4-1987

The Effects of Computer Assisted Instruction in Basic Skills Courses on High-Risk Ninth Grade Students

Thomas E. Dellario

Western Michigan University

Follow this and additional works at: https://scholarworks.wmich.edu/dissertations

Part of the Secondary Education and Teaching Commons

Recommended Citation

https://scholarworks.wmich.edu/dissertations/2214

This Dissertation-Open Access is brought to you for free and open access by the Graduate College at ScholarWorks at WMU. It has been accepted for inclusion in Dissertations by an authorized administrator of ScholarWorks at WMU. For more information, please contact maira.bundza@wmich.edu.
THE EFFECTS OF COMPUTER ASSISTED INSTRUCTION
IN BASIC SKILLS COURSES ON HIGH-RISK
NINTH GRADE STUDENTS

by

Thomas E. Dellario

A Dissertation
Submitted to the
Faculty of The Graduate College
in partial fulfillment of the
requirements for the
Degree of Doctor of Education
Department of Educational Leadership

Western Michigan University
Kalamazoo, Michigan
April 1987
THE EFFECTS OF COMPUTER ASSISTED INSTRUCTION IN BASIC SKILLS COURSES ON HIGH-RISK NINTH GRADE STUDENTS

Thomas E. Dellario, Ed.D.
Western Michigan University, 1987

The purpose of this research was to determine the effects of computer assisted instruction (CAI) in basic skills English and mathematics courses on high-risk ninth grade students. Utilizing an ex post facto design, the study was undertaken to determine if CAI courses make any measurable difference in students' academic achievement. The study also examines three nonacademic concerns relating to the school-imposed, high-risk, label carried by these students: attendance, student behavior, and dropouts.

Data were collected from school personnel offices on 384 ninth grade students enrolled in four high schools of two urban school districts. Because of student drops from school, moves, and absenteeism during testing, 182 students were eliminated, leaving 202 as final subjects in the study. The instruments utilized in this study included the Metropolitan Achievement Test, the Nelson Reading Test, the Stanford Diagnostic Mathematics Test, and the California Achievement Test.

The five components of (a) reading achievement, (b) mathematics achievement, (c) attendance, (d) student behavior, and (e) student dropout all contributed in ascertaining if a difference existed

Reproduced with permission of the copyright owner. Further reproduction prohibited without permission.
between students enrolled in computer assisted instruction courses and students enrolled in traditional courses. Differences were found favoring the treatment group in three of the five components: reading achievement, mathematics achievement, and attendance. The fourth component, student behavior, and the fifth component, student dropout, were the two areas where difference between the groups was not found.

As computer assisted instruction is fast becoming an acceptable method of delivering subject matter content, especially to remedial students, and as so many students are still lacking the basic skills upon entry into high schools, the positive results of this study contain important information for educational planners and future researchers. By knowing some academic areas are meeting with success and some nonacademic areas are also positively influenced, better determinations can be made about future uses of computer assisted instruction in academic environments.
INFORMATION TO USERS

While the most advanced technology has been used to photograph and reproduce this manuscript, the quality of the reproduction is heavily dependent upon the quality of the material submitted. For example:

- Manuscript pages may have indistinct print. In such cases, the best available copy has been filmed.

- Manuscripts may not always be complete. In such cases, a note will indicate that it is not possible to obtain missing pages.

- Copyrighted material may have been removed from the manuscript. In such cases, a note will indicate the deletion.

Oversize materials (e.g., maps, drawings, and charts) are photographed by sectioning the original, beginning at the upper left-hand corner and continuing from left to right in equal sections with small overlaps. Each oversize page is also filmed as one exposure and is available, for an additional charge, as a standard 35mm slide or as a 17"x 23" black and white photographic print.

Most photographs reproduce acceptably on positive microfilm or microfiche but lack the clarity on xerographic copies made from the microfilm. For an additional charge, 35mm slides of 6"x 9" black and white photographic prints are available for any photographs or illustrations that cannot be reproduced satisfactorily by xerography.
Dellario, Thomas Edward

THE EFFECTS OF COMPUTER ASSISTED INSTRUCTION IN BASIC SKILLS COURSES ON HIGH-RISK NINTH GRADE STUDENTS

Western Michigan University

Ed.D. 1987

University Microfilms International 300 N. Zeeb Road, Ann Arbor, MI 48106
PLEASE NOTE:

In all cases this material has been filmed in the best possible way from the available copy. Problems encountered with this document have been identified here with a check mark ✓.

1. Glossy photographs or pages
2. Colored illustrations, paper or print
3. Photographs with dark background
4. Illustrations are poor copy
5. Pages with black marks, not original copy
6. Print shows through as there is text on both sides of page
7. Indistinct, broken or small print on several pages ✓
8. Print exceeds margin requirements
9. Tightly bound copy with print lost in spine
10. Computer printout pages with indistinct print
11. Page(s) lacking when material received, and not available from school or author.
12. Page(s) seem to be missing in numbering only as text follows.
13. Two pages numbered. Text follows.
14. Curling and wrinkled pages
15. Dissertation contains pages with print at a slant, filmed as received ✓
16. Other

University Microfilms International

Reproduced with permission of the copyright owner. Further reproduction prohibited without permission.
ACKNOWLEDGMENTS

I wish to express my sincere gratitude and thanks to my
committee, Dr. Uldis Smidchens (chair), Dr. Richard Harring, and
Dr. Charles Warfield, for their patience and guidance throughout the
writing of this paper. I also wish to express my appreciation and
love to my wife, Cheryl, and my two sons, Brandon and Jared, for
their love, understanding, patience, and sacrifice throughout the
creation of this dissertation. Appreciation is further expressed to
my parents, Pat and Peggy Dellario, my father and mother-in-law,
Bruce and Doris MacMurray, and Dr. John Kofel for their constant
support and encouragement.

Thomas E. Dellario
TABLE OF CONTENTS

ACKNOWLEDGMENTS ............................................ ii
LIST OF TABLES ........................................ vii

CHAPTER

I. STATEMENT OF PROBLEM ..................................... 1
   Background ................................................ 5
   Need for the Study ...................................... 7
   Research Hypotheses .................................. 11
      English/Reading ...................................... 11
      Mathematics ........................................ 12
      Attendance ......................................... 12
      Behavior ........................................... 12
      Dropouts ........................................... 12
   Limitations ............................................ 12
   Organization of the Study ............................ 13

II. REVIEW OF LITERATURE ................................. 15
   Introduction ........................................... 15
   Research Summaries .................................. 16
      Combined English/Reading/Mathematics Research
      Studies .......................................... 21
      English/Reading .................................... 24
      Mathematics ........................................ 31
      Student Attendance ................................ 37
      Active Learning .................................... 37

Reproduced with permission of the copyright owner. Further reproduction prohibited without permission.
<table>
<thead>
<tr>
<th>CHAPTER</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>Motivation/Feedback/Reinforcement</td>
<td>38</td>
</tr>
<tr>
<td>Student Behavior</td>
<td>44</td>
</tr>
<tr>
<td>Individualized Instruction</td>
<td>44</td>
</tr>
<tr>
<td>Classroom Management</td>
<td>45</td>
</tr>
<tr>
<td>Lowered Frustration</td>
<td>46</td>
</tr>
<tr>
<td>Student Dropouts</td>
<td>47</td>
</tr>
<tr>
<td>Opportunity for Success</td>
<td>47</td>
</tr>
<tr>
<td>Summary</td>
<td>50</td>
</tr>
<tr>
<td>III. METHODOLOGY</td>
<td>52</td>
</tr>
<tr>
<td>Introduction</td>
<td>52</td>
</tr>
<tr>
<td>Research Design</td>
<td>53</td>
</tr>
<tr>
<td>Variables</td>
<td>54</td>
</tr>
<tr>
<td>Independent Variable: Method of Instruction</td>
<td>54</td>
</tr>
<tr>
<td>CAI Method</td>
<td>55</td>
</tr>
<tr>
<td>Traditional Method</td>
<td>59</td>
</tr>
<tr>
<td>Dependent Variables</td>
<td>60</td>
</tr>
<tr>
<td>Subjects</td>
<td>65</td>
</tr>
<tr>
<td>Field Setting</td>
<td>67</td>
</tr>
<tr>
<td>Instruments</td>
<td>69</td>
</tr>
<tr>
<td>The Stanford Diagnostic Mathematics Test</td>
<td>69</td>
</tr>
<tr>
<td>The Nelson Reading Skills Test</td>
<td>71</td>
</tr>
<tr>
<td>The Metropolitan Achievement Test</td>
<td>77</td>
</tr>
<tr>
<td>The California Achievement Test</td>
<td>82</td>
</tr>
</tbody>
</table>

Reproduced with permission of the copyright owner. Further reproduction prohibited without permission.
Table of Contents—Continued

CHAPTER

Data Collection ....................................... 83
Dependent Variable ................................... 83
Data Analysis ......................................... 85
Basic Skills English/Reading ....................... 86
Basic Skills Mathematics ............................ 86
Student Attendance ................................... 87
Student Behavior ..................................... 87
Student Dropouts .................................... 88

IV. PRESENTATION OF DATA ............................ 90
Introduction ......................................... 90
General Characteristics of the Population .......... 90
   School Districts ................................... 92
   Subjects' Gender .................................. 92
   Subjects' Race .................................... 94
   Academic Handicaps ............................... 95
Testing of Hypotheses ................................ 96
   Basic Skills English/Reading ................. 97
   Basic Skills Mathematics ....................... 97
   Student Attendance ............................... 99
   Student Behavior ................................. 101
   Student Dropouts ................................. 102
Summary ............................................. 104

V. CONCLUSIONS, RECOMMENDATIONS, AND SUMMARY .... 106
Table of Contents—Continued

Introduction ........................................ 106
Conclusions .......................................... 106

The Effect of a Year-Long Basic Skills English Course Employing CAI on High-Risk Ninth Grade Students ........................................ 107

The Effect of a Year-Long Basic Skills Mathematics Course Employing CAI on High-Risk Ninth Grade Students ................. 108

The Effect of a Year-Long Basic Skills Course Employing CAI on Attendance of High-Risk Ninth Grade Students ..................... 109

The Effect of a Year-Long Basic Skills Course Employing CAI on the Behavior of High-Risk Ninth Grade Students ................... 109

The Effects on the Dropout Rate of Students After a One-Year Basic Skills Course of Instruction Employing Computer Assisted Instruction ......................... 110

Recommendations ...................................... 111

Summary ............................................. 113

APPENDICES ........................................ 117
A. Reading Efficiency System Flow Chart ...................... 118
B. Stanford Diagnostic Mathematics Test .......................... 120
C. Glossary of Terms ..................................... 122

BIBLIOGRAPHY ........................................ 125

vi

Reproduced with permission of the copyright owner. Further reproduction prohibited without permission.
LIST OF TABLES

1. Comparisons of School Districts by Race .................. 68
2. Comparisons of School Districts by Sex .................. 68
3. Correlations Among Form A SDMT Raw Scores and Stanford Mathematics Tests Raw Scores and Related Data for High School Students in the Blue Level Standardization Sample ....................... 70
4. SDMT Subtest and Total Kuder-Richardson Formula 20 Reliability Coefficients, Standard Errors of Measurement, and Related Data for the Blue Level Standardization Sample ....................... 72
5. SDMT Subtest and Total Alternate-Form Reliability Coefficients, Standard Errors of Measurement, and Related Data for the Blue Level Equating of Forms Sample ....................... 73
6. Mean Difficulty Index by Grade and Subtest in Total Spring Standardization Sample ....................... 75
7. Percentage of Fall Standardization Subsample Attempting One or More of the Last Three Items of Each Form 3 Subtest ....................... 76
8. Level A Equivalent-Halves Reliability of Raw Scores ....................... 78
9. Level B Equivalent-Halves Reliability of Raw Scores ....................... 79
10. Level C Equivalent-Halves Reliability of Raw Scores ....................... 80
11. Kuder-Richardson Formula 20 Reliability Coefficients and Standard Errors of Measurement--Fall of Grade 11 ....................... 81
12. General Characteristics of the Population From September 1983 to June 1984 ....................... 91
13. Total Number of Subjects in Treatment and Comparison Groups ....................... 92
14. Total Number of Dual Enrollees (Mathematics and English) ....................... 93
Table of Contents—Continued

15. Total Number of Male and Female Subjects in Both School Districts ...................... 93
16. Total Number of Male and Female Dual Enrollees .............................................. 94
17. Total Number of Minority and White Subjects in Both School Districts .................. 95
18. Total Number of Minority and White Dual Enrollees .......................................... 95
19. Total Number of Reading and Mathematics Subjects in Both School Districts .......... 96
20. Reading Stanine Scores Comparing Treatment Group to Comparison Group: t-Test Values ................. 98
22. Comparison of Absenteeism as Displayed by Treatment Group Versus Comparison Group: t-Test Values .......... 100
23. Number of Negative Behaviors Comparing Treatment Group to Comparison Group ......... 102
24. Proportions Comparing Treatment Group Dropouts to Comparison Group Dropouts: z-Test Values .......... 103
CHAPTER I

STATEMENT OF PROBLEM

The need for secondary educational programs to deal with students' basic skills deficiencies is greater now than ever before. Student dropouts, inappropriate behaviors, erratic attendance patterns, and poor self-concepts are oftentimes linked to the students' inability to compete or cope with the academic environment of their school. National, state, and local critics of educational institutions are placing demands upon educators to improve academic performance. One of the most often cited criticisms comes from the National Commission on Excellence in Education's (1983) A Nation at Risk: "A tide of mediocrity has devastated public education." "We have in effect," warned the Commission, "been committing an act of unthinking, unilateral educational disarmament" (p. 50). The critics of American education, oftentimes politicians, are sounding boards for the concerns of the American public. The president of the United States endorsed the Commission's findings by voicing his own concerns. By pointing out what he sees as six immediate needs, Reagan (1984) indirectly criticized public education. The president's six-point plan for educators includes the following:

First, we need to restore good, old-fashioned discipline. Second, we must end the drug and alcohol abuse that plagues hundreds and thousands of our children. Third, we must raise academic standards and expectations. Fourth, we must encourage good teaching. Fifth, we must restore parents and state and local governments to their rightful place in
the educational process. Sixth and last, we must teach the basics. (p. 14)

As the governor of North Carolina and a leader on the President's Task Force on Education, Hunt has been another prominent politician reiterating the feelings of the American public. Hunt (1983) noted: "After 12 years of schooling, students in other advanced nations may have the equivalent of four full years more schooling than American high school graduates--in a curriculum that is more demanding than the typical American school's" (p. 14). Professional educators, however, are equally concerned over the quality of education in our public schools. Former U.S. Commissioner of Education and president of the Carnegie Foundation, Boyer (1983) criticized our secondary schools when he said "A deep erosion of confidence in our schools, coupled with disturbing evidence that at least some of the skepticism is justified, has made revitalizing the American high school an urgent matter" (p. 1).

Some graduated high school students are now accusing and naming in law suits those perceived to be responsible for his or her level of illiteracy. Based on A Nation at Risk (National Commission on Excellence in Education, 1983), President Reagan and Governor Hunt's criticisms, Boyer's report on secondary education in America and numerous other current national reports on education, it seems imperative that educational institutions become effective in eradicating the basic skill deficiencies of students.

Basic skill deficiencies can be defined as those skill areas being used ineffectively or those not retained by students when a
particular mastery level was expected to be achieved. With the potential of computer assisted instruction (CAI) and the increasing sophistication of software, it is the intention of this investigator to explore whether, through the use of computer assisted instruction, educators may become more proficient in helping students acquire and retain the basic skills needed to compete at every grade level.

The problem posed by this study asks the question: What are the effects on pupil performance after a one-year exposure to a basic skills curriculum emphasizing computer assisted instruction? A key concept involved in this question centers around the term basic skills. For the purpose of this study the term basic skills refers to those skills being taught in two secondary classes or courses of study: English/reading and mathematics. The skills which are being repeated from previous grade levels include reading, writing, spelling, addition, subtraction, multiplication, division, etc. The second concept, and equally important, refers to the term computer assisted instruction (CAI). For this investigation, CAI relates primarily to the microcomputer and the software containing course content which is commercially prepared and sold.

The next questions this researcher investigated concern two academic disciplines:

1. In the area of English/reading, what are the effects on pupil performance after a one-year exposure to a basic skills curriculum emphasizing CAI programs? This course work contains units of study in literature, grammar, composition, mechanics, punctuation, spelling, and vocabulary development.
2. In the area of mathematics, what are the effects on pupil performance after a one-year exposure to a basic skills curriculum emphasizing CAI programs? The mathematics course, entitled General Math, referred to throughout this study is a course for students who have had difficulty with basic mathematics skills. The emphasis for this course is on mastering fractions, decimals, percentages, areas, volume, measurement (both English and metric), and the four basic functions of addition, subtraction, multiplication, and division.

To further investigate the effects of a one-year exposure to a basic skills curriculum emphasizing computer assisted instruction, the study addresses the following three nonacademic areas: attendance, student behavior, and dropout rate.

1. What are the effects on pupil attendance after a one year exposure to a basic skills curriculum emphasizing CAI programs?

2. What are the effects on pupil behavior after a one year exposure to a basic skills curriculum emphasizing CAI programs? The term pupil behavior will hereafter refer to those behaviors which are considered inappropriate for the classroom and requires a teacher to send the student out of class, e.g., disturbing the learning environment, continually out of seat, etc.

3. What are the effects on pupil dropout rate after one year exposure to a basic skills curriculum emphasizing CAI programs? The term dropout refers to that specific student who has left the high school or junior high school program prior to graduation and with no record or information indicating a transfer to another school.
The purpose of this study is to compare the achievement of remedial ninth grade students who are a part of a one year basic skills computer assisted instruction program with other remedial ninth grade students who are a part of a one year traditional course of instruction. This study speaks to the need of comparing pre and post scores in an effort to predict the effectiveness of computer assisted instruction programs when mandated for high school freshmen with basic skills deficiencies. Attention will be focused on the basic academic skills of mathematics and English/reading.

Enrollment conditions will be described in terms of the student enrollment of two school districts. This enrollment will be reported in terms of racial and sexual percentages of the student body compared to the racial and sexual percentages of the students mandated into the basic skills programs.

Background

An agonizing, age old problem still perplexes the modern educator: how to deal with the student who has demonstrated or manifested basic skill deficiencies and some obvious outgrowths of that problem, including erratic attendance patterns and poor behaviors, which ultimately end with many of these students dropping out of school. Aaron, Muench, and Call (1975) stated: "A computer managed, individually prescribed learning program can positively effect juveniles with severe social, emotional and learning problems" (p. 106). The focus of this study is not intended to provide a "cure all" for all students, but perhaps a possible solution for some educationally
disadvantaged students who can and want to improve in the basic skills area. The bases for using CAI in English and mathematics basic skills classes include the features of "active learning," much guided practice, constant and immediate feedback to students, and the use of a variety of approaches in teaching these skills until a specific goal is reached. Phillips (1981) noted that many of the software packages currently on the market follow a pretest-instructional lesson-posttest pattern until an 80% mastery level is achieved.

