable.

_____10. You have exceeded the vocabulary of the computer.

A.	SYNTAX ERROR	H.	LET
B.	NEW	I.	GOTO
C.	String	J.	Program
D.	INPUT	K.	DEL
E.	RUN	L.	IF-THEN
F.	Cursor	M.	RETURN
G.	PRINT	N.	LIST

11. Write the symbols used in BASIC for the following arithmetic operations. (1 point each)

subtraction	_____	addition	_____
multiplication	_____	division	_____

12. What is the result to running the following program? Show the RUN. (4 points)

```
10   LET H = 22
20   PRINT H
30   LET H = H + 4
40   IF H <= 38 THEN GOTO 20
50   END
```

13. Which of the lines in the PAGE 1 program are outside of the loop ?

14. Which of the lines in the PAGE 1 program are inside of the loop ?

Match the BASIC symbol for each of the following comparisions: (4 points each)

______	15.	is equal to	A.	<
______	16.	is less than	B.	<=
______	17.	is greater than	C.	>
______	18.	is less than or equal to	D.	>=
______	19.	is greater than or equal to	E.	=
______	20.	is not equal to	F.	<>

______ 21. Which of the following are variables in correct form ?

A. FD$ C. 6C$
B. 4F   D. ID

______ 22. What is the result of running the following program ?

```
10  LET F = 17
20  LET I = 9
30  PRINT F - I + 3
```

A. 26
B. 8
C. 11
D. 4

______ 23. What is the result of running the following program ?

```
10  LET H = 20
20  LET T = 5
30  LET G = 15
40  PRINT H + G / T
```

A. 10
B. 40
C. 7
D. 23

______ 24. IF X <> 26 THEN PRINT "TGIF"
Suppose X = 26, will the program print TGIF
Yes or No ?

______ 25. T or F The LET can not be omitted when typing a LET Statement in a program into the computer.

VITA

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Candidate for the Degree of

Master of Science

Thesis: METHODS OF LEARNING IN A MICROPROCESSOR APPLICATIONS COURSE

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