This approach to improving erratic attendance patterns of low basic skills students stems from the belief and findings in the literature that this type of student needs an innovative approach to education. It is this investigator's belief that the use of micro-computers is an innovative technique that will motivate academic performance, draw the student into the school environment, and improve his or her self-image, as well as improve the student's image among his or her peers. Regularity in attendance increases the chances of success in any academic course and lessens the chance of being ostracized by teachers and peers as being different from the student enrolled in the regular school program. Beck and Chamberlain (1983), while researching a developmental reading program, found their CAI/CMI subjects averaged more days of attendance per pupil with an overall average of 99.5 days compared to 92.7 days for the control group (N = 372). The use of the CAI program seems to enhance the students' desire to participate in these types of courses because these programs are extremely patient and correct students' mistakes.
without any verbal editorializing. Because of these factors, it is believed that improved attendance will occur.

Behaviorally, this investigator's hypothesis proposes improvement based on a higher interest level by the student, an improved self-image, knowledge that the use of the computer can mean higher paying jobs in the future, more interaction time with a computer, and less interaction with peers or teachers.

Finally, the investigator's hypothesis that the student dropout rate will decrease is based on the following assumptions: These students will have found a new interest in learning, an improved self-image, a more positive outlook concerning the future, a feeling of acceptance by the peers and academic community, and a reason for wanting to come to school.

Need for the Study

The use of CAI has been the focus of numerous research studies. Although Bradtmueller's (1983) review of research focused primarily on reading, he also summarized what is currently known about the positive and negative effects concerning this method of instruction. Covering the period from 1975 to 1983, Bradtmueller (1983, p. 8) cited the following pros and cons of using microcomputers.

Pros of using microcomputers include the following:

1. Highly motivating and encouraging.
2. Helps prepare students for a computerized world.
3. Fosters independent study.
4. Gives immediate feedback to students.
5. Encourages individualization.

Cons of the use of the microcomputer include the following:
1. Too expensive to purchase and maintain.
2. Requires excessive time for teachers to learn to operate.
3. Incompatibility of software programs.
4. Forced multiple choice format requires no writing.
5. Poor software and price.
6. Cost is often the major factor in purchase rather than program.
7. Machine may lose its appeal if used too often.

The investigator of this study chose to further develop the current research on CAI effects on secondary students with basic skill deficiencies in the academic areas of mathematics and reading. Three socialization factors will be examined as a by-product of the basic skills program. These factors include regularity of attendance, student behaviors, and rate of student dropout. This study will examine the academic and socialization progress of students enrolled in such a program.

This study is important for its practical considerations. The use of computer assisted instruction programs is becoming more popular in public and private school districts as a means of providing instructional support to students with basic skill deficiencies. The effectiveness of CAI programs must be studied before widespread use is employed. More specifically, CAI programs can be a "boom" in the area of basic skills instruction if the desired results are achieved;
however, they can be very costly in terms of money, time, and energy, especially if they produce little or no results or even negative consequences.

This study concerns the use of CAI programs in certain environments and situations which may provide practical help for school districts considering implementing such an approach. The current review of literature will point out research supporting the use of CAI and some guidelines for organizing a basic skills program. More specifically, the strategies underlying CAI programs offering help to school districts and their students are in the following areas: (a) active learning, (b) individualized instruction, (c) motivation, feedback, and reinforcement, (d) opportunity for success, (e) lowered frustration, and (f) classroom management. This study will add to the current body of educational research while indicating areas that need further exploration.

The various audiences that would be affected in this study include: (a) school districts interested in implementing a CAI basic skills program, (b) parents with children having deficiencies in the basic skills areas, (c) school principals and curriculum directors of districts with enough students having deficiencies to warrant such a program, (d) teachers of English/reading and mathematics, (e) those students who are experiencing basic skills deficiencies, and finally, (f) school employees charged with writing government proposals for "soft monies" to fund such programs.

This study is important to these groups as the Basic Skills Program under investigation is a prototype in the state of Michigan;
and if the CAI programs are found to be predictors of academic success, the aforementioned parties may be affected positively. If the study fails to identify the CAI basic skills program as a predictor of academic success, then these same aforementioned parties should investigate other methods for solving the basic skills deficiencies dilemma.

Various basic skills programs or basic skills projects are mentioned throughout this study. To help clarify this concept a sketch of a typical program is drawn for the reader. Students are predominately selected by test scores drawn from a nationally norm referenced achievement test. These students' new daily schedules range anywhere from 10 minutes to 2 hours per day, and anywhere from 1-9 months per year in a lab setting working with a microcomputer and one or more commercially produced software instructional programs. Curriculum content may cover any number of subjects but generally includes reading, vocabulary, spelling, and mathematics. Teachers in such programs are generally volunteers from the regular teaching staff assigned 1 or 2 years to the program. These basic skills programs may be pullout programs or in lieu of regular instruction. Accurate records are kept on pupils' academic progress, attendance, etc., for verification to a higher authority and fellow teachers that progress is being made, for good public relations with parents, and for funding purposes.
Research Hypotheses

One consistent theme presented by the majority of authors publishing information in the area of basic skills has been that students with basic skills deficiencies in a secondary school setting ultimately reach a level of frustration, some as early as the first week of school or some as late as the end of the school term. The frustration is heightened if this individual is required to compete in the regular school program without special assistance. It was also noted that during these periods of frustration a reaction ultimately occurred. Those reactions most frequently reported tended to be a verbal or physical assault on a peer, a teacher, or some inanimate object in the environment. Administrators, teachers, and counselors further report that deferred reactions of those frustrations resulted in erratic attendance or officially dropping out of school (Maser, 1977). Throughout the literature search on CAI and basic skills, the same two academic subjects were most often cited: English and/or reading and mathematics.

Based on the preceding information from the review of literature this study tested the following hypotheses:

English/Reading

Students involved in a year-long basic skills English/reading course employing CAI programs will demonstrate greater growth in reading skills than students involved in a traditional English course.
Mathematics

Students involved in a year-long basic skills mathematics course employing CAI programs will demonstrate greater growth in mathematics skills than students involved in a traditional mathematics course.

Attendance

Students involved in a year-long basic skills course employing CAI programs will demonstrate greater daily attendance than students in a traditional course.

Behavior

Students involved in a year-long basic skills course employing CAI programs will demonstrate less negative behaviors than students in a traditional course.

Dropouts

Students involved in a year-long basic skills course employing CAI programs will have a lower percentage of dropouts than students in a traditional course.

Limitations

The population of the study was limited to students in four Class A high schools, who had scored in the stanine ranges of 1, 2, or 3 of nationally normed achievement tests. The courses which were chosen were English/reading and mathematics. Because this research
study was ex post facto in nature, random assignment of subjects to treatment or control groups was impossible. The researcher did, however, use the total population of the treatment and comparison groups for comparison purposes.

Organization of the Study

In this chapter a statement of the problem was presented with background information of that problem. A need for the study was presented based on a summary of pros and cons of what is known about computer assisted instruction. The research hypotheses, presented herein, were developed from the findings of the literature search reported in Chapter II. Finally, the chapter concludes with limitations and an organization of the study.

Chapter II, Review of the Literature, covers the current literature on the effects of CAI as it relates to the academic subjects of reading and mathematics. The use of CAI in terms of basic skills is divided into the following subtopics: active learning of students, increased motivation, immediate feedback and reinforcement, effects of individualized instruction, advantages to the teacher because of more efficient classroom management, improved behaviors of students due to lowered frustration levels, and an implied reduced rate of student dropouts because the prospects are brighter for the future due largely to the opportunities for success CAI can provide.

Chapter III, Methodology, includes an explanation of the research design used in this study, operations of the independent variables, and measurements of the dependent variables; a discussion
of the subjects and field settings is presented with rationale for their use along with background demographic information. The instruments used to measure the dependent variables are thoroughly explained, highlighted by the validity and reliability of each instrument. The chapter closes with an explanation of how the data were collected by the investigator and what processes were used to analyze those data.

Chapter IV reports the findings of the study, while Chapter V summarizes the study, presents conclusions, and proposes recommendations for future users and researchers interested in studying computer assisted instruction.
CHAPTER II

REVIEW OF LITERATURE

Introduction

This chapter reports the current body of knowledge in the area of basic skills as taught in a secondary school setting through computer assisted instruction. The researcher will establish the rationale for each hypothesis that is to be tested and why each hypothesis is a reasonable one to explore based on the current body of knowledge.

The review of literature contained four outstanding summary studies which open the chapter by providing background information. These studies were helpful in understanding what advantages CAI offered before the mass production of the microcomputer in 1975 and what effects this technology had on CAI up until 1980.

The next section titled "Combined English/Reading/Mathematics Research Studies" includes those studies which examined reading and mathematics CAI programs concurrently. The third section reviews only English/reading CAI programs similar to the fourth section which reviews only mathematics CAI programs. The remaining sections discuss the CAI-related research on active learning, motivation/feedback and reinforcement, individualized instruction, classroom management, lowered frustration, and opportunity for success. The chapter closes with a summary.

15
Support for all five hypotheses came from many research reviews all concentrating on the effectiveness of CAI. To provide an historical background of CAI this chapter opens with four research summaries covering over 100 "hard" data studies, including all grade levels and extending from the years 1966 through 1980.

Research Summaries

Jamison, Suppes, and Wells (1974), after reviewing over 30 studies involving in excess of 10,000 students, concluded: "There appears to be rather strong evidence for the effectiveness of CAI over traditional instruction where effectiveness is measured by standardized achievement tests" (p. 55).

While comparing CAI to four other media alternatives to instruction, these researchers said:

1. At the elementary level, CAI is apparently as effective as a supplement to regular education.

2. No examples yet of CAIs being introduced with a concomitant change in student-teacher ratio which would, for example, cover costs of CAI.

3. At present one can only conclude CAI can be used in some situations to improve achievement scores, particularly for disadvantaged students.

4. At the college level CAI is about as effective as traditional instruction when used as a replacement.

5. Initial cost of instruction per hour makes CAI the most expensive alternative instructional media. (Jamison et al., 1974, p. 55)

In a final note these researchers said:

No simple uniform conclusion can be drawn about the effectiveness of CAI. In comparison, CAI is apparently
effective as a supplement to regular instruction. At the secondary level a conservative conclusion is that CAI is about as effective as traditional instruction when it is used as a replacement. It may also result in substantial savings of students' time in some classes. (Jamison et al., 1974, p. 55)

CAI is the newest but most expensive media alternative. This technology provides the richest and most highly individualized interaction between student and the curriculum of any method of instruction yet developed. (Jamison et al., 1974, p. 42)

The second research review, conducted by Edwards, Norton, Taylor, Van Dusseldorp, and Weiss (1974) summarizes 33 CAI research studies. The following comments answer the question of their review title, "Is CAI Effective?"

1. "Studies have been fairly consistent in showing that increased achievement results from the use of CAI as a supplement to traditional instruction" (p. 122).

2. "It appears that drill and practice is the most effective mode of CAI. Almost all studies of CAI drill and practice have shown it to be effective when compared to traditional classroom instruction" (p. 123).

3. "Several studies have shown that learning can be compressed through CAI" (p. 124).

4. "CAI seems to be more effective for low ability than for middle or upper ability students" (p. 124).

5. "The results are not completely consistent, but boys tend to gain more from CAI than girls" (p. 124).

6. "All studies that have measured students' and teachers' attitudes toward CAI have found that both groups like CAI, except
when there are hardware problems" (p. 124).

7. "A great deal of research on the effectiveness of CAI still needs to be done. The only area that has been covered fairly well is CAI drill and practice in arithmetic" (p. 125).

8. "Eight studies found little or no difference in results when CAI was used as a substitute for traditional instruction" (p. 148).

Thomas (1979) is the author of the third review of research on CAI. This review concentrates on results within secondary school settings only. The reviews, although mixed, indicate that achievement gains over more traditional methods were the norm. In certain studies, however, where excellent instruction was provided, the achievement gains were parallel to those attained through CAI. Retention was said to be equal but attitudes toward the computer and subject matter taught on the computer were more favorable than the traditional method. "Perhaps the most valuable finding," said Thomas, "in the long run, CAI students gain mastery status in a shortened period of time" (p. 111). In conclusion: "The studies reviewed paint a positive picture for computer assisted instruction" (p. 111).

"Over all," Thomas adds:

Computer-assisted instruction (CAI) is a pedagogical technique in which a student interacts with instructional stimuli at a computer terminal, usually on a one-to-one basis. The CAI rubric includes: (a) drill, in which the student responds in a rather quick fashion to brief items or questions under a sort of "flash card" format; (b) practice, in which the student answers more complex questions which may require some off-line computation or the completion of multiple steps in the problem solution;
tutorial programs, which resemble programmed instructional texts in that paragraph material, interspersed questions, and response sensitive branching are present; (d) simulations, which model phenomena of a complex nature and in which random events typically are introduced; and (e) problem solving programs, which eliminate complex calculations to foster student understanding of principles and rules. (p. 103)

One of the more impressive studies on CAI and its influence on active learning was conducted by Rapaport and Savard (1980). In this extensive report prepared for the Alaska Department of Education Office of Planning and Research, these investigators thoroughly analyzed a school effectiveness project. This report was the last in a series of reviews of research literature and represented a condensed analysis of all related literature on CAI that could be found to date. A section of this report entitled "Major Findings" included three subheadings with the following key points highlighted:

**Achievement**

Traditional instruction, supplemented by CAI leads to higher achievement than traditional instruction alone.

Two of three reviews failed to report a single case of contradictory findings.

The third review found only three courses where traditional instruction was superior (one secondary typing course, one college accounting course, and one community college business course).

All elementary and virtually all secondary studies reported achievement gains by students receiving CAI.

Studies on CAI as a replacement for traditional instruction were inconclusive.

Three studies report CAI is more effective for low-ability students than for high-ability students.

Two studies reported boys benefited more from CAI than girls, but one study failed to find any difference.
Attitude

Most studies found CAI students have a better attitude towards subject matter than students who received traditional instruction alone.

Some studies found no difference in attitude; however, one study (Thomas, 1979) found more negative attitudes by CAI students.

The most usual finding was that students had a very positive and enthusiastic response to the CAI course.

Other Findings

All studies reported the amount of time taken by students to learn the material found that, compared with traditionally-instructed students, CAI students completed the same amount of material in less time or more material in the same amount of time.

There was no consistent evidence that there was any difference in the retention rates of CAI and traditionally instructed students.

Three studies indicated that students can be assigned to share terminals and still achieve as much as students assigned to individual terminals. (pp. 7-8)

Based on their findings, Rapaport and Savard (1980) believe CAI is an effective supplement to traditional instruction. They cautioned, however, that "The evidence is not strong enough to support teaching by CAI exclusively; a combination approach seems to work best" (p. 9).

In a final note Rapaport and Savard (1980) added:

We recommend CAI for active promotion and expansion. Its particular use would definitely benefit rural schools not being able to offer a wide spectrum of curricular offerings, schools struggling with low-achieving students, and schools with students who tended to be alienated by traditional teaching methods. With the realization that CAI may be beyond the capabilities of some small districts, it is suggested that the state Departments of Education take a
leadership role in providing both financial and technical expertise. (p. 9)

Combined English/Reading/Mathematics Research Studies

This section reports the findings of studies which included both mathematics and reading.

A tightly controlled research study titled Computer-Managed Instruction for Behaviorally Disordered Adolescents was conducted by Aaron et al. (1975). With an objective of measuring reading and mathematics skill improvements, the investigators matched 36 experimental and 36 control subjects from a population of 450. Subjects were matched on pretest California Achievement Test scores, chronological age, IQ, and mean mental age.

The t test scores were analyzed for the following areas of reading: vocabulary, comprehension, and total reading. Mean gains in reading for the experimental group ranged from 8 months to 1 year above the control group. When tested for significance the gains of the experimental group over the control group were significant at .01 level for vocabulary and total reading and .05 level for comprehension. The vocabulary scores for the experimental group were 9 months of growth over the control group. Comprehension scores were 6.5 months of growth over the control group, and the experimental group's reading scores were 8 months of growth over the control group.

These figures were even more impressive when considering the mean number of days of 140.94 of traditional instruction for the control group compared to the mean number of days (120.89) of CAI
instruction for the experimental group. A mean difference of 20.05 days less instruction was realized for the treatment group.

Students' gains in mathematics favored the experimental group on all the mathematics subtests. The differences between pretest and posttest data of the experimental group showed mean gains in mathematics 3 to 5 months above the gains made by the control group. The mathematics subtests under investigation included computation, problem solving, and total mathematics.

Teachers were evaluated by means of frequency and rate counts of reinforcements, praise, etc. No significant difference was noted between experimental and control group teachers.

The impact of computer assisted instruction on disadvantaged young adults at a Job Corp site was the focus of Giller and Shugoll's (1983) research. Pretests matched subjects needing remedial work in reading or mathematics (N = 807). Experimental subjects used PLATO CAI lessons, while control groups utilized a traditional approach. Groups were randomly assigned treatment or control status, and 135 hours of instruction were administered before the Stanford Achievement posttest was given.

The results of the research are described by Geller and Shugoll (1983):

The effectiveness of CAI compared to an individualized control group yield some mixed but promising findings. Most promising is the existence of significant differences in gain in reading between the experimental and control groups. Mean gain in reading was one full grade equivalent level higher for students supplementing their instruction with CAI than for students not receiving supplementary CAI.

Reproduced with permission of the copyright owner. Further reproduction prohibited without permission.
The results in mathematics were less encouraging. Mean scores failed to identify any difference in gain between students using supplementary CAI and those not using it. (pp. 24-25)

While working for the Bristol Public Schools in Connecticut, Gerzanick, Lanoza, and Nolan (1982) co-chaired a study on the use of CAI with remedial mathematics and reading students. Ninth grade students who failed to meet the Statewide Level of Expected Performance on the Connecticut Ninth Grade Proficiency Test became the subjects of the study. The basic design of the program established a laboratory in each of the three high schools. The labs were equipped with Commodore and Apple II computers, 150 remedial mathematics software programs, and 200 language arts/reading software programs. The experimental group was scheduled 1 to 3 periods per week in the computer lab, while the control group worked in the regular classroom. In a pilot study evaluation report, it was said: "Computer assisted remediation students did achieve highly significant test score increases in mathematics and language arts" (p. 51). These researchers selected an alpha level of .001 to determine significance.

A longitudinal evaluation of CAI in a Title I project was undertaken by Lavin and Sanders (1983). The objective of this 3-year study was to determine whether computer learning could improve reading and mathematics standardized test scores. A quasi experimental approach using treatment and control groups was undertaken. Experimental groups in each area received 10 minutes of CAI drill on a daily basis. Evaluations were conducted separately in each program.
year, 1979-1982. Pre-post mean differences showed that supplementary CAI treatment to have been more effective than were the regular services alone. The results were summarized as follows:

Gains for CAI [in mathematics and reading] students was, in every case, greater than the corresponding gain for non-CAI students. The experimental (CAI) group outperformed the comparison group consistently at all grade levels. The statistically significant effect was replicated across all grade level groupings at probability levels that must be considered educationally meaningful. (p. 12)

An interesting note on this study points out that in the spring of 1982 reading gains were verified by the Joint Dissemination Review Panel (JDRD) in Washington, DC, which functions out of the Department of Education.

English/Reading

This section includes research studies linking only English/reading achievement to CAI.

A research study linking reading achievement to CAI was completed by Beck and Chamberlain (1983). Using Commodore Pet computers for the CAI/CMI pilot group and traditional reading materials for the regular group, the investigators reported the objective of raising reading skills for underachieving senior high students was met. Students' growth achievement from the Metropolitan Achievement Test was measured by normal curve equivalents (NCEs). The overall mean NCE gain for the pilot group was 8.1, while the mean NCE gain for the regular group was 6.7. The pilot group score fell short of the expected reading gain of 1.5 NCEs for each month or a total of 10.5 NCEs for the 7-month program. Although the reading achievement gain
objective was not attained, the CAI/CMI objective of reaching a
mastery level on seven prescriptive reading skills was attained.

This evaluation objective is described by the researchers:

**Objective 1.2** Participants in the Prescription Learning Laboratory who have attended at least 80% of the instructional period will have passed an average of seven prescriptive reading skill objectives from the time of the placement test to May 27, 1983, as measured by the Prescription Learning Laboratory Mastery Test. (p. 2)

A second research study on reading achievement with the same population, secondary students, takes on a slightly different perspective. Carver and Hoffman (1981), using a recently developed technique called programmed prose, determined the effects of practice through repeated reading on gain in reading ability. The PLATO IV computer was the base instruction system, six high school students with poor reading skills were the subjects, and comparisons of a pretest and posttest on two separate 6-month studies was the methodology. As programmed prose requires reading and rereading until a mastery level is achieved, specific gains in fluency on the task were evident. Only one measure of general reading ability showed a large amount of gain from grade level 5 to 8. Yet, on another measure, speed and accuracy, there was little or no evidence of gain.

In their concluding remarks, Carver and Hoffman (1981) stressed the following:

In conclusion, the effects on reading practice using repeated readings upon gain in reading ability may depend upon (a) whether gain is measured on tasks specific to the practice or tasks that are more general in nature; and (b) whether ... the student is still trying to learn to read material that can already be comprehended by listening. With high school students at about Grade Level 5 in reading ability, the present research suggests clearly that

Reproduced with permission of the copyright owner. Further reproduction prohibited without permission.
extensive practice with repeated readings of material will improve their ability to perform similar reading tasks. However, these data also suggest that such practice will not improve their reading ability in general. It may be that the repeated readings type of reading practice will produce gain in reading ability only for students who have a listening ability level that is higher than their reading ability level. For those students who have already progressed to the point where their reading ability level is equal to their listening ability level, their future gains in reading ability are likely to come from sustained practice in situations where they are comprehending new information or knowledge. (p. 389)

Visualizing the use of the microcomputer as a tool to teach reading skills with a "game-like" curriculum, Weaver (1982) conducted a study titled Perceptual Units Training for Improving Word Analysis Skills. Subjects of the study included four high school students termed poor readers on the Nelson-Denny Reading Test. A training program was devised to develop automaticity of one subcomponent of reading—locating and disembedding multiletter units within words. The system involved the use of a training task implemented in a microcomputer based game called Speed. The game required students to detect whether a target unit was presented within words, e.g., prefixes, suffixes, and root words, that were shown in rapid succession. The purpose of the task was to increase student monitoring rates without increasing the number of errors made. Performance records indicated the training program was successful.

Weaver (1982), in a discussion of his findings, reported the following:

Substantial improvements were evident in both student learning rates and performance levels. Maintenance tests designed to measure the stability of the gains in speed conducted regularly after the training had ended yielded positive results. In addition, the students completed a
battery of tasks (perceptual unit detection, pseudoword pronunciation, and span of apprehension) to gauge the transfer of training effects to other reading components. These test results showed that the training program enabled students to increase their efficiency in detecting units over a range of conditions. Transfer effects were also found in the pseudoword pronunciation task and on the span of apprehension task. (p. 10)

Capitalizing on the game-like environment was appealing to Frederiksen (1983) as he successfully linked the development of reading skills to the microcomputer. This research was conducted to investigate the interactions among component processes of reading and to determine if a hierarchical training model, in which particular reading components are developed sequentially, is an effective way to build reading skills for a target population.

Three game-like microcomputer training systems were constructed each concerned with a critical reading skill previously shown to pose difficulties for secondary school students with poor reading skills: (a) perception of multiletter units appearing within words, (b) efficient phonological decoding of words, and (c) use of context frames in accessing and integrating meaning of words read in context. Subjects spent 2 hours per week for a period of 4 to 6 weeks on a single training system. Each of the three systems had a built-in component to provide a game-like environment.

Commenting on his findings, Frederiksen (1983) said:

Results showed that in all cases, subjects were able to reach levels of performance in the trained skills that equalled or exceeded those of high ability readers. There was also strong evidence for the transfer of acquired skills to other functionally related reading components. For subjects who completed the entire training sequence, there were increases in reading speed in an inference task, with no drop in comprehension, suggesting that improvements
in the level of automaticity of multiple skill components of reading can reduce the effort required in reading for comprehension. (p. 176)

A descriptive study of a computer-based support system for parents to use in reinforcing reading skills was conducted by Regan (1982). The use of the computer was the key element in student instruction and as a communication and management tool in conveying information to parents. As a result of the program called "Operation Fail-Safe" the Houston School District found student reading achievement increased significantly at every grade level. Parent participation, as measured by attendance at school meetings, increased 32%; and parent attitudes towards education was said to be greatly improved as a result of the newly established communication channels. Finally, the computer technology employed in the Fail-Safe program conserved teacher time and improved learner productivity by increasing time on task.

A study investigating the use of the computer to affect reading comprehension among intermediate grade readers was conducted by Reinking (1983). Technological attributes of the computer when compared to standard printed material were hypothesized to afford a more interactive medium for written communication. The computer was used, therefore, to provide the textual manipulation not available in printed text and aimed at increasing comprehension. The choice of textual manipulations made available to the students on this CAI program included: a definition of selected words, a simplified version of the passage, more background information, or the main idea of each paragraph. The results and conclusions offered by Reinking

Reproduced with permission of the copyright owner. Further reproduction prohibited without permission.
Results indicated a significant treatment effect on passage scores and vocabulary knowledge but not on the standardized comprehension measure. A significant interaction between treatment and passage difficulty was also evidenced on the passage comprehension measure. Subjects also selected background information significantly more often than the other manipulations.

A major conclusion was that the comprehension of intermediate grade readers may increase when the computer is used to control the presentation of textual manipulations. This conclusion is consistent with research documenting metacognitive deficiencies among younger readers. The study also demonstrated the feasibility of using the computer to gather data on reading and study behavior. (p. 253)

Way (1971), using the DOVACK CAI Reading system, field tested 391 low income, minority, elementary and secondary students over a period of 3 years. Objectives included testing the system for adaptability to the populations for which it was designed, its effectiveness in meeting goals and objectives, and its economic feasibility. Achievement tests were used to evaluate rate of learning, reading comprehension, and vocabulary usage. The author concluded that:

The DOVACK system was subjectively favorable to other methods. However, no definitive general conclusions could be inferred from the hard data because of both the small sample size and the cultural inappropriateness of some tests. The cost per student for the program was about seven dollars. (p. 15).

A paper presented to the National Council of Teachers of English by Mulcahy (1983) stressed the value of vocabulary development through computer based education. Although the programs mentioned are directed for use on the college level, the concept of remedial reading instruction even at the college level has made an impact. This author adds another possibility to the list of programs/systems
previously mentioned: "An individually authored CAI/CMI program
incorporates the best of interactive reinforcement of course goals
and objectives" (p. 7).

PLATO, LOGO, and DOVACK are all CAI programs designed to provide
individualized learning. Geoffrion and Bergeron (1977) developed yet
another CAI program titled Computer Animated Reading Instruction
System (CARIS). In a paper presented to the American Educational
Research Association in April of 1977, the CARIS system was intro­
duced to the educational community. The CARIS system was developed
to teach reading to children with varied sensory, cognitive, and
physical handicaps. The system employs an exploratory learning
approach which encourages children to experiment with the reading and
writing of words and sentences. The authors explained:

The unique aspect of this program is the brief computer­
animated cartoons providing the child with visual feedback
of the meaning of sentences constructed by the child.
Pilot experiments show that children with varied learning
handicaps can develop reading skills through use of this
system. (p. 7)

Although the CARIS system is designed for preschool and elemen­
tary students, it does point out that the teaching of reading through
CAI has expanded to all levels.

Another research study of reading comprehension was conducted by
Bradley (1983). The purpose was to describe and compare commercial
microcomputer reading programs currently on the market. The Scott
Foresman programs were said to have significantly more features than
the other programs under investigation. The Scott-Foresman reading

Reproduced with permission of the copyright owner. Further reproduction prohibited without permission.
program was used as a supplementary program for the treatment group in this study.

Mathematics

This section contains research studies linking only mathematics achievement to CAI.

Henderson (1983a) conducted a field study to test the effectiveness of instructional materials presented on an Apple II plus microcomputer and the effects of a videocassette recorder interfaced with the microcomputer. The curriculum presented dealt with instruction of factors and prime numbers. The sample population was 101 high school students who had not made normal progress in mathematics learning and had failed to pass the basic skills competency test required for high school graduation. The measurement instruments, a criterion-referenced pretest and posttest and a School Learning Questionnaire (SLQ) were administered to both experimental and control students. Henderson reported his findings as follows:

The results of the field trials showed that the computer-video instructional modules were effective in teaching or reteaching mathematical skills to secondary school students. However, the hypothesis that exposure to the instructional materials would be reflected in an increase in effort attributions specific to mathematics was not supported. (p. 6)

In a follow-up study, Henderson (1983b) was interested in the development and validation of computer-video modules for students experiencing difficulty in learning mathematics. By using females and minorities as presenters of materials, special consideration was given to students underrepresented in mathematics (particularly women

Reproduced with permission of the copyright owner. Further reproduction prohibited without permission.
and minorities). The concepts under study included operations for factors, prime numbers, and fractions. The teach–reteach method offered through CAI mathematics programs is again pointed to as a key concept in helping underachievers. The researchers in this study spoke to the variables and the results of their work:

Cognitive social theory provided a framework for the incorporation of attentional, retentional, and motivational variables into the videosequences. Results of field trials show that the modules were effective in teaching/reteaching mathematical skills/concepts to secondary school students who had not made normal progress in mathematical learning. In the first trial, students who used materials gained a significant advantage over control subjects in skills/concepts involving factors and prime numbers. The pattern of gains attributable to these modules was replicated in a second trial, but without a control group. Comparable effects were also found to be associated with use of fractions modules, but these results should be interpreted with caution because of a lack of a control group. Additional results indicate that the interactive computer–video modules had a beneficial effect on affective as well as cognitive outcomes. (p. 99)

Hotard and Cortez (1983) initiated a research study on the effectiveness of computer assisted instruction in a Title I mathematics program for Grades 5–8. Students from two different schools were matched and members of matched pairs were randomly assigned to a CAI or non-CAI group. Both groups (N = 468) received standard mathematics lab instruction for 6 months. The experimental group, however, received 10 minutes of daily CAI. Pre-post evaluations showed educationally meaningful grade equivalent gains for the CAI group.

In 1982–83 results for all students were obtained in a standard score format, and comparison data from the state and nation were obtained. Results demonstrated stable, sizeable, meaningful gains for CAI students, as compared with non-CAI students in Lafayette Parish and with state and national results showing that daily CAI practice enhances the process of remediation. (p. 9)
An impressive field study completed by Poore, Qualls, and Brown (1981) linked functionally illiterate individuals to a basic skills learning system titled PLATO. The objective was to raise the skill ability of the subjects \((N = 236)\) to an eighth grade level of competency in reading and mathematics. This study deals specifically with the mathematics component of the system and was conducted in three Florida high schools as part of a mathematics remediation program. PLATO includes 73 mathematics lessons requiring 75% of the lessons to be completed on the computer. Mixed practice lessons; application activities; and four types of testing: diagnostic, pretest, mastery, and retention, are also included.

The subjects were all high school students who failed the Florida Statewide Assessment Test. After spending 20 hours in the PLATO lessons, an overall median gain of 1.5 grade equivalents (GE) was achieved. Overall, 207 students had positive GE gain scores, 18 had negative gain scores, and 11 had no gain from pretest to posttest.

A by-product of the study was an attitude survey. The students answered 35 questions 1 week into the program (preattitude survey) and at the conclusion of the program (postattitude survey). A 1.0 indicated a very positive attitude and 4.0 indicated a very negative attitude. There was a significant decline \((p < .01)\) from the preattitude to postattitude survey but the result was still positive (1.87). The researchers believed this was due to the novelty effect wearing off. Of the students surveyed, 76% said they would like to take another course on PLATO.

Reproduced with permission of the copyright owner. Further reproduction prohibited without permission.
In an exhaustive effort to discover research studies linking CAI to only ninth grade remedial mathematics students, this investigator located just one field study that was similar to this ex post facto study. The field study conducted by Igo (1970) was undertaken to determine if ninth grade remedial mathematics students might benefit from CAI. Although there were no hard data to support a relationship, local student teachers and classroom teachers where the program had been field tested remarked on the success of the program and the high performance of their students. Informal reports by the teachers indicate they consider the experience in the CAI classrooms to be the most rewarding of their careers.

The literature was highly supportive in using CAI with basic skills mathematics students. Other than the Igo (1970) study there was no evidence of a study that used only high school freshmen, or that matched a one-school-year time frame as used in this study. Lanese (1983), using subjects in Grades 7-12, found significant results in basic mathematical computational skills with the exception of Grades 9 and 12. This project undertaken in the Cleveland public schools used microcomputers to provide supplemental remedial instruction in mathematics. The project also provided in-service training for classroom teachers on the use of microcomputers for mathematics remediation and on the development of remedial mathematics software. In the school year 1982-1983 operational problems impeded the progress of the four stated objectives: implementation and management of the project, assessing student achievement, providing in-service training for teachers, and developing remedial software, all of which

Reproduced with permission of the copyright owner. Further reproduction prohibited without permission.
met with varied success in 20 different schools. Lanese's study included 979 subjects in December of 1982; however, in May of 1983 only 736 subjects were given the posttest. Lanese's objective was as follows: "Among the students who received supplemental instructions via the microcomputer, 75% or more will demonstrate a significant increase in basic mathematical computational skills (pre-post of at least ten percentage points)" (p. 1). Although the sample population did not attain the objective:

Significant gains were made, however by fewer than 75% of each individual grade level except ninth and twelfth. Grades seven, eight, ten and eleven, evidenced an increase in performance greater than 10%. Grades nine and twelve failed to attain a 10% increase in pre-to-post mean scores. (p. 2)

There is cumulative evidence that computers seem to provide an effective means of improving performance in mathematics as well as a wide variety of subjects. A number of reviews summarizing computer assisted instruction (Edwards et al., 1974; Henderson, 1983; Jamison et al., 1974; Rapaport & Savard, 1980; Thomas, 1979) have all shown quite consistent positive effects on both achievement and attitudes. A growing number of these positive effects relate to the field of mathematics education and more specifically to the teaching of mathematics basic skills to the educationally disadvantaged student (Aaron et al., 1975; Henderson, 1983a, 1983b; Hotard & Cortez, 1983; Lanese, 1983).

Although the majority of evidence read and reported by this investigator supported CAI as an effective method of reading and mathematics instruction, there were reports partially negating their
use (e.g., Edwards et al., 1974; Jamison et al., 1974; Rapaport & Savard, 1980; Thomas, 1979). Furthermore, there was little reported usage of CAI used with high school students who were reading at a first, second, or third grade level. It was the absence or lack of these data that lead the investigator to believe there was a need for further investigation. Research reports supported the use of CAI, supported the use of CAI with basic skills, supported using CAI programs in elementary reading/writing programs, and support was also present for varying periods of time (usually 6 months or less). Not any one report, however, provided a combination of all the above concepts interacting together. This was the reason this investigator was convinced that the following hypotheses needed testing:

Students involved in a year-long basic skills English/reading course employing CAI programs will demonstrate greater growth in reading skills than students involved in a traditional English course.

Students involved in a year-long basic skills mathematics course employing CAI programs will demonstrate greater growth in mathematics skills than students involved in a traditional mathematics course.

The second hypothesis addressed the use of computer assisted instruction in a mathematics basic skills course. Again the literature was highly supportive of this approach when working with the student experiencing basic skills deficiencies. The rationale for CAI in this area related to the teach-reteach method until a mastery level was achieved. The infinitesimal patience and opportunities to try new problems/approaches provided by this method were the key
components which could not be matched in a traditional classroom setting.

Student Attendance

The following research studies cover the areas of active learning and motivation/feedback and reinforcement, and in doing so establish the concept of the hypothesis, attendance.

Active Learning

Children learn better when they are involved actively in their learning, and computers provide interaction between the student and the machine (Platt, 1984). "The child must act for the machine to respond," said Platt, "and each action of the child causes a reaction of the computer" (p. 44).

A report published by the International Resource Development Company points to the growing presence of computers in the classroom and implies those student sharing access to a computer will have a significant edge over those students in school districts which do not. Frankel (1980), project manager for the study, said:

Computer Aided Instruction (CAI) can be used to create an active game/simulation atmosphere to replace the dry textbook approach of previous generations. When learning is fun, more of it happens. Still, it will be some time before the many wrinkles get ironed out of the software products. (p. 81)

In a concluding section of their research summary, Rapaport and Savard (1980) reported:

The research findings make it clear that CAI is an effective supplement to traditional instruction. Computer
assisted instruction is popular with students and often improves their attitudes toward the subject matter. The CAI approach usually results in learning more material in a given time period, or the same material in less time. Fears that students would forget CAI learned material more easily than traditional materials appear to be unfounded although findings in this area are mixed or inconclusive. (p. 9)

Motivation/Feedback/Reinforcement

Children are interested in computers because the machines are part of today's high-tech world. For basic skills students and high-risk students this is especially important because computers allow these individuals to do school work more easily, to compete on a more equal footing with students who do not have basic skill handicaps, while adding credibility among peers in the entire school environment. This point is further established by Feddern (1984) as she recalls a classroom experience. "One morning before school as a group of children clustered around our computer, I overheard a 4th grader ask John 'How come you're in Special Education if you're so smart?'" (p. 58).

In a highly significant study Gerzanick et al. (1982) reported the following regarding the motivation indicators, "They (the lab students) made 389 visits beyond the scheduled lab sessions for an average of 13.5 additional visits per student" (p. 51). The co-directors considered this convincing evidence of increased student interest in improving their basic skills performance through the use of the computer labs. They further added, "Other, more subjective results were gathered from those involved in the project. These
included statements about the ease of program operation and student survey results which showed positive changes in skill performance, attention span and improved self-image" (p. 52).

In an article titled "Open to Suggestion," Bengfort (1983), a high school remedial reading teacher, wrote about her students and satisfaction while working with the microcomputer.

It gives my students a real boost to know they can handle a computer. Self-esteem grows still more when they help to produce the program and then master their work on it. Another advantage is increased motivation. With computers, all students are able to succeed. This is especially important for someone who has poor writing skills--to type a response is easy. (p. 639)

Another testimonial comes from Fletcher and Sawyer (1984) while working on an Indian education project for the Department of Education, Washington, DC:

Even more gratifying was our observation of the Indian children at the computers. They were keenly motivated to learn. They were excited. They were enthusiastic. More important as apparent from the "happy faces" indicating a correct response, they were learning. (p. 2)

While investigating the use of CAI programs, discussions of the technology, primarily the microcomputer, were almost always positive; however, Rauch (1983) found some negative aspects which deterred motivation and cited the following disadvantages to using CAI programs:

Many students are fearful because they do not know how to operate the terminals. Another disadvantage is that the large scale computer systems may on occasion be "down," that is, it is not operating when the student is scheduled time to run a program. Although the student may re-schedule, it is frustrating. (p. 5)

Another problem that arises from frustration is the damaged or stolen
software and, sometimes, that frustration is directed towards the
terminal resulting in physical damage. This is seen more often with
the educationally disadvantaged student. (While collecting attend­
ance data on the treatment group of this study it was noted that a
small number of the subjects were suspended from school because of
stolen materials or damage to equipment in the computer lab.)

McTeer (1978) found that problems with CAI programs arose when
the teachers had difficulty trying to access a computer terminal.
Still another problem is the sophistication and accuracy of software
available. McTeer said, "Many of the earliest software programs were
inundated with errors of academic accuracy" (p. 1). McTeer also
reported:

With the development of the portable computer, which is
relatively inexpensive, teachers must have some knowledge
of how to write learning activities for programs devised
for the portable computer or have access to someone who can
write such a program. This remains to be a problem; how­
ever, American Universities are now requiring computer
courses and programming as a basic skills requirement.
(p. 2)

Immediate is the keyword on the feedback of a computer lesson
given to a student once he or she has finished. As a result, stu­
dents receive positive reinforcement for performing successfully and
guided corrections when they make a mistake.

CAI programs are designed to immediately assign the student to
subject matter areas or levels where he or she experiences a particu­
lar level of success and moves him or her forward as rapidly as
mastery over the subject matter is demonstrated. In most of the
basic skills programs in this study an 80% mastery level is required
before the student can proceed to the next level. Maser (1977) sees CAI programs as an alternative for individual instruction because of some unique characteristics. The first, and of great importance, is that these programs give instant feedback to the child's responses and allows the child to correct the errors. A second important characteristic is immediacy of reinforcement.

Children who have learning deficits typically have poor tolerance to delayed gratification. That is, these children usually see minimal relationship between actions today and success or failure as represented by marks on a report card. The computer terminal, with its one or two seconds response time, graphically provides the pupil immediate feedback to his input. The student knows he is in control and can readily see the cause and effect relationship in his answers. There is also good evidence that the immediate response of the computer terminal provides effective reinforcement to learning activities. As CAI effectively brings up the achievement level of lower quartile pupils especially there is a reduction in the frustration level and the pupils' self-confidence improves. In general, the emotional climate of the institution improves. (Maser, 1977, p. 3)

In the evaluation report, Maser (1977) cited students' achievement gains in the basic skills of mathematics, reading, and language arts of 1.22 to 1.45 months for each month in the computer-assisted instruction (CAI) project. This year long Title I/CAI program was implemented in the Highline School District of Seattle, Washington. The major emphasis of the program was to provide an alternate approach to individualizing instruction for economically and educationally disadvantaged students. Students meeting those criteria, 442 elementary and 239 secondary, became the subjects of the study.

Attitude surveys revealed that students, parents, and teachers had positive feelings about CAI. Eighty-four percent of the parents...
indicated they would like to have their children participate in the program again the following year.

Teachers working with their students using microcomputers often-times believe that the computer has some unique motivational value. This conclusion is supported from watching children feed quarters into arcade games in shopping malls across the country. For the most part, very little research had been reported on this phenomenon until the writings of Malone (1981). Using what he understood to be the unique aspects of computer games, this research scientist has been teaching programmers in the educational community how to design their own educational programs. He stated that three major concepts are used in designing enjoyable educational programs: challenge, fantasy, and curiosity.

Using these major concepts and the attributes of: variable difficulty levels, multiple goal levels, randomness, emotional appeal, visual effects, surprises, and constructive feedback, Malone (1983) diagrams, outlines, and supplies examples of how to design enjoyable educational programs.

Malone (1981) presented these concepts in a report for the Xerox Corporation Research Center titled What Makes Things Fun to Learn? A Study of Intrinsically Motivating Computer Games. In the report the author clarifies the possibilities for the new technology:

The new technology of computers— with its uniquely rich possibilities for responsive fantasy, captivating sensory effects, and individual adaptability— has an unprecedented potential for creating fascinating educational environments. But as our cultural experience with television indicates, great potential does not guarantee wise use. I have tried to point the way, in this report, toward a
humane and productive use of this new educational technology that avoids the dangers of soulless drudgery on the one hand and mind-numbing entertainment on the other. (p. 49)

As very little is said in the research about designing "game" type programs, Malone (1981, 1983) appears to be an educational explorer leading researchers into untapped regions with the potential of great rewards. Weaver (1982) and Frederiksen (1983), in their efforts to build on the "game" type program, are seemingly the first followers of Malone's exploration.

The third hypothesis posed by this investigator relates to pupil attendance. The underlying rationale for this hypothesis is supported by a basic logical assumption that if a child is involved in active learning, is motivated by the method of instruction, receives immediate feedback and reinforcement, and is accepted by peers and teachers, then the desire to attend school will be strengthened.

In a search of the literature on computer-assisted programs many authors alluded to active learning, motivation, feedback, reinforcement, and acceptance by peers and instructors, only one study related its findings to attendance (Aaron et al., 1975).

This researcher, convinced that attendance could provide meaningful data regarding the success of students or CAI programs chose to test the next hypothesis:

Students involved in a year-long basic skills course employing CAI programs will demonstrate greater attendance than students in traditional courses.
Student Behavior

The following research studies covering: individualized instruction, classroom management, and lowered frustration will establish the rationale for the fourth hypothesis, reduced negative behavior.

Individualized Instruction

Computers can be programmed to provide instruction at each child's academic level and to pinpoint the skills each child needs to strengthen. The computer can be adjusted to the child's rate of response; and now, with the new talking computers, a child who is not paying attention or responding can be reminded via a spoken message. Williams (1985) pointed out the availability of speech synthesizers means materials can be presented in spoken form to children who are visually impaired or whose attention is apt to stray from the task at hand.

Programmed instruction on the microcomputer for remedial students is the technique employed by the Bristol Public Schools. Directors of the Computer-Assisted Remediation Program, Gerzanick et al. (1982), found: "Two characteristics appear instrumental in successful remediation: self-paced instruction and the emerging technology of computer instruction" (p. 50). One significant feature of this program is that ninth grade students are mandated by law to receive diagnosis and remedial instruction if they fail to meet the statewide level of expected performance.
In a technical report to the Office of Education, Department of Health, Education, and Welfare, Igo (1970) commented on the teaching staff and subjects while field testing a CAI mathematics program. "They acquired an appreciation for the efficacy of individualized instruction through their CAI plan" (p. 2).

Classroom Management

Recordkeeping is a time-consuming nightmare for many teachers. Those fortunate enough to have a computer at home, in the classroom, or have access to one in the school can lighten their burden by programming the machine to keep track of each child's progress, freeing the teacher from the task of recordkeeping. A computer can lighten the teacher's workload also as he or she initiates some students into individualized instruction programs thus allowing more time to work with other students in small groups.

This point was established by Regan (1982):

The computer technology employed in the Fail Safe program conserved teacher time and improved learner productivity by increasing time on task. The program addressed the need to (1) supplement the developmental reading program through home tutoring; (2) minimize the teacher's paperwork/recordkeeping burden; (3) use technology to improve productivity and contain costs; (4) ensure a long range commitment to reading improvement through shared accountability; and (5) focus energies on the elementary level where potential for academic intervention is greater. (p. 7)

While working for the Exxon Educational Foundation, Jaycox (1979) published a paper titled Computer Application in the Teaching of English. The paper was written to familiarize English teachers with the current status of CAI. An editorial note in the paper cues
the reader to the importance of the computer as a managerial tool:

"Most important, the computer can relieve teachers of many time consuming clerical tasks, freeing them to concentrate on instruction and the learning process" (p. 13).

Smith (1970) used CAI in the teaching of reading and found its greatest strength lies in decoding and record keeping.

By keeping exact records of each child's achievements (elements or phases of decoding) and using that information for scheduling individualized instruction is a tremendous asset for the teaching of reading. The computer seems to be the most favored teaching device of the future. (p. 20)

Lowered Frustration

Children's level of self-consciousness is considerably less when working with a computer as opposed to working before classmates and teachers. Williams (1985) reported that many students who aren't willing to risk failures in front of the class respond well to a computer that will not criticize or make fun of them. "Computers, after all, have infinite patience and a lesson on a computer is confidential" (p. 44).

The majority of the research indicates positive attitudes by subjects in regard to the use of the microcomputer. Fletcher and Sawyer (1984), however, reported an incident of higher frustration.

Based upon an observation of one rather unfortunate incident, which I would say was not typical, the teacher has to make certain that the child does not engage in activities beyond his or her capabilities. This could cause frustration or resentment of an innovative learning tool. (p. 2)

This point is well taken as the frustration or resentment mentioned is believed to be the original cause of why students attend
school irregularly or ultimately drop out of school. As CAI in this study is expected to help students in these areas, the frustration from working on a CAI program would be self-defeating.

From the Holland Elementary School in Minneapolis, Spiroff, a teacher, said:

I have seen the computers stretch gifted kids and rescue kids bored to tears by math. Students like working on the computer, so much that they have to be peeled off the terminal and ordered to go home each afternoon. "If you do something wrong, the computer doesn't get mad at you," says Ari Levi, age 12. "And if you get it right, the teacher can't make that neat noise the computer makes." (Luehrmann & Spiroff, 1981, p. 88).

Because of the use of individualized instruction, timesaving classroom management techniques, and a lowered frustration level for pupils, it is this investigator's contention that behavior problems of the educationally disadvantaged will decrease. This contention was the rationale for the following hypothesis:

Students involved in a year-long basic skills course employing CAI programs will demonstrate less negative behaviors than students in a traditional course.

Student Dropouts

The final hypothesis, dropout rate, is established through five research studies dealing with the theme opportunity for success.

Opportunity for Success

Because computer lessons can be programmed for a child's ability level, the opportunities for success are increased.
Computer conferencing, as Moore (1983) explained, is a contemporary change in our ways of communicating. In a broad evolutionary sense, communicating has been limited to "verbal and gestural symbol-ism in a face-to-face interaction" (p. 68). The word literacy has taken on new meaning in our society also. Being computer literate, and communicating with a computer in our world of ever-increasing technology means a brighter future with greater potential for employment. Luehrmann, a California computer consultant, calculated that 10 to 20 hours of "hands-on" computer experience will equate into a $1,000 annual advantage in today's job market (Luehrmann & Spiroff, 1981, p. 4).

Programming, the writing of computer programs, is now taught to students to even further open doors of computer acceptance into the educational curriculum. Carlson (1983) related that the analytical and syntactical skills learned in programming can be transferred to more general situations that can help the child to a more mature style of thinking and working as well as teaching a strong skill for potential employers to admire.

In a research study conducted at a Job Corps site for disadvantaged young adults, Geller and Shugall (1983) pointed to some side effects:

It is interesting to note that participants in the experimental group in both reading and mathematics had a much lower dropout rate than the controls. This may suggest that students showed greater interest in the CAI models. Also, participants in the CAI model had a shorter mean length of stay in Job Corps. Coupled with the lower dropout rate, this last finding may indicate that participants in the CAI model obtained the benefits of Job Corps in a shorter period of time. (p. 25)
One specific opportunity that CAI programs are offering today's students falls in the area of career development. Mallory (1978) reported on the summer program for economically disadvantaged youth (SPEDY) program as having a positive and significant attitude change on the students involved in this 10-week experiment. Teachers in the program believed the delivery system, the computer-based classroom work, was the key element in the program being responsible for the significant results. Mallory reported these significant results as follows:

The evaluation results showed a positive and significant attitude change on the part of the youth who had taken both the career development and employability skills experiences. On a post test they rated as highly significant the amount of preparation and the amount of knowledge they had gained from the program. As a result of the summer program, the youth felt they were better prepared to plan their careers, choose an occupation and prepare themselves to be employed. The analysis of the quantity and quality of skill gains shows gains that were statistically significant but were less than expected by program personnel. (p. 13)

Using pretests and posttests to determine skill gains, the researchers found:

A 75% increase in the level of coping skills for school and work settings.

A 75% increase was found in the ability of youth to identify job openings, develop resumes, and take interviews.

As a result of the program, about three times as many youth, 70% vs. 26%, perceive themselves as being well prepared (responses 6 through 9 on a 9-point scale) to choose an occupation that met their career goals.

Approximately 60 percent of the youth felt the program influenced a change in their occupational goal.
From 60 to 80 percent of the youth who took each part of the program rated it as helpful (6 to 9 on a 9-point scale).

From 48 to 74 percent of the youth rated each part of the program as being influential (a 4 or 5 on a 5-point scale). (p. 31)

It is these areas of feedback and reinforcement and, opportunities for success (now and in the not too distant future) that the investigator believes will lead the educationally handicapped student to develop positive feelings about school, a more mature style of thinking and, as a result, will deter his or her thoughts of dropping out of school. Convinced that the dropout rate could provide meaningful data regarding the success of CAI programs, this researcher chose to test the final hypothesis:

Students involved in a year-long basic skills course employing CAI programs will demonstrate less dropouts than students in a traditional course.

Summary

This chapter opened with four summaries of research findings which provides supportive evidence to the effectiveness of CAI as a means to enhance student achievement in what is commonly referred to as the basic skills areas.

While focusing on the role of computer-assisted instruction in a basic skills course, this chapter has presented a review of literature that concentrated on several factors influencing this method of instruction. The first two factors concern the areas of English/reading and mathematics as these are the two basic skills courses.
under investigation in this study and the areas where most research has been recorded. The chapter next focused on seven major concepts which positively affect the users of CAI programs.

Active learning, motivation, feedback, and reinforcement factors are highlighted and point out why attendance becomes a variable in the study. Individualized instruction, classroom management, and lowered frustration were three factors which provided the rationale for the hypothesis concerning the behavior of students in the study. Finally, the concept of opportunity for success was the factor which led this investigator to believe that the final hypothesis, the rate of student dropouts, was important to study.

While all of these areas strongly supported the use of CAI with the educationally-handicapped student, the literature seems to focus mainly on reading and mathematics. The theme of a strong motivational factor while using CAI programs was redundant throughout the literature search.

In light of the knowledge presented throughout the review of literature, this investigator believed there was a need for testing the five hypotheses. The reading and mathematics hypotheses are first tested as they are the academic areas and truly the focal point of the review of literature and the focus of this study. The three nonacademic areas of attendance, behavior, and dropout rate are next tested. While these areas are mentioned in the literature review, they are of secondary importance to the study.
CHAPTER III

METHODOLOGY

Introduction

The purpose of this research project was to compare the achievement of students with academic deficiencies enrolled in a basic skills curriculum emphasizing computer assisted instruction (CAI) to students with academic deficiencies enrolled in the traditional school program.

In this chapter the investigator will explain the rationale for the type of design that was used for the study, the subjects that were selected, and how and why they were so selected. A discussion of the field setting will describe the locations and populations of the school districts involved in the study and describe the socioeconomic backgrounds and racial and sexual percentages of the students attending these schools.

The independent variable for the study is explained in terms of what programs are included in the CAI method of teaching and what components are included in each program. The dependent variable will be discussed in terms of the kinds of measurement instruments, how they were used, a justification of these instruments, and evidence of their reliability and validity.

The next section of this chapter explains to the reader what the research hypotheses are, how they are operationalized, and how they
were tested. Information also is provided explaining how and from where the investigator collected the data, and finally, the statistical analysis explains how the scores were processed.

Research Design

This investigation can best be described as an ex post facto field study because all subjects were previously identified based on their stanine scores and the fact that the investigator did not manipulate or control the subjects. The researcher did, however, use the total population of the treatment and comparison groups in this study.

Kerlinger (1973) described ex post facto research as a "systematic, empirical inquiry in which the scientist does not have direct control of independent variables because their manifestations have already occurred or because they are inherently not manipulatable" (p. 379). With the inability to control in an ex post facto design the investigator is left with making inferences. Kerlinger further added, "Inferences about relations among variables are made, without direct intervention, from component variation of independent and dependent variables" (p. 379). Kerlinger also believed, "There is no difference whatever in the basic logic, it can be shown that the argument structure and its logical validity are the same in experimental and ex post facto research" (p. 380).

The research compared the academic achievement of students with skill deficiencies enrolled in a basic skills curriculum emphasizing computer assisted instruction to that of students with skill
deficiencies taking traditional courses on a concurrent time sched­
ule. The two courses under investigation for this project include
ninth-grade English and ninth-grade mathematics. The achievements of
students in both groups were compared on the differences of pretest
and posttest scores at the conclusion of the year-long courses.

The two courses were chosen from the 1983-1984 schedule at two
Michigan Class A high schools and two other Michigan Class A high
schools of similar size, socioeconomic backgrounds, and comparable
racial and sexual makeups.

Variables

Independent Variable: Method of Instruction

This section includes the method of instruction for both CAI
treatment subjects and the comparison subjects receiving the tradi­
tional instruction. This section is divided by the subheadings CAI
method and traditional method. Under the subheading CAI, a discus­
sion of three reading programs is presented: the Vanderlaan Language
Program, Critical Reading, and the CAI Reading Efficiency System.
The mathematics component (SRA) drill and instruction mathematics CAI
program is next presented. The CAI method section concludes with a
short discussion and a survey report on the hardware used by the
treatment subjects.

Under the second subheading, traditional method, an explanation
of what units of study are taught and what textbooks are used in both
English and mathematics is given. A comparison of curriculum, number
of days of instruction, number of periods in a day, and number of minutes in a period is made between the CAI treatment groups and the traditional comparison groups.

CAI Method

The VanderLaan Language Program is one of three commercially purchased programs used in the basic skills English courses. The content of this program stresses the following primary reading skills: vocabulary, literal comprehension, main ideas, details, cause/effect/sequence, and inferential comprehension. This particular program suggests a sequential order for the teaching of reading.

1. Level pretest.
2. Instructional lesson—comprehension.
3. Practice lessons.
4. Vocabulary instructions.
5. Reading of the selections.
6. Answering questions.
7. Level posttest #1.
9. Level posttest #2.

The second reading program employed is titled "Critical Reading" and is produced by the Borg-Warner Educational Systems Company (May, 1983). The major purpose of using "Critical Reading" is to help those students to master rules of inference, providing the student with a better understanding of the written material. Borg-Warner introduces the material at a relatively simple level and builds to
more difficult levels progressively, enabling the student to work through each critical reading unit. To assist the individual through these units, positive reinforcement is given for each response as well as an explanation of the correct answer.

Critical reading not only will help students master rules of inference, but will also help them develop an understanding of the meaning of paragraphs while they strengthen their general comprehension skills. Teachers feel this skill is extremely important and probably the key element in improving stanine scores on the standardized reading tests.

In A State of the Art Report, McDonald (1983) said: "Of fifty-two (52) institutions, including public schools and universities, from all over the United States, 96% of those report having purchased software" (p. 81) and of the top 10 companies they listed, Borg-Warner was the most popular.

The third reading CAI program used in the basic skills English courses was discussed by Phillips (1981) in his manual on reading efficiency systems. Phillips stated that

Students must be taught how to comprehend before attempting to practice lessons. Many reading programs on the market today provide a variety of practice lessons which require the student to use efficient comprehension skills, but do not provide the instruction in how to comprehend. This philosophy appears to be that the student will learn through practice alone. The CAI's Reading Efficiency System provides thorough, individualized instructions which precede an extensive practice system. (p. 81)

The approach, Phillips contended, frees the instructor to work individually with slower students who need the extra attention.
A comprehension program of this nature is basically designed to teach students how to read efficiently in content areas. Many students are unable to pass tests, participate in class discussions, or write reports or theme papers because of their inability to comprehend what they read or keep up with the required reading assignments. The CAI Reading Efficiency System utilized the basic reading sequence, as seen in Appendix A. This approach teaches students how to effectively read and comprehend articles of all types. Phillips (1981) further stated:

Through this approach the student learns to comprehend better and more quickly as well as increase his/her reading speed. The approach also provides an effective, practical approach which can be immediately utilized by that student.

The philosophy of teaching vocabulary by the CAI method precludes that new words are learned through repetitive usage and exposure rather than single exposure to an isolated word. Therefore, a vocabulary program providing multiple exposures to each new word in a variety of settings is superior. Each exposure requires the student to use his/her own knowledge of the word as well as to merely see the word. (p. 87)

This method is employed by the CAI Reading Efficiency System.

The basic skills mathematics teachers use the Science Research Associate's (SRA) Drill and Instruction Mathematics CAI program. This program enables students to practice basic mathematics skills and immediately find out how well they are doing. It also offers tutorial instruction that students can request as they need it. Being quite proud of this component, SRA boasts:

The Computer Drill and Instruction: Mathematics Program contains hundreds of carefully sequenced lessons covering the major Arithmetic skills. Drill is backed up with instructional segments called "Helps" which permit students to ask for a step-by-step explanation of any problem simply
by pressing the Apple's ? key. The animated "Helps" are interactive tutorials which allow students to work through solutions at their own pace. Helps can also be used effectively for group instruction. (p. 33)

A management program is also used to monitor and record each student's progress, continually diagnosing and delivering exercises at the appropriate level of difficulty. One special attribute of the program is that no special computer training is required. The teacher remains in control through the use of simple, nontechnical procedures that are carried out in English—not in a computer language. The content and style of the SRA program were consistent with practices in the classroom and textbooks as well as meeting the school districts' objectives.

Another feature divides the SRA mathematics program into levels according to the grades at which skills are usually practiced for mastery. Mastery level is determined when a student reaches an 80% rating on a given posttest. The following skills/concepts are those taught and practiced through the CAI program: (a) addition, (b) subtraction, (c) multiplication, (d) division, (e) whole numbers, (f) fractions, (g) decimals, (h) computation, (i) ratio and percentage, (j) measurement, (k) pre-algebra, and (l) applications.

The Apple II is the microcomputer used by the treatment subjects of this study. Downing (1983) described the Apple company as one of the earliest of personal computers. It makes the widely sold Apple II and now has a new model: the Apple III. There is a wide variety of compatible hardware peripherals and software packages that can be used with the Apple computers. A book published by the Apple company
entitled Kids and the Apple (Carlson, 1983) is designed for beginner programmers and was used in the CAI treatment schools. McDonald (1983) also reported in her A State of the Art Report that of the 52 institutions she surveyed, 69% of the respondents used the Apple computer.

Traditional Method

The second method of instruction is the traditional English and mathematics courses as taught in the comparison school districts. Remedial English, as taught in the ninth grade, matches almost identically the units of study which are taught in the treatment school district. The textbooks used are the Houghton-Mifflin ninth grade English text (primarily dealing with grammar and composition) and the Houghton-Mifflin Galaxie Series (primarily deals with reading/literature). The following is a list of required units of study, imposed by the school district, which each teacher covers in the year-long course: Literature/reading units of study include: (a) short story, (b) modern drama, (c) poetry, (d) literature terminology, (e) novel, (f) independent reading, and (g) vocabulary. Grammar/composition units of study include: (a) descriptive writing, (b) narrative writing, (c) parts of speech, (d) mechanics, (e) essay writing, (f) research reporting, (g) study skills, (h) spelling, and (i) journals (optional).

The ninth grade mathematics course for the lower track students (students with Stanines 1-3) is titled "Basic Mathematics" in the comparison school district. The primary text used is the Addison-
Wesley General Mathematics. Some teachers may use some additional supplemental materials; however, they rely on these materials only to reinforce the basic units of study covered in the textbook. The following are those units covered by every ninth grade mathematics teacher, as they are mandatory, over a one school year period: (a) addition, (b) subtraction, (c) multiplication, (d) division, (e) whole numbers, (f) fractions, (g) decimals, (h) percentages, (i) measurements, and (j) pre-algebra. In drawing comparisons of the two school districts this investigator was surprised how closely the curriculum of these subject matter areas matched. Time sequence of the school districts are also practically identical as state law required 180 days of instruction during the school year and both districts run a six-period day with approximately 55 minutes of instruction daily for both the mathematics and English courses.

**Dependent Variables**

This section includes the five dependent variables corresponding to the five hypotheses of the study. Under the first subheading, reading, and the second subheading, mathematics, a discussion of the instruments that were used and the criteria determining those scores are presented. The third subheading simply addresses the comparison on attendance. The fourth subheading, behavior, explains the various infractions which may have caused a referral to be written and how the districts were compared. The fifth subheading, dropouts, mentions not only the comparison of districts on this topic but also a clarification on the use of the term dropout.
The first of five dependent variables concerns reading ability. In this investigation there were three standardized tests used to measure this skill: the Metropolitan Achievement Test, the Nelson Reading Test, and the California Achievement Test. All three of these tests use the same three criteria in determining a reading score.

Word meaning, the first criterion, is presented in three different ways: isolation, in phrase context, and in passage context. These three categories are viewed as three alternative approaches to the measurement of the same thing, not as measures of different attributes. The second criterion used to determine the reading score is reading comprehension. In assessing reading comprehension, use is made of brief passages that reflect a variety of subject matter similar to that encountered in school reading situations. The specifications of the reading comprehension section calls for a division of items into three tasks:

1. Literal tasks that deal with specific information stated within a passage. Generally, "what," "who," and "how many" types of questions are asked to assess recall of (or ability to relocate) specific details or the main ideas in a passage.

2. Translational tasks that require the selection of the correct answer to questions that are presented in a restated form. Thus, students are required to select synonyms for paraphrased re-statements of main ideas or related details, to determine the correct
referents to pronouns, to recognize simple inferences, to answer sequence questions, etc.

3. Higher level tasks that ask the reader to determine implicitly stated main ideas or details, identify cause and effect relationships, make judgments about events and attitudes of authors or characters, etc. Although examinees may need to infer correct answers from the information given in passages, the questions are generally limited to the content of the passage in order not to require readers to rely heavily on general information in answering the questions.

The third criterion determining the reading score, total reading, represents a combined performance of the two subtests, word meaning and reading comprehension. Since the best single indication of reading achievement is a score based mainly on the student's performance in actual reading situations, the total reading score is weighted to give more emphasis to Reading Comprehension than to Word Meaning. The ratio of Word Meaning to Reading Comprehension is 1:2. (The technically oriented reader will note this a ratio of raw scores. The ratio of the standard deviations for the reading skills test only approximates 1:2 at the different levels.)

The total reading score is an estimate of overall reading strength taking into account both the knowledge of words and their meanings, and the demonstrated understanding of what is read.

The reading stanine scores used to compare the subjects in the investigation were determined by converting the raw scores (Word Meaning and Reading Comprehension) to a total reading score, then the
total reading score was converted to a grade equivalent score, and finally, the grade equivalent score was converted to a stanine score.

**Mathematics**

The second dependent variable addresses mathematics skills. This variable was measured on the Stanford Diagnostic Mathematics Test (SDMT). The SDMT assesses three interrelated areas of mathematical competence: concepts of the number system and numeration, skill in computation, and application of these concepts and skills to problem-solving situations. Within these three areas of mathematical competence, specific behaviors, referred to as concept/skill domains, are measured. These concept/skill domains, mentioned earlier in the chapter, are: addition, subtraction, multiplication, division, whole numbers, fractions, decimals, computation, ratio and percentage, measurement, pre-algebra, and applications.

**Student Attendance**

The third dependent variable is concerned with comparing the attendance of students in the basic skills courses with that of the students in the traditional courses. This information was gathered from the schools' records for the entire 1983-1984 school year.

**Student Behavior**

The fourth variable concerns the behaviors of the subjects enrolled in both the basic skills and the traditional courses. Both school systems keep records on an official behavior referral form,
written by teachers, when the behavior of a student is inappropriate for the classroom. A behavioral referral is written to the attention of an administrative assistant based on a violation of any one of three possible categories. As very few of the referrals were differentiated by category and would have required a subjective value judgment on the part of this investigator, the decision to report only the total number of referrals for each school district was made.

Category 1 deals with misconduct and is only brought to the attention of the central office when the teacher has exhausted some of the options available to him or her in trying to solve the problem, i.e., phone calls to the parents, verbal reprimand, assigning a detention (after school), a teacher-student conference, extra work assignments, or withdrawal of privileges.

Category 2 deals with more serious displays of misconduct and requires a teacher to write a behavior referral, e.g., damage, destruction or loss of school property, restroom or locker room violations, forgery, threats, fighting, verbal abuse, or profanity.

The third category, the most serious, concerns illegal misconduct and may require law enforcement authorities to be alerted. The following are examples of Category 3 which require an immediate report to the central office:

1. Sale of alcohol or drugs.
2. Use of explosives or weapons.
3. Stolen property or vandalism over $50.
4. Making a bomb threat or false fire alarm.
5. Arson.
6. Assault or battery with desired effect of physically harming any student or staff member.

7. Extortion.

**Student Dropouts**

The final dependent variable concerns the number of ninth grade student dropouts in each of the high schools when comparing school districts. This information was determined by official records obtained from the dean of students in each building. Transfer students are excluded from the dropout rate thereby narrowing those data to only those students who have left school (nonattending) with no official information reported to the central office of the individuals whereabouts.

A thorough discussion of the instruments used to measure the five aforementioned dependent variables and the qualities of each may be found in a forthcoming section titled Instruments. The measurement procedures for the dependent variables are discussed in the data analysis section on page 85.

**Subjects**

This ex post facto study includes the predetermined selection of subjects into comparison groups. The students in this research project were selected according to their stanine scores taken from the schools' records. As students with a stanine of 1, 2, or 3 were automatically screened into the basic skills project in the treatment school district, and all of these students were included as subjects,
randomization selection was impossible.

The number of subjects used as a comparison group were also selected on the basis of stanine scores of 1, 2, or 3 from two other Class A high schools in a southwest Michigan urban community.

Test results on the Stanford Diagnostic Mathematics Test, the Nelson Reading Test, and the Metropolitan Achievement Test identified student deficiencies indicating a need for a special program. Both CAI treatment schools reported that the number of ninth grade students who enrolled in September of 1983 with stanine scores of 1, 2, or 3 in reading and/or mathematics was large enough to warrant a special remedial program.

Textbooks used in the ninth grade required courses are at or near the ninth grade reading level. Students with a stanine score of 1, 2, or 3 were unable to read these textbooks; therefore, these students were experiencing difficulty in passing these courses. The required ninth grade courses for graduation are English and social studies. In addition, students in Stanines 1, 2, and 3 on the Stanford Diagnostic Mathematics Test are required to take ninth grade mathematics. Records showed that prior to the 3 years of the implementation of the basic skills program (1981-1983), the number of failures by ninth graders taking these classes had increased enough to warrant a special program.

Teachers, administrators, and counselors in the treatment schools agreed a need existed for a special program to address the skill deficiencies of these students. Specifically, skill development was focused on the cognitive and affective domains. Cognitive
domain needs of these students included improving skills in the areas of reading, mathematics, and writing. The students were also deficient in consumer economics, global awareness, and basic geography thus creating a need for them to become knowledgeable in those areas as well. Effective study skills needed to be emphasized in all areas.

Affective domain needs identified as being necessary to succeed in high school course work included developing a positive self-image, short and long term goal setting, and prevocational awareness. Continual and consistent feedback and evaluation was also crucially needed by these students.

Field Setting

The school district containing the treatment schools is located in a midwestern urban area of southwestern Michigan. The total enrollment of the school district is approximately 14,000 students, while the two Class A high schools in this district comprise approximately 3,400 students in Grades 9-12. The two Class A high schools representing the comparison group have approximately 2,500 students, Grades 9-12, and are also located in a midwestern urban area of southwest Michigan. The total school population of this district is approximately 9,000. The students in both academic communities are very similar in regards to socioeconomic backgrounds, racial and sexual percentages of the student body, and homogeneity of classroom groupings. These comparisons are shown in Tables 1 and 2.
## Table 1
Comparisons of School Districts by Race

<table>
<thead>
<tr>
<th>Racial code</th>
<th>Treatment %</th>
<th>Comparison %</th>
</tr>
</thead>
<tbody>
<tr>
<td>White, nonminority</td>
<td>63.9</td>
<td>61.0</td>
</tr>
<tr>
<td>Black, minority</td>
<td>34.5</td>
<td>36.0</td>
</tr>
<tr>
<td>Hispanic-American</td>
<td>0.3</td>
<td>2.0</td>
</tr>
<tr>
<td>Asian-American</td>
<td>1.1</td>
<td>0.8</td>
</tr>
<tr>
<td>American Indian</td>
<td>0.2</td>
<td>0.2</td>
</tr>
</tbody>
</table>

## Table 2
Comparisons of School Districts by Sex

<table>
<thead>
<tr>
<th>Sex</th>
<th>Treatment %</th>
<th>Comparison %</th>
</tr>
</thead>
<tbody>
<tr>
<td>Male</td>
<td>51.23</td>
<td>50.75</td>
</tr>
<tr>
<td>Female</td>
<td>48.77</td>
<td>49.25</td>
</tr>
</tbody>
</table>

The socioeconomic conditions of both school districts represent a cross section of all socioeconomic levels. This cross section includes families from the lowest class ranging up through the upper level classes. Students come from families whose heads are professional and managerial leaders to families whose heads are on relief.
Instruments

The dependent variables were measured on the Metropolitan Achievement Test, the Nelson Reading Test, the California Achievement Test, and the Stanford Diagnostic Mathematics Test, using the stanine scores of students in all four Class A high schools. The pretest and posttest scores were compared, the growth of student achievement noted, and a comparison of that growth between the treatment subjects and the control group subjects are reported and discussed in Chapter IV of this study.

The Stanford Diagnostic Mathematics Test

Validity

The content validity of the Stanford Diagnostic Mathematics Test (SDMT) was determined by the staff members who used the test. Through careful examination of the concept/skill domains presented in a table of the teacher's manual and reprinted in Appendix B, the staff concluded the content of the mathematics program is indeed reflected in the test questions.

The authors of this test obtained criterion-related validity information during the standardization phase of the National Standardization Research Program in which students taking Form A of the SDMT also took the mathematics tests of the Stanford Achievement Test. Table 3 contains summary data and intercorrelations of Form A Blue Level subtest and SDMT total raw scores and correlations of these scores with comparable subtests of the Stanford mathematics
<table>
<thead>
<tr>
<th>Test</th>
<th>Intercorrelations</th>
<th>Mean</th>
<th>SD</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Standard Diagnostic Mathematics Test</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1 Test 1: Number System and Numeration</td>
<td>.78</td>
<td>.82</td>
<td>.94</td>
</tr>
<tr>
<td>2 Test 2: Computation</td>
<td>.69</td>
<td>.91</td>
<td>.75</td>
</tr>
<tr>
<td>3 Test 3: Applications</td>
<td>.89</td>
<td>.81</td>
<td>.73</td>
</tr>
<tr>
<td>4 Tests 1 + 2 + 3: SDMT Total</td>
<td>.87</td>
<td>.86</td>
<td>.86</td>
</tr>
<tr>
<td><strong>Stanford Mathematics Tests</strong>&lt;sup&gt;a&lt;/sup&gt;</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5 Test 1: Concepts</td>
<td>.82</td>
<td>.84</td>
<td>.93</td>
</tr>
<tr>
<td>6 Test 2: Computation</td>
<td>.82</td>
<td>.94</td>
<td></td>
</tr>
<tr>
<td>7 Test 3: Applications</td>
<td>.94</td>
<td></td>
<td></td>
</tr>
<tr>
<td>8 Tests 1 + 2 + 3: Total Mathematics</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>


<sup>a</sup>Mathematics Tests of the 1973 edition of Stanford Achievement Test, Advanced Level, Form B.
tests for high school students in the National Standardization Research Program (Beatty, Madden, Gardner, & Darlsen, 1976).

Reliability

The reliability of the SDMT was reported in terms of raw scores. One way error can enter into a score is from the inconsistency of the items in the test. The more heterogeneous the abilities measured by the test, the less reliable becomes the raw score. Kuder-Richardson Formula 20 was used to determine the internal consistency reliability of the SDMT scores. Table 4 presents subtest and SDMT total Kuder-Richardson Formula 20 reliability coefficients and standard errors of measurement in raw score and scaled score units sample taking the Blue Level of SDMT. Different testing situations and different, but equivalent, test content were solved for by using alternate-form reliability measures. Table 5 presents alternate-form reliability coefficients and standard errors of measurements (in raw score units) and related data for five participating school systems.

The Nelson Reading Skills Test

Validity

Content validity on the Nelson Reading Skills Test (NRST) is evaluated by the development of the questions in ascending order (easier to tougher questions, item tryouts, and a verbal commitment from teachers that the test questions do in fact represent the content of the course work) (Hanna, Schell, & Schreiner, 1976).
<table>
<thead>
<tr>
<th>No. of Items</th>
<th>Raw Scores</th>
<th>Scaled Scores</th>
<th>Raw Scores</th>
<th>Scaled Scores</th>
</tr>
</thead>
<tbody>
<tr>
<td>N</td>
<td>Mean</td>
<td>SD</td>
<td>R</td>
<td>SE</td>
</tr>
<tr>
<td>Form A</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Grade 8</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Test 1: Number System and Numeration</td>
<td>36</td>
<td>1368</td>
<td>20.8</td>
<td>8.5</td>
</tr>
<tr>
<td>Test 2: Computation</td>
<td>48</td>
<td>1368</td>
<td>31.4</td>
<td>10.8</td>
</tr>
<tr>
<td>Test 3: Applications</td>
<td>33</td>
<td>1368</td>
<td>18.4</td>
<td>7.1</td>
</tr>
<tr>
<td>Tests 1 + 2 + 3: SDMT Total</td>
<td>117</td>
<td>1368</td>
<td>70.5</td>
<td>24.5</td>
</tr>
<tr>
<td>High school</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Test 1: Number System and Numeration</td>
<td>36</td>
<td>1494</td>
<td>24.5</td>
<td>7.8</td>
</tr>
<tr>
<td>Test 2: Computation</td>
<td>48</td>
<td>1494</td>
<td>36.3</td>
<td>9.1</td>
</tr>
<tr>
<td>Test 3: Applications</td>
<td>33</td>
<td>1949</td>
<td>21.0</td>
<td>7.0</td>
</tr>
<tr>
<td>Tests 1 + 2 + 3: SDMT Total</td>
<td>117</td>
<td>1494</td>
<td>81.8</td>
<td>21.8</td>
</tr>
</tbody>
</table>

Table 5
SDMT Subtest and Total Alternate-Form Reliability Coefficients, Standard Errors of Measurement, and Related Data for the Blue Level Equating of Forms Sample

<table>
<thead>
<tr>
<th>Grade (N = 306)</th>
<th>No. of Items</th>
<th>Form A&lt;sup&gt;b&lt;/sup&gt;</th>
<th>Form B&lt;sup&gt;b&lt;/sup&gt;</th>
</tr>
</thead>
<tbody>
<tr>
<td>Test 1: Number System and Numeration</td>
<td>36</td>
<td>21.2</td>
<td>.87</td>
</tr>
<tr>
<td>Test 2: Computation</td>
<td>48</td>
<td>31.1</td>
<td>.83</td>
</tr>
<tr>
<td>Test 3: Applications</td>
<td>33</td>
<td>18.8</td>
<td>.81</td>
</tr>
<tr>
<td>Tests 1 + 2 + 3: SDMT Total</td>
<td>117</td>
<td>71.1</td>
<td>.92</td>
</tr>
<tr>
<td>Grade 9 (N = 320)</td>
<td>No. of Items</td>
<td>Form A&lt;sup&gt;b&lt;/sup&gt;</td>
<td>Form B&lt;sup&gt;b&lt;/sup&gt;</td>
</tr>
<tr>
<td>Test 1: Number System and Numeration</td>
<td>36</td>
<td>22.4</td>
<td>.90</td>
</tr>
<tr>
<td>Test 2: Computation</td>
<td>48</td>
<td>34.0</td>
<td>.90</td>
</tr>
<tr>
<td>Test 3: Applications</td>
<td>33</td>
<td>19.6</td>
<td>.83</td>
</tr>
<tr>
<td>Tests 1 + 2 + 3: SDMT Total</td>
<td>117</td>
<td>76.0</td>
<td>.95</td>
</tr>
</tbody>
</table>


<sup>a</sup>Combined Form A followed by Form B and Form B followed by Form A sequences. <sup>b</sup>Raw scores.
Two key points were made clear in the discussion of validity by the authors of the NRST. First, the breadth of content described refers to that which was developed and tried out; the smaller amount of content that survived the developmental research and that was ultimately included in the final test is not as variable in some dimensions as the larger amount of content originally developed. Second, there are nonessential additional technical topics, e.g., grade progressions of difficulty and passage dependence, that cast supplementary light on the construct validity of the reading skills test. (Hanna et al., 1976, p. 10)

Data on these topics will be discussed separately.

Test content reflected the environment of the people who were to take the test. The adequacy of this component was considered as important to the authors as was the objective criteria. Interest levels and topics were collected from the following sources: published research, teachers' and librarians' opinions, and personal insights of the authors. Frequency in the word meaning subtest was checked against Carroll's (1971) *American Heritage Word Frequency Book*. Readability was checked on such factors as syntactical and conceptual complexity on the Dale-Chall (1948) indices. A final check on validity was the input at all stages of the test preparation by professional educators with diverse racial and ethnic backgrounds. Similarly, ideas and guidance were obtained from women educators who were sensitive to and sympathetic with the position of progressive women's groups.

Criterion-related validity was established through the National Standardization Research Program as explained in the validity section of the SDMT. The NRST consisted of two phases, the spring...
standardization conducted in March 1976, and the fall, October 1976, reference group used to help establish empirical data points. Tables 6 and 7 representing the spring and fall standardization samples are reprinted here for the reader's convenience.

Table 6
Mean Difficulty Index by Grade and Subtest in Total Spring Standardization Sample

<table>
<thead>
<tr>
<th>Mean difficulty index in grade</th>
<th>Level A</th>
<th>Level B</th>
<th>Level C</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>3 4</td>
<td>5 6</td>
<td>7 8 9</td>
</tr>
<tr>
<td>Word meaning</td>
<td>62.7</td>
<td>72.5</td>
<td>65.5</td>
</tr>
<tr>
<td>Reading comprehension</td>
<td>61.7</td>
<td>75.0</td>
<td>64.2</td>
</tr>
<tr>
<td>Sound-symbol correspondence</td>
<td>80.3</td>
<td>87.0</td>
<td>60.5</td>
</tr>
<tr>
<td>Root words</td>
<td>78.1</td>
<td>85.2</td>
<td>85.1</td>
</tr>
<tr>
<td>Syllabication</td>
<td>84.4</td>
<td>90.4</td>
<td>89.3</td>
</tr>
<tr>
<td>Reading rate comprehension</td>
<td>--</td>
<td>--</td>
<td>82.7</td>
</tr>
<tr>
<td>check items</td>
<td>--</td>
<td>--</td>
<td>85.7</td>
</tr>
</tbody>
</table>


Reliability

Estimates of reliability were secured by means of a split-halves method; the estimates were then adjusted for full length by the use
Table 7

<table>
<thead>
<tr>
<th>Level</th>
<th>Grade</th>
<th>Subtest</th>
<th>Percent finishing</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>3</td>
<td>Word Meaning</td>
<td>85.0</td>
</tr>
<tr>
<td>A</td>
<td>3</td>
<td>Reading Comprehension</td>
<td>96.4</td>
</tr>
<tr>
<td>A</td>
<td>3</td>
<td>Sound-Symbol Correspondence</td>
<td>99.6</td>
</tr>
<tr>
<td>A</td>
<td>3</td>
<td>Root Words</td>
<td>99.6</td>
</tr>
<tr>
<td>A</td>
<td>3</td>
<td>Syllabication</td>
<td>99.3</td>
</tr>
<tr>
<td>B</td>
<td>5</td>
<td>Word Meaning</td>
<td>94.1</td>
</tr>
<tr>
<td>C</td>
<td>7</td>
<td>Reading Comprehension</td>
<td>92.0</td>
</tr>
</tbody>
</table>


of the Spearman-Brown formula. As there are two forms of the NRST (Form 1 pretest, and Form 2 posttest), both forms were administered to a sample of students at each grade level with approximately half the students taking Form 1 and the other half taking Form 2. These samples coincide quite closely with the national standardization sample in score means and standard deviations. Therefore, no adjustments in the findings for a typical variability of the samples were deemed necessary. Examination of the differences at each grade level between split-halves reliability estimate for the first- and second-

Reproduced with permission of the copyright owner. Further reproduction prohibited without permission.
administered forms revealed no consistent differences favoring the reliability of either. Therefore, the data for the two administration orders were combined.

The authors of this test also reported for three levels of the test (A, B, and C), respectively, the mean, standard deviation, split-halves reliability, and standard error of measurement of each power score of each form. The standard error of measurement was used to establish the confidence intervals used in percentile bands. It was also noted that wider confidence bands resulted in more conservative, e.g., alternate-forms, methods of assessing reliability. The three levels of the test (A, B, and C) are reprinted here in Tables 8, 9, and 10.

The Metropolitan Achievement Test

Validity

The validity of this achievement test is defined primarily in terms of content validity. This test was chosen by the treatment school system as the objectives and items quite adequately covered the curriculum areas the test was intended to measure. The content validity was judged by the staff who used a Compendium of Instructional Objectives listing in detail all objectives included in the various tests.
<table>
<thead>
<tr>
<th>Grade</th>
<th>n</th>
<th>Form</th>
<th>Word meaning</th>
<th>Reading comprehension</th>
<th>Total reading</th>
<th>Sound-symbol correspondence</th>
<th>Root words</th>
<th>Syllabication</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>3</td>
<td>364</td>
<td>M</td>
<td>SD</td>
<td>r</td>
<td>SEM</td>
<td>M</td>
<td>SD</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>15.3</td>
<td>6.1</td>
<td>.89</td>
<td>2.0</td>
<td>18.4</td>
<td>6.9</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>14.8</td>
<td>6.4</td>
<td>.90</td>
<td>2.0</td>
<td>17.4</td>
<td>7.0</td>
</tr>
<tr>
<td></td>
<td>4</td>
<td>473</td>
<td>18.6</td>
<td>5.2</td>
<td>.89</td>
<td>1.7</td>
<td>12.7</td>
<td>5.9</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>18.6</td>
<td>5.6</td>
<td>.90</td>
<td>1.8</td>
<td>20.8</td>
<td>6.4</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Grade</th>
<th>n</th>
<th>Form</th>
<th>Word meaning</th>
<th>Reading comprehension</th>
<th>Total reading</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>M  SD  r   SEM</td>
<td>M  SD  r   SEM</td>
<td>M  SD  r   SEM</td>
</tr>
<tr>
<td>5</td>
<td>438</td>
<td>3</td>
<td>20.3 7.2  .92 2.1</td>
<td>22.4 6.9  .85 2.7</td>
<td>65.1 19.9  .92 5.8</td>
</tr>
<tr>
<td>4</td>
<td>4</td>
<td>20.4 7.5  .92 2.1</td>
<td>23.2 7.4  .87 2.7</td>
<td>66.9 21.2  .93 5.8</td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>453</td>
<td>3</td>
<td>22.7 7.3  .92 2.0</td>
<td>23.8 7.2  .89 2.4</td>
<td>70.3 20.9  .94 5.2</td>
</tr>
<tr>
<td>4</td>
<td>4</td>
<td>22.9 7.4  .92 2.1</td>
<td>24.4 7.9  .89 2.6</td>
<td>71.7 22.1  .94 5.6</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Grade</th>
<th>n</th>
<th>Form</th>
<th>Word meaning</th>
<th>Reading comprehension</th>
<th>Total reading</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>M</td>
<td>SD</td>
<td>r</td>
</tr>
<tr>
<td>7</td>
<td>428</td>
<td>3</td>
<td>21.1</td>
<td>8.8</td>
<td>.92</td>
</tr>
<tr>
<td></td>
<td></td>
<td>4</td>
<td>20.8</td>
<td>8.2</td>
<td>.90</td>
</tr>
<tr>
<td>8</td>
<td>381</td>
<td>3</td>
<td>23.0</td>
<td>8.6</td>
<td>.92</td>
</tr>
<tr>
<td></td>
<td></td>
<td>4</td>
<td>23.0</td>
<td>8.2</td>
<td>.92</td>
</tr>
<tr>
<td>9</td>
<td>212</td>
<td>3</td>
<td>23.7</td>
<td>8.9</td>
<td>.93</td>
</tr>
<tr>
<td></td>
<td></td>
<td>4</td>
<td>23.5</td>
<td>8.2</td>
<td>.93</td>
</tr>
</tbody>
</table>

Reliability

Reliability data for the levels of the test used are presented in Table 11. Kuder-Richardson Formula 20 reliability estimates, and standard errors of measurements in terms of raw scores, and scaled scores are given. Data are based on all pupils' test in the fall standardization using Form JS. Data for the spring standardization and Form KS differ minimally from the JS coefficients.

Table 11
Kuder-Richardson Formula 20 Reliability Coefficients and Standard Errors of Measurement—Fall of Grade 11

<table>
<thead>
<tr>
<th>Test</th>
<th>(k)</th>
<th>(r)</th>
<th>Standard error of measurement</th>
</tr>
</thead>
<tbody>
<tr>
<td>Reading</td>
<td>.93</td>
<td>.93</td>
<td>2.6</td>
</tr>
<tr>
<td>Mathematics</td>
<td>.91</td>
<td>.91</td>
<td>2.8</td>
</tr>
<tr>
<td>Language</td>
<td>.88</td>
<td>.88</td>
<td>3.2</td>
</tr>
<tr>
<td>Basic Battery</td>
<td>.96</td>
<td>.96</td>
<td>5.1</td>
</tr>
</tbody>
</table>

The California Achievement Test

Validity

The California Achievement Test (CAT) is norm-referenced and criteria-referenced. This test was chosen by the comparison school system because the objectives and test items covered the curriculum areas the test was intended to measure. A team of teachers and administrators selected the CAT and informed the researcher the content validity was judged to be excellent. The series of tests is designed to measure achievement in the basic skills commonly found in the state and district curricula guidelines. The test items have been written to content categories that reflect educational objectives commonly found in current state and district curriculum guides, published tests and instructional programs, and criterion-referenced assessment instruments.

Reliability

The reliability of the CAT will be described by several kinds of data. Internal consistency was determined by use of the Kuder-Richardson Formula 20 (KR-20) and the Spearman-Brown formula. An alternate-form or test-retest reliability study was conducted on a nationwide sample. Data on timing, directions, scoring procedures, and passage dependency of reading comprehension items showed significant results. Presently, new studies are being conducted related to scaling, norming, score comparability, and equating of achievement scores.
Of the four tests used to measure the dependent variables, the California, Stanford, and the Metropolitan are all very well-known, highly respected, and used nationally. They appear to be extremely thorough in covering the curriculum which they measure. The Nelson reading test, on the other hand, is less widely used and does not share the distinct reputation or popularity of the other three tests. All four tests do handle the content validity and reliability quite effectively as previously discussed.

Data Collection

Dependent Variable

The data were collected on all subjects of the study from four Class A high schools. The researcher visited all four schools' academic records offices and first identified all subjects of the study. This was completed by hand-picking all ninth grade students entering the high school in September of 1983 with stanine scores of 1, 2, or 3 in the areas of reading and/or mathematics. These individuals, once identified, were charted for a stanine range of 1, 2, or 3 on the following tests: (a) the Nelson Reading Skills Test, (b) the Metropolitan Achievement Test, (c) the Stanford Diagnostic Mathematics Test, and (d) the California Achievement test.

The data were gathered on the school districts' computer systems in the fall (October) and in the spring (May) of the 1983-84 school year. The Nelson Reading Test was the only test used as a double check of students' reading ability and given mid-year (January) to
chart student growth. These mid-year scores were not incorporated into this study.

Attendance data for the CAI treatment schools were also collected from the school's computer system. Each individual student's attendance was broken down into four quarters or marking periods. The four quarterly absence reports were added for each student, thus providing a yearly total for absenteeism.

Attendance data for the comparison school district were extracted from handwritten attendance reports submitted to the superintendent's office. Total numbers of days absent were reported by monthly totals. Absenteeism for September through June were added for each subject, providing a yearly total.

Behavior referral data and student dropout data were collected from charts supplied by the basic skills teachers in each school. Simple addition was applied for the monthly total of referrals for each student, while a yearly total of student dropouts had been previously tallied on the charts. The comparison school referral data were extracted from students' cumulative record folders. This information was extracted by hand from each student's folder and a total was recorded for the school year. It was noted, however, that in both school districts the category indicating the seriousness of the behavioral offence was missing.

The dropout data in the comparison school district were collected in the same manner as were the attendance data in the treatment school district. The dropout totals were extracted from the handwritten report sheets submitted from each school to the
superintendent's office. It was noted that in both school districts dropout data for the subjects in the study were indicated specifically as a dropout of school, a move out of the school district, or a transfer within the school district to another program.

Confidentiality of the treatment and comparison school districts was protected by elimination of using the names of either school district in this report. Subjects remained anonymous to anyone except this investigator. As a further protective measure the treatment and comparison subjects were assigned numbers and their names never left the school districts' records offices.

Data Analysis

Presence or absence of the computer-assisted instruction basic skills program was identified as the independent variable in the study and was treated as nominal data. The averaged stanine scores of the students in the English and mathematics courses, representing the first two hypotheses, were two of five dependent variables and were treated as interval data. The rate of absenteeism, the number of behavioral referrals written, and the number of dropouts reported, representing the last three hypotheses, were the three final dependent variables and were also treated as interval data.

This ex post facto research study contributes to the fund of knowledge about basic skills courses employing computer-assisted instruction programs by testing the aforementioned hypotheses.
Basic Skills English/Reading

It is hypothesized that students enrolled in a basic skills English course employing CAI for one school year will show a greater growth in reading skills than students enrolled in a traditional English course for the same amount of time.

The operational hypothesis is that the students in the CAI English course will achieve a higher mean reading score than students in the traditional English course. The $t$ test for independent means was used to test the null hypothesis that students in a basic skills CAI course will show no difference in mean reading scores than their peers in a traditional English course.

Basic Skills Mathematics

It is hypothesized that students enrolled in a basic skills mathematics course employing CAI for one school year will show a greater growth in math skills than students enrolled in a traditional mathematics course for the same amount of time.

The operational hypothesis is that the students in the CAI mathematics course will achieve a higher mean mathematics score than students in the traditional mathematical course. The $t$ test for independent means was used to test the null hypothesis; students in a basic skills CAI mathematics course will show no difference in mean mathematics scores than their peers in a traditional mathematics course.
**Student Attendance**

It is hypothesized that students enrolled in basic skills courses employing CAI for one school year will show greater attendance than students enrolled in a traditional course for the same period of time. This hypothesis was tested using the t test for independent means to compare the mean number of days absent of the treatment group to the mean number of days absent of the comparison group.

The operational hypothesis is that students enrolled in the CAI courses will show a lower mean number of days absent than students enrolled in the traditional courses. The t test for independent means was used to test the null hypothesis; students in a basic skills CAI course will show no difference in mean number of days absent than their peers in a traditional course.

**Student Behavior**

It is hypothesized that students enrolled in a basic skills course employing CAI for one school year will demonstrate less negative behavior than students enrolled in a traditional course. The number of written behavior referrals submitted by the teaching staff on the subjects in the study was the basis of determination. This hypothesis was tested using the t test for independent means to compare the mean number of behavior referrals of the treatment group to the mean number of behavior referrals to the comparison group.
The operational hypothesis is that students enrolled in the CAI courses will show a lower mean number of behavior referrals than students enrolled in the traditional courses. The t test for independent means was used to test the null hypothesis that students enrolled in a basic skills CAI course will show no difference in mean number of behavior referrals than their peers in a traditional course.

**Student Dropouts**

It is hypothesized that students enrolled in a basic skills course employing CAI for one school year would show less dropouts than students enrolled in a traditional course for the same amount of time.

The hypothesis was tested using the z test of two proportions. The operational hypothesis is that students enrolled in the CAI course will show a lower rate of dropouts than students enrolled in the traditional course. The z test of two proportions was used to test the null hypothesis; students enrolled in a basic skills CAI course will show no difference in dropout rates than their peers in a traditional course.

In comparing the respective mean values of the first four dependent variables, the t test for independent means will be used to determine the differences between the student enrolled in the CAI courses and the students enrolled in the traditional courses. These results will provide a comparison on the reading, mathematics, attendance, and behavior between treatment and comparison students.
These results will also determine whether there was a significant difference in mean scores favoring those students enrolled in the basic skills courses employing CAI programs.

A \( z \) test of two proportions was used to determine the difference in proportions between the treatment subjects and the comparison subjects on their dropout rates. These results will show whether there was a significant difference in proportions favoring those students enrolled in the basic skills courses employing CAI programs. The null hypothesis will be subjected to a statistical analysis in order to infer the truth of the research hypothesis. A probability of .05 for committing a Type I error will be used in testing the null hypothesis.
CHAPTER IV

PRESENTATION OF DATA

Introduction

The findings of the study are reported in this chapter. General biographical data are reported in the first of two sections of the chapter. The second section contains results of each of five null hypotheses tested. An analysis of data concerning each of the null hypotheses will be presented. The procedures used to arrive at each conclusion will also be discussed and each conclusion presented.

General Characteristics of the Population

The population consisted of 384 (100%) ninth grade students from two different school districts. A total number of 202 (52.6%) were the final subjects of the study. Of the 384 subjects identified in September of 1983, 182 (47.4%) were not final subjects of the study by June of 1984. This group of students fell into one of four categories: dropout from school, moved out of the school district, moved to another program within the school district, or were missing posttest scores due to absenteeism during testing (incomplete data). The breakdown of the subjects is described by school district in Table 12, which shows the general characteristics of the population from September 1983 to June 1984.
<table>
<thead>
<tr>
<th>Group name</th>
<th>Total number of students 9/1983</th>
<th>Dropouts from school</th>
<th>Moves out of the district</th>
<th>Moves to other programs within the district</th>
<th>Incomplete data</th>
<th>Final subjects of the study 6/1984</th>
</tr>
</thead>
<tbody>
<tr>
<td>CAI treatment group</td>
<td>216</td>
<td>7</td>
<td>21</td>
<td>10</td>
<td>49</td>
<td>23</td>
</tr>
<tr>
<td>Traditional comparison group</td>
<td>168</td>
<td>7</td>
<td>22</td>
<td>13</td>
<td>39</td>
<td>23</td>
</tr>
</tbody>
</table>
School Districts

The data in Table 13 indicate that 4% (N = 116) of the subjects were from the treatment group while 4% were comparison group subjects (N = 86). These numbers are proportional given the 4:3 ratio of treatment to comparison total school populations.

Table 13
Total Number of Subjects in Treatment and Comparison Groups

<table>
<thead>
<tr>
<th>Group name</th>
<th>Frequency</th>
<th>Percentage (based on initial sample)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Treatment</td>
<td>116</td>
<td>4</td>
</tr>
<tr>
<td>Comparison</td>
<td>86</td>
<td>4</td>
</tr>
</tbody>
</table>

The data in Table 14 are called to the attention of the reader to point out those subjects who are dual enrollees (individuals with below average stanine scores in both mathematics and English). In the treatment group, 22.4% (N = 26) are dual enrollees and 18.6% of the subjects (N = 16) were identified in the comparison group.

Subjects' Gender

The data reported in Table 15 indicate that 53% (N = 61) of the treatment subjects were males and 47% (N = 55) were females. The data also reported that 53% (N = 46) of the comparison group were males and 47% (N = 40) were females.
Table 14
Total Number of Dual Enrollees
(Mathematics and English)

<table>
<thead>
<tr>
<th>Group name</th>
<th>Frequency</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Treatment</td>
<td>26</td>
<td>22.4</td>
</tr>
<tr>
<td>Comparison</td>
<td>16</td>
<td>18.6</td>
</tr>
</tbody>
</table>

Table 15
Total Number of Male and Female Subjects
In Both School Districts

<table>
<thead>
<tr>
<th>Group name</th>
<th>Male</th>
<th>Female</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Freq.</td>
<td>%</td>
</tr>
<tr>
<td>Treatment</td>
<td>61</td>
<td>53</td>
</tr>
<tr>
<td>Comparison</td>
<td>46</td>
<td>53</td>
</tr>
</tbody>
</table>

The data reported in Table 16 indicate that 58% of the dual enrollees of the treatment group were males (N = 15), while 42% were females (N = 11). The data also indicate that 56% of the dual enrollees of the comparison were males (N = 9), while 44% were females.

Subjects' Race

The data in Table 17 indicate that 61% (N = 71) of the treatment subjects entering the ninth grade with stanines of 1, 2, or 3 in
Table 16
Total Number of Male and Female Dual Enrollees

<table>
<thead>
<tr>
<th>Group name</th>
<th>Male</th>
<th></th>
<th>Female</th>
<th></th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Freq.</td>
<td>%</td>
<td>Freq.</td>
<td>%</td>
<td>Freq.</td>
</tr>
<tr>
<td>Treatment</td>
<td>15</td>
<td>58</td>
<td>11</td>
<td>42</td>
<td>26</td>
</tr>
<tr>
<td>Comparison</td>
<td>9</td>
<td>56</td>
<td>7</td>
<td>44</td>
<td>16</td>
</tr>
</tbody>
</table>

English or mathematics are minority students with a basic skill handicap, while 39% (N = 45) are nonminority white students. The data further indicates that 60% (N = 52) of the comparison subjects are minority students with the same handicap, while 40% (N = 34) are nonminority white comparison subjects. These figures indicate a 3:2 ratio of minority to nonminority students as subjects for this study. Ironically, the reverse is true of the total school population for both the treatment and control school districts. A 2:3 ratio of 36% minority students and 64% nonminority students indicates a heavy imbalance when comparing the subjects in the study to their respective total school population.

The data reported in Table 18 indicate that 62% of the treatment dual enrollees were minority students (N = 16) and 38% were nonminority treatment dual enrollees (N = 10). The data further reported that 63% of the comparison dual enrollees were minority students (N = 10) and 37% were nonminority comparison dual enrollees (N = 6).
Table 17

Total Number of Minority and Nonminority Subjects in Both School Districts

<table>
<thead>
<tr>
<th>Group name</th>
<th>Minority</th>
<th>Nonminority</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Freq.</td>
<td>%</td>
<td>Freq.</td>
</tr>
<tr>
<td>Treatment</td>
<td>71</td>
<td>61</td>
<td>45</td>
</tr>
<tr>
<td>Comparison</td>
<td>52</td>
<td>60</td>
<td>34</td>
</tr>
</tbody>
</table>

Table 18

Total Number of Minority and Nonminority Dual Enrollees

<table>
<thead>
<tr>
<th>Group name</th>
<th>Minority</th>
<th>Nonminority</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Freq.</td>
<td>%</td>
<td>Freq.</td>
</tr>
<tr>
<td>Treatment</td>
<td>16</td>
<td>62</td>
<td>10</td>
</tr>
<tr>
<td>Comparison</td>
<td>10</td>
<td>63</td>
<td>6</td>
</tr>
</tbody>
</table>

The subjects of each racial population were identified as either belonging to a nonminority or minority group.

*Academic Handicaps*

*Reading/Mathematics*

The data reported in Table 19 indicate that more subjects are experiencing difficulty in the area of reading than in mathematics at a 2:1 ratio. Treatment reading students in Table 19 equaled 95,
treatment mathematics students equaled 47, while 26 of those students were dual enrollees. Comparison reading students in Table 19 equaled 69, comparison mathematics students equaled 33 and 16 of those students were dual enrollees.

Table 19
Total Number of Reading and Mathematics Subjects in Both School Districts

<table>
<thead>
<tr>
<th>Group name</th>
<th>Reading</th>
<th>Mathematics</th>
<th>Dual Enrollees</th>
</tr>
</thead>
<tbody>
<tr>
<td>Treatment</td>
<td>95</td>
<td>47</td>
<td>26</td>
</tr>
<tr>
<td>Comparison</td>
<td>69</td>
<td>33</td>
<td>16</td>
</tr>
</tbody>
</table>

Testing of Hypotheses

The statistics that were analyzed in this chapter came from raw data gathered from the school records and will be presented in comparison terms. This information was necessary to evaluate the effects of computer assisted instruction in basic skills courses and, more specifically, to determine what effect was made on the high risk ninth grade student enrolled in that course.

Each of the first four hypotheses will be discussed, comparing mean scores of the treatment group to the mean scores of the comparison group on the following criteria: reading and mathematics scores, number of days absent, and the number of behavior referrals for each group. The fifth hypothesis deals with dropout data and will be discussed separately in terms of comparing proportions of subjects in
the treatment group to subjects in the comparison group.

The five hypotheses will first be presented followed by results and conclusions with illustrations of data in a table format. A .05 level of probability was used for committing a Type I error.

**Basic Skills English/Reading**

It is hypothesized that students enrolled in a basic skills English course employing CAI for one school year will show a greater growth in reading skills than students enrolled in a traditional English course for the same amount of time. The operational hypothesis is that the students in the CAI English course will achieve a higher mean reading score than students in the traditional English course. The t-test for independent means was used to test the null hypothesis that students in a basic skills CAI course will show no difference in mean reading scores than their peers in a traditional English course.

The t-test statistical analysis revealed a significant difference in reading scores favoring the treatment group versus the comparison group at the .05 alpha level. Therefore, the tested null hypothesis was rejected. The t-test results are presented in Table 20.

**Basic Skills Mathematics**

It is hypothesized that students enrolled in a basic skills mathematics course employing CAI for one school year will show a
greater growth in mathematics skills than students enrolled in a
traditional math course for the same amount of time.

Table 20
Reading Stanine Scores Comparing Treatment Group to
Comparison Group: t-Test Values

<table>
<thead>
<tr>
<th>Group</th>
<th>N</th>
<th>Mean</th>
<th>SD</th>
<th>t value</th>
<th>df</th>
<th>1-tailed prob.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Treatment</td>
<td>95</td>
<td>1.25</td>
<td>1.93</td>
<td>2.04</td>
<td>162</td>
<td>.022*</td>
</tr>
<tr>
<td>Comparison</td>
<td>69</td>
<td>0.72</td>
<td>1.09</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*Significant at the .05 alpha level.

The operational hypothesis is that the students in the CAI
mathematics course will achieve a higher mean mathematics score than
students in the traditional mathematical course. The t test for
independent means was used to test the null hypothesis; students in a
basic skills CAI mathematics course will show no difference in mean
mathematics scores than their peers in a traditional mathematics
course.

The t-test statistical analysis indicated a significant difference in mathematics scores favoring the treatment group versus the
comparison group at a .05 alpha level. Based on this finding (data),
this researcher rejected the null hypothesis. The t-test results are
presented below in Table 21.
Table 21
Mathematics Stanine Scores of Subjects in the Treatment Group Versus Subjects in the Comparison Group: _t_-Test Values

<table>
<thead>
<tr>
<th>Group</th>
<th>N</th>
<th>Mean</th>
<th>SD</th>
<th><em>t</em> value</th>
<th>df</th>
<th>1-tailed prob.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Treatment</td>
<td>47</td>
<td>1.64</td>
<td>1.67</td>
<td>2.13</td>
<td>78</td>
<td>.018*</td>
</tr>
<tr>
<td>Comparison</td>
<td>33</td>
<td>0.93</td>
<td>1.06</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*Significant at .05 alpha level.

The data in Table 21 indicate that the treatment group enrolled in the computer assisted mathematics course did show greater growth in basic mathematics skills than did the group of students enrolled in the traditional math course.

Student Attendance

It is hypothesized that students enrolled in basic skills courses employing CAI for one school year will show greater attendance than students enrolled in a traditional course for the same period of time. This hypothesis was tested using the _t_ test for independent means to compare the mean number of days absent of the treatment group to the mean number of days absent of the comparison group.

Reproduced with permission of the copyright owner. Further reproduction prohibited without permission.
The operational hypothesis is that students enrolled in the CAI courses will show a lower mean number of days absent than students enrolled in the traditional courses. The t-test for independent means was used to test the null hypothesis; students in a basic skills CAI course will show no difference in mean number of days absent than their peers in a traditional course.

A significant difference at the .05 alpha level was seen in the t-test statistics favoring the treatment group to the comparison group. Therefore, the null hypothesis was rejected. The t-test results are presented in Table 22.

Table 22
Comparison of Absenteeism as Displayed by Treatment Group Versus Comparison Group: t-Test Values

<table>
<thead>
<tr>
<th>Group</th>
<th>N</th>
<th>Mean</th>
<th>SD</th>
<th>t  value</th>
<th>df</th>
<th>1-tailed prob.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Treatment</td>
<td>116</td>
<td>8.75</td>
<td>10.32</td>
<td>-3.65</td>
<td>200</td>
<td>.001*</td>
</tr>
<tr>
<td>Comparison</td>
<td>86</td>
<td>14.70</td>
<td>12.85</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*Significant at .05 alpha level.

The data in Table 22 showed that comparison group subjects missed more school during 1983-84 school year than did treatment group subjects.
Student Behavior

It is hypothesized that students enrolled in a basic skills course employing CAI for one school year will demonstrate less negative behavior than students enrolled in a traditional course. The number of written behavior referrals submitted by the teaching staff on the subjects in the study was the basis of determination. This hypothesis was tested using the $t$ test for independent means to compare the mean number of behavior referrals of the treatment group to the mean number of behavior referrals to the comparison group.

The operational hypothesis is that students enrolled in the CAI courses will show a lower mean number of behavior referrals than students enrolled in the traditional courses. The $t$ test for independent means was used to test the null hypothesis that students enrolled in a basic skills CAI course will show no difference in mean number of behavior referrals than their peers in a traditional course.

The $t$-test statistics revealed no significant differences in behavior between treatment group and comparison group subjects. Therefore, the null hypothesis was not rejected. The $t$-test results are presented in Table 23.

The data presented in Table 23 did not show support for a difference. As the mean column indicates, the groups were identical with the mean number of written referrals; therefore indicating no support for the hypothesis that students enrolled in a basic skills
CAI course would demonstrate less negative behaviors than students enrolled in a traditional course of instruction.

Table 23
Number of Negative Behaviors Comparing Treatment Group to Comparison Group

<table>
<thead>
<tr>
<th>Group</th>
<th>N</th>
<th>Mean</th>
<th>SD</th>
<th>t value</th>
<th>df</th>
<th>1-tailed prob.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Treatment</td>
<td>116</td>
<td>0.97</td>
<td>1.97</td>
<td>0.00</td>
<td>200</td>
<td>.499</td>
</tr>
<tr>
<td>Comparison</td>
<td>86</td>
<td>0.97</td>
<td>1.94</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*Significant at the .05 alpha level.

Student Dropouts

It is hypothesized that students enrolled in a basic skills course employing CAI for one school year would show less dropouts than students enrolled in a traditional course for the same amount of time.

The hypothesis was tested using the z test of two proportions. The operational hypothesis is that students enrolled in the CAI course will show a lower rate of dropouts than students enrolled in the traditional course. The z test of two proportions was used to test the null hypothesis; no support was found for the existence of a difference between the dropout rate of students in the CAI program and the traditional program.
The total number of subjects in the treatment group began with 137 students. Twenty-one of those students dropped out of school during the 1983-84 school year. Using these figures then, the proportion of those who dropped from school would be 21/137, or .15. The comparison group total population equaled 108, while 22 of those students dropped out during the same period of time. Using these figures then, the proportion of those students who dropped from school would be 22/108, or .20. The Huntsberger and Billingsley (1973) text, *Elements of Statistical Inference*, was used in calculating a z test of two proportions. The alpha level was set at .05. The z score for the test equaled a -1.10 value, while the exact probability, corresponding to the z score, equaled a .13 value. Since the exact probability value of .13 was not less than the .05 probability level of significance this researcher was not able to reject the null hypothesis. The z-test results are presented in Table 24.

<table>
<thead>
<tr>
<th>Group</th>
<th>Population</th>
<th>No. of dropouts</th>
<th>Proportions</th>
<th>z score</th>
<th>Exact prob.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Treatment</td>
<td>137</td>
<td>21</td>
<td>.15</td>
<td>-1.10</td>
<td>.13</td>
</tr>
<tr>
<td>Comparison</td>
<td>108</td>
<td>22</td>
<td>.20</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*Significant at the .05 alpha level.*
The data presented in Table 24 showed no significant difference with either group displaying a higher dropout rate than the other. Consequently, there is no support for the hypothesis that students enrolled in a basic skills CAI course would show less dropouts than students enrolled in a traditional course of instruction.

Summary

The purpose of this chapter was to present the results of the study. The chapter was divided into two sections.

The first section contained general characteristics of the population. This biographical data included total number of subjects in both school districts; numbers, percentages, and reasons for dropouts; the criteria for comparing the groups; and breakdown of subjects based on gender, sex, and academic handicaps.

Each of the five hypotheses was tested comparing the total treatment group to comparison group. A .05 probability for making a Type I error was used in testing each of the five hypotheses. The results of this research demonstrated that there was a relationship between the growth in reading skills and the method of instruction. The mean achievement score (1.25) for the treatment group was superior to that of the comparison group (0.72), indicating a strong difference favoring the reading treatment group to the reading comparison group.

The results of the research further demonstrated a similar relationship between the growth in mathematics skills and the method of instruction. The mean achievement mathematics score for the
treatment group (1.64) was superior to that of the mean achievement mathematics score for the comparison group (0.93), indicating a higher level of attainment by the treatment students.

The results of the research on absenteeism indicated a mean of 8.75 days absent for the treatment group and a mean of 14.69 days absent for the comparison group. The treatment group was absent significantly less than the comparison group based on the .05 alpha level. With these results, it is believed that the courses employing computer assisted instruction contained various factors which motivated the treatment students to come to school on a more regular basis.

The research findings showed no support for a relationship between students' behavior and the method of instruction. Similarly, the research findings on student dropouts showed no support for a relationship between students dropping out of school and the method of instruction.
CHAPTER V

CONCLUSIONS, RECOMMENDATIONS, AND SUMMARY

Introduction

This chapter develops conclusions as a result of the data analysis, suggests some implications of the findings, identifies concerns with recommendations for future research, and summarizes the entire study.

As stated earlier, this study has been conducted to investigate the effect that computer assisted instruction has on high-risk basic skills students after a full school year of study. Because of the popularity of the microcomputer and the natural curiosity of the students to the equipment, it was believed that the subjects would show a growth in reading and mathematics ability, attend school on a more regular basis, show improvement in classroom behavior, and lastly, demonstrate a decreased number of school dropouts.

Conclusions

The following conclusions related directly to the hypotheses discussed in Chapter II. Each hypothesis is discussed as well as conclusions and implications based upon literature and the results of the study.
The reading hypothesis stated that ninth grade students who were lacking basic English skills (reading) would show more growth in the area of reading after a one-year program of computer assisted instruction than students who were enrolled in a traditional English program.

The data analysis supported the hypothesis. The relationship between the teaching of reading to high-risk ninth grade students and the use of computer assisted instruction was established. The treatment group showed an increase in reading growth with a 1.25 mean stanine score while the comparison group's mean stanine score was 0.72. The treatment group's mean score was much greater than that of the comparison group's score suggesting a superior means of delivering instruction may have been the reason for the increased growth in reading.

As the upgrading of basic skills for ninth grade students is the content of this study, it was interesting to read how Hunt (1983) perceived this task be accomplished. "It is the skills of analysis and problem solving, the 'learning-to-learn' skills where our schools face their greatest need for improvement" (p. 16). The use of technology and the computer are pointed out consistently by this same author as the means to achieve these ends.
The Effect of a Year-Long Basic Skills Mathematics Course Employing CAI on High-Risk Ninth Grade Students

The mathematics hypothesis states that ninth grade students who were lacking basic mathematics skills would show more growth in math after a one-year course employing computer assisted programs as a method of instruction than students who were enrolled in a traditional mathematics course.

Again the data analysis supported the hypothesis, the relationship between the teaching of mathematics to high-risk ninth grade students and the use of computer assisted instruction was established. The treatment group showed an increase in growth of mathematics skills with a 1.64 mean stanine score while the comparison group's mean stanine score was 0.93.

The implication that CAI appears to be the key factor for success in this study is supported by the findings of Aaron et al. (1975), Gerzanick et al. (1982), Hotard and Cortez (1983), and Lavin and Sanders (1983). These citations provide further evidence, similar to this study, that secondary students deficient in basic skills may benefit from microcomputer remedial mathematics instruction.

In conclusion, it appears that the basic skills subjects of this study benefited from the individualized instruction, the technology of microcomputer instruction, and the drill instruction software with the unique tutorial component developed by SRA.
The Effect of a Year-Long Basic Skills Course Employing CAI on Attendance of High-Risk Ninth Grade Students

The attendance hypothesis states that ninth grade students enrolled in a CAI basic skills course would attend school on a more regular basis than students enrolled in a traditional course. This hypothesis was supported by the data analysis. The relationship between increased attendance and enrollment in a CAI course is a positive one. The treatment group students were absent far less than the comparison group students. The mean for the treatment group was 8.75 days absent, while the comparison group's mean was 14.6 days absent during the 1983-84 school year (see Table 22, Chapter IV). The implication of these data indicate that the CAI basic skills course may be more of an acceptable challenge. The use of the microcomputer, the self-paced instruction, the individualized attention, the immediate feedback, and the lessened fear of criticism are all possible reasons why the treatment students are attending school on a more regular basis. The implications of these data also indicate that students, because they are interested and challenged, will think less about dropping out of school.

The Effect of a Year-Long Basic Skills Course Employing CAI on the Behavior of High-Risk Ninth Grade Students

The behavior hypothesis states that high-risk ninth grade students scheduled in a CAI basic skills course would demonstrate less negative behaviors than students enrolled in a traditional course. This hypothesis was not supported by the data analysis. This
hypothesis was tested by the number of occurrences, severe enough to warrant a written referral to support personnel, resulting in a mean for each group being almost identical. The mean number of written referrals equaled 0.97 for the treatment group and 0.97 for the comparison group. These data indicate that there is no support for the hypothesis. This hypothesis was formulated through the research of literature and some observations by this researcher. The observations occurred during "time on task" sessions when students, seemingly, were on task and with no obvious display of negative behavior. This researcher believes with a larger population to study and over a longer period of time this hypothesis would be supported by the data. This viewpoint agrees with Bradtmueller (1983) as he pointed out in his study, "Not only is the microcomputer removing the fear of failure, but also is useful as a behavioral control devise" (p. 9).

Although other studies (Aaron et al., 1975; Bradtmueller, 1983; Mallory, 1978) found a correlation between behavior and CAI, this investigator did not. Based on the data of this study, student behavior cannot be linked to a basic skills CAI course.

The Effects on the Dropout Rate of Students After a One-Year Basic Skills Course of Instruction Employing Computer Assisted Instruction

The dropout hypothesis indicates that students enrolled in a basic skills CAI course would show less dropouts than students enrolled in a traditional course. The data analysis did not support this hypothesis. The dropout proportion for the treatment group was 21/137, or .15, while the comparison group dropout proportion was
Based on the data of this study, student dropout cannot be linked to a basic skills CAI course.

Recommendations

The connection between the use of computer assisted instruction and high-risk secondary students deficient in basic skill areas has been researched and supported in several studies. Historically, CAI is still a relatively new concept in the field of education, more research can and should be done to examine the specific areas of research germane to this study: basic skills mathematics, basic skills reading, attendance, student behaviors, and dropouts.

Further replications of this study should be undertaken to determine the long range effect of CAI to student achievement and more specifically those nonacademic areas previously mentioned. A longitudinal study would provide data regarding the changing attitudes, behaviors, attendance, dropout rates, and perhaps further improved test scores in the academic areas. It is believed that, in the area of student behavior, a researcher would see a significant difference between a treatment group and a comparison given a larger population, a longer period of time, and perhaps a more sophisticated method to measure that variable. The same comment holds true for student dropouts. Studies should also be carried out to determine the effects CAI has on other grade level students (7, 8, 10, 11, and 12) as well as other areas of the curriculum, including science, the social sciences, and business education courses, to name only a few.
More specifically, while future researchers are investigating these areas it is highly recommended that attention be given to software. Since the mid 1970s and the development of the microcomputer the software has become quite sophisticated. Both the quality and quantity have increased greatly. This whole area of CAI software may be substantive enough of a topic to support independent research investigations on its own.

It is also suggested that future studies should expand on the number of school districts in the study and in doing so analyze the demographic variables of sex and race when heterogeneous populations are targeted. As this particular population may have been unique or simply too small, certain variables were not tested. Alternative research methods may also prove to be more reliable and valid in terms of demonstrating relationships among variables.

The ex post facto design of this study, while appropriate for an educational environment, has some inherent flaws. Kerlinger (1973) pointed out "direct control is not possible: neither experimental manipulation nor random assignment can be used by the researcher" (p. 380). Although the groups in this study were homogeneously mixed, the lack of manipulation of the independent variable and the lack of randomization leave the researcher on shaky ground. This design further leaves the investigator with an insecure assurance of the findings because of the possibility of suggesting erroneous or misleading interpretations of the data.

The implications of these flaws inhibits this investigator by allowing only an inference to be drawn about the relationship of the
variables in this study. Therefore, this researcher cannot, with any assurance, generalize the findings to groups outside this study.

The reality of research being conducted in a social (educational) organization much of the time limits the investigator to ex post facto research; however, if the circumstances ever allowed an investigator the opportunity to conduct an experimental study findings would surely be less suspect.

Summary

The purpose of this study was to determine the effects of basic skills computer assisted instruction courses on high-risk ninth grade students. It was the contention of this investigator that the recent growth of technology and the sophistication of software could make an impact on remedial high school education. This investigator further believed that a comparative study could serve as an important source of information and as a basis for future studies on the same or similar topics. The review of literature clearly identified reading and mathematics as the two basic skill subject areas addressed through CAI; they became the first two target areas of the study.

The three nonacademic areas of the study, attendance, student behavior, and dropout rate, were areas consistently discussed in the literature. It was also believed these areas would greatly enhance the support for use of CAI with high-risk students if a significant relationship could be established.

It was all of the above considerations from which this investigator drew the five hypotheses for the study. As CAI was the method...
of instruction affecting all five hypotheses it was believed a final justification for its use be mentioned. The rapid growth of technology and the mass production of the microcomputer have affected the schools by making classroom sets affordable. Armed with this knowledge and backed by the review of literature, this researcher can now support the use of CAI for the following reasons:

1. CAI is an effective supplement to traditional education.
2. CAI is more effective with educationally disadvantaged students.

Based on the review of literature alone, the following statements also show support for the use of CAI:

1. Learning time can be shortened through CAI use.
2. Student attitudes are positive toward CAI use.
3. Teacher attitudes are positive toward CAI use.

At present, many school systems having purchased microcomputers are still at the neophyte stage with their use. One state has legislated mandatory use of computer assisted instruction for secondary students having failed grade level competency tests.

As a basis for this study, a survey was made of the current research on use of computer assisted instruction. Relevant studies in the area were: Aaron et al. (1975), Edwards et al. (1974), Geller and Shugoll (1982), Gerzanick et al. (1982), Henderson (1983a, 1983b), Jamison et al. (1974), Lanese (1982), Malone (1981, 1983), McDonald (1983), Moser (1977), Rapport and Savard (1980), and Thomas (1979),
Given the premise that CAI is a successful teaching method for high-risk ninth grade students, it was anticipated and now may be concluded that the attendance of these individuals has improved.

Behavioral problems are still a major concern in secondary schools across the country. Although the findings of this study proved little to support CAI as an aid in this area it was thought that with a larger population to study the evidence would support the hypothesis. Also supporting this hypothesis were a number of reviews of research on CAI that have shown quite consistent positive effects on both achievement and attitudes (Aaron et al., 1975; Bengfort, 1983; Fletcher & Sawyer, 1984).

The dropout statistics in this study did not support the hypothesis that there is a relationship between the dropout rate and the method of instruction.

As a basis for this study, data were collected from students' cumulative record folders (demographic information), the appropriate schools' attendance offices, and the computerized test records from the superintendents' offices. This raw data, once compiled, provided the necessary information to run a t test for independent means with a pooled variance estimate and a z test of two proportions. The analyzed data were used to compare the mean scores or the difference in proportion of the treatment group to the comparison group on the five hypotheses. A .05 probability for making a Type I error was used in testing each of the hypotheses.

The study results were conclusive on ascertaining the positive relationship between growth in reading and mathematics for high-risk
students while using CAI as a teaching method. The results also indicated a conclusive relationship between a CAI basic skills course and improved attendance. The hypotheses concerning student behavior and student dropouts, however, showed inconclusive results.

Throughout this study the Basic Skill Project of the treatment schools has been mentioned. In the last 2 years this Basic Skills Project has received much notoriety and academic acclaim on a statewide level. The use of computer assisted instruction has offered the unique aspects to the overall popularity of this program. As a result, various area school districts have been sending representatives to this school district to examine its basic skills program. At least one other school district has already started investing heavily on implementing the program. The results of the study and the review of the literature provide a starting point when considering CAI as a means to assist high-risk basic skills students.
APPENDICES
Appendix A

Reading Efficiency System Flow Chart
Appendix B

Stanford Diagnostic Mathematics Test
### 1.0 TEST 1: Number System and Numeration

<table>
<thead>
<tr>
<th>Concept/Skill Domain</th>
<th>Concept/Skill Domain Objective</th>
<th>Item Cluster</th>
</tr>
</thead>
</table>
| 1.1 Whole Numbers and Decimal Place Value | The student will demonstrate an understanding of the system of whole numbers and decimal place value by counting, by reading and interpreting numerals, and by approximating numbers. | 1.112 Naming Numbers and Counting (items 1-3)  
1.121 Reading Numerals (items 4-8)  
1.122 Interpreting Numerals (items 7-9)  
1.123 Place Value and the Operations (items 10-12)  
1.125 Rounding and Estimating (items 13-16) |
| 1.2 Rational Numbers and Numeration | The student will demonstrate an understanding of the system of rational numbers by interpreting fractions and decimals, by naming rational numbers in terms of percent, and by performing simple operations with positive and negative numbers (integers). | 1.21 Common Fractions (items 19-21)  
1.22 Decimals (items 22-24)  
1.23 Percent (items 25-27)  
1.24 Positive and Negative Numbers (items 28-30) |
| 1.3 Operations and Properties | The student will demonstrate an understanding of the fundamental operations and their properties. | 1.3 Same as Concept/Skill Domain (items 31-36) |

### 2.0 TEST 2: Computation

<table>
<thead>
<tr>
<th>Concept/Skill Domain</th>
<th>Concept/Skill Domain Objective</th>
<th>Item Cluster</th>
</tr>
</thead>
</table>
| 2.2 Subtraction of Whole Numbers | The student will demonstrate the ability to use the standard algorithm for subtraction with renaming. | 2.23 Standard Algorithm, with Renaming (items 1-6)  
2.24 Standard Algorithm, No Partial Product, with Renaming (items 7-9) |
| 2.3 Multiplication of Whole Numbers | The student will demonstrate the ability to use the standard algorithm for multiplication with renaming, with and without partial products. | 2.33 Standard Algorithm, No Partial Product, with Renaming (items 10-16)  
2.34 Standard Algorithm, with Partial Product (items 17-20) |
| 2.4 Division of Whole Numbers | The student will demonstrate the ability to use the standard algorithm for division with internal remainders. | 2.43 Standard Algorithm, One-Digit Divisor, with Internal Remainder (items 21-24)  
2.44 Standard Algorithm, Two-Digit Divisor (items 25-29) |
| 2.6 Fractions | The student will demonstrate the ability to add, subtract, multiply, and divide common and mixed fractions with and without renaming. | 2.51 Addition and Subtraction (items 30-32)  
2.52 Multiplication (items 33-36)  
2.53 Division (items 37-40) |
| 2.7 Decimals | The student will demonstrate the ability to locate the decimal point in the product for a multiplication example in which one factor is a decimal and in the unknown factor (quotient) for a division example in which the product (dividend) is a mixed decimal. | 2.54 Multiplication (items 41-44)  
2.55 Division (items 45-48) |
| 2.8 Number Sentences | The student will demonstrate the ability to solve simple and parenthetical number sentences (equations) and proportions. | 2.7 Same as Concept/Skill Domain (items 49-52)  
2.81 Simple and Parenthetical (items 53-56)  
2.82 Proportions (items 57-60) |

### 3.0 TEST 3: Applications

<table>
<thead>
<tr>
<th>Concept/Skill Domain</th>
<th>Concept/Skill Domain Objective</th>
<th>Item Cluster</th>
</tr>
</thead>
</table>
| 3.1 Problem Solving | The student will demonstrate the ability to describe problems in mathematical terms, to solve two-step consumer problems and problems involving ratio, and to determine the information needed to solve a problem. | 3.12 Solution Models (items 1-3)  
3.14 Solving Two-Step Problems (items 4-6)  
3.15 Solving Rate Problems (items 7-9) |
| 3.2 Reading and Interpreting Tables and Graphs | The student will demonstrate the ability to read and interpret tables and graphs. | 3.21 Reading and Interpreting Tables (items 10-13)  
3.22 Reading and Interpreting Graphs (items 14-21)  
3.311 Geometric Shapes and Properties (items 22-24)  
3.312 Applying Geometric Properties to Measurement (items 25-27) |
| 3.3 Geometry and Measurement | The student will demonstrate an understanding of geometry by identifying geometric figures and recognizing geometric properties; and will demonstrate the ability to measure by applying geometric properties to measurement and by interpreting English and metric units of measure. | 3.34 Metric Units of Measure (items 28-30)  
3.35 English to Metric Conversion (items 31-33) |
Appendix C

Glossary of Terms
1. Basic skills: Those skills being taught in the ninth grade classes which are being repeated from previous grade levels, i.e., reading, writing, spelling, addition, subtraction, multiplication, division, geography, etc. Skills not mastered to obtain a stanine of 4 or higher on the MAT or CAT.

2. Skill deficiencies: Those skill areas considered to not be used effectively or retained by students when they were in the appropriate grade level as cited above.

3. Computer-assisted instruction (CAI): For this project the term related to the software containing course content which is commercially prepared and sold.

4. Traditional English course: The study of the English language containing units of study in literature, grammar, composition, mechanics, punctuation, spelling, vocabulary, and oral communications.

5. Traditional mathematics course: This is the course for students who have had difficulty with basic mathematic skills. The emphasis for this course is on mastering fractions, decimals, percentage, areas, volume, measurement (both English and metric), and verbal problems as they relate to the above topics.

6. Stanine scores: Normalized standard scores expressed as a simple 9-point scale having a mean of 5 and a standard deviation of 2. Each half of the 9 bands, except the highest and lowest, represents a range of one-half a standard deviation in a normal distribution of scores. Stanines 1, 2, and 3 indicate below-average performance; 4, 5, and 6 average performance; and Stanines 7, 8, and 9.
above-average performance. These achievement categories are most often used to facilitate groupings for instruction.

7. Dropout rate: This term refers to the number of students officially leaving the school prior to graduation and with no record or information indicating a transfer to another school.

8. High risk students: This term refers to those individuals who are most likely to become a dropout statistic.

9. Pupil behavior: Those behaviors inappropriate for the classroom thus requiring a teacher to send a student from the class to support personnel for disciplinary action.
BIBLIOGRAPHY


Reproduced with permission of the copyright owner. Further reproduction prohibited without permission.


